Contents of Volume 2
August 1975

datapro 70

NOTE: Please refer to the Index, at the front of Volume 1, for a detailed listing of all the products covered in DATAPRO 70.

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All About Alphanumeric Display Terminals

This comprehensive report provides detailed specifications of 154 alphanumeric display terminals from 70 vendors, presents the results of an extensive user survey covering more than 13,000 installed terminals, and offers practical guidelines for selecting a display terminal that will meet your specific needs.

Alphanumeric display terminals are becoming increasingly important tools in a broad range of modern business and industrial environments. These versatile devices have found their way into innumerable applications, many of which were once solely dependent on teleprinters as the only available cost-effective vehicle for interactive data communications. As an alternative to the teleprinter, alphanumeric display terminals provide numerous features that transcend those of the most sophisticated teleprinters. But by the very essence of the design of these terminals, the displayed data is characterized by evanescence, a crippling limitation to prospective users who need a hard-copy record—or who insist on indulging themselves in the security blanket of hard copy. For those who occasionally need hard copy, this disadvantage can easily be offset by the addition of an ancillary printer (at added cost) that produces hard copy on demand.

The current market offers a broad variety of alphanumeric display terminals, ranging from the so-called "dumb" terminals with rock-bottom prices of less than $75 per month to programmable units ranging upward from several hundred dollars per month. Some of the more sophisticated terminals are built around minicomputers with as much as 32K bytes of memory, are supported by stored programs, and offer a host of peripheral devices including disk and tape drives, diskette and cassette drives, printers, card readers, and punched tape readers and punches. These top-of-the-line terminals are actually small computer systems designed to function in a distributed processing environment.

New Technology

Many display terminal vendors are responding to the exploding semiconductor market by replacing conventional hard-wired controller logic with state-of-the-art microprocessors and semiconductor memories. By implementing the new technology, the vendor cuts production costs, adds intelligence, and safeguards against creeping obsolescence. In most cases, the new architecture is transparent to the user. But some vendors permit users to submit their own parameters for the controlling microprogram (firmware). Still other vendors permit the user to generate his own microprogram, thereby satisfying the demands of his immediate application. The user should be advised, however, that at this time microprocessors generally do not provide the flexibility and capability of minicomputers.

Alphanumeric display terminals, the subject of this report, are designed principally to display messages composed of alphanumeric characters, although a limited graphic capability may be an added feature. Alphanumeric terminals are attracting most of the attention and generating most of the revenue in the current display market. Graphic display terminals, which are covered in a separate DATAPRO 70 report (70D-010-91), account for only a small portion of the overall market.

Until quite recently the CRT (cathode ray tube) was virtually the sole means for displaying dynamic visual information, for business as well as entertainment use (in commercial television). Other devices for displaying information are now gaining popularity. These non-CRT devices include LED's (light emitting diodes, such as those used in calculators), plasma (gaseous) displays (such as the Burroughs Self-Scan panel), liquid-crystal displays, etc. But CRT displays still dominate the display industry, because they are still by far the cheapest method for displaying large amounts of data. Solid-state displays, such as those mentioned above, are currently limited to displays ranging from a few characters to a line of some two or three dozen characters (although Burroughs uses its Self-Scan panel to display up to 256 characters in an 8-line by 32-character format in its TD-700 unit). Because of their prohibitive costs for displaying large quantities of data such as the 2000-character displays in current use, solid-state displays are still a long way from replacing the ubiquitous CRT.

Brand new from Hewlett-Packard, and with all the bells and whistles, the microprocessor-based 2640A includes up to 8K bytes of memory that stores up to 3 full pages of data for display on its 1920-character screen. Incidentally, 2640 is also the terminal's price tag for an order of 6 units.

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IBM's new communications discipline, Synchronous Data Link Control (SDLC), introduced as an integral component of its "Advanced Function for Communications" in September 1974, is likely to become a de facto industry standard for future data communications terminals. SDLC is an improved form of communications discipline for higher transmission efficiency. IBM has already introduced a number of specialized and general-purpose terminals that use the new communications protocol, and has upgraded its 3270 Information Display System to provide the capability as an alternative to the BSC (binary synchronous) discipline.

Vendors who sell directly to the IBM market have already been impacted by the introduction of SDLC. Obviously, these vendors will have to incorporate SDLC compatibility in order for their products to remain viable in the future. Many are already in the process of doing this, while others are planning to be compatible with IBM's SDLC by the end of 1975 or early 1976. Vendors whose products are microprocessor-based can provide SDLC compatibility at any time in the future by merely changing the microprograms that control the units' operations. Vendors whose market is the low-speed (asynchronous) Teletype-compatible environment need not concern themselves with SDLC in the immediate future, but they may at some time need to respond to IBM's 3767 and 3770 series typewriter terminals, which can operate with SDLC.

The smooth-looking ICC 40+, a Teletype Model 40 replacement, is the initial entry into the alphanumeric display market by ICC/Milgo, a leading modem vendor. Configuration flexibility permits the CRT to be mounted above the keyboard or to stand alone as shown above. The CRT can be tilted and swiveled for operator viewing convenience.

Market Contention

Since 1965, when the first commercially available alphanumeric display terminals were introduced, dozens of display terminal vendors have appeared on the scene. Many have already stumbled and fallen by the wayside; others have survived to become today's major display vendors. Still others seek a place in the crowded display terminal market that is already amply supplied by leading mainframe manufacturers and by large independents such as Hazeltine and Sanders. All these companies, new and old, obviously believe that a vast market exists for alphanumeric display terminals.

What is the nature of this market? To what extent have display terminals impacted computer users? Do they represent a panacea for all computer input/output problems? What do their users think of them? Should you be using them? And if so, which of the many available models represents the best overall choice for you? This report attempts to answer these questions by clearly and comprehensively describing the characteristics of today's alphanumeric display terminals and their role in data communications environments. The current offerings of 70 vendors are summarized in the accompanying comparison charts, and the experience of almost 400 users with over 13,000 CRT terminals is reported in clearcut form. This year's user survey response, incidentally, was substantially greater than last year's response of 268 users reporting on 7,800 terminals.

Industry Profile

The computer terminal market is one of the fastest-growing segments of the computer industry. The total number of terminals in use skyrocketed from a mere 50,000 in 1965 to an estimated 1.5 million by the end of 1974—a 30-fold increase over the course of a decade. And the market is still young. Projections place the total installed base toward the end of the 1970's at about 2.5 million terminals, unless affected by a lingering industry slowdown.

The total data terminal business for 1974 was valued at $1.3 billion, representing a 24 percent gain over 1973. The if-sold value of classical, non-intelligent alphanumeric display terminals shipped in 1974 was estimated at $245 million, a 12 percent gain over 1973. The growth of sales for all types of terminals is expected to slow in 1975, but still show a gain over 1974 of 5 to 15 percent. Sales will probably gain momentum again in 1976 and the later years of the 1970's. By 1980, the annual value of equipment sold should be more than twice the 1974 figure.

The classical display terminal will not match the growth of the overall terminal market. But that does not mean that display terminals are going into eclipse. Substantial markets are opening for intelligent terminals, key/disk data entry systems, point of sale (or transaction-oriented) systems, banking teller terminal systems, etc. By 1980,

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intelligent terminals will probably represent one-quarter of the total terminal market referenced above. Also by 1980, POS and banking terminal systems may represent a market roughly half the size of the general-purpose terminal market above. Some portion of these markets will involve display terminals.

Thus, the display terminal is rapidly becoming a component as well as a final end-user product. Precise market estimates may be difficult to make because of this change, but one thing is clear: the convenience and glamour of displayed data will play a prominent role in the design of new information handling systems of all types.

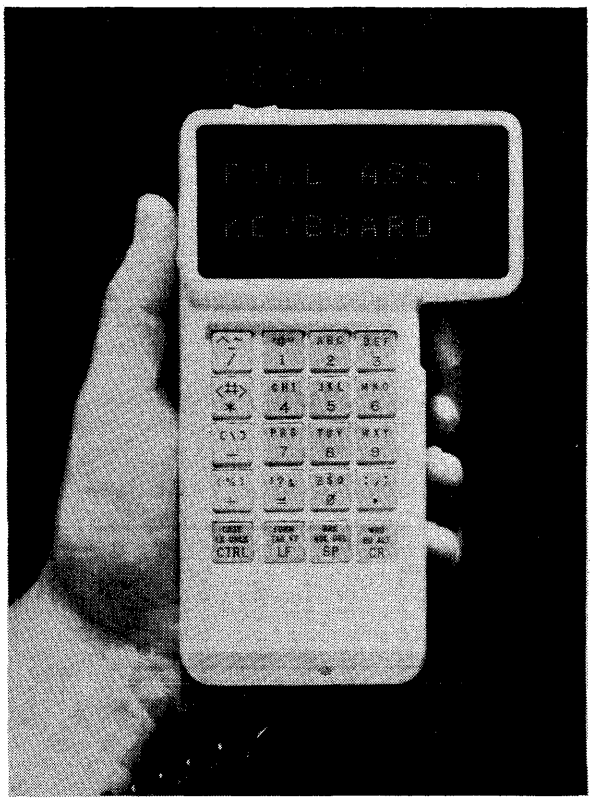
Display or Teleprinter?

Not all applications are best served by alphanumeric display terminals. Though they are not as glamorous as their "glass" counterparts, teleprinters can best satisfy applications where minimum cost and/or a fully justified need for printed copy are the criteria. Before selecting an alphanumeric display terminal over a teleprinter, you should consider the following key factors:

- *Cost*—Teleprinters in general are priced substantially below most display terminals. Based on current costs, few display terminals can compete with the rock-bottom costs of many teleprinters (especially Teletypewriters), though the average unit cost of display units continues to shrink as the result of large-scale integration and high-volume production techniques.

- *Output medium*—Teleprinters provide a permanent record of important data, and the copy can be formatted according to user needs. Single copies can be filed for ready access or circulated to satisfy individual needs. Multiple copies can be produced for wide distribution. Printed copy can also be used for OCR input, provided that it is printed in an OCR-readable font. Display terminals provide faster, more convenient access to required information, and can usually be equipped with ancillary printers to produce hard-copy records of the displayed data when required.

- *Operating speeds*—Teleprinters are generally far slower in operation than their counterpart display terminals. Typical print speeds range from 10 to 30 characters per second for most teleprinters (though a few are capable of 120 cps or even higher speeds). Typical display speeds range from 300 to 1200 characters per second. Operating speeds this high, however, are simply not warranted in many applications, though they can sometimes lead to savings in communications line costs. On the other hand, line costs for teleprinters can be considerably reduced through buffering, which divorces printer operation from the communications medium and permits data to be transmitted at speeds up to 9600 bps.



Designed for data entry/display applications where the operator should not be confined to a chair, this hand-held display unit produced by Termiflex displays one or two 10-character lines using LED's (light emitting diodes). A 500- or 1000-character memory provides a scrolling capability, i.e., sequential display of 10-character line segments on command. The three-level keyboard can generate a full ASCII character set. A cord, just visible against the dark background, connects the display unit with the communications or I/O channel interface.

- *Editing, data entry, and formatting*—Teleprinters are designed primarily for data communications, and they generally do not provide sophisticated capabilities for editing, data entry, or data formatting. When implemented, editing is usually limited to a single line (the one just keyed) unless the teleprinter includes a cassette tape unit, which can significantly enhance the edit capability. Though display terminals have popularized the "fill-in-the-blanks" concept, data entry applications that require the use of fixed formats are not restricted to display devices; at least one teleprinter vendor (Texas Instruments) has implemented the concept (on its Model 742) via the use of user-recorded formats on cassette tape. TI also provides validation software. Sophisticated capabilities such as editing and data entry, however, drive up the costs of teleprinters in competition with display terminals, and unless there is a definite requirement for printed copy, a display terminal will usually be the better buy. Formatted output is featured on some printers, but again the cost is driven upward.

- *Reliability*—Most of the current teleprinters are reasonably reliable devices, but like all mechanical

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devices they are subject to wear and misalignment. Display terminals offer generally higher reliability as a result of their totally electronic operation.

Major Display Markets

Excluding specialized terminals for dedicated markets such as brokerage houses and financial firms, the alphanumeric display terminal industry has focused its attention on three principal markets: Teletype replacement, IBM 3270 and 2260 replacement, and programmable terminals.

The most active of these three markets has been, and will probably continue to be, that of Teletype replacement, because it represents the greatest profit potential for the small terminal manufacturers.

Replacements for the IBM 2260 have reached their peak of market penetration and are now offered by most independents on an "as available" basis. The IBM replacement industry is now directed mainly toward 3270 replacements.

Programmable ("intelligent") terminals promise to capture both the older IBM 2260 and newer IBM 3270 replacement markets by virtue of their software emulation capability. The key marketing advantage of the programmable terminals is their capability to emulate virtually any terminal through microprogram control. These versatile terminals are thus less vulnerable to obsolescence. In addition, many of the programmable terminals can be equipped with extensive complements of peripheral equipment and can effectively perform a wide variety of local data editing, formatting, and processing functions.

IBM's Best-Seller, the 3270

The IBM 3270 has strongly impacted the alphanumeric display terminal market since deliveries began late in 1971. Representing a significant price/performance improvement over its forerunner, the IBM 2260, the 3270 continues to carve a sizeable slice of the marketplace. Priced well below the 2260, the 3270 features expanded functional capabilities, such as twice the display capacity of the 2260 and increased transmission and printing speeds. It also provides sophisticated operating capabilities, such as program-controlled formatting, program function keys, and more sophisticated commands. But the 3270 is not a direct replacement for the 2260. Thus, IBM computer users must consider fairly extensive software conversions in order to switch from the 2260 to the 3270.

Recognizing the complexity involved in replacing existing 2260 installations with 3270's, the independents introduced attractive alternatives—2260 replacement terminals that provide compatibility with existing 2260 operating software but offer 3270-like features, such as a large screen size, flexible cluster configurations that can accommodate multiple printers, faster printers, editing capabilities, increased transmission speeds, etc., all at substantial cost savings over the prices of either the IBM 2260 or 3270 displays. The more prominent of these independents were Courier, Delta Data Systems, GTEIS, ITT, and Trivex. Meanwhile, these and other independents began to direct their attention to the development of 3270 replacement terminals.

IBM discouraged the continued use of the 2260 by not supporting it under new communications software packages such as the Network Control Program (NCP), used with the 3704 and 3705 Communications Controllers, and VTAM, the principal access method for telecommunications support under DOS/VS and OS/VS, when these facilities were announced. However, both the 3704 and 3705 Communications Controllers continue support for the 2260 under the Emulation Program, which furnishes the capability of a 270X hard-wired controller. There are also indications that IBM will insert support for 2260's under the full System/370 operating software. Although IBM is clearly directing its support away from the System/360 market, the independents are determined to keep it alive. And IBM has reinstituted support for the 2260 under the latest versions of its data communications monitor (CICS) and data base management system (IMS) for the 370 family.

A number of independent vendors have introduced direct replacements for IBM's 3270 Information Display System. Among these are Computer Optics, Courier, Four-Phase Systems, Genesis One, GTEIS, Incoterm, Raytheon, Sanders, Sycor, Terminal Communications, and Trivex. Other vendors whose products are microprogrammable can also provide IBM 3270 compatibility. Still others will enter the market in the coming months. As one might expect, the independents are offering more than just substantial price reductions. Enhancements include additional screen sizes, increased configuration flexibility, greater printing capabilities, data validation via user programs, display enhancements, etc. Not all these enhancements are offered for the same terminal, so users should examine each product separately for those characteristics that satisfy the needs of their specific applications.

IBM in Retrospect

IBM announced its intention to enter the alphanumeric display terminal market during the early years and in 1966 introduced the 2260 Display Station, a clustered terminal accommodating as many as 24 individual CRT displays that could be used at the central computer site or at a remote site via a communications facility. With its introduction of the 2260, IBM placed its stamp of approval on display terminals as a practical medium for data entry and set the stage for a viable display terminal industry by establishing the initial parameters.

Because IBM has long dominated the computer industry, it follows that IBM should also dominate the display terminal industry. It does. IBM followed the 2260 in 1967

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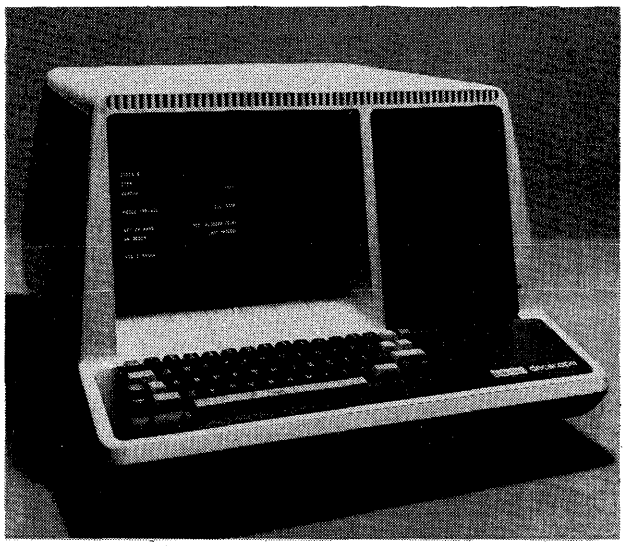
The Zentec 9002 is one of a new breed of terminals by relative newcomers to the display terminal market. This user-programmable terminal features microprocessor control, up to 16K bytes of memory (including ROM, PROM, and RAM), a 1920-character screen, and a detachable keyboard.



Digital Equipment's attractive VT50 DECscope, introduced in September 1974, features a 960-character screen with typewriter-style keyboard and an integral non-impact hard-copy device (not visible). Its low price of $1,250 (in unit quantities) makes it a formidable competitor for the Teletype replacement market.

by introducing a single-tube version, the 2265, which was designed for communications only. Since both terminals communicate with the IBM System/360 computers and are supported by IBM software, their growth has been generally proportional to the increasing number of System/360 installations. The 2260 and 2265 reigned as IBM's sole display terminals until mid-1971, when IBM announced the previously discussed 3270 Information Display System as a more sophisticated and less expensive replacement.

The principal weaknesses of the IBM 2260 and 2265 were small display capacity, lack of an editing capability, a rather crude and inflexible fixed-format capability, a very limited hard-copy capability, and last, but by no means least, high unit cost. Products of vacuum-tube technology, the IBM 2260 and 2265 are now clearly obsolescent though still widely used. As display terminals produced by other terminal makers became more sophisticated, reflected by the advancing state of the art, the IBM terminals began to look conspicuously dated.

Enter the Independents

It did not take the independent manufacturers long to recognize the fact that a ripe replacement market existed. Several companies began to produce and market CRT display terminals designed to replace the IBM 2260 and 2265 displays at substantial dollar savings. Most featured enhancements such as larger display capacities, edit and format handling features, provision for handling several printers operating in local and/or remote modes, and other noteworthy capabilities. Most of these enhancements require some alterations to the IBM communications software, but these can generally be implemented by a minor partial sysgen to write the new operating parameters.

Producing a cheaper and better substitute for IBM's display terminals became easier as time passed as a direct result of large-scale integration, the use of semiconductor memories, and the infusion of low-priced keyboards. However, all is not sunshine and roses; early installations of IBM-replacement displays have frequently experienced lengthy debugging periods during which all kinds of problems arose, ranging from simple to complex. In some cases, hardware proved to be unreliable; in others, timing problems existed. The former may be resolved by component changes; the latter may require more extensive changes because they involve the timing of the exchange of information and commands between computer and display terminal. Datapro has found, as a result of conversations with many users, that during the installation and debugging period, a good many of the independent manufacturers have demonstrated a high degree of overall competence and are quick to respond to the users' needs.

The Teletype Replacement Market

While some of the independents pursued the IBM replacement market, others chose to take on Teletype. This is by no means an easy task when you stop to consider that the outright purchase price of a Teletype Model 33 ASR is less than $1,000 and that a KSR costs about half as much. But the independents were offering more than just a CRT in place of a printer. The Model 33, as you probably know, is a limited-usage machine, supposedly good for about four hours per day. Its heavy-duty equivalent, the Model 35, carries a price tag about three times as high. Both machines provide limited transmission rates of 10 characters per second. And what about paper tape? It's cheap but crude compared with the use of magnetic tape cassettes. These limitations provide the prime incentives for teletypewriter replacement.

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CRT terminals can compete with the price of the Teletype Model 35 and provide the kind of equipment reliability required for continuous usage by virtue of the use of electronic components. In addition, CRT terminals can offer transmission speeds that are limited only by the inherent capacity restraints of the communications facility. Many of the Teletype-compatible CRT terminals offer a range of switch-selectable speeds from 10 to 240 characters per second. Other features, such as an edit capability and the transmission of message blocks, can be considered as gravy. To satisfy specific user needs, such as occasional printed output and a recording medium for on- or off-line operation, many vendors supply low-priced, nonimpact printers and magnetic tape cassette recorders.

The Teletype Model 40

While the independent CRT manufacturers were busy replacing Teletype terminals, Teletype Corporation witnessed steadily declining revenues—a strong impetus that forced Teletype to change its image from that of an old-line supplier of low-speed, message-oriented equipment to that of a sophisticated terminal manufacturer. Though long dedicated to the production of teleprinters and punched tape equipment, Teletype gained experience with CRT terminals in the late 1960's, when development began on communication display terminals for AT&T in-house applications such as order entry.

Teletype's impressive display terminal, the Model 40, was unveiled in May 1973. The unit was offered on a purchase-only basis by Teletype, a subsidiary of AT&T's Western Electric Company, and as the Dataspeed 40 Service, a tariffed service offered by AT&T and its Bell System operating companies.

The joint introduction of the Teletype Model 40 and AT&T Dataspeed 40 Service spread waves of apprehension that penetrated the very foundation of the communications terminal industry, largely composed of small, independent manufacturers. The Model 40 offers an impressive collection of capabilities and features at very competitive prices. With AT&T's backing, it can be expected to have a major impact upon the already-crowded CRT terminal market. Industry analysts have raised the possibility that Teletype and IBM may run up against one another, with the two giants competing for the large corporate customers who will be merging their data and message networks. Two years have passed since the introduction of the Model 40. Deliveries began in late 1973, and the large deliveries have been and will continue to be primarily to AT&T. Most users will be introduced to the Model 40 through the Dataspeed 40 service, a convenient way for acquiring terminals.

So convenient is this method of acquisition that independent vendors, sensitive to the marketing clout of large companies such as AT&T and IBM, have raised the spectre of unfair competition. And the Model 40 has become a new target for emulation. One company, ICC (the modem maker), has introduced a compatible product, the 40+, with the now-typical characteristics of a terminal emulator: compatibility plus additional features. As the usage of the Model 40 grows, you can expect more imitators with more features to be introduced.

User Experience

To assess the current level of user satisfaction with display terminals, and to determine the patterns of usage of these terminals, Datapro conducted an extensive user survey. A CRT Display Reader Survey Form was included in the January 1975 supplement to DATAPRO 70 and mailed to all subscribers. By March 1, usable responses had been received from a total of 398 users with a total of 13,460 installed display stations.

Because many of the users reported on more than one model of display, the user replies generated a total of 543 responses or individual equipment ratings and profiles. The orientation of the users participating in the survey can be shown by the following table:

	Responses		Displays	
Responses on:	Number	Percent	Number	Percent
IBM displays	229	42	6,606	49
Other displays	314	58	6,854	51
Total	543		13,460	

Overall, the average number of displays per response was 25.1, while the average number of displays per responding user was 33.8.

The users were asked to rate the overall performance, ease of operation, hardware reliability, maintenance service, and software and technical support for each display by assigning a rating of excellent, good, fair, or poor. The resulting ratings for 52 popular display models or families are summarized in Table I. Prospective buyers should note that the small sample sizes for some of these models make it unwise to draw firm conclusions from the indicated ratings.

To put the raw counts into a form more readily grasped, Datapro calculated a weighted average for each rating category. Each user response was assigned a weight of one, and the ratings were weighted on the conventional scale of 4, 3, 2, and 1 for excellent, good, fair, and poor, respectively. The data is presented as an additional information source, not as the final word on the worth of the displays represented.

The ratings assigned by the responding users can also be combined to form an overall picture of current user satisfaction with the IBM displays, other manufacturers' displays, and all displays:

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Table I. USERS' RATINGS OF ALPHANUMERIC DISPLAY TERMINALS

Display Supplier and Model	Number of User Responses	Number of Displays in Use	Weighted Averages and Response Counts																								
			Overall Performance					Ease of Operation					Hardware Reliability					Maintenance Service					Software and Technical Support				
			WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P
ADDS 580	3	14	3.3	1	2	0	0	3.3	1	2	0	0	3.3	1	2	0	0	3.0	1	1	1	0	2.7	1	1	0	1
ADDS 880	5	21	3.4	2	3	0	0	3.4	2	3	0	0	3.6	3	2	0	0	2.8	0	4	1	0	2.8	0	3	1	0
ADDS, others	2	5	3.0	0	2	0	0	3.0	0	2	0	0	3.5	1	1	0	0	3.0	0	2	0	0	3.0	0	2	0	0
Beehive, all models	10	85	3.1	3	5	2	0	3.3	4	5	1	0	3.1	4	3	3	0	2.4	0	4	3	1	2.7	1	4	4	0
Bell of Canada Vucom I	7	71	2.9	2	3	1	1	2.9	1	5	0	1	3.4	4	2	1	0	3.3	2	5	0	0	2.2	0	2	2	1
Bunker Ramo 2200 Series	7	265	3.6	4	3	0	0	3.7	5	2	0	0	3.0	1	5	1	0	3.1	2	4	1	0	2.5	0	3	3	0
Burroughs TD 700	6	30	3.5	3	3	0	0	3.5	3	3	0	0	3.3	3	2	1	0	3.3	2	4	0	0	2.8	2	1	3	0
Burroughs TD 800	11	80	3.0	2	7	2	0	3.0	1	9	1	0	3.0	2	7	2	0	2.8	1	7	3	0	2.8	2	6	2	1
Burroughs, others	8	207	3.5	4	4	0	0	3.5	5	2	1	0	3.1	2	5	1	0	3.1	2	4	1	0	3.0	3	2	3	0
Control Data 700 Series	6	123	3.3	2	4	0	0	3.2	2	3	1	0	2.8	1	3	2	0	3.2	2	3	1	0	2.8	0	3	1	0
Courier 60/260/265	5	192	3.2	1	4	0	0	3.8	4	1	0	0	3.2	1	4	0	0	2.8	0	3	1	0	2.6	1	2	1	1
Courier 270	6	84	3.4	2	3	0	0	4.0	6	0	0	0	3.5	3	3	0	0	2.7	1	3	1	1	2.5	2	1	1	2
Courier, others	5	52	2.8	1	1	2	0	3.8	3	1	0	0	2.8	1	2	0	1	2.3	0	2	1	1	2.7	1	1	0	1
Data 100 term. console	4	4	3.5	2	2	0	0	3.8	3	1	0	0	3.5	2	2	0	0	3.3	1	3	0	0	2.3	0	2	0	1
Datapoint 3000 Series	8	19	3.1	3	3	2	0	3.3	3	4	1	0	3.3	4	2	2	0	3.0	2	4	2	0	2.7	1	3	3	0
Datapoint 1100/2200	2	7	3.5	1	1	0	0	3.5	1	1	0	0	3.0	0	2	0	0	2.5	0	1	1	0	2.5	0	1	1	0
DEC VT05	6	22	3.7	4	2	0	0	3.8	5	1	0	0	3.7	4	2	0	0	3.5	4	1	1	0	3.0	2	2	2	0
Four-Phase IV/70	14	231	3.2	3	11	0	0	3.4	5	9	0	0	3.3	5	8	1	0	2.6	1	6	7	0	2.4	2	3	8	1
Four-Phase, others	6	295	3.7	4	2	0	0	3.7	4	2	0	0	3.8	4	1	0	0	2.8	2	1	3	0	2.7	2	2	0	2
GTEIS 7000	3	130	3.7	2	1	0	0	4.0	3	0	0	0	2.7	0	2	1	0	2.3	0	2	0	1	2.0	0	1	1	1
GTEIS 7100	5	206	3.0	1	3	1	0	3.8	4		0	0	2.6	0	3	2	0	2.4	0	2	3	0	2.4	0	2	3	0
GTEIS 7700	13	351	3.4	5	8	0	0	3.6	8	5	0	0	3.1	3	8	2	0	2.8	3	5	5	0	2.7	1	8	3	1
GTEIS 7800	4	107	3.5	2	2	0	0	3.8	3	1	0	0	3.5	2	2	0	0	2.8	1	2	0	1	2.5	1	1	1	1
GTEIS, others	3	34	3.7	2	1	0	0	3.7	2	1	0	0	3.0	1	1	1	0	3.0	1	1	1	0	2.3	0	2	0	1
Hazeltine 1000	7	13	3.3	2	5	0	0	3.0	1	5	1	0	3.1	2	4	1	0	2.6	0	3	2	0	2.5	0	3	3	0
Hazeltine 2000	37	237	3.3	17	15	3	1	3.4	18	14	2	1	3.2	14	15	4	2	2.7	9	13	7	6	2.3	2	10	15	4
Honeywell 7700	3	73	3.0	0	3	0	0	2.7	0	2	1	0	3.0	0	3	0	0	3.0	0	3	0	0	1.3	0	0	1	2
Honeywell, others	5	273	2.8	1	2	2	0	3.2	2	2	1	0	2.6	1	2	1	1	2.8	1	2	2	0	2.6	1	1	3	0
IBM 2260	12	129	3.0	1	9	1	0	3.1	3	5	2	0	3.2	2	9	0	0	3.3	3	8	0	0	2.9	0	10	1	0
IBM 3275	35	303	3.5	20	12	3	0	3.3	12	20	3	0	3.5	20	10	4	0	3.3	15	14	6	0	2.8	7	15	9	2
IBM 3277	133	3,832	3.5	72	56	2	0	3.4	60	65	6	0	3.5	68	57	6	0	3.3	52	69	8	1	2.9	23	70	31	3
IBM 3270, others	49	2,342	3.4	21	27	1	0	3.4	21	27	1	0	3.3	22	22	5	0	3.3	20	23	5	1	2.7	8	20	17	3
Incoterm SPD 10/20	6	223	3.2	2	3	1	0	3.8	5	1	0	0	2.8	1	3	2	0	2.5	0	3	3	0	3.0	2	2	2	0
Infoton Vistar	3	38	4.0	3	0	0	0	3.7	2	1	0	0	4.0	3	0	0	0	3.0	2	0	0	1	3.0	1	1	1	0
Infoton Vistar G/T	3	27	3.7	2	1	0	0	3.3	1	2	0	0	3.3	1	2	0	0	3.0	0	3	0	0	3.0	0	2	0	0
ITT Asciscope	3	10	3.3	2	0	1	0	3.7	2	1	0	0	3.0	2	0	0	1	1.7	0	1	0	2	1.0	0	0	0	1
Lear Siegler ADM-1	4	18	3.5	2	2	0	0	3.5	2	2	0	0	2.8	1	2	0	1	3.3	2	1	1	0	3.0	1	1	1	0
Lear Siegler, others	4	68	3.5	2	2	0	0	3.5	2	2	0	0	2.8	1	1	2	0	2.8	0	3	1	0	2.8	1	1	2	0
NCR 796 Series	4	32	4.0	4	0	0	0	4.0	4	0	0	0	3.8	3	1	0	0	4.0	4	0	0	0	3.0	0	2	0	0
Research Inc. Teleray	3	29	3.7	2	1	0	0	3.7	2	1	0	0	4.0	3	0	0	0	2.7	1	1	0	1	2.0	0	0	2	0
Sanders 720	4	113	3.0	1	2	1	0	3.3	2	1	1	0	2.0	0	1	2	1	2.3	0	2	1	1	2.8	1	1	2	0
Sanders 804/810	5	54	3.0	0	5	0	0	3.4	2	3	0	0	3.0	2	1	2	0	2.6	0	3	2	0	1.8	0	0	4	1
Sycor 340	7	70	3.0	1	5	1	0	3.6	4	3	0	0	3.3	4	2	0	1	2.9	0	6	1	0	2.3	0	3	3	1
TEC, all models	4	453	3.5	2	2	0	0	3.5	2	2	0	0	3.3	1	3	0	0	3.3	1	2	0	0	2.8	1	1	2	0
Tektronix 4023	7	127	3.9	6	1	0	0	3.4	4	2	1	0	3.9	6	1	0	0	2.9	1	5	0	1	3.0	2	2	2	0
Teletype Model 40	5	257	3.8	4	1	0	0	3.8	4	1	0	0	3.6	3	2	0	0	3.2	3	1	0	1	3.2	3	1	0	1
Terminal Comm. TC-60	4	102	2.5	0	3	0	1	3.5	2	2	0	0	2.8	0	3	1	0	2.3	0	2	1	1	2.3	0	2	1	1
Terminal Comm. TC-62	4	126	3.3	1	3	0	0	3.5	2	2	0	0	3.3	1	3	0	0	2.8	0	3	1	0	3.0	0	2	0	0
Terminal Comm. TC-270	4	135	2.8	0	3	1	0	3.5	2	2	0	0	2.5	0	3	0	1	2.8	0	3	1	0	3.0	0	3	0	0
Univac Uniscope 100	10	668	3.6	6	4	0	0	3.6	6	4	0	0	3.5	6	3	1	0	3.5	6	3	1	0	2.8	1	7	1	1
Wyle 8000 Series	6	87	3.0	1	4	1	0	3.2	1	5	0	0	2.5	0	3	3	0	2.8	1	3	2	0	2.3	0	1	2	0
All Others	23	986	3.2	9	11	2	1	3.4	11	10	2	0	2.8	6	8	6	2	2.9	7	7	2	4	2.7	5	6	3	4
IBM Totals	229	6,606	3.5	114	104	7	0	3.4	96	117	12	0	3.4	112	98	15	0	3.3	90	114	19	2	2.8	38	115	58	8
Independent Totals	314	6,854	3.3	126	158	23	4	3.5	161	134	14	2	3.1	113	140	45	11	2.9	66	147	65	23	2.6	43	110	93	31
GRAND TOTALS	543	13,460	3.4	240	262	30	4	3.4	257	251	26	2	3.3	225	238	60	11	3.0	156	261	84	25	2.7	81	225	151	39

LEGEND: Weighted Average (WA) is based on assigning a weight of 4 to each user rating of Excellent (E), 3 to Good (G), 2 to Fair (F), and 1 to Poor (P).

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IBM Displays	Excellent	Good	Fair	Poor
Overall performance	51%	46%	3%	0%
Ease of operation	43	52	5	0
Hardware reliability	50	43	7	0
Maintenance service	40	51	8	1
Software & technical support	17	53	26	4
Other Displays				
Overall performance	41%	51%	7%	1%
Ease of operation	52	43	4	1
Hardware reliability	37	45	14	4
Maintenance service	22	49	21	8
Software & technical support	15	40	34	11
All Displays				
Overall performance	45%	48%	6%	1%
Ease of operation	48	47	5	0
Hardware reliability	42	45	11	2
Maintenance service	30	49	16	5
Software & technical support	17	45	30	8

As you can see from these figures and Table I, users rated the IBM and the other (non-IBM) displays as essentially equivalent in ease of operation, while awarding IBM a clear-cut advantage in the other four rating categories. Both IBM and the independents scored higher in this year's survey than in last year's. While the software and technical support ratings improved this year, both IBM and the independents still have lots of room for further improvement in this area.

The users were also asked questions designed to determine usage patterns for display units. The results can be summarized as follows:

Manner of use	Number of user responses	Percent of total
Remotely, via communications lines	355	65
Locally, directly connected to a computer	336	62
Single station, stand-alone	231	44
Clustered	255	47
Programmable	57	10
Structured data entry, a la keypunch	77	14
Fill-in-the-blanks formatted data entry	315	58
Free-form (text) data entry	182	34
Extensive editing	261	48
Little or no editing	152	28

Buying Guidance

In selecting a display terminal, as in acquiring most other types of computer equipment, your chances of picking the unit that's best for your installation will be far greater if your're willing to take the time to go about it in a systematic, logical way. The following selection procedure should help you get the maximum gain in computer throughput per dollar spent.

1. *Define the essential parameters* for a display terminal that will satisfy your needs; then, using Tables II through VI, select the features that meet the requirements of your application.

2. *Find out who supplies the terminals* with the parameters and features you have selected. Use the accompanying comparison charts to determine which manufacturers produce terminals that appear to satisfy your needs. Then check the User Experience section of this report to see how users rate each manufacturer's products. You'll probably be able to narrow down the list of potential suppliers to a few firms that have demonstrated their ability to supply and service, at competitive prices, the specific type of terminal you need.

3. *Check the maintenance provisions.* Since maintenance is one of the key differentiating factors among the independent suppliers, you'll want to pay especially careful attention to this important area. Find out what organization supplies the maintenance service and learn all you can about it. Check the total size of the organization, the location and staffing of the closest service point, the promised response time for emergency service, the hours during which service is available, the nature and frequency of preventive maintenance, the size and location of the spare parts inventory, the procedure for handling engineering change orders, and the scope of the supplier's training program for his service technicians.

4. *Talk to users.* The terminals that appear most promising at this point should now be further investigated by conferring with present users. The user's ratings given in this report should serve as a first cut. Then ask each supplier for a list of customers. Be selective. Ask for installations similar to the one you're planning, at least with respect to communications discipline and number of terminals. And don't take no for an answer. Then, find out all you can from each user. Ask why he chose that unit, when it was installed, what problems were encountered in installing it, how many failures have occurred, how quickly they were corrected, and whether any incompatibilities have been detected. Finally, ask how he thinks the terminal or the associated support could be improved. The answers to these questions are likely to be highly enlightening, not only about the display terminals but about mainframe support as well.

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5. *Choose the vendor and model.* By now, you should have all the information you'll need to choose the terminal that will satisfy your requirements at the lowest overall cost. If so, it's just about time to place your order.

6. *Negotiate a sound contract.* Now that you know which terminal you want, don't just sign the supplier's standard contract or order form. If you do, you're likely to end up with a lot less security and support than the user who's willing to take the time and trouble to indulge in some old-fashioned haggling. What's more, you may even be able to shave some more dollars off the price tag.

Display Terminal Characteristics

The accompanying comparison charts summarize the characteristics of 154 commercially available alphanumeric display terminals from 70 vendors. Nearly all of the information was supplied by the manufacturers during the months of February and March 1975. Their cooperation is acknowledged and greatly appreciated.

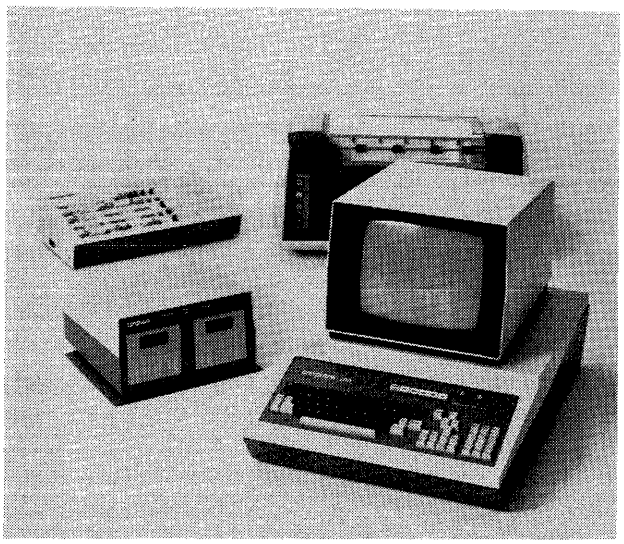
Datapro sent repeated requests for information to more than 80 companies known or believed to be in the display terminal business. The 70 usable responses summarized in our charts provide a comprehensive picture of the commercial display terminals that are currently available in the United States and Canada. *The absence of any specific company from our charts means that the company either failed to respond to our repeated information requests or was unknown to us.*

The chart entries and their significance are explained in the following paragraphs.

Arrangement

Display terminals are available in one of two basic terminal configurations, *stand-alone or cluster.* Stand-alone units are typically those that contain all components that support the operation of the terminal, including display, keyboard, and interface, within a single cabinet. (Auxiliary units such as printers, cassette tape recorders, etc., are usually external devices.) Sometimes a stand-alone unit includes separate cabinets for terminal control and keyboard/display portions, and it may even include one or two separate displays.) A cluster configuration typically includes a terminal control unit and a number of individual, cable-connected keyboard/display units, sometimes located several thousand feet from the controller. In some cases the vendor provides a multiplexer that accommodates a cluster of stand-alone terminals.

Terminals that are designed to be hand-carried in a suitcase-like enclosure are noted by the entry *portable case.*



Designed around a minicomputer, Computek's Model 200 is user-programmable and includes extensive software support. The unit features three screen sizes of up to 2000 characters, and 1K to 16K bytes of memory including ROM and RAM. Peripherals include single or dual cassette and diskette units, printers, card reader, and light pen. A diagnostic test set is shown at the upper left.

Datapro defines a *user-programmable* terminal as one that operates under the direction of a user-created program stored within the terminal. Vendors of microprocessor-based terminals sometimes allow the user to create his own microprogram, which is "burned" into a read-only memory (ROM). Minicomputer-based terminals are generally software-supported and usually provide at least an assembly language for users to create application programs.

Direct connection to computer refers to terminals that are capable of direct attachment to a computer via the computer's I/O channel and that can operate as on-line peripheral subsystems. Because most terminals can be equipped with RS-232 interfaces, they can be directly attached to many minicomputers with serial I/O interfaces.

Some terminals are designed as direct replacements for other terminals. In the CRT terminal market, replacement terminals fall into three principal categories: those designed to replace an IBM 2260 and/or 2265, those designed to replace an IBM 3270, and those designed to replace a Teletype teletypewriter, Models 33 and 35. Datapro included these three entries to define the category of *compatibility.*

Display Organization

Printed information is generally arranged according to an orderly format consisting of a maximum number of printed lines per page and characters per line. The orderly arrangement of printed matter also characterizes the arrangement of data displayed on the face of a CRT screen or other display device. The electronic circuitry ▷

**TABLE II.
DISPLAY TERMINAL FEATURES
FOR THE REQUIREMENTS
COMMON TO MOST
APPLICATIONS**

Requirements	Helpful Features
Minimum input errors	function keys editing format control
Minimum operator training	typewriter keyboard format control
Maintainability	local technical service modularity replaceable components
Low cost	LSI circuits high production
Operator satisfaction	green or white phosphor quiet operation flicker-free display cool operation linear presentation brightness control satisfactory character size
Good appearance	attractive styling pleasing color compact size white phosphor cabinet material character style
Unobtrusiveness	compact size quiet operation cool operation
Minimum space	compact size LSI circuits
Glamour	color display cabinet styling

**TABLE III.
DISPLAY TERMINAL FEATURES
FOR PHYSICAL APPLICATION
REQUIREMENTS**

Requirements	Helpful Features
Large screen	raster TV scan
Withstanding dirty environment	adequate filtering cassettes instead of tape reels
Distant viewing	large characters
Clustered terminals	multistation controller
Single terminal	stand-alone device
Communication line economy	party-line interface high speed full-duplex capability multiplexing built-in data set

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Requirements	Helpful Features
Text handling	upper/lower-case character set large character matrix editing cursor control slewing cursor
Data entry	format control cursor control column counter editing
Pointing	light pen large character matrix cursor
Minimum typing	function keys cursor control block transmission editing
Input verification	field selection cursor control blanking editing blinking tab stops
Operator alert	blinking color display audible signal
Protecting data fields	format control field protection
Re-entering data	slewing cursor cursor control editing
Drawing bar charts	graphic capability special character generator

TABLE IV.
DISPLAY TERMINAL FEATURES FOR MAN/MACHINE APPLICATION REQUIREMENTS

Requirements	Helpful Features
Remote operations	data set interface long-line driver/receiver interface
Fast access	high speed function keys
Hard copy	printer cassettes (for later transcription)
Local storage	page memory cassettes
Simultaneous I/O	full duplex peripheral devices
Logging	printer cassette

TABLE V.
DISPLAY TERMINAL FEATURES FOR SYSTEM APPLICATION REQUIREMENTS

Requirements	Helpful Features
Special symbols	character generator options
Television compatibility	raster scan
Teletype compatibility	72-character line 10-character/second speed ASCII coding and discipline
Punched card compatibility	80-character line
Code conformity	ASCII coding
Special inputs	function keys special keyboard capability

TABLE VI.
DISPLAY TERMINAL FEATURES FOR COMPATIBLE APPLICATION REQUIREMENTS

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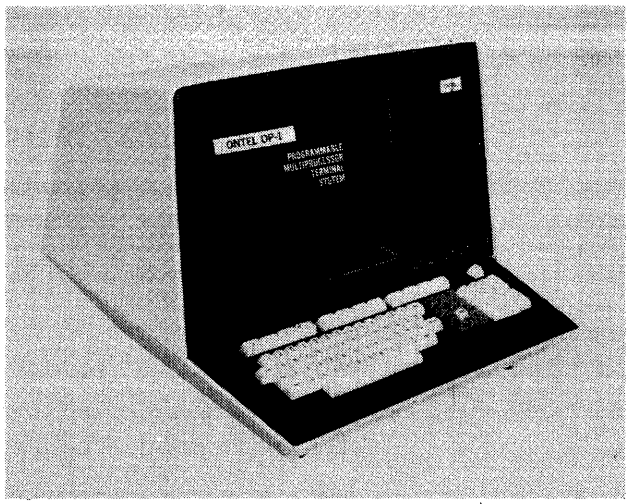

New from Ontel, the user-programmable OP-1 is microprocessor-based and includes up to 16K bytes of memory and a 1920-character screen. The terminal is available with 3M single or dual cartridge tape drives, Diablo 20 or 30 series cartridge disk drives, and an impact printer.

that produces the display image is designed to a specified set of parameters which define the capacity (i.e., the maximum number of *display positions*), and the *display format* (i.e., the maximum number of displayable lines and displayable characters per line). Information is displayed in a rectangular area smaller than the total surface area of the display device. The factors that determine the required size of the *display area* are the display arrangement and the size of the displayable characters, which is normally a fixed parameter.

Symbol formation and the set of *displayable symbols* are functions of the character generator, which accepts coded characters (typically ASCII) from the computer and keyboard and converts them to a number of dots or strokes so that the form of the symbol or image can be displayed. In CRT's, characters are formed by a variety of techniques, including dots, strokes, starburst, or monoscope. The dot technique is by far the most popular. Each character is formed within a matrix of dots, and only those dots required to form the specific character are intensified. Typically, a dot matrix contains 35 dots arranged 7 dots high by 5 dots wide. Characters can be made clearer by increasing the number of dots within the matrix. The stroke technique forms characters by drawing short straight lines between specified points.

Solid-state display devices, such as plasma (gas) and LED (Light Emitting Diodes) are gaining popularity, but at present are generally limited to small display capacities consisting of a few characters. These typically form a character image in much the same way as a CRT display (i.e., via a dot matrix), though some present segmented symbols.

Keyboard

Keyboard *style* defines the general arrangement of keys; e.g., typewriter or data entry style. The *character set* refers to the set of symbols that appear on the keytops and, in many cases, to the actual character codes generated for each key depression, such as ASCII, EBCDIC, APL, etc. Some terminals are available with more than one keyboard style to satisfy particular user needs.

Some terminals are available with program *function keys.* These are special keys whose character codes are interpreted by the user's program. A function key is used to reduce the number of required input keystrokes and therefore save time and reduce the number of input errors. The key cap explains the function performed by the system when the system receives the unique code that is generated by the depression of each function key. Depressing one key could instruct the system to "sell one seat" or "call Chart A," for example.

A *numeric keypad* is a special keyboard feature that includes a set or block of 10 numeric keys, usually located to the right of the main keygroup. These numeric keys are arranged in an adding-machine format and are particularly useful for applications that require volume numeric entry or arithmetic calculations.

Keyboards that can either fit flush against the display or be located some distance away via cable connection are referred to as *detachable* keyboards. This feature provides increased configuration flexibility and operator convenience.

Features

Today's display terminals offer a wide variety of potentially useful features and capabilities. No one terminal has them all, however, and some stripped-down economy models offer very few of them.

Many of these equipment features are essentially self-explanatory, and the unique features of specific terminals are thoroughly explained and evaluated in the individual DATAPRO 70 Peripheral reports on those terminals. For these reasons, only the features which are of general interest and which do not readily explain themselves are described in the paragraphs that follow. Comprehensive lists of desirable terminal features for specific application requirements, however, are presented in Tables II through VI.

The *cursor* marks the position on the screen where the next character will be read or written from memory. Cursor control enables the operator to maneuver the cursor on the screen and facilitates the input and output of data. Some terminals also have *program-addressable/readable cursors,* which enable the position of the cursor to be written or read by the computer under program control. Some cursors *blink;* others keep moving as long as the control key remains depressed; and all should be of the nondestructive type. Different manufacturers use a variety of symbols to indicate the cursor position on the screen.

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Typical cursor controls include:

- Move left (L)—moves the cursor one space to the left (which can be from the initial character position of a line to the last character position of the previous line if the terminal features wraparound).
- Move right (R)—moves the cursor one space to the right (which can be from the last character position of a line to the first character position of the next line if the terminal features wraparound).
- Move up (U)—moves the cursor to the same position on the previous line (which can be from the first line to the last line if the terminal features wraparound).
- Move down (D)—moves the cursor to the same position on the following line (which can be from the last line to the first line if the terminal features wraparound).
- Home top (H)—moves the cursor to the initial character position of the first line.
- Home bottom—moves the cursor to the initial character position of the last line.
- Tab—moves the cursor forward to the next tap stop or backward to the previous tab stop (backtab).
- Return (Rt)—moves the cursor to the initial character position of the next line (identical to the carriage return function of a typewriter).
- Backspace—moves the cursor one space to the left.
- Line Feed—moves the cursor to the same position on the following line.

Editing features in a display terminal may consist of any combination of the functions listed below, although the best terminal for editing purposes would include all of them. Each function is performed with respect to the current position of the cursor. The desirable editing functions are:

- *Character insert*—the capability to insert a character into an existing line of displayed text; the text spreads to accommodate the added character. The "spreading" capability may terminate at the last character position of the line or at the last displayable position on the screen. Data is lost when it is spread beyond the termination point.
- *Character delete*—the capability to delete a character from an existing line of displayed text; the remaining text closes up when the character is deleted.
- *Line insert*—the capability to insert a line of text into existing text; the text spreads to accommodate the added line.
- *Line delete*—the capability to delete a line of text from existing text; the remaining text closes up when the line is deleted.
- *Erase*—the capability to erase a character, line of text, message, field, or the complete screen. Most terminals include *character erase* and some form of *display erase,* which may erase the entire contents of the display, just that portion following the cursor location, or a combination of both functions.

Some display terminals are equipped with a *roll* feature. This feature is analogous to the movement of printed copy exiting from a teletypewriter as it is printed, and is an important feature for applications that require the operator to scan several blocks of text to locate key information. As each line of text is received from the computer or cassette tape, all existing lines of text move up or down by one line, depending on the direction of roll. (Some displays can roll in either direction, while others provide only one direction.) Data is lost as it rolls off the screen unless the display memory exceeds the screen capacity.

Most businesses use printed forms for daily activities such as billing, ordering, payroll, and a host of other applications. Some CRT terminals can duplicate the printed form on the face of the screen, and data can be keyed into the blank spaces just as the typist enters data into a printed form. This "fill-in-the-blanks" approach to data entry requires a *protected format* capability. Display terminals that incorporate this feature treat the fixed format differently from the keyed data. Field identifiers such as "name" or "salesman number" are protected from inadvertent key entry, and allowable entries are confined to the variable fields (blank spaces) following the field identifiers. Some terminals automatically tab to the beginning of the next variable field immediately following the entry of the character that completes each field. The tab key is used where a field is partially filled.

Having completed entry into the fixed format, the operator transmits the data to the central computer. A feature called *partial screen transmit* promotes line economies by transmitting only the keyed data; the fixed format remains displayed and the "blanks" are erased for the next entry.

Some special features that enhance the operation of a display terminal include:

- *Character repeat*—enters a continuous sequence of the symbol generated by a depressed key as long as the key remains depressed.
- *Character or field blinking*—draws the operator's attention to vital information by blinking only that character or field that presents the important data.
- *Programmable brightness levels*—visually separate different kinds of displayed information by displaying

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each type at a different intensity level. This feature is analogous to the use of color displays.

- *Reverse video*—displays a "negative" image of data; i.e., data normally displayed in white on a dark background is displayed in black on a white background. This feature can be used for alerting one's attention to pertinent data, and can often be used with character or field blinking as well as with programmable brightness levels. It may be possible to display one or more characters or fields or the entire screen in reverse video.

- *Audible alarm*—alerts the attention of an operator absent from the terminal to a pending message.

Auxiliary Devices

External I/O devices can add considerable flexibility to the applications possibilities for display terminals. A *cassette recorder* or *diskette drive* can be used to store display formats, data to be transmitted, or user programs in the case of intelligent terminals. A *printer* provides hard copy when required. A *light pen* permits the user to initiate commands or to "call for" a page of data by pointing the pen at a displayed entry. Although the above I/O devices are the most common, other devices can be and are used, such as industry-compatible 7- or 9-track magnetic tape drives, disk drives (cartridge or pack type), card readers, etc.

Transmission

The display terminal contains a communications interface that enables communications between the terminal and the central computer site. *Mode* and *technique* define the operating mode and the method in which data is transmitted. There are three operating modes: simplex (transmission in one direction only), half duplex (transmission both directions, but not simultaneously), and full duplex (simultaneous transmission in both directions).

Data is transmitted synchronously or asynchronously. Asynchronous transmission is characterized by the transmission of data in irregular spurts, where the duration of time can vary between successive transmitted characters; the transmission from an unbuffered teletypewriter is a good example. Synchronous transmission implies the transmission of data in a steady stream. Each transmitted character is clocked, and the time interval between successive characters is always precisely the same. The communications interface either provides clocking or accepts external clocking signals from the data set.

The transmission *code* refers to the bit pattern of the transmitted characters. Two codes are prominent, EBCDIC and ASCII; the latter has been accepted as an industry and government standard, and is now by far the most commonly used code.

The *communications discipline* refers to the type of line protocol or control code sequences with which the terminal is compatible, such as ASCII, Binary Synchronous Communications (BSC), or Synchronous Data Link Control (SDLC).

The CRT terminal is a high-speed device that is typically capable of transmitting and receiving several thousand characters per second; however, it must run at a *speed* that is compatible with the communications system in which it is used. Most terminals are used on voice-grade facilities, which limit the transmission speed to a practical maximum of 4800 bits per second over the dial network and 9600 bits per second over leased or private lines.

Message format refers to the way data is transmitted, e.g., by block or by character. Terminals that are designed to be transmission-compatible with a Teletype unit transmit a character for each key depression. Buffered terminals transmit data in multi-character blocks. The block mode permits data to be composed and edited prior to each transmission and generally permits more efficient utilization of the communications facility. Some terminals offer manual selection between the two modes.

Polling/addressing characterizes terminals that are capable of operating in a multiple-terminals-per-line environment such as that employed by the IBM 3270 and 2260/2265 display terminals. Basic to implementing this capability is the ability of a terminal to distinguish a control message intended for it alone. Polling invites the terminals to send data. Addressing informs the terminal that a message from the central computer is coming, so that it will be conditioned to receive. Central control of the message traffic is maintained by the central computer.

Automatic answer refers to the facility for unattended operation on the dial network whereby incoming calls are automatically answered and messages are received without human intervention.

The terminal's interface generally meets the standard *EIA RS-232B/C* specification and connects to a modem or acoustic telephone coupler.

Some terminals contain an *integral modem* that can be connected directly to a communications line via a Bell System Data Access Arrangement. In some cases the manufacturer also provides an *acoustic and/or inductive telephone coupler* so that the terminal can be connected to a conventional telephone handset.

Pricing and Availability

The comparison charts show the monthly rental prices under 1-year and 2-year leases and the purchase prices for each display unit and for its controller where applicable. Many terminal suppliers do not lease their equipment, and in these cases you'll find dashes in the lease price entries. Also, a number of terminal makers sell their wares on an

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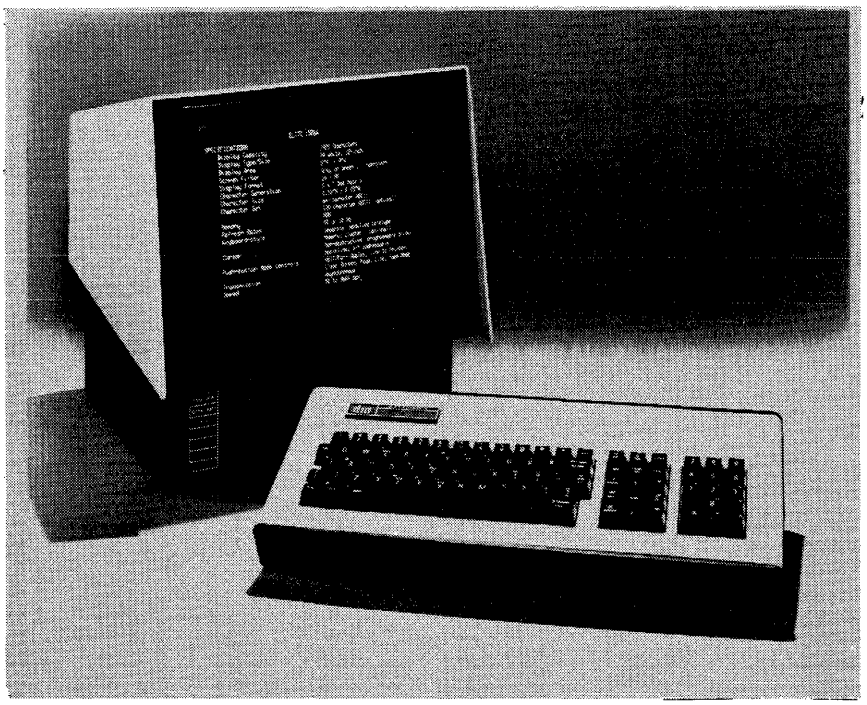

The Datamedia Elite 1520A features Teletype compatibility, a 1920-character screen, a full upper and lower case character set, and a detachable typewriter-style keyboard with numeric pad–all for just $65 per month ($1,555 purchase).

OEM basis only, for incorporation into systems supplied by other vendors. Single entries generally indicate the price of a basic unit without options; price ranges show the price of the basic unit and the price of an expanded unit with all options.

Date of first delivery indicates when the first production model of each terminal was delivered (or is scheduled to be delivered) to a customer.

Number installed to date shows how many terminals of each type had been delivered to customers as of approximately March 1, 1975. All figures were supplied by the manufacturers themselves, and a number of companies chose not to release this information.

Serviced by specifies the party responsible for maintaining the terminal. In some cases the manufacturer provides total service; in others a national service organization is responsible. Service is sometimes rendered under the combined efforts of both the supplier and an independent service organization.

Comments at the bottom of the charts describe significant or unusual features, capabilities, or applications which are not reflected in the standard entries.

Manufacturers

Listed below, for your convenience in obtaining additional information, are the full names and addresses of the 70 vendors whose products are summarized in the comparison charts.

Ann Arbor Terminals, Inc., 6107 Jackson Road, Ann Arbor, Michigan 48103. Telephone (313) 769-0926.

Applied Digital Data Systems, Inc., 100 Marcus Boulevard, Hauppauge, New York 11787. Telephone (516) 231-5400.

Beehive Terminals, 870 West 2600 South, PO Box 19244, Salt Lake City, Utah 84119. Telephone (801) 487-0741.

Bunker Ramo Corporation, Trumbull Industrial Park, Trumbull, Connecticut 06609. Telephone (203) 377-4141.

Burroughs Corporation, Business Machines Group, Room 2A38, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-9115.

California Computer Products, Inc. (CalComp), 2411 W. LaPalma Avenue, Anaheim, California 92801. Telephone (714) 821-2011.

Computek, Inc., 143 Albany Street, Cambridge, Massachusetts 02139. Telephone (617) 864-5140.

Computer Communications, Inc., 2610 Columbia Street, Torrance, California 90503. Telephone (213) 320-9101.

Computer Optics, Inc., Berkshire Industrial Park, Bethel, Connecticut 06801. Telephone (203) 744-6720.

Conrac Corporation, Conrac Division, 600 N. Rimsdale Avenue, Covina, California. Telephone (213) 966-3511.

Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-4656.

Courier Terminal Systems, Inc., 2202 E. University Drive, Phoenix, Arizona 85034. Telephone (602) 244-1392.

Data General Corporation, Route 9, Southboro, Massachusetts, 01770. Telephone (617) 485-9100.

Datamedia Corporation, 7300 N. Crescent Boulevard, Pennsauken, New Jersey 08110. Telephone (609) 665-2382.

Data 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

Datapoint Corporation, 9725 Datapoint Drive, San Antonio, Texas 78284. Telephone (512) 696-4520.

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Delta Data Systems Corporation, Woodhaven Industrial Park, Cornwells Heights, Pennsylvania 19020. Telephone (215) 639-9400.

Digital Equipment Corporation, 146 Main Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.

Digi-Log Systems, Inc., Babylon Road, Horsham, Pennsylvania 19044. Telephone (215) 672-0800.

Four-Phase Systems, Inc., 19333 Vallco Parkway, Cupertino, California 95014. Telephone (408) 255-0900.

Genesis One Computer Corporation, 300 East 44th Street, New York, New York 10017. Telephone (212) 557-3500.

GTE Information Systems, Inc., One Stamford Forum, Stanford, Connecticut 06904. Telephone (203) 357-2000.

Hazeltine Corporation, Greenlawn, New York 11740. Telephone (516) 261-7000.

Hendrix Electronics, Inc., 645 Harvey Road, Manachester, New Hampshire 03103. Telephone (603) 669-9050.

Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. Telephone (415) 493-1501.

Honeywell Information Systems, Inc., 60 Walnut Street, Wellesley Hills, Massachusetts 02181. Telephone (617) 237-4100.

International Business Machines Corporation (IBM), Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

Incoterm Corporation, 6 Strathmore Road, Natick, Massachusetts 01760. Telephone (617) 655-6100.

Infoton, Inc., Second Avenue, Burlington, Massachusetts 01803. Telephone (617) 272-6660.

This modern display terminal produced by Applied Digital Systems (ADDS) is available as a Teletype replacement (Model Data 980) or an IBM 3275 replacement (Model 980A). Features include a 1920-character screen, full edit and data entry capabilities, and numeric keypad.

Interface Technology, Inc., St. Louis, Missouri 63132. Telephone (314) 426-6880.

International Communications Corporation (ICC), 8600 N.W. 41st Street, Miami, Florida 33166. Telephone (305) 592-7654.

International Telephone & Telegraph Corporation (ITT), Data Equipment & Systems Division, East Union Avenue, East Rutherford, New Jersey 07073. Telephone (201) 935-3900.

Jacquard Systems, 1505 11th Street, Santa Monica, California 90404. Telephone (213) 393-3711.

Kustom Electronics Inc., Data Communications Division, 1010 West Chestnut, Chanute, Kansas 66720. Telephone (316) 431-4380.

Lear Siegler, Inc., Electronic Instrumentation Division, 714 North Brookhurst Street, Anaheim, California 92803. Telephone (714) 774-1010.

Megadata Computer and Communications Corporation, 10 Evergreen Place, Deer Park, New York 11729. Telephone (516) 589-6800.

Microtech Data Systems, Inc., 1141 East Janis Street, Carson, California 90746. Telephone (213) 637-1981.

NCR Corporation, EDP Products, Building 23, 3rd Floor, Main & K Streets, Dayton, Ohio 45409. Telephone (513) 449-6620.

Olivetti Corporation of America, 500 Park Avenue, New York, New York 10022. Telephone (212) 371-5500.

Omron Systems, Inc., 432 Toyama Drive, Sunnyvale, California 94086. Telephone (408) 734-8400.

Ontel Corporation, 3 Fairchild Court, Plainview, New York 11803. Telephone (516) 822-7800.

Pertec Business Systems, 17112 Armstrong Avenue, Santa Ana, California 92705. Telephone (714) 540-8340.

Plantronics, Inc., 385 Reed Street, Santa Clara, California 95050. Telephone (408) 249-1160.

Quotron Systems, Inc., 5454 Beethoven Street, Los Angles, California 90066. Telephone (213) 398-2761.

Randal Data Systems, 2807 Oregon Court, Torrance, California 90503. Telephone (213) 320-8550.

Raytheon Data Systems Company, Division of Raytheon Company, 1415 Boston-Providence Turnpike, Norwood, Massachusetts 02162. Telephone (617) 762-6700.

Research, Inc., PO Box 24064, Minneapolis, Minnesota 55424. Telephone (612) 941-3300.

Sanders Data Systems, Inc., Daniel Webster Highway, Nashua, New Hampshire 03060. Telephone (603) 885-6685.

Scientific Measurement Systems, Inc., 26 Olney Avenue, Cherry Hill, New Jersey 08003. Telephone (609) 424-5220.

Selecterm, Inc., 59 Union Square, Summerville, Massachusetts 02143. Telephone (617) 623-7800.

I.P. Sharp Associates, Ltd., PO Box 1900, Karleton Place, Ontario. Telephone (613) 257-3610.

The Singer Company, 2350 Washington Avenue, San Leandro, California 94577. Telephone (415) 357-6800.

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Sycor, Inc., 100 Phoenix Drive, Ann Arbor, Michigan 48104. Telephone (313) 971-0900.

SYS Computer Corporation, 17-25 DiCarolis Court, Hackensack, New Jersey 07601. Telephone (201) 488-0300.

TEC, Inc., 9800 North Oracle Road, Tuscon, Arizona 85704. Telephone (602) 297-1111.

Tektronix, Inc., PO Box 500, Beaverton, Oregon 97005. Telephone (503) 644-0161.

Teleram Communications Corporation, 1032 Mamaroneck Avenue, Mamaroneck, New York 10543. Telephone (914) 698-7789.

Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2000.

Termiflex Corporation, 17 Airport Road, PO Box 1123, Nashua, New Hampshire 03060. Telephone (603) 889-3883.

Terminal Communications, Inc., 3301 Terminal Drive, Raleigh, North Carolina 27611. Telephone (919) 834-5251.

Texas Scientific Corporation, 8000 Harwin Drive, Houston, Texas 77036. Telephone (713) 785-7731.

Trivex, Inc., Information Systems Division, 3180 Red Hill Avenue, Costa Mesa, California 92626. Telephone (714) 546-7781.

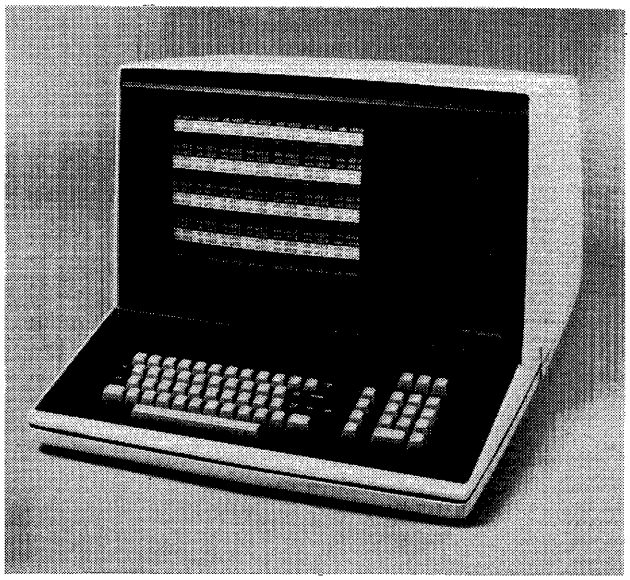
UNIVAC Division, Sperry Rand Corporation, PO Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

Video Data Systems, 657 Old Willets Path, Hauppauge, New York 11787. Telephone (516) 234-1010.

Wang Laboratories, Inc., 836 North Street, Tewksbury, Massachusetts 01876. Telephone (617) 851-4111.

Westinghouse Canada, Ltd., Box 510, Hamilton, Ontario, Canada L8N 3K2. Telephone (416) 528-8811.

Wiltek, Inc., Glover Avenue, Norwalk, Connecticut 06850. Telephone (203) 853-7400.



Here's a good example of reverse video (dark characters on a light background). Produced by Ann Arbor Terminals, the Design III features Teletype compatibility, a variety of screen sizes up to 3200 characters, a detachable Teletype-style keyboard including numeric keypad, and a host of options.

Wyle Computer Products, a Division of Wyle Laboratories, 3200 Magruder Boulevard, Hampton, Virginia 23666. Telephone (213) 322-1763.

Xerox Corporation, 70 South Aviation Boulevard, El Segundo, California 90245. Telephone (213) 679-4511.

Zentec Corporation, 2368-C Walsh Avenue, Santa Clara, California 95050. Telephone (408) 246-7662. □

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SUPPLIER AND MODEL	Ann Arbor Terminals DESIGN III KSR/RO	Ann Arbor Terminals Series 200 KSR/RO	Applied Digital Data Systems (ADDS) Consul 580 & MRD 380	Applied Digital Data Systems (ADDS) Consul 880A & MRD 780A	Applied Digital Data Systems (ADDS) Consul 920 & MRD 780
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	1	1	1; up to 96 chained	1
Portable case	No	No	No	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	—	—	—	No	No
Teletype 33/35-compatible	Std.	Std.	Std.	No	MRD 780 only
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	256 to 3200	256 to 3200	1920	1920	1920
Display arrangement, lines x chars/line	8 x 32 to 40 x 80	8 x 32 to 40 x 80	24 x 80	24 x 80	24 x 80
Display area, height x width, inches	14-inch diag. tube	9- to 23-inch tube	8 x 10	8 x 10	8 x 10
Displayable symbols	64, 96, or 128	64, 96, or 128	64	64	96 (920); 64 (780)
Symbol formation	5 x 7 or 7 x 9 dot matrix	5 x 7 or 7 x 9 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Teletype (KSR)	Teletype (KSR)	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	None	None	None	None	11 opt. (920)
Numeric keypad	Std.	Opt.	Std.	Std.	Std.
Detachable keyboard	Std.	Std.	No	No	Opt. (780)
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	L, R, U, D, H	L, R, U, D, H	L, R, U, D, H
Cursor blinking	Opt.	Opt.	Opt.	No	No
Character insert and delete	Opt.	Opt.	No	Std.	Std. (780 only)
Line insert and delete	Opt.	Opt.	No	No	No
Erase	Char. & screen; line opt.	Char. & screen; line opt.	Char. & screen std.	Char., line, screen	Char., line, screen
Roll	Std.	Std.	Std.	Std., up only	Std.
Protected format	Opt.	Opt.	No	Std.	Std.
Partial screen transmit	Opt.	Opt.	No	Std.	Std.
Tabulation	Opt.	Opt.	No	Std.	Std.
Addressable/readable cursor	Std., address. only	Std., address. only	Std., address. only	Std., address. only	Std.
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Opt.	Opt.	No	Std.	Std.
Programmable brightness levels	2 opt.	2 opt.	No	2 std.	2 std.
Reverse video	Opt.	Opt.	No	No	Std., selectable
Audible alarm	Opt.	Opt.	Std.	No	Std. (920 only)
Other capabilities	Special char. sets, limited graphics	Special char. sets	—	Vector generation; 72 x 160 dots	Vector generation (780 only); 72 x 160 dots
AUXILIARY DEVICES					
Cassette drive	None	None	RS-232 interface	RS-232 interface	Interface (920)
Diskette drive	None	None	RS-232 interface	RS-232 interface	Interface (920)
Printer	Opt. interface	Opt. interface	Non-input (NCR)	Non-impact (NCR)	Non-impact (920)
Light pen	None	None	None	None	None
Other devices	None	None	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII	ASCII	ASCII	ASCII	ASCII
Speed, bits/second	Up to 9600	Up to 9600	Up to 9600	Up to 9600	Up to 9600
Message format	Char./block opt.	Char./block opt.	Char. only	Block	Char./block
Polling/addressing capability	Opt.	Opt.	No	Std.	No
Automatic answerar	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	Std.; 20 ma. opt.	Std.	Std.
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	No	No	No	Std.	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	—
Display unit, 2-year lease, $/mo.	—	—	—	—	—
Display unit, purchase price, $	1,145 to 2,545	725 to 1,075	1,795 (Consul 580)	3,265-3,845(880A)	2,600 (920)
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	—
Date of first production delivery	12/73	5/70	'73(580); '74(380)	9/73	4/70
Number of displays installed to date	500 KSR; 100 RO	2,000 KSR; 3,000 RO	3,000 (580); 200 (380)	600 (880A); 200 (780A)	5,000 (920); 750 (780)
Serviced by	Ann Arbor	Ann Arbor	NCR	NCR	NCR
COMMENTS	Terminals are available in a total of 5 display formats: 16 x 32, 24 x 40, 16 x 80, 24 x 80, and 40 x 80. DESIGN III uses same circuitry as Series 200, but is housed in attractive casework. Series 200 is available as circuit boards with monitor in desk or rack mounting		Also available from NCR as Model 796-101; MRD 380 is rack-mount controller priced at $1,195	Also available from NCR as Model 796-301; MRD 780A is rack-mount controller priced at $2,825 to to $3,170	MRD 780 is rack-mounted controller, separate keyboard and monitors; price is $2,265

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SUPPLIER AND MODEL	Applied Digital Data Systems (ADDS) Consul 980 & MRD 980	Applied Digital Data Systems (ADDS) Consul 980A	Applied Digital Data Systems (ADDS) Envoy 680	Beehive Terminals Mini Bee 2	Beehive Terminals Mini Bee 4
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	1	1	1	1
Portable case	No	No	Std.; 26 lbs.	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	Minicomputer only	No	No	No	No
Teletype 33/35-compatible	Std.	No	Std.	Std.	Std.
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	Std.; IBM 3275	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	1920	1920	1920	2000	2000
Display arrangement, lines x chars/line	24 x 80	24 x 80	24 x 80	25 x 80	25 x 80
Display area, height x width, inches	8 x 10	8 x 10	4 x 5	6.5 x 8.4	6.5 x 8.4
Displayable symbols	96	96	64	64	128
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	11 opt.	11 opt.	None	None	None
Numeric keypad	Std.	Std.	No	Opt.	Std.
Detachable keyboard	No	No	No	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	L, R, U, D, H	L, R, U, D, H	L, R, U, D, H	L, R, U, D, Rt.	L, R, U, D, H, Rt.
Cursor blinking	No	No	No	Std.	Std.
Character insert and delete	Std.	Std.	Std.	No	No
Line insert and delete	Std.	Std.	No	No	No
Erase	Std.	Std.	Std.	Char., line, screen	Char., line, field, screen
Roll	Std., up only	Std., up only	Std., up only	Std., up only	Std., up only
Protected format	Std.	Std.	Std.	No	Std.
Partial screen transmit	Std.	Std.	Std.	No	Std.
Tabulation	Std.	Std.	Std.	No	Std.
Addressable/readable cursor	Std., address. only	Std.	Std., address. only	No	Std., address. only
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Std.	Std.	Std.	No	No
Programmable brightness levels	2 std.	2 std.	2 std.	No	No
Reverse video	Std.	Std.	No	No	Std.
Audible alarm	Std.	Std.	No	Std.	Std.
Other capabilities	Vector generation; 72 x 160 dots	—	Vector generation; 72 x 160 dots	—	—
AUXILIARY DEVICES					
Cassette drive	RS-232 interface	RS-232 interface	RS-232 interface	None	RS-232 interface
Diskette drive	RS-232 interface	RS-232 interface	RS-232 interface	None	RS-232 interface
Printer	Non-impact (NCR)	Impact (Centronics)	RS-232 interface	None	RS-232 interface
Light pen	None	None	None	None	None
Other devices	None	None	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Synchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII	BSC	ASCII	ASCII	ASCII
Speed, bits/second	Up to 9600	Up to 9600	Up to 300	Up to 9600	Up to 9600
Message format	Char./block	Block	Char./block	Char. only	Char./block
Polling/addressing capability	No	Std.	No	No	No
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	No	Std.	Std.
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	No	No	Std.	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	—
Display unit, 2-year lease, $/mo.	—	155; 125 (3-yr.)	99-106 (3-yr.)	—	—
Display unit, purchase price, $	2,800 (Consul 980)	3,200	3,895 to 4,090	1,795	2,395
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	—
Date of first production delivery	11/74;4/75(MRD)	6/75	4/70	8/73	4/74
Number of displays installed to date	600 (Consul 980)	—	300	—	—
Serviced by	NCR	NCR	NCR	Factory & Sorbus	Factory & Sorbus
COMMENTS	MRD 980 is rack-mount controller priced at $1,995				

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SUPPLIER AND MODEL	Beehive Terminals Super Bee 2	Beehive Terminals Super Bee 3	Beehive Terminals Speedi Bee 8	Beehive Terminals Texterm	Bunker Ramo Model 2204/15
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Cluster
Maximum displays/controller	1	1	1	1	36
Portable case	No	No	No	No	No
Programmable by user	Yes, via ROM	Yes, via ROM	No	Yes, via ROM	No
Direct connection to computer	No	No	No	No	Std.
Teletype 33/35-compatible	Std.	No	No	No	No
IBM 2260/2265-compatible	No	No	No	No	Std.
IBM 3270-compatible	No	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	2000	2000	2000	2000	1920
Display arrangement, lines x chars/line	25 x 80	25 x 80	25 x 80	25 x 80	24 x 80
Display area, height x width, inches	6.5 x 8.4	6.5 x 8.4	6.5 x 8.4	7.5 x 9.5	5.4 x 7.2
Displayable symbols	128	128	128	256	96
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	8 std.	8 std.	None	8 std.	16 std.
Numeric keypad	Std.	Std.	Opt.	Std.	Std.
Detachable keyboard	Std.	Std.	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, Rt.	L, R, H, Rt.
Cursor blinking	Std.	Std.	Std.	Std.	No
Character insert and delete	Std.	Std.	No	Std.	Std.
Line insert and delete	Std.	Std.	No	Std.	No
Erase	Char., line, field, screen	Char., line, field, screen	Char., line, field, screen	Char., line, field, screen	Char., line
Roll	Std., up or down	Std., up or down	No	Std., up or down	No
Protected format	Std.	Std.	Std.	Std.	No
Partial screen transmit	Std.	Std.	Std.	Std.	Std.
Tabulation	Std.	Std.	Std.	Std.	Std.
Addressable/readable cursor	Std.	Std.	Std., address. only	Std.	Std., address. only
Character repeat	Std.	Std.	Std.	Std.	No
Character or field blinking	Std.	Std.	Std.	Std.	Std.
Programmable brightness levels	No	No	Std.	2 std.	No
Reverse video	Std.	Std.	Std.	Std.	No
Audible alarm	Std.	Std.	Std.	Std.	Opt.
Other capabilities	Paging, forward or backward, std.	Paging, forward or backward, std.	—	Paging, forward or backward, std.	None
AUXILIARY DEVICES					
Cassette drive	None	Single cassette	None	None	None
Diskette drive	None	None	None	None	None
Printer	RS-232 interface	RS-232 interface	None	RS-232 interface	Impact
Light pen	None	None	None	None	None
Other devices	None	None	None	None	Paper tape reader/ punch
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Async./sync.	Asynchronous	Async./sync.	Asynch./sync.
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	User-specified	User-specified	—	User-specified	ASCII
Speed, bits/second	Up to 9600	Up to 9600	500K char./sec.	Up to 9600	1200 to 4800
Message format	Char./block	Char./block	Char./block	Block	Block
Polling/addressing capability	Opt.	Std.	No	Std.	Std.
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	No; TTL 8-bit par'l.	Std.	Std.
Integral modem	No	No	No	No	Opt.
Acoustic/inductive telephone coupler	No	No	No	No	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	—
Display unit, 2-year lease, $/mo.	—	—	—	—	44
Display unit, purchase price, $	3,295	3,695	3,695	3,995	1,550
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	93 to 380
Controller, purchase price, $	—	—	—	—	3,500 to 15,000
Date of first production delivery	5/73	6/74	—	—	3/73
Number of displays installed to date	—	—	—	—	—
Serviced by	Factory & Sorbus	Factory & Sorbus	Factory & Sorbus	Factory & Sorbus	Bunker Ramo
COMMENTS					All display models can be intermixed on same controller

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SUPPLIER AND MODEL	Bunker Ramo Model 2206/17	Bunker Ramo Model 2210	Bunker Ramo Model 2212	Burroughs TD 700	Burroughs TD 800
ARRANGEMENT					
Stand-alone or cluster	Cluster	Cluster	Cluster	Stand-alone	Stand-alone
Maximum displays/controller	36	36	36	1	1
Portable case	No	No	No	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	Yes	Yes	Yes	Std., Burr. only	Std., Burr. only
Teletype 33/35-compatible	No	No	No	No	No
IBM 2260/2265-compatible	Std.	Std.	Std.	Opt.	Opt.
IBM 3270-compatible	No	No	No	Opt.	Opt.
DISPLAY ORGANIZATION					
Display positions, chars/display	1920	200	480	256	960/1920
Display arrangement, lines x chars/line	24 x 80	10 x 20	12 x 40	8 x 32	12/24 x 80
Display area, height x width, inches	6.25 x 8.75	2 x 2.25	3 x 4	3.25 x 8.75	7.5 x 9.5
Displayable symbols	96	96	96	64	64
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Block	Block	Typewriter/data entry	Typewriter/data entry/numeric
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	16 std.	6 std.	12 std.	None	None
Numeric keypad	Std.	Std.	Std.	No	No
Detachable keyboard	Std.	No	No	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Home, Return	L, R, H, Rt.	L, R, H, Rt.	L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	No	No	Not specified	Std.
Character insert and delete	Std.	Std.	Std.	Opt.	Std.
Line insert and delete	No	No	No	No	No
Erase	Line, screen	Screen	Line, screen	Char., screen	Char., screen
Roll	No	No	No	No	No
Protected format	No	No	No	Std.	Std.
Partial screen transmit	Std.	Std.	Std.	Opt.	Std.
Tabulation	Std.	Std.	Std.	Opt.	Std.
Addressable/readable cursor	Std., address. only	Std., address. only	Std., address. only	No	No
Character repeat	No	No	No	No	Std.
Character or field blinking	Std.	Std.	Std.	No	No
Programmable brightness levels	No	No	No	No	No
Reverse video	No	No	No	No	No
Audible alarm	Opt.	No	No	No	Std.
Other capabilities	None	None	None	—	—
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	None
Diskette drive	None	None	None	None	None
Printer	Impact	Impact	Impact	Impact	Impact
Light pen	None	None	None	None	None
Other devices	Paper tape reader/ punch	Paper tape reader/ punch	Paper tape reader/ punch	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex	Half duplex
Technique	Async./sync.	Async./sync.	Async./sync.	Async./sync.	Async./sync.
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII	ASCII	ASCII	ASCII/BSC	ASCII/BSC
Speed, bits/second	1200 to 4800	1200 to 4800	1200 to 4800	Up to 9600	Up to 9600
Message format	Block	Block	Block	Char./block	Char./block
Polling/addressing capability	Std.	Std.	Std.	Std.	Std.
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	Std.	Opt.	Opt.
Integral modem	Opt.	Opt.	Opt.	No	No
Acoustic/inductive telephone coupler	Opt.	Opt.	Opt.	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	115	130 to 145
Display unit, 2-year lease, $/mo.	40	19	37	113 (3-yr.)	127 to 142 (3-yr.)
Display unit, purchase price, $	1,490	760	1,345	4,150	5,000 to 5,500
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	93 to 380	93 to 380	93 to 380	—	—
Controller, purchase price, $	3,500 to 15,000	3,500 to 15,000	3,500 to 15,000	—	—
Date of first production delivery	1/70	1/70	1/70	6/73	9/73
Number of displays installed to date	Over 30,000	—	—	—	—
Serviced by	Bunker Ramo	Bunker Ramo	Bunker Ramo	Burroughs	Burroughs
COMMENTS		Small desk-top unit containing block keyboard and 3-inch screen	Small desk-top unit containing 3 block keygroups and 6-inch screen	Uses Burroughs Self-Scan gas technology display panel; display, control, and keyboard are separate; several terminals can share one modem	

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SUPPLIER AND MODEL	Burroughs TD 820	CalComp Virtual Terminal System	Computek Model 200	Computer Communications Model CC-40	Computer Optics CO:77
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Cluster	Either	Either	Either
Maximum displays/controller	1	60	4	15	32
Portable case	No	No	Opt.	No	No
Programmable by user	No	Opt.	Via PROM	No	No
Direct connection to computer	Std., Burr. only	Std., IBM 360/370	Std.	No	No
Teletype 33/35-compatible	No	No	Via microprogram	No	No
IBM 2260/2265-compatible	Opt.	No	Via microprogram	Opt.	No
IBM 3270-compatible	Opt.	Opt.	Via microprogram	No	Std.
DISPLAY ORGANIZATION					
Display positions, chars/display	960/1920	240/480/960/1920	480/960/2000	960/1920	480/960/1920
Display arrangement, lines x chars/line	12/24 x 80	6/12 x 40/80	25 x 80	24 x 40/80	12 x 40/80; 24 x 80
Display area, height x width, inches	14.8 x 16.4	12 (diagonal)	6 x 8	Variable	16-inch diag.
Displayable symbols	96	128; to 512 opt.	128	64; 96 opt.	64; 96 opt.
Symbol formation	5 x 7 dot matrix	7 x 9 dot matrix	14 x 20 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	Typewriter/data entry	Typewriter/data entry/console	Data entry	Typewriter	Several
Character set	ASCII	EBCDIC	ASCII	ASCII	ASCII/EBCDIC
Program function keys	All keys	10 std.; 15 opt.	22 std.	16 std.	Std.
Numeric keypad	Opt.	Opt.	Std.	None	Opt.
Detachable keyboard	Std.	Std.	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, Rt.
Cursor blinking	No	Std.	Opt.	Std.	No
Character insert and delete	Std.	Std.	Std.	No	Std.
Line insert and delete	Std.	Opt.	Std.	No	Opt.
Erase	Char., line, screen	Char., field, screen	Char., line, screen	Char., line, screen	Char., field, line, screen
Roll	Std., up & down	Opt.	Std.	No	No
Protected format	Std.	Std.	Std.	Std.	Std.
Partial screen transmit	Std.	Std.	Std.	Std.	Std.
Tabulation	Std.	Std.	Std.	Std.	Std.
Addressable/readable cursor	Std.	Std.	Std.	Std.	Std.
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Std.	Std., field only	Std.	Std.	No
Programmable brightness levels	No	2 std.	2 std.	No	2 std.
Reverse video	Std.	Std.	Std.	No	No
Audible alarm	Std.	Opt.	Opt.	Opt.	Opt.
Other capabilities	Blanking, field overflow & inhibit, lower-case lockout, search	—	—	Paging	—
AUXILIARY DEVICES					
Cassette drive	Single/dual drive	Opt.	Single/dual drive	None	None
Diskette drive	Single spindle	Opt.	Single/dual spindle	None	None
Printer	Impact	Impact	Impact/non-impact	Impact/non-impact	Impact
Light pen	No	Opt.	Opt.	Opt.	Opt.
Other devices	ID card reader	Card reader, disk drive	Card reader	None	ID card reader
TRANSMISSION					
Mode	Half duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Synchronous		Async./sync.	Synchronous
Code	ASCII	ASCII/EBCDIC	Any	ASCII	ASCII/EBCDIC
Communications discipline	ASCII/BSC	BSC/SDLC	Any	ASCII	BSC/SDLC
Speed, bits/second	Up to 9600	2400 to 34,800	110 to 19,200	150 to 9600	1200 to 9600
Message format	Char./block	Char./block	Char./block	Block	Block
Polling/addressing capability	Std.	Std.	Opt.	Std.	Std.
Automatic answer	No	Opt.	No	Std.	Opt.
EIA RS-232C interface	Opt.	Std.	Std.	Std.	Std.
Integral modem	No	No	Opt.	No	No
Acoustic/inductive telephone coupler	No	No	Opt.	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	160 to 175	100	Contact vendor	—	61 to 68
Display unit, 2-year lease, $/mo.	150 to 165 (3-yr.)	91	—	115 to 194 (3-yr.)	56 to 62
Display unit, purchase price, $	6,200 to 6,800	4,000	3,000 to 8,500	—	1,504 to 1,682
Controller, 1-year lease, $/mo.	—	315	—	—	290 to 295
Controller, 2-year lease, $/mo.	—	287	—	—	260 to 270
Controller, purchase price, $	—	12,000	—	3,850 to 5,600	7,424
Date of first production delivery	2nd qtr. 1975	12/73	1972	3/74	1st qtr. 1974
Number of displays installed to date	—	—	Over 1,200	150	Over 400
Serviced by	Burroughs	CalComp	Computek	CCI	CO & Syntonic
COMMENTS			Minicomputer-based unit with up to 16K bytes of RAM & PROM memory; extensive software support	Controller price includes one display unit	Also see Report 70D-192-01 for details

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SUPPLIER AND MODEL	Conrac 401 Series	Conrac 480 Series TTY Plus	Control Data Model 711	Control Data Model 713	Control Data Model 714
ARRANGEMENT					
Stand-alone or cluster	Either	Either	Stand-alone	Stand-alone	Cluster
Maximum displays/controller	16	8/16/32	1	1	15
Portable case	No	No	No	No	No
Programmable by user	Via ROM; Plus only	No	No	No	No
Direct connection to computer	No	No	No	No	No
Teletype-33/35-compatible	Opt.	Std.	No	Yes	No
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	Opt.	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	2000	960/2000	640/1280 opt.	640/1280 opt.	640/1280
Display arrangement, lines x chars/line	25 x 80	12/25 x 80	8/16 x 80	8/16 x 80	8/16 x 80
Display area, height x width, inches	7.5 x 10	7.5 x 10	8 x 10	8 x 10	8 x 10
Displayable symbols	128	64; 128	64; 96 opt.	64; 96 opt.	64; 96 opt.
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 9 dot matrix	5 x 9 dot matrix	5 x 9 dot matrix
KEYBOARD					
Style	Several	Teletype; others opt.	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	Teletype	ASCII
Program function keys	20 std., + 10 opt.	10 opt.	None	None	None
Numeric keypad	Opt., Plus only	Opt.	Std.	Std.	Std.
Detachable keyboard	Opt., -3 only	No	No	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.—12, 25	Std.	Std.	Std.
Character insert and delete	Std.	Std.—25; opt.—8,12	Opt.	No	Opt.
Line insert and delete	Std.	Std.—25; opt.—8	Opt.	No	Opt.
Erase	Char., line, screen	Char., line, screen	Char. & screen; line opt.	Char. & screen	Char. & screen; line opt.
Roll	Std.	Std.—25; opt.—8,12	Std., up only	Std.	Std.
Protected format	Std.; plus only	Std.—25; opt.—8,12	—	—	—
Partial screen transmit	Std.	Std.—8,25; opt.—12	Opt.	Std.	Opt.
Tabulation	Std.	Std.—25	Std.	No	No
Addressable/readable cursor	Std.	Addr. std.; read—25	No	No	No
Character repeat	Std.	Opt.	Std.	Std.	Std.
Character or field blinking	Std.	Std.—8,25	No	No	No
Programmable brightness levels	2 std.	2 std.—25	2 std.	No	2 std.
Reverse video	No	No	No	No	Opt.
Audible alarm	Yes	Std.	Std.	Std.	Std.
Other capabilities	—	—	None	None	None
AUXILIARY DEVICES					
Cassette drive	None	RS-232 interface,25	None	None	None
Diskette drive	2 ports opt.	RS-232 interface,25	None	None	None
Printer	2 ports opt.	Impact	Impact/non-impact	Non-impact	Impact/non-impact
Light pen	None	None	None	None	None
Other devices	Contact vendor	Contact vendor	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Asynchronous	Synchronous	Asynchronous	Async./sync.
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII; others opt.	ASCII	ASCII/CDC BSC	ASCII	ASCII/CDC BSC
Speed, bits/second	110 to 9600; 50K opt.	110 to 9600; 50K opt.	2000 to 4800	75 to 300	2000 to 4800
Message format	Char./block	Char./block	Block	Char. only	Char./block
Polling/addressing capability	Std., Plus only	Opt., 25 only	Std.	Std.	Std.
Automatic answer	No	Std.	Std.	No	Std.
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	90 to 111	60 to 70	75 to 89
Display unit, 2-year lease, $/mo.	—	—	—	—	—
Display unit, purchase price, $	1,800 to 3,600	1,000 to 2,600	3,500 to 4,120	1,995 to 2,315	3,300 to 3,900
Controller, 1-year lease, $/mo.	—	—	—	—	140 to 160
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	3,000 to 6,000	3,000 to 5,000	—	—	5,300 to 6,300
Date of first production delivery	9/70; 5/75 (Plus)	73/4-8,12;5/75—25	6/71	4/71	7/73
Number of displays installed to date	Over 5,000	NA	1,000	1,800	165
Serviced by	Conract & Sorbus	Conrac & Sorbus	CDC	CDC	CDC
COMMENTS	Model 401-B is equipped with Burroughs interface; Model 401 Plus is microprocessor-based and is available with programming support	480 Series currently includes 3 models: 8, 12, and 25. Vendor sells OEM only			

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SUPPLIER AND MODEL	Courier Executerm 60 & 260	Courier Executerm 65 & 265	Courier 2700	Courier 2750	Data General Model 6012
ARRANGEMENT					
Stand-alone or cluster	Cluster	Stand-alone	Cluster	Stand-alone	Stand-alone
Maximum displays/controller	16	1	32	1	1
Portable case	No	No	No	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	Std., IBM 360/370	No	Std., IBM 360/370	No	Yes
Teletype 33/35-compatible	No	No	No	No	Std.
IBM 2260/2265-compatible	Std.	Std.	Opt.	No	No
IBM 3270-compatible	No	No	Std.	Std.	No
DISPLAY ORGANIZATION					
Display positions, chars/display	480/960/1920	480/960/1920	480/960/1920	480/960/1920	1920
Display arrangement, lines x chars/line	12 x 40/80;24 x 80	12 x 40/80;24 x 80	12 x 40/80;24 x 80	12 x 40/80;24 x 80	24 x 80
Display area, height x width, inches	7 x 10	7 x 10	7 x 10	7 x 10	7 x 9
Displayable symbols	64	64	64; 96 opt.	64; 96 opt.	64
Symbol formation	7 x 8 dot matrix	7 x 8 dot matrix	7 x 10 dot matrix	7 x 10 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter/data entry	Typewriter/data entry	Typewriter/data entry	Typewriter/data entry	Typewriter/data entry
Character set	ASCII/EBCDIC	ASCII	ASCII/EBCDIC	ASCII/EBCDIC	ASCII
Program function keys	8 opt.	8 opt.	6/12 std.	6/12 std.	No
Numeric keypad	Opt.	Opt.	Opt.	Opt.	Std.
Detachable keyboard	No	No	Std.	Std.	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.	Std.	Std.	Std.
Character insert and delete	Std.	Std.	Std.	Std.	No
Line insert and delete	No	No	No	No	No
Erase	Char., line, screen	Char., line, screen	Char., line, screen	Std.	Char., line, screen
Roll	Std., up only	Std., up only	No	No	Std.
Protected format	Std.	Std.	Std.	Std.	Std.
Partial screen transmit	Std.	Std.	Std.	Std.	Std.
Tabulation	Std.	Std.	Std.	Std.	Std.
Addressable/readable cursor	Line address std.	Line address std.	Std.	Std.	No
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Std., field only	Std., field only	Std., field only	Std., field only	Std.
Programmable brightness levels	No	No	2 std.	2 std.	No
Reverse video	No	No	No	No	No
Audible alarm	Opt.	Opt.	Opt.	Opt.	Opt.
Other capabilities	—	—	—	—	—
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	None
Diskette drive	None	None	None	None	None
Printer	Impact	Impact	Impact	Impact	None
Light pen	None	None	Opt.	Opt.	None
Other devices	None	None	ID card reader, 80-col. card reader	ID card reader	None
TRANSMISSION					
Mode	Half duplex	Half duplex	Half duplex	Half duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Synchronous	Synchronus	Asynchronous
Code	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC	ASCII
Communications discipline	ASCII	ASCII	BSC	BSC	ASCII
Speed, bits/second	1200 to 4800	1200 to 4800	1200 to 9600	1200 to 9600	110 to 4800
Message format	Block	Block	Block	Block	Char./block
Polling/addressing capability	Std.	Std.	Std.	Std.	No
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	—
Display unit, 2-year lease, $/mo.	95 to 150	121 to 160	103 to 173	138 to 219	—
Display unit, purchase price, $	3,000 to 4,500	3,500 to 5,000	3,300 to 5,700	4,500 to 7,200	2,700
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	120 to 350	—	200 to 450	—	—
Controller, purchase price, $	4,000 to 10,000	—	5,000 to 11,000	—	350
Date of first production delivery	7/70; 5/71 (260)	7/70; 4/71 (265)	1/74	1/74	9/74
Number of displays installed to date	5,000 (incl. 65/265)	5,000 (incl. 60/260)	2,400 (incl. 2750)	2,400 (incl. 2700)	—
Serviced by	Courier	Courier	Courier	Courier	Data General
COMMENTS			Uses standard IBM 3270 cables. Also see Report 70D-269-03	Also see Report 70D-269-03	

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SUPPLIER AND MODEL	Datamedia Elite 1500A	Datamedia Elite 1520A	Datamedia Elite 2000A	Datamedia Elite 2100A	Datamedia Elite 2500A
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	1	1	1	1
Portable case	Model 1500P	No	No	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	No	No	No	No	No
Teletype 33/35-compatible	Std.	Std.	Std.	Std.	Std.
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	No	No	No.	No
DISPLAY ORGANIZATION					
Display positions, chars/display	256/480/960/ 1440/1920	1920	960/1440/1920	1440/1920	1920
Display arrangement, lines x chars/line	8 x 32; 6 to 24 x 80	24 x 80	12/18/24 x 80	18/24 x 80	24 x 80
Display area, height x width, inches	1.5/3/4.5/6 x 9	6 x 9	3/4.5/6 x 9	4.5/6 x 9	6 x 9
Displayable symbols	64	64; 128 opt.	64	64	127
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7/9 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	—	None	None	No	11 std.
Numeric keypad	Opt.	Opt.	Opt.	Opt.	Std.
Detachable keyboard	Std.	Std.	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	Rt. only	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	Std.; non-blink opt.	No	No	Opt.
Character insert and delete	No	No	No	No	Opt.
Line insert and delete	No	No	No	No	Opt.
Erase	Screen only	Char., line, screen	Char., line, screen	Char., line, screen	Char., line, screen
Roll	Std., up only	Std., up only	Std., up only	No	Std., up only
Protected format	No	No	No	No	Std.
Partial screen format	No	No	Std.	Std.	Std.
Tabulation	No	No	No	No	Opt.
Addressable/readable cursor	No	Std., address. only	No	Std., address. only	Std., address. only
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	No	No	No	No	Std.
Programmable brightness levels	No	No	No	No	2 std.
Reverse video	No	No	No	No	No
Audible alarm	Std.	Std.	Std.	Std.	Std.
Other capabilities	—	—	—	—	—
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	None
Diskette drive	None	None	None	None	None
Printer	RS-232 interface	RS-232 interface	RS-232 interface	RS-232 interface	RS-232 interface
Light pen	None	None	None	None	None
Other devices	None	None	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Async./sync.
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII	ASCII	ASCII	ASCII	ASCII
Speed, bits/second	50 to 4800	50 to 9600	50 to 1800	50 to 9600	50 to 9600
Message format	Char. only	Char. only	Char./block	Block	Char./block
Polling/addressing capability	No	No	No	Std.	Opt.
Automatic answer	Opt.	No	Opt.	No	Opt.
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	Opt.	Opt.	Opt.	Opt., 1200 bps	Opt.
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	65	65 to 75	75	—	85 to 95
Display unit, 2-year lease, $/mo.	65	65 to 75	75	—	85 to 95
Display unit, purchase price, $	1,375 to 1,555	1,555 to 1,705	1,775 to 1,895	2,035 to 2,095	2,080 to 2,480
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	—
Date of first production delivery	2/72	1/75	9/70	10/72	7/73
Number of displays installed to date	—	—	—	—	—
Serviced by	Datamedia	Datamedia	Datamedia	Datamedia	Datamedia
COMMENTS	Also available as RO unit using ASCII or Baudot				

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SUPPLIER AND MODEL	Data 100 Model 73	Datapoint 1100	Datapoint 3000 & 3300	Datapoint 3360	Datapoint 3600
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	1	1	1	1
Portable case	No	No	No	No	No
Programmable by user	No	Yes	No	No	No
Direct connection to computer	No	Yes	No	No	No
Teletype 33/35-compatible	Std.	Yes, via program	Std.	No	No
IBM 2260/2265-compatible	No	Yes, via program	No	Std.	No
IBM 3270-compatible	No	Yes, via program	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	960/1920	960	1800	2048	1920
Display arrangement, lines x chars/line	12/24 x 80	12 x 80	25 x 72	25 x 82	24 x 80
Display area, height x width, inches	6 x 9	3.5 x 7	7.5 x 10	5 x 8	5 x 8
Displayable symbols	64	94	64	64	94
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Teletype	Typewriter	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	No	None	None	None	None
Numeric keypad	Std.	Std.	Std.	Std.	Std.
Detachable keyboard	No	No	No	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	Std.	Std.	Std.	Std.
Character insert and delete	No	Std.	No	No	No
Line insert and delete	No	Std.	No	No	No
Erase	No	Std.	Std.	Std.	Std.
Roll	Std., up only	Std., up only	Std.	No	Std., up only
Protected format	No	No	No	No	No
Partial screen transmit	Std.	No	No	No	No
Tabulation	Std.	Std.	No	Opt.	No
Addressable/readable cursor	Std., address. only	Std., address. only	No	No	Std., address. only
Character repeat	Std.	No	Std.	Std.	No
Character or field blinking	No	No	No	No	No
Programmable brightness levels	No	No	No	No	No
Reverse video	No	No	No	No	No
Audible alarm	Std.	Std.	Std.	Std.	Std.
Other capabilities	None	—	None	None	None
AUXILIARY DEVICES					
Cassette drive	None	Dual drive std.	None	None	None
Diskette drive	None	4 spindles std.	None	None	None
Printer	RS-232 interface	Impact	Impact	Impact	Impact
Light pen	None	None	None	None	None
Other devices	None	Disk, tape drives, card reader	None	None	None
TRANSMISSION					
Mode	Half duplex	Half/full duplex	Half/full duplex	Half/full duplex	Full duplex
Technique	Async./sync.	Asynch./synch.	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	Any	ASCII	ASCII	ASCII
Communications discipline	ASCII/BSC	Any	ASCII	ASCII	ASCII
Speed, bits/second	110 to 1200	Up to 9600	110 to 2400	300 to 4800	110 to 9600
Message format	Char. only	Char./block	Char. only	Block	Char. only
Polling/addressing capability	No	Std.	No	No	No
Automatic answer	No	Opt.	No	No	No
EIA RS-232C interface	Std.	Std.	Opt.	Std.	Std.
Integral modem	No	Opt.	No	No	No
Acoustic/inductive telephone coupler	No	Opt.	Opt.	Opt.	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	105	183 to 215	—	—	67
Display unit, 2-year lease, $/mo.	97	165 to 294	—	—	60
Display unit, purchase price, $	3,360	7,200 to 8,040	2,400 to 3,240	3,900	1,950
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	—
Date of first production delivery	8/70	1/74	1968/1970	1/70	12/74
Number of displays installed to date	—	2,000	6,000	500	100
Serviced by	Data 100	Datapoint	Datapoint	Datapoint	Datapoint
COMMENTS		Minicomputer-based unit. See Report 70D-315-01 for details			

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SUPPLIER AND MODEL	Delta Data Systems 5000/APL, 5100, 5200, & 5500	Delta Data Systems Model 5300	Delta Data Systems Model 4000	Digi-Log Model 209 TeleComputer	Digi-Log Model 33
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1 or 64 via mux.	1 or 64 via mux.	1 or 64 via mux.	10	10
Portable case	No	No	No	Std., 10 lbs.	Std., 10 lbs.
Programmable by user	No	Opt.	Opt.	No	No
Direct connection to computer	No.	Opt.	No	No	No
Teletype 33/35-compatible	Std.	No	Std.	Std.	Std.
IBM 2260/2265-compatible	Opt.	Std.	Opt.	No	No
IBM 3270-compatible	No	Opt.	Opt.	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	1024 to 3072	2160	2048	640	1280
Display arrangement, lines x chars/line	27 x 80	27 x 80	25 x 80	16 x 40	16 x 80
Display area, height x width, inches	6 x 11	6 x 11	6 x 11	Variable	Variable
Displayable symbols	64; 96 opt.	64	224	64	64
Symbol formation	7 x 9 dot matrix	7 x 9 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Teletype	Teletype	Typewriter	Teletype	Teletype
Character set	ASCII/APL	ASCII/APL	ASCII; others opt.	ASCII	ASCII
Program function keys	Opt.	None	Std.	None	None
Numeric keypad	Std.	Opt.	Std.	None	None
Detachable keyboard	Opt.	Opt.	Opt.	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.	Std.	Opt.	Opt.
Character insert and delete	Std., except 5100	Std.	Std.	No	No.
Line insert and delete	Std., except 5100	Std.	Std.	No	No
Erase	Char., line, field, screen	Char., line, field, screen	Char., line, field, screen	Char., screen	Char., screen
Roll	Std., up & down	Std., up & down	Std., up & down	Std., up only	Std., up only
Protected format	Std.	Std.	Std.	No	No
Partial screen transmit	Std.	Std.	Std.	No	No
Tabulation	Std.	Std.	Std.	No	No
Addressable/readable cursor	Std.	Std.	Std.	Std., address. only	Std., address. only
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Std.	Std.	Std.	Opt.	Opt.
Programmable brightness levels	No	No	No	No	No
Reverse video	Opt.	Std.	Std.	No	No
Audible alarm	Std.	Std.	Std.	Opt.	Opt.
Other capabilities	Paging	Paging	—	None	None
AUXILIARY DEVICES					
Cassette drive	Single/dual drive	Single/dual drive	RS-232 interface	RS-232 interface	RS-232 interface
Diskette drive	Opt.	Opt.	RS-232 interface	RS-232 interface	RS-232 interface
Printer	Impact/non-impact	Impact/non-impact	Impact/non-impact	RS-232 interface	RS-232 interface
Light pen	Opt., except 5500	Opt.	None	None	None
Other devices	Multiplexer with 16 to 64 channels	Multiplexer with 16 to 64 channels	Multiplexer with 16 to 64 channels	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Async./sync.	Async./sync.	Asynchronous	Asynchronous
Code	ASCII	EBCDIC/ASCII	ASCII; others opt.	ASCII	ASCII
Communications discipline	ASCII	ASCII/BSC	ASCII; others opt.	ASCII	ASCII
Speed, bits/second	110 to 9600	1200; 2400 opt.	110 to 9600	75 to 9600	75 to 9600
Message format	Char./block	Char./block	Char./block	Char. only	Char. only
Polling/addressing capability	Opt.	Std.	Opt.	No	No
Automatic answer	Opt.	No.	Opt.	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral mdoem	Opt.	Opt.	No	Opt.	Opt.
Acoustic/inductive telephone coupler	Opt.	Opt.	Opt.	Opt.	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	155 to 200	155 to 200	155 to 178	—	—
Display unit, 2-year lease, $/mo.	135 to 185	135 to 185	137 to 157	—	—
Display unit, purchase price, $	2,800 to 3,400	2,800 to 3,400	3,000 to 3,870	—	—
Controller, 1-year lease, $/mo.	150 to 174	150 to 174	—	—	—
Controller, 2-year lease, $/mo.	135 to 157	135 to 157	—	—	—
Controller, purchase price, $	3,750 to 4,350	3,750 to 4,350	—	1,195 to 1,695	1,295 to 1,720
Date of first production delivery	1970	1970	2/75	9/72	9/72
Number of displays installed to date	4,000	200	—	1,200	Over 800
Serviced by	Delta & GTE	Delta & GTE	Delta & GTE	Digi-Log	Digi-Log
COMMENTS	MultiTerm 2 is a microprocessor-based multiplexer with up to 64K of memory and software emulators for IBM 2260/ 2265 & 3270	Microprocessor-based unit; quantity discounts available for 6 or more units	Microprocessor-based unit; quantiy discounts available for 6 or more units	A portable controller that uses separate monitor and keyboard (incluided in higher cost above)	A portable controller that uses separate monitor and keyboard (included in higher cost above)

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SUPPLIER AND MODEL	Digi-Log Series 300	Digi-Log Series 400	Digi-Log Series 3300 Microterm	Digital Equipment Model VT-50	Four-Phase Systems System IV/40
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Cluster
Maximum displays/controller	10	10	1	1	16
Portable case	Std., 10 lbs.	Std.	No	No	No
Programmable by user	No	No (by vendor)	No (by vendor)	No	Std.
Direct connection to computer	No	Yes, minicomputer	Yes, minicomputer	Yes	No
Teletype 33/35-compatible	Std.	Yes, via microprog.	Yes, via microprog.	Std.	Std.
IBM 2260/2265-compatible	No	Yes, via microprog.	Yes, via microprog.	No	Std.
IBM 3270-compatible	No	Opt., via micro-prog.	Yes, via microprog.	No	Std.
DISPLAY ORGANIZATION					
Display positions, chars/display	640/1280	640/1280	1920	960	1152/1920
Display arrangement, lines x chars/line	16 x 40/80	16 x 40/80	24 x 80	12 x 80	24 x 48/80
Display area, height x width, inches	Variable	Variable	Variable	8.7 x 4.3	7.25 x 10.25
Displayable symbols	63	128	128	64	125
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7/9; 7 x 9 dot	5 x 7 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	No keyboard	No keyboard	Typewriter	Typewriter	Typewriter/data entry
Character set	—	—	ASCII	ASCII	ASCII/EBCDIC
Program function keys	—	—	10 opt.	4 std.	12 std.
Numeric keypad	—	—	Opt.	No	Std.
Detachable keyboard	—	—	Opt.	No	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Opt.	Opt.	Std.	Std.	Std.
Character insert and delete	No	No	Std.	No	Std.
Line insert and delete	No	No	Std.	No	Std.
Erase	Char., screen	Screen	Char., line, screen	Line, screen	Char., line, screen
Roll	Std., up only	Std., up only	Std., up only	Std., up only	Std.
Protected format	No	No	Std.	No	Std.
Partial screen transmit	No	No	Std.	No	Std.
Tabulation	No	No	Std.	Std.	Std.
Addressable/readable cursor	Std., address. only	No	Std.	No	Std.
Character repeat	No	No	Std.	No	Std.
Character or field blinking	Opt.	Std.	Std.	No	Std.
Programmable brightness levels	No	No	2 std.	No	3 opt.
Reverse video	No	No	Std.	No	No
Audible alarm	Opt.	Opt.	Opt.	Std.	Opt.
Other capabilities	None	None	Word wraparound, underscore	—	Format storage
AUXILIARY DEVICES					
Cassette drive	RS-232 interface	RS-232 interface	RS-232 interface	None	None
Diskette drive	RS-232 interface	RS-232 interface	RS-232 interface	None	Opt.
Printer	RS-232 interface	RS-232 interface	RS-232 interface	Std., non-impact	Impact
Light pen	None	None	None	None	None
Other devices	None	None	None	None	Disk drive, others
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Async./sync.	Async./sync.	Asynchronous	Async./sync.
Code	ASCII	ASCII/EBCDIC	ASCII	ASCII	ASCII/EBCDIC
Communications discipline	ASCII	ASCII/BSC	ASCII/BSC	ASCII	ASCII/BSC
Speed, bits/second	110 to 9600	50 to 9600	75 to 9600	75 to 9600	Up to 9600
Message format	Any	Any	Char./block	Char. only	Char./block
Polling/addressing capability	No	No	Opt.	No	Std.
Automatic answer	No	No	No	No	Std.
EIA RS-232C interface	Std.	Std.	Opt.; 20/60 ma.opt.	Std.	Std.
Integral modem	No	No	Opt.	No	No
Acoustic/inductive telephone coupler	No	No	Opt.	Opt.	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	45 to 51
Display unit, 2-year lease, $/mo.	—	—	—	—	43 to 49 (3-yr.)
Display unit, purchase pice, $	—	—	2,100 to 5,000	1,250	1,845 to 2,075
Controller, 1-year lease, $/mo.	—	—	—	—	375 to 890
Controller, 2-year lease, $/mo.	—	—	—	—	339 to 810
Controller, purchase price, $	790 to 1,100	1,995	—	60	17,325 to 41,850
Date of first production delivery	3/74	12/74	9/73	9/74	7/73
Number of displays installed to date	Over 200	Over 100	700	—	Over 1,000
Serviced by	Digi-Log	Digi-Log	Digi-Log	DEC	Four-Phase
COMMENTS	Portable controller; uses separate monitor and key-board (included in higher cost above)	Hard-wired controller	Microprocessor-based unit; PROM microprogram designed to user's specifications	Provides local copy of displayed data via integral printer	Minicomputer-based system with disk or diskette storage and up to 72K bytes of memory; pricing does not include printers. Also see Report 70D-435-02

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SUPPLIER AND MODEL	Four-Phase Systems System IV/70	Genesis One Model G77 "The Plug"	GTE Information Systems IS/7801, IS/7801A, & IS/7802	GTE Information Systems IS/7700 & IS/7701	GTE information Systems IS/7100
ARRANGEMENT					
Stand-alone or cluster	Cluster	Cluster	Cluster	Cluster	Stand-alone
Maximum displays/controller	32	32	5/26	24	1
Portable case	No	Opt.	No	No	No
Programmable by user	Std.	No	No (by vendor)	No	No
Direct connection to computer	Std.	No	IS/7802 only	IS/7701 only	No
Teletype 33/35-compatible	Std.	No	No	No	No
IBM 2260/2265-compatible	Std.	No	No	Std.	Std.
IBM 3270-compatible	Std.	Std.	Std.	No	No.
DISPLAY ORGANIZATION					
Display positions, chars/display	1152/1920	1920	240/480/960/1920	240/480/960/1920	240/480/960/1920
Display arrangement, lines x chars/line	24 x 48/80	24 x 80	6/12x40;12/24x80	6/12x40;12/24x80	6/12x40;12/24x80
Display area, height x width, inches	7.25 x 10.25	14-inch diag.	7.5 x 9.5	7.5 x 9.5	7.5 x 9.5
Displayable symbols	125	94	128	64	64
Symbol formation	7 x 9 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter/data entry	Typewriter/data entry	Typewriter/data entry/console	Typewriter/data entry	Typewriter/data entry
Character set	ASCII/EBCDIC	EBCDIC	ASCII/EBCDIC	ASCII	ASCII
Program function keys	12 std.	Std.	12 std.	None	None
Numeric keypad	Std.	Opt.	None	None	None
Detachable keyboard	Std.	Std.	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H	U, D, L, R, H
Cursor blinking	Std.	Opt.	Std.	No	No
Character insert and delete	Std.	Std.	Std.	Std.	Std.
Line insert and delete	Std.	No	No	No	No
Erase	Char., line, screen	Char., field, screen	Char., field, line, screen	Char., field, line, screen	Char., field, line, screen
Roll	Std.	No	No	No	No
Protected format	Std.	Std.	Std.	Std.	Std.
Partial screen transmit	Std.	Std.	No	Std.	Std.
Tabulation	Std.	Std.	Std.	Std.	Std.
Addressable/readable cursor	Std.	Std., address. only	Std.	Std., address. only	Std., address. only
Character repeat	Std.	Std.	Std.	No	No
Character or field blinking	Std.	No	Std., field only	Std.	Std.
Programmable brightness levels	3 opt.	2 std.	2 std.	No	No
Reverse video	No	No	Std.	No	No
Audible alarm	Opt.	Opt.	Std.	No	No
Other capabilities	Format storage	—	Double-width chars., line drawings	None	None
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	None
Diskette drive	Opt.	None	None	None	None
Printer	Impact	Impact	Impact	Impact	Impact
Light pen	None	Opt.	Opt.	None	None
Other devices	Card reader, disk and tape drives	ID card reader	None	None	None
TRANSMISSION					
Mode	Half/full duplex	See Comments	Half duplex	Half duplex	Half duplex
Technique	Async./sync.	—	Synchronous	Asynchronous	Asynchronous
Code	ASCII/EBCDIC	—	ASCII/EBCDIC	ASCII	ASCII
Communications discipline	ASCII/BSC	—	BSC	ASCII	ASCII
Speed, bits/second	Up to 9600	—	1200 to 9600	1200 to 9600	1200 to 9600
Message format	Char./block	—	Block	Block	Block
Polling/addressing capability	Std.	—	Std.	Std.	Std.
Automatic answer	Std.	—	No	No	No
EIA RS-232C interface	Std.	—	Std.	Std.	Std.
Integral modem	No	—	No	No	No
Acoustic/inductive telephone coupler	No	—	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	45 to 51	—	—	—	—
Display unit, 2-year lease, $/mo.	43 to 49 (3-yr.)	113	47 (1st 8); 117	Controller & disp.	78 to 114
Display unit, purchase price, $	1,845 to 2,075	3,800	1,535 (1st 8); 2850	costs are combined	4,680 to 4,980
Controller, 1-year lease, $/mo.	370 to 1,510	—	—	—	—
Controller, 2-year lease, $/mo.	348 to 1,372 (3-yr.)	—	700 (01); 738 (02)	148 to 213	—
Controller, purchase price, $	16,000 to 64,250	—	17,120 to 18,000	12,235 to 12,335	—
Date of first production delivery	2/71	1/75	2/75; 4/75 (01A)	4/72	6/72
Number of displays installed to date	Over 10,000	50	2,500	5,000	1,500
Serviced by	Four-Phase	Sorbus	GTE/IS	GTE/IS	GTE/IS
COMMENTS	Minicomputer-based system; up to 96K bytes of memory; extensive software; pricing does not include I/O; see Report 70D-435-01	Replaces IBM 3277-2 Display Station; plugs into IBM 3271-2 (remote) or 3272-2 (local) Control Units. Also see Report 70D-458-01	Cluster limit for IS/7801A is 5. Prices for clusters over 8 for 7801/02 are substantially higher. Contact vendor for 7801A pricing	Supports up to 12 buffered printers at 30 to 165 cps	Supports one printer

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SUPPLIER AND MODEL	Hazeltine 1000 and 1200	Hazeltine 2000	Hazeltine 3000	Hendrix 5200/5200B	Hendrix 6000 Series
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Either	Stand-alone	Cluster
Maximum displays/controller	1	1	16	1	8
Portable case	No	No	No	No	No
Programmable by user	No	No	No	No	Opt.
Direct connection to computer	No	No	No	No	No
Teletype 33/35-compatible	Std.	Std.	No	No	Opt.
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270/-compatible	No	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	960; 1920(H-1200)	1998/2000	1998	3072	1296
Display arrangement, lines x chars/line	12 or 24x80(1200)	27 x 74; 25 x 80	27 x 74	32 x 96	18 x 72
Display area, height x width, inches	4.6 x 9.2	5.75 x 8.5	5.75 x 8.5	17-inch diag.	12-inch diag.
Displayable symbols	64; 96 opt.	64; 96 opt.	64; 96 opt.	128; 256	256
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	Teletype	Teletype	Teletype	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	TTS	TTS
Program function keys	None	None	None	None	Over 30
Numeric keypad	None	Std.	Std.	None	None
Detachable keyboard	No	Std.	Std.	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	D, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	No	No	Std.	Std.
Character insert and delete	No	Std.	Std.	Std.	Std.
Line insert and delete	No	Std.	Std.	Std.	Std.
Erase	Screen only	Screen only	Screen only	Std.	Std.
Roll	Std., up only	Std., up only	Std., up only	Std.	Std.
Protected format	No	Std.	Std.	No	Std.
Partial screen transmit	No	Std.	Std.	Std.	Std.
Tabulation	No	Std.	Std.	Opt.	Opt.
Addressable/readable cursor	No	Std., address. only	Std., address. only	No	Std.
Character repeat	No	Std.	Std.	Std.	Std.
Character or field blinking	No	Opt., field only	Opt., field only	No	Std.
Programmable brightness levels	No	2 std.	2 std.	2 std. plus 2 opt.	2 std. plus 2 opt.
Reverse video	No	No	No	Std.	Std.
Audible alarm	Std.	Std.	Std.	No	Std.
Other capabilities	—	—	Message waiting indicator	—	—
AUXILIARY DEVICES					
Cassette drive	None	Dual drive	Dual drive	None	None
Diskette drive	None	None	None	None	None
Printer	Opt. (H-1200)	Impact/non-impact	Impact/non-impact	None	Opt.
Light pen	None	None	None	None	None
Other devices	None	Remote monitors	Remote monitors	Paper tape reader, punch	Paper tape reader, punch; 2.4M-byte disk
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex
Technique	Asynchronous	Asynchronous	Async./sync.	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	TTS/ASCII	—
Communications discipline	ASCII	ASCII	Any	—	—
Speed, bits/second	110 to 9600	110 to 9600	110 to 9600	110 to 9600	110 to 9600
Message format	Char. only	Char./block	Char./block	Char. only	Char. only
Polling/addressing capability	No	No	Std.	No	No
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	Std.	Opt.	Opt.
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	Opt.	Opt.	Opt.	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	49; 65 (H-1200)	98	125	—	—
Display unit, 2-year lease, $/mo.	—		110	—	—
Display unit, purchase price, $	1,495; 1,590(1200)	2,995	3,900	11,900 to 14,900	5,900
Controller, 1-year lease, $/mo.	—	—	50 to 75	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	1,200 to 1,800	—	32,300 to 79,900
Date of first production delivery	6/73; 10/74(1200)	10/70	3/74	1970	1972
Number of displays installed to date	NA	Over 18,000	—	—	—
Serviced by	Syntonic	Syntonic	Syntonic	Hendrix	Hendrix
COMMENTS	Options include answerback and 202C or current loop interface	Options include answerback and 202C or current loop interface	Microprocessor-based unit uses vendor-programmed ROM	Designed for text editing	Designed for text editing and text publishing

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SUPPLIER AND MODEL	Hewlett-Packard Model 2640A	Honeywell MTS 7500	Honeywell VIP 7700	IBM 3277 Information Display System	IBM 3275 Information Display System
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Either	Either	Cluster	Stand-alone
Maximum displays/controller	1	8	10	32	1
Portable case	No	No	No	No	No
Programmable by user	No	Std.	No	No	No
Direct connection to computer	HP minicomputers	No	Yes, Honeywell	3272/3277	No
Teletype 33/35-compatible	Std.	Opt.	No	No	No
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	No	No	—	—
DISPLAY ORGANIZATION					
Display positions, chars/display	1920	960	960/1920	480/1920	480/1920
Display arrangement, lines x chars/line	24 x 80	12 x 80	12/24 x 80	12 x 40; 24 x 80	12 x 40; 24 x 80
Display area, height x width, inches	5 x 10	3.5 x 7	5.5 x 8.5	14 (diagonal)	14 (diagonal)
Displayable symbols	64; up to 512 opt.	94	63; 96 opt.	64	64
Symbol formation	9 x 15 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter	Several	Several
Character set	ASCII	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC
Program function keys	8 std.	2 std.	36 opt.	Std.	Opt.
Numeric keypad	Std.	Yes	Std.	Std.	Std.
Detachable keyboard	Std.	No	No	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R	U, D, L, R
Cursor blinking	Std.	Std.	Std.	No	No
Character insert and delete	Std.	Std.	Std.	Std.	Std.
Line insert and delete	Std.	Std.	Std.	No	No
Erase	Screen, field	Std.	Std.	Char., field, line, screen	Char., field, line, screen
Roll	Std., up & down	Std., up only	No	No	No
Protected format	Std.	Yes	Std.	Std.	Std.
Partial screen transmit	Std.	No	Std.	Std.	Std.
Tabulation	Std.	Std.	Std.	Std.	Std.
Addressable/readable cursor	Std.; abs. or rel.	Std.	Std., address. only	Std., address. only	Std., address. only
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Std.	No	Std.	No	No
Programmable brightness levels	2 opt.	No	No	2 std.	2 std.
Reverse video	Std.	No	No	No	No
Audible alarm	Std.	Std.	No	Opt.	Opt.
Other capabilities	Paging (by 24 lines), scrolling, underscore	—	Char. & field blanking, inhibit field transmission	—	—
AUXILIARY DEVICES					
Cassette drive	None	Dual drive	Dual drive	None	None
Diskette drive	None	None	None	None	None
Printer	None	Impact	Impact	IBM 3284/3286	IBM 3284/3286
Light pen	None	None	None	Opt.	Opt.
Other devices	None	Disk drive, 2.5M bytes	ID card reader, security keylock	Operator ID card reader	Operator ID card reader
TRANSMISSION					
Mode	Half/full duplex	Half duplex	Half duplex	Half duplex	Half duplex
Technique	Asynchronous	Synchronous	Synchronous	Synchronous	Synchronous
Code	ASCII	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC
Communications discipline	ASCII	Honeywell	Honeywell	BSC/SDLC	BSC/SDLC
Speed, bits/second	110 to 2400	110 to 9600	2000 to 4800	1200 to 7200	1200 to 7200
Message format	Char./block	Char. only	Block	Block	Block
Polling/addressing capability	No	Std.	Std.	Std.	Std.
Automatic answer	No	No	Std.	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	Std.	No	No	No
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	Full pay-out lease	301	157 to 285	97 to 199	145 to 292
Display unit, 2-year lease, $/mo.	Available	250 (3-yr.)	135 to 242 (3-yr.)	—	—
Display unit, purchase price, $	3,000 to 4,000	9,800	4,860 to 8,770	4,072 to 7,732	6,222 to 12,072
Controller, 1-year lease, $/mo.	—	—	98	178 to 702	—
Controller, 2-year lease, $/mo.	—	—	85 (5-yr.)	—	—
Controller, purchase price, $	—	—	3,025	6,630 to 17,964	—
Date of first production delivery	1/75	1973	10/73	2nd qtr. 1972	2nd qtr. 1972
Number of displays installed to date	—	NA	Over 2,000	—	—
Serviced by	Hewlett-Packard	Honeywell	Honeywell	IBM	IBM
COMMENTS	Microprocessor-based unit; basic unit includes 1K-byte display memory, expandable to 8K bytes	Manufactured by Datapoint as the Datapoint 1100 (Report 70D-315-01)		Prices include all options except cost of printers. Also see Report 70D-491-11	Prices include all options except cost of printers. Also see Report 70D-491-11

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SUPPLIER AND MODEL	IBM 2260 Display Station	IBM 2265 Display Station	IBM 3790 Communication System	Incoterm SPD 325	Incoterm SPD 320
ARRANGEMENT					
Stand-alone or cluster	Cluster	Stand-alone	Cluster	Stand-alone	Cluster
Maximum displays/controller	24	1	16	2	8/16
Portable case	No	No	No	No	No
Programmable by user	No	No	Std.	No	No
Direct connection to computer	Std.	No	No	No	No
Teletype 33/35-compatible	No	No	No	No	No
IBM 2260/2265-compatible	—	—	No	No	No
IBM 3270-compatible	No	No	No	Std.	Std.
DISPLAY ORGANIZATION					
Display positions, chars/display	240/480/960	960	480/1920	480/960/1920	480/960/1920
Display arrangement, lines x chars/line	6/12 x 40; 12 x 80	15 x 64; 12 x 80	12 x 40; 24 x 80	12/24 x 40/80	12/24 x 40/80
Display area, height x width, inches	4 x 9	4.6 x 10.3	14 (diagonal)	6.5 x 9	6.5 x 9
Displayable symbols	64	64	64	64	64
Symbol formation	5 x 7 dot matrix	Stroke	7 x 9 dot matrix	7 x 10 dot matrix	7 x 10 dot matrix
KEYBOARD					
Style	Typewriter/ numeric	Typewriter	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII/EBCDIC	EBCDIC	EBCDIC
Program function keys	None	None	Opt.	24 std.	24 std.
Numeric keypad	Opt.	None	Std.	Std.	Std.
Detachable keyboard	Std.	Std.	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R	U, D, L, R	U, D, L, R	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	No	No	Std.	Std.
Character insert and delete	No	No	Std.	Std.	Std.
Line insert and delete	No	No	No	Std.	Std.
Erase	Screen; line opt.	Line, field, screen	Char., field, line, screen	Char., line, screen	Char., line, screen
Roll	No	No	No	No	No
Protected format	Std.	Std.	Std.	Std.	Std.
Partial screen transmit	Std.	Std.	Std.	Std.	Std.
Tabulation	Opt.	Opt.	Std.	Std.	Std.
Addressable/readable cursor	Opt., address. line	Opt., address. line	Std., address. only	Std.	Std.
Character repeat	No	No	Std.	Std.	Std.
Character or field blinking	No	No	No	Std.	Std.
Programmable brightness levels	No	No	2 std.	2 std.	2 std.
Reverse video	No	No	No	No	No
Audible alarm	No	No	Opt.	Opt.	Opt.
Other capabilities	—	Opt. destructive cursor	—	None	None
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	Single drive
Diskette drive	None	None	None	None	None
Printer	IBM 1053	IBM 1053	IBM 3793	Impact	Impact
Light pen	None	None	Opt.	None	None
Other devices	None	None	Operator ID card reader	None	None
TRANSMISSION					
Mode	Half duplex	Half duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Synchronous	Synchronous	Synchronous
Code	ASCII	ASCII	EBCDIC	ASCII/EBCDIC	ASCII/EBCDIC
Communications discipline	ASCII	ASCII	SDLC	BSC/SDLC	BSC/SDLC
Speed, bits/second	1200/2400	1200/2400	1200/2400	1200 to 9600	1200 to 9600
Message format	Block	Block	Block	Block	Block
Polling/addressing capability	Std.	Std.	Std.	Std.	Std.
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	Opt.	Std.	Std.
Integral modem	No	No	Opt.	No	No
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	40 to 69	202	See Comments	Contact vendor	Contact vendor
Display unit, 2-year lease, $/mo.	—	—	See Comments	Contact vendor	Contact vendor
Display unit, purchase price, $	1,295 to 2,179	6,448	See Comments	Contact vendor	Contact vendor
Controller, 1-year lease, $/mo.	407 to 1,632	173 to 262	—	—	Contact vendor
Controller, 2-year lease, $/mo.	—	—	—	—	Contact vendor
Controller, purchase price, $	17,530 to 79,316	8,460 to 12,442	—	—	Contact vendor
Date of first production delivery	6/66	4/69	1st qtr. 1975	1974	1974
Number of displays installed to date	—	—	—	—	—
Serviced by	IBM	IBM	IBM	Incoterm	Incoterm
COMMENTS	Prices do not include cost of printer. Also see Report 70D-491-05	Prices do not include cost of printer. Also see Report 70D-491-06	Remote shared-processor data entry system. Pricing is complex and depends upon system configuration; see Report 70D-491-42		

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SUPPLIER AND MODEL	Incoterm SPD 10/20	Incoterm SPD 10/25	Incoterm SPD 20/20	Infoton Vistar & Vistar 2	Infoton Vistar/GT
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Cluster	Stand-alone	Stand-alone
Maximum displays/controller	2	2	16	1	1
Portable case	No	No	No	No	No
Programmable by user	Std.	Std.	Std.	No	No
Direct connection to comptuer	No	No	No	No	No
Teletype 33/35-compatible	Opt.	Opt.	Opt.	Std.	Std.
IBM 2260/2265-compatible	Opt.	Opt.	Opt.	No	No
IBM 3270-compatible	No	Std., IBM 3275	Opt.	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	960/1920	960/2000	960/1920	1920	1920
Display arrangement, lines x chars/line	15/30 x 64	12/25 x 80	12/24 x 80	24 x 80	24 x 80
Display area, height x width, inches	6.5 x 9	6.5 x 9	6.5 x 9	9 x 7	9 x 7
Displayable symbols	64; 121 opt.	64; 128 opt.	64; 128 opt.	64	64
Symbol formation	7 x 10; 8 x 10 (opt.) dot	7 x 10; 8 x 10 (opt.) dot	7 x 10; 8 x 10 (opt.) dot	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Several	Several	Several	Data entry	Data entry
Character set	Several	Several	Several	ASCII	ASCII
Program function keys	24	24	24	None	None
Numeric keypad	Opt.	Opt.	Opt.	Std.	Opt.
Detachable keyboard	Std.	Std.	Std.	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	None
Cursor blinking	Opt.	Opt.	Std.	Std.	Std.
Character insert and delete	Opt.	Opt.	Opt.	Std.	Std.
Line insert and delete	Opt.	Opt.	Opt.	Std.	No
Erase	Opt.	Opt.	Opt.	Char., field, line, screen	Screen only
Roll	Opt.	Opt.	Opt.	Std., up only	Std., up only
Protected format	Opt.	Std.	Std.	Std.	No
Partial screen transmit	Opt.	Opt.	Opt.	Std.	No
Tabulation	Opt.	Opt.	Opt.	Std.	No
Addressable/readable cursor	Std.	Std.	Std.	Std., Vistar 2 only	No
Character repeat	Opt.	Opt.	Opt.	Std.	Std.
Character or field blinking	Opt.	Opt.	Opt.	No	No
Programmable brightness levels	No	2 std.	2 std.	2 std.	No
Reverse video	No	No	No	No	No
Audible alarm	Opt.	Opt.	Opt.	Std.	Std.
Other capabilities	—	—	—	None	None
AUXILIARY DEVICES					
Cassette drive	Single/dual drives	Single/dual drives	Single/dual drives	None	None
Diskette drive	Single/dual spindle	Single/dual spindle	Single/dual spindle	None	None
Printer	Impact	Impact	Impact	None	None
Light pen	None	None	None	Opt.	None
Other devices	Card readers & punches; mag. tape drives	Card readers & punches; mag. tape drives	Card readers & punches; mag. tape drives	Opt.	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Async./sync.	Async./sync.	Asynchronous	Asynchronous
Code	ASCII/EBCDIC	ASCII/EBCDIC	ASCII/EBCDIC	ASCII	ASCII
Communications discipline	BSC/SDLC	BSC/SDLC	BSC/SDLC	ASCII	ASCII
Speed, bits/second	Up to 9600	Up to 9600	Up to 9600	75 to 9600	75 to 9600
Message format	Char./block	Char./block	Char./block	Char./block	Char. only
Polling/addressing capability	Opt.	Opt.	Opt.	Opt., Vistar 2	No
Automatic answer	Opt.	Opt.	Opt.	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	210 (1); 265 (2)	240 (1); 305 (2)	—	—	—
Display unit, 2-year lease, $/mo.	—	—	60	—	—
Display unit, purchase price, $	6,090(1); 7,875(2)	7,405(1); 9,030(2)	1,665	2,295; 2,395 (2)	1,595
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	355	—	—
Controller, purchase price, $	—	—	10,105	—	—
Date of first production delivery	6/70	11/74	4/74	2/73; 3/75 (2)	12/73
Number of displays installed to date	Over 8,000	—	—	3,000 (Vistar)	Over 1,500
Serviced by	Incoterm	Incoterm	Incoterm	Optical Scanning	Optical Scanning
COMMENTS	Extensive software support includes emulators and assemblers; up to 32 displays per line via multiplexer. Also see Report 70D-495-01	Alternate display format is 15/31 x 64	Extensive software support includes emulators and assemblers; alternate display format is 15/30 x 64. Also see Report 70D-495-01	Switch-selectable speeds; 20/60 ma. interface also std.	Switch-selectable speeds; 20/60 ma. interface also std.

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SUPPLIER AND MODEL	Infoton Vistar Plus	Interface Technology Model 736	International Communications Corp. ICC 40+ Data Display System	ITT Model 3501 Asciscope	ITT Model 3100 Alphascope
ARRANGEMENT					
Stand-alone or cluster	Either	Stand-alone	Stand-alone	Stand-alone	Either
Maximum displays/controller	64	1	1	1	1/4/8/16/32
Portable case	No	No	No	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	No	No	Yes	No	Yes, IBM
Teletype 33/35-compatible	Std.	Std.	Opt.	Std.	No
IBM 2260/2265-compatible	No	No	No	No	Std.
IBM 3270-compatible	No	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	400/800/1600	4/8/12/16	1920	960	240/480/960/1360/1920
Display arrangement, lines x chars/line	10/20 x 40/80	1 x 16	24 x 80	12 x 80	6/12/17/24x40/80
Display area, height x width, inches	5.5 x 8.7	0.3-inch high chars.	5.75 x 10.5	5 x 8	5 x 8
Displayable symbols	64	15	127	65	65
Symbol formation	5 x 7 dot matrix	7-segment LED's	7 x 11 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Data entry	Numeric block	Typewriter	Teletype	Typewriter
Character set	ASCII	Numerics only	ASCII	ASCII	ASCII
Program function keys	None	2 std.	Opt.	None	None
Numeric keypad	Std.	—	None	None	Opt.
Detachable keyboard	No	No	Std.	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	—	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	No	No	Std.	Std.
Character insert and delete	Std.	No	Std.	No	Std.
Line insert and delete	Std.	No	Std.	No	No
Erase	Field, screen	No	Char., line, screen	Char., screen	Char., line, screen
Roll	Std.	No	Opt.	Std.	No
Protected format	Std.	No	Opt.	No	Opt.
Partial screen transmit	Std.	No	Std.	Std.	Std.
Tabulation	Std.	No	Opt.	No	Std.
Addressable/readable cursor	No	No	Opt., address. only	No	No
Character repeat	Std.	No	Std.	Std.	Std.
Character or field blinking	Both std.	No	Both opt.	No	No
Programmable brightness levels	No	No	2 std.	No	No
Reverse video	No	No	Std.; cursor only	No	No
Audible alarm	Std.	Opt.	Std.	Std.	Std.
Other capabilities	None	—	Calculate, paging	None	None
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	None
Diskette drive	None	None	None	None	None
Printer	RS-232 interface	None	Impact	Impact/non-impact	Impact/non-impact
Light pen	Opt.	None	None	None	None
Other devices	—	Opt. interface	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex
Technique	Async./sync.	Asynchronous	Async./sync.	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII	ASCII	ASCII	ASCII	ASCII
Speed, bits/second	110 to 4800	110/300	Up to 2400	110/300/1200/2400	1200/2400/4800
Message format	Block	Char. only	Char./block	Char./block	Block
Polling/addressing capability	Opt.	No	Opt.	No	Std.
Automatic answer	No	No	Opt.	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	Opt.	Std.	No
Acoustic/inductive telephone coupler	No	Opt.	No	Std.	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	145	65	40 to 45
Display unit, 2-year lease, $/mo.	—	—	128	—	—
Display unit, purchase price, $	3,395 to 3,745	600	3,850	2,195	1,200 to 1,400
Controller, 1-year lease, $/mo.	—	—	—	—	95 to 1,920
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	6,150 to 68,525
Date of first production delivery	7/71	8/74	2/75	12/72	9/70
Number of displays installed to date	Over 2,000	60	30	1,000	1,000
Serviced by	Infoton	Interface Technology	ICC	ITT	ITT & 3rd party
COMMENTS	Switch-selectable speeds; 20/60 ma. interface also std.; 8-channel concentrator expandable to 64 channels	Terminal contains an LED display and numeric keyboard			

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SUPPLIER AND MODEL	Jacquard J100 & J105	Kustom MCT-10	Lear Siegler Model 7700A	Lear Siegler ADM-1	Lear Siegler ADM-2
ARRANGEMENT					
Stand-alone or cluster	Either	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	30 J105's per J100	1	1	1	1
Portable case	No	No; mobile	No	No	No
Programmable by user	Std.	No	No	No	No
Direct connection to computer	IBM360/70,Univac	No	No	No	No
Teletype 33/35-compatible	Std.	No	Std.	Std.	Std.
IBM 2260/2265-compatilbe	No	No	No	No	No
IBM 3270-compatible	Opt.	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	1920	256	2000	960/1920	1920
Display arrangement, lines x chars/line	24 x 80	8 x 32	25 x 80	12/24 x 80	24 x 80
Display area, height x width, inches	8 x 10	3.38 x 9.18	6 x 9	6 x 9	6 x 9
Displayable symbols	96	64	64	96	128
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter	Teletype	Teletype
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	85	11 std.	None	None	16/32
Numeric keypad	Std.	None	Opt.	Opt.	Std.
Detachable keyboard	Std.	No	Opt.	No	Opt.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H	U, D, L, R, H	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.	Std.	Std.	Std.
Character insert and delete	Std.	No	Std.	Std.	Std.
Line insert and delete	Std.	No	Std.	Std.	Std.
Erase	Char., line, screen	Screen only	Std.	Char., line, screen	Char., line, screen
Roll	Std.	No	Std.	Std.	Std.
Protected format	Std.	No	Yes	Std.	Std.
Partial screen transmit	Std.	Std.	Std.	Std.	Std.
Tabulation	Std.	No	Yes	Std.	Std.
Addressable/readable cursor	Std.	No	Std.	Std.	Std.
Character repeat	Std.	No	Std.	Std.	Std.
Character or field blinking	Std.	No	Std.	Std.	Std.
Programmable brightness levels	2 opt.	No	2 std.	2 std.	2 std.
Reverse video	No	No	No	No	No
Audible alarm	Opt.	Std.	Std.	Opt.	Opt.
Other capabilities	8 programmable lamp indicators	None	—	—	—
AUXILIARY DEVICES					
Cassette drive	Yes	None	None	None	None
Diskette drive	Yes	None	None	None	None
Printer	Impact	Non-impact	Non-impact	RS-232 interface	RS-232 interface
Light pen	Opt.	None	None	None	None
Other devices	Several	None	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Synchronous	Asynchronous	Asynchronous	Asynchronous
Code	ASCII/EBCDIC	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII/BSC/SDLC	ASCII	ASCII	ASCII	ASCII
Speed, bits/second	110 to 9600	866/1300	110 to 9600	Up to 19,200	110 to 9600
Message format	Char./block	Block	Char./block	Char./block	Char./block
Polling/addressing capability	Std.	Std.	Opt.	Opt.	Opt.
Automatic answer	Opt.	Std.	No	No	No
EIA RS-232C interface	Std.	No	Std.; 20/60 ma.opt.	Std.; 20 ma. opt.	Std.; 20 ma. opt.
Integral modem	Opt.	Std.	Opt.	No	No
Acoustic/inductive telephone coupler	Opt.	No	Opt.	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	—
Display unit, 2-year lease, $/mo.	100 to 120	—	—	—	—
Display unit, purchase price, $	1,950 to 2,350	3,650	2,795 to 2,895	1,600	2,500
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	220 to 1,300	—	—	—	—
Controller, purchase price, $	4,400 to 25,400	27,500 to 90,000	—	—	—
Date of first production delivery	3/74	3/72	6/71	8/73	6/74
Number of displays installed to date	20	290	1,000	2,000	1,000
Serviced by	Jacquard & SirVess	Kustom	Lear Siegler	Lear Siegler	Lear Siegler
COMMENTS	J100 contains a CRT, keyboard, and minicomputer with up to 128K bytes of core memory	Mobile terminal for communication via two-way radio; contains plasma display		Up to 96 terminals can be multi-dropped	Up to 96 terminals can be multi-dropped

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SUPPLIER AND MODEL	Lear Siegler ADM-3	Megadata SiR-1000 U & SiR-1075/77	Megadata SiR-1000C-4/8	Megadata SiR-1000/WP	Microtech 8/640 & 8/640 II
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Either	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	8 to 32	1	1	1
Portable case	No	Std.	Std.	No	No
Programmable by user	No	Std.	Std.	Opt.	Std.
Direct connection to computer	No	—	—	Yes	No
Teletype 33/35-compatible	Std.	No	Opt.	Opt.	Opt.
IBM 2260/2265-compatible	No	No	Opt.	Opt.	No
IBM 3270-compatible	No	No	Opt.	Opt.	No
DISPLAY ORGANIZATION		512/1024/1920/			
Display positions, chars/display	960/1920	2160	1536/2160	6400	640; 640/720 (II)
Display arrangement, lines x chars/line	12/24 x 80	8/16 x 64; 24 x 80	64 x 24; 27 x 80	80 x 80	10 x 64; 15 x 48
Display area, height x width, inches	6 x 9	8 x 10	10 x 10	10 x 12	—
Displayable symbols	64	64; 128 opt.	192	192	64; 64-128 (II)
Symbol formation	5 x 7 dot matrix	7 x 8 dot matrix	7 x 8 dot matrix	8 x 12	7 x 9 dot matrix
KEYBOARD					
Style	Teletype	Typewriter	Typewriter	Typewriter	Any
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	None	Up to 51	51	71	8 std.
Numeric keypad	Opt.	Opt.	Std.	Opt.	Std.
Detachable keyboard	No	Opt.	Opt.	Opt.	Opt.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	L, R, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	Std.	Std.	Std.	Std.
Character insert and delete	No	Std.	Std.	Std.	Std.
Line insert and delete	No	Std.	Std.	Std.	Std.
Erase	Screen only	Char., line, screen	Char., line, screen	Char., line, screen	Char., line, screen
Roll	Std.	Std.	Std.	Std.	No
Protected format	No	Std.	Std.	Std.	Std.
Partial screen transmit	No	Std.	Std.	Std.	Std.
Tabulation	No	Std.	Std.	Std.	Std.
Addressable/readable cursor	No	Std.	Std.	Std.	Std.
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	No	Std.	Std.	Std.	Std.
Programmable brightness levels	No	Std.	Std.	Std.	2 std.
Reverse video	No	Std.	Opt.	Std.	No
Audible alarm	Yes	Std.	Std.	Std.	Std.
Other capabilities	Destructible or non-dustructible cursor, keylock	Text editing functions; graphics via a 10 x 10 dot matrix	—	Search, word inhibit	—
AUXILIARY DEVICES					
Cassette drive	RS-232 interface	Opt.	Yes	Opt.	Std.; opt. (II)
Diskette drive	RS-232 interface	Single/dual spindle	Yes	Opt.	Opt., up to 4 (II)
Printer	RS-232 interface	Yes	Yes	Opt.	Opt. (II)
Light pen	None	Opt.	None	Opt.	No
Other devices	None	Card reader, ID card reader	Card reader	Opt.	Disk and tape drives and others
TRANSMISSION					
Mode	Half/full duplex	Half duplex	Half duplex	Half/full duplex	Half duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Async./sync.
Code	ASCII	ASCII	ASCII	ASCII	ASCII; Any (II)
Communications discipline	ASCII	ASCII	ASCII	ASCII	ASCII; Any (II)
Speed, bits/second	Up to 19,200	Up to 19,200	Up to 19,200	Up to 13,000 char/sec.	50 to 9600
Message format	Char. only	Char./block	Char./block	Char./block	Char./block
Polling/addressing capability	No	Std.	Std.	Std.	Std.
Automatic answer	No	Opt.	Opt.	Opt.	Opt., std. (II)
EIA RS-232 interface	Std.	Std.	Std.	Std.	Opt., std. (II)
Integral modem	No	Opt.	Opt.	Opt.	Opt.
Acoustic/inductive telephone coupler	No	Opt.	Opt.	Opt.	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	765	—
Display unit, 2-year lease, $/mo.	—	—	—	390	—
Display unit, purchase price, $	995	4,500 to 7,500	5,000 to 7,500	7,500	Sold OEM only
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	2,100 (multiplexer)	—	—	—
Date of first production delivery	5/75	12/73	1973	12/74	—
Number of displays installed to date	—	Over 150	Over 500	Over 100	—
Serviced by	Lear Siegler	Megadata and C&W	Megadata and C&W	Megadata	—
COMMENTS		SiR-1000U replaces UNIVAC's Uniscope. Both units are designed for text editing, with the 1075/77 having the most capabilities	Data can be displayed in 4 or 8 colors	Designed for text editing (word processing)	Both terminals include memory: 8K bytes to 16K or 64K bytes (II only)

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SUPPLIER AND MODEL	Microtech MSIS	NCR 796 Series Models 101, 201 & 301	Olivetti DE-520	Olivetti TCV 270	Omron 8025 A, B, & C
ARRANGEMENT					
Stand-alone or cluster	Cluster	Stand-alone	Stand-alone	Either	Stand-alone
Maximum displays/controller	10	1	1	32	1
Portable case	Opt.	No	No	No	No
Programmable by user	Std.	No	Opt.	Opt.	Opt., A; Std., B
Direct connection to computer	Parallel interface	NCR 8200 (101)	Std.	No	—
Teletype 33/35-compatible	No	Std.	Std.	No	Std., A & B
IBM 2260/2265-compatible	No	No	No	Std.	No
IBM 3270-compatible	No	No	No	Std.	Std., C only
DISPLAY ORGANIZATION					
Display positions, chars/display	32	1920	341	480/1920	1920
Display arrangement, lines x chars/line	2 x 16	24 x 80	11 x 31	12 x 40; 24 x 80	24 x 80
Display area, height x width, inches	—	8 x 10	4.75 x 5.5	12 inch diag.	8 x 10
Displayable symbols	64	64	64; 96 opt.	96	224
Symbol formation	Dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	Data collection	Typewriter	Typewriter	Typewriter/data entry	Typewriter/data entry
Character set	ASCII	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC
Program function keys	13 std.	None	None	12 opt.	16 std.; 48 opt.
Numeric keypad	Std.	Std.	Std.	Opt.	Std.
Detachable keyboard	No	No	No	Std.	Opt.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	No cursor	U, D, L, R, H	L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	Opt., 101 only	Std.	Std.	Std.
Character insert and delete	No	Std., 201 & 301	No	Std.	Std.
Line insert and delte	No	No	No	No	Delete std., C
Erase	No	Screen only	Char., line, screen	Char., field, screen	Char., line, screen
Roll	No	Std.	No	No	Std., A & B
Protected format	Std.	Std., 201 & 301	Std.	Std.	Std.
Partial screen transmit	Std.	Std., 201 & 301	Std.	Std.	Std.
Tabulation	No	Std.	Std.	Std.	Std.
Addressable/readable cursor	No	Std.	Std.	Std.	Std.
Character repeat	No	Std.	Std.	Std.	Std.
Character or field blinking	No	Std., 201 & 301	Std., char. only	Opt., field only	Field std., A & B
Programmable brightness levles	No	2 std., 201 & 301	No	3 std.	2 std.
Reverse video	No	No	No	No	Std., A & B
Audible alarm	Std.	Std., 101; Opt.,201	Std.	Std.	Std.
Other capabilities	—	Vector generation, 72 x 160 dots	None	—	Paging & scrolling
AUXILIARY DEVICES					
Cassette drive	No	None	Single/dual drives	None	1 or 2 drives, A & B
Diskette drive	Single spindle	None	Single/dual spindle	Single/dual spindle	None
Printer	Opt.	Non-impact (NCR)	Impact	Impact	Impact/non-impact
Light pen	No	None	None	Opt.	None
Other devices	Hand-held wand	None	Card reader, mag. tape unit, punched tape units	ID card reader	—
TRANSMISSION					
Mode	Half duplex	Half/full duplex	Half duplex	Half duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Async./sync.	Async./sync.	Async., A,B/sync., C
Code	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC	ASCII/EBCDIC
Communications displine	ASCII	ASCII	ASCII/BSC	ASCII/BSC	ASCII/BSC
Speed, bits/second	2400; 9600 paral.	110 to 9600	110 to 4800	600 to 4800	Up to 2400/9600 (C)
Message format	Block	Char.,blk.-201/301	Block	Block	Char./block
Polling/addressing capability	Std.	Std., 301 only	Opt.	Std.	Opt., A&B; std., C
Automatic answer	Std.	Opt.	Opt.	No	Opt., A&B
EIA RS-232C interface	Std.	Std.	Opt.	Std.	Std.
Integral modem	Opt.	No	No	No	Opt.
Acoustic/inductive telephone coupler	No	Opt., 101 & 201	Opt.	No	Opt., A & B
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	80 to 150	165 to 350	99 to 196	—
Display unit, 2-year lease, $/mo.	—	—	157 to 332	94 to 189	85 to 370
Display unit, purchase price, $	Sold OEM only	2,000 to 3,500	6,100 to 14,000	3,620 to 6,440	3,250 to 14,300
Controller, 1-year lease, $/mo.	—	—	—	120	—
Controller, 2-year lease, $/mo.	—	—	—	115	—
Controller, purchase price, $	—	—	—	3,800	—
Date of first production delivery	—	1/75	2/71	10/74	12/73
Number of displays installed to date	—	1,875 (all models)	13,000	—	Over 600
Serviced by	—	NCR	Olivetti	Olivetti	Omron & W.U.
COMMENTS	Data collection terminal for factory use; uses plasma (gas) display	All units manufactured by ADDS as models 580 (101), 880 (201), and 880A (301)	Manufactured by Sycor, Inc. as Model 340; uses Olivetti TPS assembler-type language	Options include 6K RAM, check digit verification, and arithmetic and logical operations	Microprocessor-based unit with up to 16K bytes of RAM in 2K or 4K increments; software support; Diablo HyType printer available

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SUPPLIER AND MODEL	Ontel OP-1	Ontel 4000 Series	Pertec Model 7100	Plantronics ComSet DS-150A	Quotron Series 800
ARRANGEMENT					
Stand-alone or cluster	Either	Stand-alone	Stand-alone	Stand-alone	Cluster
Maximum displays/controller	1	1	1	1	24
Portable case	No	No	Std.	No	No
Programmable by user	Std.	No	No (by vendor)	No	No
Direct connection to computer	No	Yes, Burr. 3500	No	No	No
Teletype 33/35-compatible	Std.	Std., some models	Std.	Std.	Opt.
IBM 2260/2265-compatible	Opt.	No	No	No	Opt.
IBM 3270-compatible	Opt.	No	No	No	Opt.
DISPLAY ORGANIZATION					
Display positions, chars/display	1600/1920	1600	960/1920	64	1200/1600
Display arrangement, lines x chars/line	20/24 x 80	80 x 20	12/24 x 80	4 x 16	20 x 60/80
Display area, height x width, inches	7 x 10	7 x 10	5.5 x 8.25	3-inch diag.	48 x 64; 6 x 8
Displayable symbols	112	112	64; 96 opt.	64	96
Symbol formation	5 x 7/9/10 dot matrix	5 x 10 dot matrix	7 x 9 dot matrix	5 x 7 dot matrix	14 x 22 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter	Touch-Tone; 12 keys	Block/typewriter
Character set	ASCII	ASCII/APL	ASCII	DTMF	ASCII
Program function keys	19 std.	None	5 std.; 11 opt.	2 std.	10 opt.
Numeric keypad	Std.	Std., some models	Opt.	Std.	None
Detachable keyboard	Std.		Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H	No cursor	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.	Std.	No	Std.
Character insert and delete	Std.	Std.	Std.	No	Opt.
Line insert and delete	Std.	Std.	Std.	No	Opt.
Erase	Char., line, screen	Char., line, screen	Screen; line opt.	Screen only	Char. & screen
Roll	Std.	Std.	Std.	No	No
Protected format	Std.	Std.	Std.	No	No
Partial screen transmit	Std.	Std.	Std.	No	Opt.
Tabulation	Std.	Std.	Std.	No	Opt.
Addressable/readable cursor	Std.	Std.	Std.	No	Std., address. only
Character repeat	Std.	Std.	Std.	No	Opt.
Character or field blinking	Std.	Std.	No	Std., field only	Opt.
Programmable brightness levels	2 std.	2 std.	2 std.	No	No
Reverse video	Std.	Std.	No	No	No
Audible alarm	Std.	Std.	Std.	No	No
Other capabilities		2nd page opt.; vector generation	—	None	None
AUXILIARY DEVICES					
Cassette drive	Single/dual drive	RS-232 interface	None	None	None
Diskette drive	None	No	None	None	Single spindle
Printer	Impact	Impact/RS-232	Impact	None	Impact/non-impact
Light pen	No	No	None	None	None
Other devices	Cartridge disk drives (Diablo Series 20 & 30)	None	None	None	Card reader, disk and mag. tape drives
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex	Half/full duplex
Technique	Async./sync. opt.	Async./sync.	Async./sync.	Asynchronous	Async./sync.
Code	ASCII	ASCII	ASCII	ASCII/DTMF	ASCII/EBCDIC
Communications discipline	ASCII	ASCII/Burroughs	ASCII	ASCII	ASCII/BSC/Baudot
Speed, bits/second	Up to 50,000	110 to 9600	Up to 9600	110, 150, 300	37.5 to 9600
Message format	Char./block	Block	Char./block	Char. only	Char./block
Polling/addressing capability	Std.	Std., Burr. only	Std.	No	Opt.
Automatic answer	Std.	No	Std.	No	No
EIA RS-232C interface	Std.	Std.	Std.	No	Std.
Integral modem	Opt.	No	Opt.	Std.	No
Acoustic/inductive telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	Sold OEM only	—	Sold OEM only	See Comments	—
Display unit, 2-year lease, $/mo.	—	—	—	—	—
Display unit, purchase price, $	2,285 (qty. 100)	3,395 to 4,360	2,235 to 2,638(qty. 51 to 100)	—	1,200 to 4,200
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	3,670 (base)	—	—	—	26,000 to 90,000
Date of first production delivery	11/74	12/73	4/74	4/73	9/71
Number of displays installed to date	100	Over 300	Over 2,000	400	6,000
Serviced by	Third party	Ontel	Pertec	Local telephone co.	Quotron
COMMENTS	Microprocessor-based unit with up to 16K bytes of RAM in 4K increments; programmable functions and operations	Microprocessor-based units; compatible with Burroughs terminals or IBM 2741	Microprocessor-based unit; ROM microprogram to user's specifications	Leased to user by local telephone co. for about $30 to $35 per month; unit attaches directly to telephone set	Clustered terminal built around a free-standing minicomputer; complete turnkey systems

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SUPPLIER AND MODEL	Randal Data Systems MM 50 & Mini/Maxi View	Raytheon Data Systems PTS-100	Research, Inc. Teleray Model 3311	Research, Inc. Teleray Models 3511 and 3711	Research, Inc. Teleray Model 3931
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Either	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	32	1	1	1
Portable case	No	No	No	No	No
Programmable by user	No	Std.	No	No	No
Direct connection to computer	Yes	Yes, IBM 360/370	No	No	No
Teletype 33/35-compatible	Std.	Opt.	Std.	Std.	Std.
IBM 2260/2265-compatible	No	Opt.	No	No	No
IBM 3270-compatible	No	Opt.	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	960/1920	480/960/1920	1920	1920	1920
Display arrangement, lines x chars/line	12/24 x 80	12x40;12/24x80	24 x 80	24 x 80	24 x 80
Display area, height x width, inches	6 x 9	7 x 10	7.5 x 9.5	7.5 x 9.5	9.4 x 11.9
Displayable symbols	64; 128 (Maxi)	64; 96 opt.	64	64; 95 (3711)	95 ASCII/APL
Symbol formation	5 x 7; 5 x 7/9 (Maxi)	7 x 7/9 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 9 dot matrix
KEYBOARD					
Style	Typewriter/data entry (Maxi)	Typewriter	Teletype	Teletype	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII/APL
Program function keys	2 std. (Maxi only)	10 std.	None	None	None
Numeric keypad	Opt., std. (Maxi)	Opt.	Opt.	Opt.	Opt.
Detachable keyboard	Std. (Mini & Maxi)	Std.	Opt.	Opt.	Opt.
FEATURES					
Cursor positioning; Up, Down, Left Right, Home, Return	L, R, U, D, H, Rt.	U, D, L, R, H	D, H, Rt.	D, L, R, H, Rt.	D, L, R, H, Rt.
Cursor blinking	Std.; opt., Maxi	No	No	No	No
Character insert and delete	Std., Maxi only	No	No	No	No
Line insert and delete	Std., Maxi only	No	No	No	No
Erase	Char., line, screen	Field only	No	Screen only	Screen only
Roll	Std., up only	No	Std., up only	Std., up only	Std., up only
Protected format	Std., Mini & Maxi	Std.	No	No	No
Partial screen transmit	Std.	Std.	No	No	No
Tabulation	Std.	Programmable	No	Opt.	Opt.
Addressable/readable cursor	Std.	Std.	No	No	No
Character repeat	Std., Mini & Maxi	Std.	Std.	Std.	Std.
Character or field blinking	Std., Mini & Maxi	Std.	No	No	No
Programmable brightness levels	Std.	2 std.	No	No	No
Reverse video	No	No	No	No	No
Audible alarm	Std.	Opt.	Std.	Std.	Std.
Other capabilities		Programmable indicators	Double-width characters	Double-width characters	Double-width characters; APL overstrike
AUXILIARY DEVICES					
Cassette drive	Single/dual drives	7 drives max.	None	None	None
Diskette drive	Single/dual spindle	None	None	None	None
Printer	Impact/non-impact	Impact/non-impact	RS-232 interface	RS-232 interface	RS-232 interface
Light pen	None	None	None	None	None
Other devices	Opt.	Card reader, disk drive	TV monitor	TV monitor	TV monitor
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Async./sync.	Asynchronous	Asynchronous	Asynchronous
Code	ASCII	ASCII/EBCDIC	ASCII	ASCII	ASCII
Communications discipline	ASCII	BSC	ASCII	ASCII	ASCII
Speed, bits/second	Up to 9600	Up to 9600	110 to 2400	75 to 9600	75 to 9600
Message format	Char./block	Block	Char. only	Char. only	Char. only
Polling/addressing capability	Opt., Maxi only	Opt.	No	No	No
Automatic answer	Opt., Maxi only	Opt.	No	No	No
EIA RS-232C interface	Std.	Opt.	Std.	Std.	Std.
Integral modem	Opt., Maxi only	No	No	No	No
Acoustic/inductive telephone coupler	Opt.	Opt.	Opt.	Opt.	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	49 to 110	198	59	68; 80 (3711)	103
Display unit, 2-year lease, $/mo.	—	188	55	64; 76 (3711)	96
Display unit, purchase price, $	1,310 to 3,000	6,900	1,430	1,610; 1,880(3711)	2,490
Controller, 1-year lease, $/mo.	—	313	—	—	—
Controller, 2-year lease, $/mo.	—	297	—	—	—
Controller, purchase price, $	—	9,050	—	—	—
Date of first production delivery	73(Maxi); 74(Mini)	9/72	2/72	4/75; 9/74 (3711)	3/75
Number of displays installed to date	700 (Maxi & Mini)	—	—	—	—
Serviced by	RDS	Raytheon	RCA Service Co.	RCA Service Co.	RCA Service Co.
COMMENTS	MM50 is available with integral printer; limited graphics with Maxi	Controlled by minicomputer; alternate display formats are 15/30 x 64. Also see Report 70D-710-01	20 ma. current loop and TTL logic interfaces also available	20 ma. current loop and TTL logic interfaces also available	20 ma. current loop and TTL logic interfaces also available

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SUPPLIER AND MODEL	Sanders Data Systems 620 & 622 Data Display Systems	Sanders Data Systems 720 Data Display System	Sanders Data Systems 804 System	Sanders Data Systems 810 System	Sanders Data Systems 8041 System
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Cluster	Stand-alone	Cluster	Stand-alone
Maximum displays/controller	1	12	1	8	1
Portable case	No	No	No	No	No
Programmable by user	No	No	Std.	Std.	Std.
Direct connection to computer	Std.	Std.	Std.	Opt.	Opt.
Teletype 33/35-compatible	No	No	Opt.	Opt.	No
IBM 2260/2265-compatible	Std.	Std.	Opt.	Opt.	No
IBM 3270-compatible	No	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	2688	2688	960/1920	480/768/960/ 1536/1920	1920
Display arrangement, lines x chars/line	40 x 52; 32 x 84	40 x 52; 32 x 84	12/24 x 80	40/64/80 x 12/24	24 x 80
Display area, height x width, inches	7.5 x 9.5	7.5 x 9.5	7.5 x 9.5	7.5 x 9.5	7.5 x 9.5
Displayable symbols	64	64	64; 96 opt.	64; 96 opt.	64
Symbol formation	Stroke	Stroke	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter/data entry	Several	Typewriter/data entry	Typewriter/data entry	Data entry
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	None	None	Std.	Std.	13 std.
Numeric keypad	None	Opt.	Std.	Std.	Std.
Detachable keyboard	Yes	Yes	Std.	Opt.	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	L, R, U, D, H, Rt.	L, R, U, D, H, Rt.	L, R, U, D, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.	Std.	Std.	Std.
Character insert and delete	Std.	Std.	Opt.	Opt.	No
Line insert and delete	No	Std.	Opt.	Opt.	No
Erase	Char. only	Char., line, screen	Opt.; char., line, screen	Std.	Std., field only
Roll	No	No	Opt.	Opt.	No
Protected format	Std.	Std.	Opt.	Opt.	Std.
Partial screen transmit	Std.	Std.	Opt.	Opt.	No
Tabulation	Std.	Std.	Std.	Std.	Std.
Addressable/readable cursor	Std.	Std.	Std.	Std.	Std.
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	Std.	Std.	Opt.	Std.	Std., field only
Programmable brightness levels	2 std.	3 std.	No	No	No
Reverse video	No	No	No	No	No
Audible alarm	No	No	Opt.	Opt.	Opt.
Other capabilities	—	—	—	—	—
AUXILIARY DEVICES					
Cassette drive	None	None	Dual drive	Dual drive	Dual drive
Diskette drive	None	None	None	None	None
Printer	Impact	Impact	Impact	Impact	Impact
Light pen	None	Opt.	Opt.	None	None
Other devices	None	None	Card reader	Card reader, disk drives	Card reader
TRANSMISSION					
Mode	Half duplex	Half duplex	Half/full duplex	Half/full duplex	Half duplex
Technique	Async./sync.	Async./sync.	Async./sync.	Async./sync.	Synchronous
Code	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC	ASCII/EBCDIC
Communications discipline	ASCII	ASCII	ASCII/BSC	ASCII/BSC	BSC
Speed, bits/second	110 to 2400	110 to 9600	110 to 9600	110 to 9600	2400
Message format	Char./block	Char./block	Char./block	Char./block	Block
Polling/addressing capability	Std.	Std.	Opt.	Opt.	No
Automatic answer	No	No	Opt.	Opt.	Opt.
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	Opt.	Opt.	No
Acoustic/inductive telephone coupler	Opt.	Opt.	Opt.	Opt.	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	200 to 220	100 to 131	210 (basic)	63 (basic)	352 (basic)
Display unit, 2-year lease, $/mo.	120 to 175 (3-yr.)	65 (basic 3-yr.)	191 (basic 3-yr.)	57 (basic 3-yr.)	332 (basic)
Display unit, purchase price, $	5,900 to 6,100	3,177 to 3,277	5,630 (basic)	1,475 (basic)	12,800 (basic)
Controller, 1-year lease, $/mo.	—	228 to 284	—	186 (basic)	—
Controller, 2-year lease, $/mo.	—	415 (basic 3-yr.)	—	171 (basic 3-yr.)	—
Controller, purchase price, $	—	7,088 to 18,000	—	6,900 (basic)	—
Date of first production delivery	1968/1970 (622)	1966	12/71	1/73 (basic)	12/71
Number of displays installed to date	Over 1,500	Over 5,000	Over 1,000	Over 400	Over 100
Serviced by	Sanders	Sanders	Sanders	Sanders	Sanders
COMMENTS			Also see Report 70D-734-01	Also see Report 70D-734-01	Emulates IBM 2780. Also see Report 70D-734-01

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SUPPLIER AND MODEL	Sanders Data Systems 8100/8108 System	Sanders Data Systems 8170 System	Scientific Measurement Systems SMS 1920	Selecterm ADDS 580	Selecterm ADDS 980
ARRANGEMENT					
Stand-alone or cluster	Cluster	Cluster	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	4/8	32	1	1	1
Portable case	No	No	Std.	No	No
Programmable by user	Std.	Std.	No	No	No
Direct connection to computer	Opt.	Std., IBM 360/370	No	Std., minicomputer	Std., minicomputer
Teletype 33/35-compatible	No	No	Std.	Std.	Std.
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	Std.	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	960/1920	480/960/1920	1920	1920	1920
Display arrangement, lines x chars/line	12/24 x 80	12 x 40/80; 24 x 80	24 x 80	24 x 80	24 x 80
Display area, height x width, inches	7.2 x 9.6	7.2 x 9.6	12-inch diag.	8 x 10	8 x 10
Displayable symbols	64; 96 opt.	96	64	64	96
Symbol formation	5 x 7 dot matrix	9 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter/data entry	Teletype/ keypunch	Typewriter	Typewriter
Character set	ASCII	EBCDIC	ASCII	ASCII	ASCII
Program function keys	13 std.	20 std.	8 std.	None	Opt.
Numeric keypad	Std.	Std.	Std.	Std.	Std.
Detachable keyboard	Opt.	Std.	Opt.	No	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H	U, D, L, R, H
Cursor blinking	Std.	Std.	Std.	Opt.	Opt.
Character insert and delete	No	Std.	Opt.	No	Std.
Line insert and delete	No	Opt.	Opt.	No	Std.
Erase	Std., field only	Char., field, screen	Line & screen	Screen only	Char. & screen
Roll	No	No	Opt.	Std.	Std.
Protected format	Std.	Std.	Std.	No	Std.
Partial screen transmit	No	Std.	Std.	No	Std.
Tabulation	Std.	Std.	Opt.	No	Std.
Addressable/readable cursor	Std.	Std.	Std., address. only	Std.	Std.
Character repeat	Std.	Opt.	Std.	Std.	Std.
Character or field blinking	Std., field only	Std.	Std.	No	Std.
Programmable brightness levels	No	2 std.	No	No	2 std.
Reverse video	No	No	Opt.	No	Std.
Audible alarm	Std.	Std.	Opt.	Std.	Std.
Other capabilities	—	—	Auto wraparound, dual intensity	—	Vector generation
AUXILIARY DEVICES					
Cassette drive	None	None	Single drive	Single/dual drive	Single/dual drive
Diskette drive	None	None	Single spindle	None	No
Printer	Impact	Impact	Impact	RS-232 interface	RS-232 interface
Light pen	None	Opt.	None	None	No
Other devices	Card reader, disk drive	Card reader	—	—	—
TRANSMISSION					
Mode	Half duplex	Half duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Synchronous	Async./sync. opt.	Asynchronous	Asynchronous
Code	EBCDIC	EBCDIC	ASCII	ASCII	ASCII
Communications discipline	BSC	BSC	ASCII	ASCII	ASCII
Speed, bits/second	2400	600 to 4800	Up to 9600	110 to 9600	110 to 9600
Message format	Block	Block	Char./block	Char. only	Char./block
Polling/addressing capability	No	Std.	Opt.	No	No
Automatic answer	Opt.	No	Opt.	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.; also 20 ma.dc	Std.; 20 ma. dc
Integral modem	Opt.	No	Std.	No	No
Acoustic/inductive telephone coupler	No	No	Opt.	Opt.	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	Contact vendor	80 to 120	132	88	123
Display unit, 2-year lease, $/mo.	—	—	94	—	—
Display unit, purchase price, $	—	3,200 to 4,800	2,245	1,895	2,900
Controller, 1-year lease, $/mo.	—	121	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	7,540	—	—	—
Date of first production delivery	4/73	2/74	9/74	9/73	9/74
Number of displays installed to date	Over 30	Over 100	100	1,500	500
Serviced by	Sanders	Sanders	SMS	Selecterm	Selecterm
COMMENTS	Emulates IBM 2770. Also see Report 70D-734-01	Also see Report 70D-734-01		Mfg. by Applied Digital Data Systems as Consul 580	Mfd. by Applied Digital Data Systems as Consul 980

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SUPPLIER AND MODEL	I.P. Sharp IPSA 100	I.P. Sharp IPSA 200	I.P. Sharp IPSA 300	Singer Models 80, 81, & 82	Sycor 340
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Cluster	Stand-alone	Stand-alone
Maximum displays/controller	1	1	8/16	1	1
Portable case	Std.	No	No	No	No
Programmable by user	No	No	No	No	Std.
Direct connection to computer	Std.	Std.	Std., minicomputer	80, 82; Singler S/10	Opt.
Teletype 33/35-compatible	No	No	Std.	No	Opt.
IBM 2260/2265-compatible	No	No	Opt.	No	No
IBM 3270-compatible	No	No	Opt.	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	256/512	960	1920	1600 (80); 960/1920	576
Display arrangement, lines x chars/line	8/16 x 32	15 x 64	24 x 80	20x80; 12/24x80	9 x 64
Display area, height x width, inches	Variable	Variable	9 to 15 in. diag.	5.5 x 8 (81, 82)	7.75 x 5.5
Displayable symbols	89 APL	93	96 ASCII/89 APL	64	62
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Data entry	Typewriter	Typewriter
Character set	APL	APL	ASCII	ASCII	ASCII/EBCDIC
Program function keys	No	No	Opt.	Up to 11	No
Numeric keypad	No	No	Opt.	Std.,80; opt.81/82	Std.
Detachable keyboard	Std.	Std.	Std.	Std., 81, 82	No
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	None	None	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	Std.	Opt.	Std.	Std.
Character insert and delete	No	No	Std.	Std.	No
Line insert and delete	No	No	Opt.	Std.	No
Erase	Screen only	Screen only	Line & screen	Char., line, screen	Std.
Roll	Std., up only	Std., up only	Opt.	Std., up only	Opt., up only
Protected format	No	No	Opt.	Std.	Std.
Partial screen transmit	No	No	Opt.	Std.	Std.
Tabulation	No	Opt.	Opt.	Std.	Std.
Addressable/readable cursor	No	Opt.	Opt.	Std.	No
Character repeat	No	Opt.	Opt.	Std.	No
Character or field blinking	No	No	Char. only	No	No
Programmable brightness levels	No	No	No	No	No
Reverse video	No	Opt.	Opt.	No	No
Audible alarm	No	Opt.	Opt.	Std.	Std.
Other capabilities	None	None	—	Paging, scrolling	None
AUXILIARY DEVICES					
Cassette drive	None	None	Opt.	No	Single/dual drive
Diskette drive	None	None	Opt.	No	Dual spindle
Printer	None	None	Opt.	Impact	Impact
Light pen	None	None	Opt.	None	None
Other devices	None	None	Card reader, disk drive	None	Card reader, 7-/9-tk. mag. tape units
TRANSMISSION					
Mode	Half duplex	Half duplex	Half/full duplex	Half/full duplex	Half duplex
Technique	Asynchronous	Asynchronous	Async./sync.	Async./sync.	Async./sync.
Code	IBM Corresp.	IBM Corresp.	ASCII	ASCII	ASCII/EBCDIC
Communications discipline	IBM 2741	IBM 2741	ASCII	Any	ASCII/BSC
Speed, bits/second	134.5	134.5	300 to 2400	Up to 9600	75 to 4800
Message format	Char. only	Char. only	Char. only	Char./block	Char./block
Polling/addressing capability	No	No	Std.	Opt.	No
Automatic answer	No	No	Opt.	Opt.	Opt.
EIA RS-232C interface	Std.	Std.	Opt.	Std., 81 only	Opt.
Integral modem	Std.	No	No	Opt.	No
Acoustic/inductive telephone coupler	Std.	No	No	No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	139 to 289	150 to 593
Display unit, 2-year lease, $/mo.	—	—	—	—	123 to 536
Display unit, purchase price, $	1,800 to 2,200	2,500 to 2,900	Contact vendor	4,000 to 9,000	6,600 to 23,720
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	—
Date of first production delivery	4/73	9/75	7/74	6/72 (80); 9/74	2/71
Number of displays installed to date	Over 100	—	—	4,000	Over 20,000
Serviced by	Sorbus	Sorbus	Sorbus	Singer	Sycor & Sorbus
COMMENTS	Portable controller with keyboard uses video monitor; replaces the IBM 2741			Models 81 & 82 are microprocessor-based with a vendor-programmable ROM. Up to 63 Model 81's can be chained on one modem	Also see Report 70D-792-01

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SUPPLIER AND MODEL	Sycor 255	Sycor 257	SYS Computer 500 PE/WP	TEC, Inc. Models 410/415 & 420/425	TEC, Inc. Model 440
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Cluster	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	32	1	1	1
Portable case	No	No	No	No	No
Programmable by user	Std.	Std.	No	No	No
Direct connection to computer	No	No	No	Parallel (TTL)	RS-232 interface
Teletype 33/35-compatible	No	No	Std.	No	Std.
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	Std.	Std.	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	480/1920	480/1920	—	1000/1920	1920
Display arrangement, lines x chars/line	12 x 40; 24 x 80	12 x 40; 24 x 80	—	20 x 50; 24 x 80	24 x 80
Display area, height x width, inches	4.5 x 8.2; 5.8 x 8.5	4.5 x 8.2; 5.8 x 8.5	14 (diagonal)	74 sq. inches	74 sq. inches
Displayable symbols	64; 96 opt.	64; 96 opt.	128	67	64
Symbol formation	9 x 7 dot matrix	9 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter/data entry	Typewriter/data entry	Typewriter	Teletype	Teletype
Character set	ASCII/EBCDIC	ASCII/EBCDIC	ASCII	ASCII	ASCII
Program function keys	12 opt.	12 opt.	15 std.	2 std.	None
Numeric keypad	Opt.	Opt.	None	Opt.	None
Detachable keyboard	Std.	Std.	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	Rt., LF, BS
Cursor blinking	Std.	Std.	Std.	Std.	Std.
Character insert and delete	Std.	Std.	Std.	Std.	No
Line insert and delete	No	No	No	Std.	No
Erase	Char., field, screen	Char., field, screen	Char., line, screen	Line, screen	Char., line, screen
Roll	No	No	Std.; up & down	Std.	Std.
Protected format	Std.	Std.	No	Std.	No
Partial screen transmit	Std.	Std.	Std.	Std.	No
Tabulation	Std.	Std.	Std.	Std.	No
Addressable/readable cursor	Std.	Std.	Std.	Std.	No
Character repeat	Partial	Partial	Std.	Std.	Std.
Character or field blinking	Std., field only	Std., field only	No	Std.	No
Programmable brightness level	3 std.	3 std.	Std.	No	No
Reverse video	No	No	Std.	No	No
Audible alarm	Std.	Std.	Std.	Std.	Std.
Other capabilities	None	None	Underscore std.	—	—
AUXILIARY DEVICES					
Cassette drive	None	None	None	None	None
Diskette drive	Dual spindle	Dual spindle	Dual spindle	None	None
Printer	Impact	Impact	Impact	RS-232 interface	RS-232 interface
Light pen	Opt.	Opt.	None	None	None
Other devices	ID card reader	ID card reader	ID card reader	None	None
TRANSMISSION					
Mode	Half duplex	Half duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Synchronous	Synchronous	Synchronous	Asynchronous	Asynchronous
Code	ASCII/EBCDIC	ASCII/EBCDIC	ASCII	ASCII	ASCII
Communications dicsipline	BSC	BSC	ASCII	ASCII	ASCII
Speed, bits/second	1200 to 4800	1200 to 4800	Up to 9600	110 to 9600	110 to 9600
Message format	Block	Block	Char./block opt.	Block	Char. only
Polling/addressing capability	Std.	Std.	Opt.	Std.	No
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std., 420/425	No
Integral modem	No	No	No	No	No
Acoustic/inductive telephone coupler	No	No		No	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	98 to 110	76 to 96	—	—	—
Display unit, 2-year lease, $/mo.	93 to 104	72 to 91	—	—	—
Display unit, purchase price, $	4,310 to 4,840	3,340 to 4,220	7,500 (basic)	2,450 to 3,100	1,920
Controller, 1-year lease, $/mo.	—	80 to 96	—	—	—
Controller, 2-year lease, $/mo.	—	76 to 91	—	—	—
Controller, purchase price, $	—	2,290 to 3,790	—	—	—
Date of first production delivery	10/73	10/73	—	2/70	1/72
Number of displays installed to date	2,000	2,000	—	1,785	960
Serviced by	Sycor & Sorbus	Sycor & Sorbus	—	TEC	TEC
COMMENTS	Also see Report 70D-792-02	Also see Report 70D-792-02	Designed for text editing (word processing) applications	Models 410/415 have parallel (TTL logic) interface; 420/425 have serial interface; rack-mounted units available	

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SUPPLIER AND MODEL	TEC, Inc. Models 450/455 & 460/465	TEC, Inc. Models 1400, 1440, & 2400	TEC, Inc. Model 4400	Tektronix Model 4023	Teleram Communications P-1800
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	1	1	1	1	1
Portable case	No	No	No	No	Std.; 23 lbs.
Programmable by user	No	No	Opt.	No	No
Direct connection to compuer	No	RS-232 interface	No	RS-232 interface	No
Teletype 33/35-compatible	450/455 only	Std.	Std.	Std.	Std.
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	No	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	1000/1920	960(1400) 1920	2000	1920	616
Display arrangement, lines x chars/line	20x50; 24x80	12/24 x 80	25 x 80	24 x 80	14 x 44
Display area, height x width, inches	—	54/74 sq. inches	—	5.5 x 9	4.5 x 5.5
Displayable symbols	67	64	128	94	127
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	7 x 9 dot matrix
KEYBOARD					
Style	TTY/typewriter	Teletype	Typewriter	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII
Program function keys	None	None	None	Std.	No
Numeric keypad	Std.; opt., 450/455	Opt.	Std.	Std.	Std.
Detachable keyboard	Std.	Std.	Std.	Std.	None
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.; Rt., LF, BS (1440)	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H
Cursor blinking	Std.	Std.	Std.	Std.	No
Character insert and delete	Std.	No	Std.	Std.	Std.
Line insert and delete	Std.	No	Std.	Std.	Std.
Erase	Line, screen	Screen only	Line, screen	Line, field, screen	Std.
Roll	Std.	Std.	Std.	No	Std.
Protected format	Std.	Std., 1400 & 2400	Std.	Std.	No
Partial screen transmit	Std.	Std., 1400 & 2400	Std.	Std.	Std.
Tabulation	Std.	Std., 1400 & 2400	Std.	Std.	Std.
Addressable/readable cursor	Std.	Std., 1400 & 2400	Std.	Std., address. only	No
Character repeat	Std.	Std.	Std.	Std.	Std.
Characte or field blinking	Std.	Std., 1400 & 2400	Std.	Std.	No
Programmable brightness levels	No	2 std., 1400&2400	2 std.	No	No
Reverse video	No	No	Std.	No	No
Audible alarm	Std.	Std.	Std.	Std.	No
Other capabilities	—	—	Scrolling	—	2048-char. memory, delete word
AUXILIARY DEVICES					
Cassette drive	None	RS-232 interface	RS-232 interface	None	Single drive
Diskette drive	None	None	RS-232 interface	None	None
Printer	RS-232 interface	RS-232 interface	RS-232 interface	Video prnt.,T-4623	None
Light pen	None	None	None	None	None
Other devices	None	None	None	None	None
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex
Technique	Asynchronous	Asnychronous	Async./sync.	Asynchronous	Asynchronous
Code	ASCII	ASCII	ASCII	ASCII	ASCII/TTS
Communications discipline	ASCII/Burroughs	ASCII	ASCII	ASCII	ASCII
Speed, bits/second	110 to 9600	110 to 9600	110 to 9600	110 to 9600	110 to 1200
Message format	Char./block	Char./block	Char./block	Char./block	Block
Polling/addressing capability	Std., 460/465	No	Std.	No	No
Automatic answer	No	No	No	No	No
EIA RS-232C interface	Std.	Std.; opt., 1440	Std.	Std.	Std.
Integral modem	No	No	No	No	Std.
Acoustic/inductive telephone coupler	No	Opt., 1440 only	No	No	Std.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	140	—
Display unit, 2-year lease, $/mo.	—	—	—	—	—
Display unit, purchase price, $	Contact vendor	1,295 to 1,995	Contact vendor	3,495	4,825
Controller, 1-year lease, $&mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	—	—	—	—
Controller, purchase price, $	—	—	—	—	—
Date of first production delivery	'70; '74, 460/465	11/74 to 4/75	6/75	7/73	10/74
Number of displays installed to date	2,480	1,950(1400&2400)	—	—	Over 20
Serviced by	TEC	TEC	TEC	Tektronix	Teleram
COMMENTS	Rack mount available		Up to 28K bytes of memory; rack mount available	Switch-selectable speeds	

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SUPPLIER AND MODEL	Teletype Model 40	Termiflex HT/1 & HT/2 Handheld Terminals	Terminal Communications TC 275	Terminal Communications TC 277	Texas Scientific Entelekon 200
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Stand-alone	Cluster	Cluster
Maximu displays/controller	1	1	1	32	32
Portable case	No	Std.; 1.5 lbs	No	No	No
Programmable by user	No	No	No	No	No
Direct connection to computer	No	RS-232C interface	No	Std.; IBM 360/370	Std.; IBM 360/370
Teletype 33/35-compatible	Opt.	Std.	No	No	No
IBM 2260/2265-compatible	No	No	No	No	No
IBM 3270-compatible	No	No	Std.	Std.	Std.
DISPLAY ORGANIZATION					
Display positions, chars/display	1920	10; 20 (HT/2)	480/1920	480/1920	1920
Display arrangement, lines x chars/line	24 x 80	1x10; 2x10 (HT/2)	12 x 40; 24 x 80	12 x 40; 24 x 80	24 x 80
Display area, height x width, inches	5.25 x 11.25	2 x 4	14 (diagonal)	14 (diagonal)	6 x 9
Displayable symbols	127	128	64	64	94
Symbol formation	7 x 9 dot matrix	5 x 7 dot LED matrix	7 x 9 dot matrix	7 x 9 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Modified "Touch-Tone"	Typewriter/data entry	Typewriter/data entry	Typewriter/data entry
Character set	ASCII	Full ASCII	ASCII/EBCDIC	ASCII/EBCDIC	EBCDIC
Program function keys	None	None	Opt.	Opt.	12 opt.
Numeric keypad	None	Std.	Std.	Std.	Opt.
Detachable keyboard	No	No	Std.	Std.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, H	L, R, U, D, H, Rt.	L, R, U, D, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	No	Std.	No	No	Opt.
Character inset and delete	Std.	No	Std.	Std.	Std.
Line insert and delete	Std.	No	Std.	Std.	No
Erase	Screen only	Screen only	Char., line, screen	Char., line, screen	Field & screen
Roll	Opt.	Std., up & down	No	No	No
Protected format	Opt.	No	Std.	Std.	Std.
Partial screen transmit	Opt.	No	Std.	Std.	Std.
Tabulation	Opt.	No	Std.	Std.	Std.
Addressable/readable cursor	No	No	Std.	Std.	Std.
Character repeat	Partial	Std.	Std.	Std.	Std.
Character or field blinking	No	No	No	No	No
Programmable brightness levels	2 opt.	No	2 std.	2 std.	2 std.
Reverse video	No	No	Opt.	Opt.	No
Audible alarm	Std.	Std.	Opt.	Opt.	Yes
Other capabilities	Scrolling, paging, expanded memory	Buffering: 500 chars. (HT/1); 1000 chars. (HT/2)	—	—	—
AUXILIARY DEVICES					
Cassette drive	Single drive	None	None	None	None
Diskette drive	None	None	None	None	None
Printer	Impact	None	Impact	Impact	Impact/non-impact
Light pen	None	None	Opt.	Opt.	Opt.
Other devices	None	None	ID card reader	ID card reader	ID card reader
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half duplex	Half duplex	See Comments
Technique	Asynchronous	Asynchronous	Synchronous	Synchronous	—
Code	ASCII	ASCII	ASCII/EBCDIC	ASCII/EBCDIC	—
Communications discipline	ASCII	ASCII	BSC	BSC	—
Speed, bits/second	110 to 4800	110/150/300/1200	1200 to 7200	1200 to 7200	—
Message format	Block/char. opt.	Char. only	Block	Block	—
Polling/addressing capability	Opt.	No	Std.	Std.	—
Automatic answer	Std.	No	No	No	—
EIA RS-232C interface	Std.	Std.	Std.	Std.	—
Integral modem	No	No	No	No	—
Acoustic/inductive telephone coupler	No	TC/1 Termi-coupler, opt.	No	No	—
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	115	66	Mkted. by Genesis
Display unit, 2-year lease, $/mo.	—	—	110	63	One as Mod. G77
Display unit, purchase price, $	3,086 to 6,473	1,190;1,570(HT/2)	4,600	2,900	—
Controller, 1-year lease, $/mo.	—	—	—	178	—
Controller, 2-year lease, $/mo.	—	—	—	178	—
Controller, purchase pice, $	—	—	—	6,630	—
Date of first production delivery	1973	6/74	1/74	2/74	3/74
Number of displays installed to date	Over 6,000	Over 200	500	1,000	—
Serviced by	Teletype & Bell System	Termiflex	TCI	TCI	Sorbus
COMMENTS	Also available from AT&T (Bell System) as Data-speed 40, and from leasing companies. Also see Report 70D-830-04	Switch-selectable speeds; red LED display; external power supplies sell for $160 (PS/1, 6 lbs.). or $390 (PS/2, 1.5 lbs.). TE/1 coupler sells for $580	Volume discounts and 3-year leases	Volume discounts and 3-year leases	Attaches to IBM 3271 (remote) or 3272 (local) control unit. Also see Report 70D-458-01

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SUPPLIER AND MODEL	Trivex 40/80	Trivex Plus 70	Univac Uniscope 100	Univac Uniscope 200	Video Data Systems 100 Series
ARRANGEMENT					
Stand-alone or cluster	Either	Either	Stand-alone	Stand-alone	Stand-alone
Maximum displays/controller	32	32	1 or 31 via 2 mux's.	1 or 31 via 2 mux's.	32
Portable case	No	No	No	No	Opt.
Programmable by user	No	No	No	No	No
Direct connection to computer	Std.	Std.	No	No	No
Teletype 33/35-compatible	No	No	No	No	Std.
IBM 2260/2265-compatible	Std.	No	No	No	No
IBM 3270-compatible	No	Std.	No	No	No
DISPLAY ORGANIZATION					
Display positions, chars/display	240/480/960	1920	960/1024	1536/1920	256 to 1920
Display arrangement, lines x chars/line	6/12x40; 12x80	24 x 80	12x80; 16x64	24 x 64/80	8x32 to 24x80
Display area, height x width, inches	6 x 9	8 x 11	5 x 10	7 x 10	Variable
Displayable symbols	64	64	64; 96 opt.	64; 96 opt.	64
Symbol formation	5 x 7 dot matrix	7 x 9 dot matrix	Stroke	7 x 9 dot matrix	7 x 8; 10 x 14 dot
KEYBOARD					
Style	Typewriter/data entry	Typewriter/data entry/console	Typewriter	Typewriter	Typewriter
Character set	ASCII	EBCDIC	ASCII	ASCII	ASCII
Program function keys	None	12 opt.	4 std.	4 std.	5 opt.
Numeric keypad	Std.	Opt.	Opt.	Opt.	None
Detachable keyboard	Std.	Std.	No	No	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Opt.	Opt.	Std.	Std.	Opt.
Character insert and delete	Std.	Std.	Std.	Std.	No
Line insert and delete	Std.	Std.	Std.	Std.	No
Erase	Std.	Char., field, line, screen	Char., line, screen	Char., line, screen	Screen only
Roll	No	Opt.	Std., up & down	Std., up & down	Opt., up only
Protected format	Std.	Std.	Std.	Std.	No
Partial screen transmit	No	Std.	Std.	Std.	No
Tabulation	Std.	Std.	Std.	Std.	No
Addressable/readable cursor	Std.	Std.	Std.	Std.	Std.
Character repeat	Std.	Std.	Std.	Std.	Std.
Character or field blinking	No	No	Std.	Std.	Char. opt.
Programmable brightness levels	No	2 std.	No	No	No
Reverse video	No	No	No	No	Opt.
Audible alarm	No	Opt.	Std.	Std.	No
Other capabilities	None	None	None	None	—
AUXILIARY DEVICES					
Cassette drive	None	None	Dual drive	Dual drive	RS-232 interface
Diskette drive	None	None	No	No	None
Printer	Impact	Impact	Impact/non-impact	Impact/non-impact	None
Light pen	None	Opt.	None	None	None
Other devices	None	ID card reader	None	None	ID card reader
TRANSMISSION					
Mode	Half duplex	Half duplex	Half duplex	Half duplex	Half/full duplex
Technique	Async./sync.	Asynchronous	Async./sync.	Async./sync.	—
Code	ASCII	EBCDIC	ASCII	ASCII	ASCII
Communications discipline	ASCII	BSC	ASCII (Univac)	ASCII (Univac)	ASCII
Speed, bits/second	Up to 9600	Up to 9600	Up to 9600	Up to 9600	110 to 9600
Message format	Block	Block	Block	Block	Char./block
Polling/addressing capability	Std.	Std.	Std.	Std.	No
Automatic answer	No	No	Std.	Std.	Opt.
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	No	No	Opt.
Acoustic/inductive telephone coupler	No	No	No	No	Opt.
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	88 (basic)	Contact vendor	133 to 175	151 to 189	—
Display unit, 2-year lease, $/mo.	79 (basic)	Contact vendor	—	—	—
Display unit, purchase price, $	2,300 (basic)	Contact vendor	4,350 to 5,696	5,100 to 6,469	—
Controller, 1-year lease, $/mo.	375 (basic)	Contact vendor	53 to 76 (mux)	53 to 76 (mux)	—
Controller, 2-year lease, $/mo.	332 (basic)	Contact vendor	—	—	—
Controller, purchase price, $	8,900 (basic)	Contact vendor	2036 to 2849(mux)	2036 to 2849(mux)	495 to 1,995
Date of first production delivery	4/71	5/75	5/70	2/75	3/73
Number of displays installed to date	3,000	—	—	—	100
Serviced by	Trivex	Trivex	UNIVAC	UNIVAC	VDS
COMMENTS			Two multiplexers can be cascaded to accommodate up to 31 terminals. Also see Report 70D-877-05	Two multiplexers can be cascaded to accommodate up to 31 terminals. Also see Report 70D-877-05	Controller uses video monitor for display; also available in printed circuit boards

All About Alphanumeric Display Terminals

SUPPLIER AND MODEL	Video Data Systems CG 1000	Wang Laboratories 2200 System	Westinghouse Models 1600 & 1600 DE	Westinghouse Model 1620	Westinghouse Model 1630
ARRANGEMENT					
Stand-alone or cluster	Stand-alone	Stand-alone	Either	Stand-alone	Stand-alone
Maximum displays/controller	32	10	24	1	1
Portable case	No	No	No	No	No
Programmable by user	No	Std.	No	No	No
Direct connection to computer	No	RS-232 interface	No	No	No
Teletype 33/35-compatible	Std.	Std.	1600 only	Std.	Opt.
IBM 2260/2265-compatible	No	No	No	No	Opt.
IBM 3270-compatible	No	No	No	No	Opt.
DISPLAY ORGANIZATION					
Display positions, chars/display	256/512	1024	1600	1920	1920
Display arrangement, lines x chars/line	8/16 x 32	16 x 64	20 x 80	24 x 80	23/24 x 64/80
Display area, height x width, inches	Variable	8 x 10.5	6 x 8	6.5 x 8.5	6.5 x 9
Displayable symbols	64	64	64; 96 opt.	64; 96 opt.	96
Symbol formation	7 x 8; 10 x 14 dot	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
KEYBOARD					
Style	Typewriter	Typewriter	Typewriter/data entry	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII	ASCII/EBCDIC
Program function keys	5 opt.	32 std.	9 std., DE only	No	Opt.
Numeric keypad	None	Std.	STd.	Opt.	No
Detachable keyboard	No	Std.	Opt.; std., DE	Opt.	Std.
FEATURES					
Cursor positioning; Up, Down, Left, Right, Home, REturn	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	U, D, L, R, H, Rt.	L, R, Rt.	U, D, L, R, H, Rt.
Cursor blinking	Std.	No	Std.	No	Std.
Character insert and delete	No	Std., opt.	Std.	No	Std.
Line insert and delete	No	Std.	Std.	No	Std.
Erase	Screen only	Char., line, screen	Char., line, screen	Char., screen	Char., line, screen
Roll	No	Std., up only	Std., up only	Std., up only	Opt.
Protected format	No	No	Std.	No	Std.
Partial screen transmit	No	No	Std.	No	Std.
Tabulation	No	Std.	Std.	No	Std.
Addressable/readable cursor	Std.	Std.	Std., address. only	No	Std.
Character repeat	Std.	No	Std.	Std.	Std.
Charcter or field blinking	Char. opt.	No	Std., char. only	No	Std.
Programmable brightness levels	No	No	No	No	No
Reverse video	Opt.	No	No	No	Std.
Audible alarm	No	Opt.	Std.	Std.	No
Other capabilities	—	—	Data validation for DE	—	—
AUXILIARY DEVICES					
Cassette drive	RS-232 interface	Single/dual drive	None	Interface only	None
Diskette drive	None	1, 2, or 3 spindles	None	None	None
Printer	None	Impact	Interface only	Interface only	Buffered interface
Light pen	None	None	None	None	None
Other devices	ID card reader	Various peripherals are available	None	None	Interface for card reader
TRANSMISSION					
Mode	Half/full duplex	Half duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	—	Asynchronous	Async./sync.	Asynchronous	Synchronous
Code	ASCII	ASCII	ASCII	ASCII	ASCII
Communications discipline	ASCII	ASCII	ASCII	ASCII	ASCII
Speed, bits/second	300	110 to 1200	110 to 9600	110 to 2400	Up to 9600
Message format	Block	Char./block	Char./block	Char. only	Block
Polling/addressing capability	No	No	Opt.; std., DE	No	Std.
Automatic answer	No	Opt.	Opt.; std., DE	No	Std.
EIA RS-232C interface	Std.	Std.	Std.	Std.	Std.
Integral modem	No	No	No	Opt.	No
Acoustic/inductive telephone coupler	No	No	No	Opt.	No
PRICING AND AVAILABILITY					
Display unit, 1-year lease, $/mo.	—	—	—	—	—
Display unit, 2-year lease, $/mo.	—	195 to 235	—	—	—
Display unit, purchase price, $	—	3,900 to 4,700	3,265; 3,400, DE	1,665	Contact vendor
Controller, 1-year lease, $/mo.	—	—	—	—	—
Controller, 2-year lease, $/mo.	—	120 to 2,500	—	—	—
Controller, purchase price, $	2,995 to 4,995	2,400 to 50,000	3,990 to 8,430	—	—
Date of first production delivery	3/75	12/73	12/71; 1/75, DE	1/75	3rd qtr. 1975
Number of displays installed to date		Over 2,000	—	—	—
Serviced by	VDS	Wang Labs.	Westinghouse	Westinghouse	Westinghouse
COMMENTS	Controller uses video monitor for for display	Minicomputer-based CRT unit with a host of available peripherals	Optional printer interfaces for Centronics 101A, 102A, and 306 printers; 1600 DE designed for on-line data entry	Switch-selectable data rates; single logic pc board	Microprocessor-based unit uses Intel 8080 with up to 6K PROM

All About Alphanumeric Display Terminals

SUPPLIER AND MODEL	Wiltek Model 500	Wyle Series 8000 & 9000	Xerox Models BC 100 & BC 200	Zentec Model 9002
ARRANGEMENT				
Stand-alone or cluster	Either	Either	Either	Stand-alone
Maximum displays/controller	32	16; 32, 9000	4	1
Portable case	No	Std.	Std.	No
Programmable by user	No	Std., 9000 only	No	Std.
Direct connection to computer	No	Std., minicomputers	Std., Xerox CPU's	RS-232
Teletype 33/35-compatible	Std.	No	Std.	Opt., no cost
IBM 2260/2265-compatible	No	Std.	No	No
IBM 3270-compatible	No	Std., 9000 only	No	No
DISPLAY ORGANIZATION				
Display positions, chars/display	1998	480/960/1920	960/1600	2000
Display arrangement, lines x chars/line	27 x 74	12 x 40/80; 24 x 80	24 x 40; 20 x 80	25 x 80
Display area, height x width, inches	12 (diagonal)	7 x 9	12 to 17 (diagonal)	8 x 11
Displayable symbols	64	64	155	128
Symbol formation	5 x 7 dot matrix	5 x 7 dot matrix	5 x 8 dot matrix	7 x 9 dot matrix
KEYBOARD				
Style	Typewriter/data entry	Typewriter/data entry	Typewriter	Typewriter
Character set	ASCII	ASCII	ASCII	ASCII
Program function keys	None	12 std., 9000 only	Std.	5 std., plus 10 opt.
Numeric keypad	Std.	Opt.	Opt.	Std.
Detachable keyboard	Std.	Std., 9000 only	Std.	Std.
FEATURES				
Cursor positioning; Up, Down, Left, Right, Home, Return	U, D, L, R, H, Rt.	U, D, L, R, H	U, D, L, R, H	U, D, L, R, H, Rt.
Cursor blinking	No	Opt., std., 9000	Std.	Std.
Character insert and delete	Std.	Std.	Std.	Std.
Line insert and delete	Std.	Std., 9000 only	Std.	Std.
Erase	Std.	Char., line, screen	Char., line, screen	Char., line, screen
Roll	No	Opt. 9000 only	No	Std., up or down
Protected format	Std.	Std.	Std.	Std.
Partial screen transmit	Std.	Std.	Std.	Std.
Tabulation	Std.	Std.	Std.	Std.
Addressable/readable cursor	Std., address. only	Std.	Std., address. only	Std.
Character repeat	Std.	Std.	Std.	Std.
Character or field blinking	No	Opt., 9000 only	Std.	Std.
Programmable brightness levels	2 std.	2 std., 9000 only	Std.	2 std.
Reverse video	No	Opt., 9000 only	No	Std.
Audible alarm	Std.	Opt., 9000 only	Std.	Std.
Other capabilities	None	—	Opt. 8-color display, point plotting	Paging and scrolling, data block transfer
AUXILIARY DEVICES				
Cassette drive	None	Opt., 9000 only	None	Opt. interface
Diskette drive	None	Opt., 9000 only	None	Opt. interface
Printer	Impact	Impact	Opt.	Impact or interface
Light pen	None	None	None	None
Other devices	ID card reader	—	None	None
TRANSMISSION				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Async./sync.	Async./sync.	Async./sync.	Async./sync. opt.
Code	ASCII	ASCII/EBCDIC	ASCII	ASCII; others opt.
Communications discipline	ASCII/BSC	ASCII/BSC	ASCII/BSC	ASCII/SDLC planned
Speed, bits/second	1200 to 2400	1200 to 9600	300 to 9600	110 to 9600
Message format	Char./block	Block	Char./block	Char./block
Polling/addressing capability	Std.	Std.	Std.	Opt.
Automatic answer	Std.	Opt., 9000 only	No	No
EIA RS-232C interface	Std.	Std.	Std.	Std.
Integral modem	Std.	No	Opt.	No
Acoustic/inductive telephone coupler	No	No	Opt.	Opt.
PRICING AND AVAILABILITY				
Display unit, 1-year lease, $/mo.	—	Contact vendor	35 to 225	—
Display unit, 2-year lease, $/mo.	—	Contact vendor	28 to 115 (4-yr.)	—
Display unit, purchase price, $	12,100	Contact vendor	3,800	3,485 to 6,400
Controller, 1-year lease, $/mo.	—	Contact vendor	195 to 235	—
Controller, 2-year lease, $/mo.	—	Contact vendor	163 to 196 (4-yr.)	—
Controller, purchase price, $	—	Contact vendor	6,500	—
Date of first production delivery	—	1972; 1975 (9000)	1970/1971	7/74
Number of displays installed to date	—	—	Over 300	Over 200
Serviced by	Wiltek	Wyle or third party	Xerox	Zentec & third party
COMMENTS	Includes two 50K-char. magnetic tape buffers. Also see Report 70D-918-01	Discounts available based on lease term & number of units per system; 9000 is micro-programmable	Model BC 100 has smaller screen capacity. Leased units are available only with the Xerox computers	Microprocessor-based unit with up to 16K bytes of memory consisting of ROM, PROM, and RAM

All About Typewriter Terminals

This comprehensive report summarizes the characteristics of 77 typewriter-style communications terminals from 34 suppliers, presents the results of an extensive survey of typewriter terminal users, and provides guidance in selecting the most suitable terminals for your needs.

The typewriter, having witnessed the passing of many generations and withstood the tests of time, is today as commonplace an instrument of human communications as the telephone. The use of the typewriter as a means of communication between man and computer is a natural extension of its conventional use. As a man/machine interface, the typewriter traces its history to the early years of commercial computers when operator/computer interaction was required on a routine basis. The typewriter has been widely used ever since as an operator's console I/O device, though it has been largely displaced in recent years by its space-age counterpart, the CRT display unit.

The dawn of data communications broadened the use of the typewriter as a convenient, low-cost means of remote communication with a central computer. Actually, the teletypewriter (or teleprinter), a communications-oriented typewriter then heavily used in message-switching networks, was adopted for use as the original interactive computer-communications terminal for the simple reason that no other suitable device existed at that time.

The explosion of the data communications environment created a vast market for communications terminals. Responding to the rising demand for such devices, a host of manufacturers sprang into existence during the past decade. Some of these companies have since fallen by the wayside, but many have survived to become today's major suppliers. Still others are still striving to achieve significant positions in this ever-expanding market.

The ubiquitous Teletype terminals, available on a purchase-only basis from the manufacturer, can now be leased from a number of independent suppliers. The Teletype Model 33 teletypewriter and tape cassette unit shown here are supplied by Western Union Data Services, which also provides installation and maintenance service.

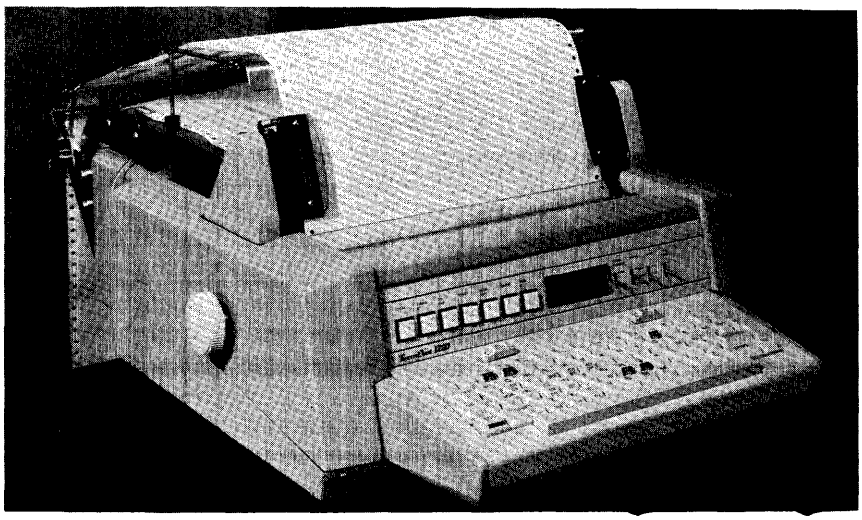
What is the nature of this market? What choices are available today? Which terminals are best liked by their users? Which of the many available models of typewriter terminals represents the best overall choice for you? This report attempts to answer these questions by clearly and comprehensively describing the characteristics of today's typewriter terminals and their role in the data communications field. The current offerings of 34 suppliers are summarized in the accompanying comparison charts, and users' experience with more than 6000 terminals is reported in detail.

The scope of this report includes only those data communications terminals that are generally classified as typewriter terminals. Datapro defines a typewriter terminal as any device that combines a keyboard, printer, and data communications interface. Some suppliers offer receive-only (RO) terminals composed of a printer (without keyboard) and communications interface. Datapro has included these terminals within the generic classification of typewriter terminals, and they are therefore covered in this report. However, serial printers marketed without data communications interfaces cannot be classed as typewriter terminals (even though they may be available with minicomputer interfaces), and are therefore not included in this report.

THE TERMINAL MARKET

The computer industry, having witnessed the inception of data communications in the early 1960's, is now spurring a dramatic growth in the overall data communications market. Authoritative industry sources estimate that more than 700,000 communications terminals are now installed, and annual revenues for the terminal market are valued at over $1 billion. Projections for 1980 forecast some 4 million terminals in use, with annual revenues valued at $5.6 billion. Interactive terminals (those equipped with operator keyboards) are currently believed to account for about 70 percent of the total number of installed terminals, with typewriter (or teleprinter) terminals, in turn, constituting the vast majority of installed interactive terminals.

All About Typewriter Terminals



GE's TermiNet 1200, an improved version of the highly regarded TermiNet 300, features full-character impact printing at operator-selectable speeds of 10, 30, or 120 characters per second and is available with 80 or 120 print positions. A magnetic tape cassette recorder can be added.

Typewriter terminals, and particularly the teletypewriters produced by Teletype Corporation, have been in greatest demand as low-cost terminals for general-purpose interactive applications such as those served by time-sharing services. The most widely used of these terminals is the Teletype Model 33 KSR, which Teletype offers at a purchase price below $1,000 and which leasing companies offer for as little as $37 per month. Such a price is tough to beat, and, until just recently, has kept the more sophisticated forms of interactive terminals from seriously impacting the market.

How much longer can the teletypewriter hold off the new contenders? It may not be for long; already some CRT terminal vendors are leasing their products at market-shattering prices made possible by the availability of large-scale integration (LSI) technology at ever-decreasing prices. Yet it is clear that typewriter-style terminals will continue to be delivered in large numbers for many years to come because of the requirements for hard-copy output imposed by many applications.

TELETYPE—THE INDUSTRY GIANT

Teletype Corporation is recognized as the leading manufacturer in the typewriter terminal industry. Its broad family of teleprinters dominates the terminal market and forms the primary de facto standard which most other terminal manufacturers emulate.

Teletype holds a unique position in the market that sets it apart from all the other terminal manufacturers. It is a subsidiary of AT&T and as such enjoys the advantages of a huge built-in market. Teletype equipment produced for AT&T's Bell System is available from Bell only as part of specific communications services. Teletype equipment is also available directly from Teletype Corporation, but on a purchase-only basis.

Because of its unusual market position, Teletype is forced to operate under several constraints. The two major agreements that dictate Teletype's market approach are a 1956 antitrust consent decree signed by AT&T and a 1971 agreement with Western Union upon the sale of the TWX network from AT&T to Western Union. The antitrust decree prevents AT&T from marketing anything that it does not use in its own communications network; therefore, Teletype cannot market a product until AT&T offers the product through one of its own services. The agreement with Western Union prevents AT&T from offering low-speed teleprinters under its Dataphone services until April 1976. The May 1973 introduction of the Teletype Model 40 system, an impressive medium-speed CRT display terminal, turned out to be the ace up Teletype's sleeve (see Report 70D-830-06).

LEASING COMPANIES

Typewriter terminals, particularly those produced by Teletype Corporation, are available from sources other than the manufacturers. These additional suppliers are third-party leasing companies that purchase OEM quantities of the terminals from the manufacturer and lease the terminals to users. Service and installation are usually provided by the leasing firm. Teletype Corporation provides classroom instruction on the servicing of its equipment for the benefit of leasing firms that market its terminals.

The more prominent leasing firms include RCA Service Company, a division of RCA, and Western Union Data Services, a division of Western Union. The products leased by both firms are included in the Datapro comparison charts of typewriter terminals.

Both RCA and Western Union provide nationwide service, which includes installation. Prime-shift service is included in the lease price of the terminals. Additional maintenance coverage is available at extra cost. Cancellation of the leases is generally permitted on 30 days notice.

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TYPICAL CHARACTERISTICS OF IMPACT VERSUS NON-IMPACT PRINTING TECHNIQUES

Print Characteristic	Impact Printing	Non-Impact Printing
Operation	Noisy	Silent
Speed	Slow	Potentially fast
Print quality	High to medium	Medium to low
Printed copies	Multiple	Single
Paper type	Ordinary	Typically special
Reliability	Low to medium	Potentially high
Cost	High to medium	Medium to low
Physical size	Medium to large	Small

SERIAL PRINTERS

The majority of today's typewriter terminals employ serial printers, so named because they print one character at a time. Serial printers are grouped into two broad categories: those that mechanically strike or "impact" the paper to produce a printed image, and those that produce a printed image by some other means. Based on this key distinction, printers are generally classed as either *impact* or *non-impact* printers. The salient characteristics of both printing techniques are compared in the table.

Both basic printing techniques can be further divided into two subcategories: those that produce a "full-character" (typewriter-like) image, and those that produce a character image formed by a matrix of dots. Of the two printing techniques, full-character printing is the more favorable form because of its high legibility and appealing appearance. But full-character serial printing generally does not lend itself well to printing speeds above 30 to 35 characters per second. This restriction results from the complex mechanical arrangement required to select the character, position the print mechanism, and strike the printed image.

The speed limitation on full-character impact printers served as the impetus for printer manufacturers to seek a different approach that would extend the upper limit of printing speed for serial impact printers. Their efforts led to the development of the matrix printer, a compromise (though it has been a successful one) between decreased character legibility and substantially higher print speeds that permits serial print rates well beyond 100 characters per second.

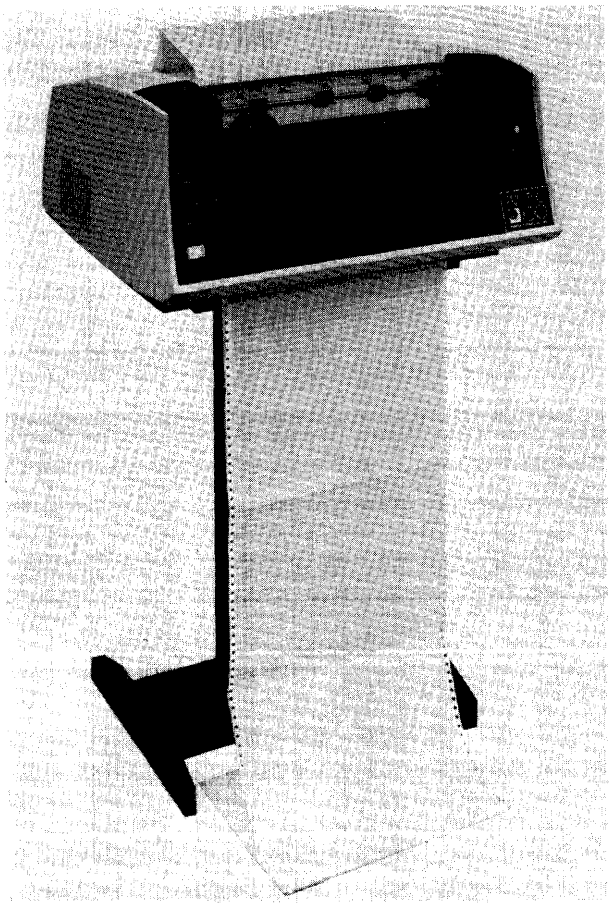
The matrix type of impact printer produces a printed image formed by a rectangular matrix of dots, typically 7 dots high by 5 dots wide. Printing is performed by moving a print head containing a column of 7 pins across the paper and selectively actuating the pins at 5 successful intervals to form each character. Centronics, a leading OEM manufacturer of serial impact printers that employ the matrix printing technique, has attained a speed of 330 characters per second with its Model 102A. The 102A uses two print heads that move bi-directionally along the same axis and in unison, so that each print head travels across just one half of the paper width. Though they contain comparatively few moving parts, matrix printers are subject to an increased amount of wear within the print head as a result of the succession of pin movements required to create each character.

The apparent speed limitation for full-character serial impact printers has been shattered by one manufacturer, Printer Technology, which produces the Printec 100, a full-character unit rated at 100 characters per second. Printer Technology approached the problem with a multiple-actuator printing technique that is really a cross between line and serial printer technology. This "print-on-the-fly" technique uses a set of six actuators, a type wheel, and a throw-away ink roller. The type wheel contains three contiguous sets of print symbols; each set is arranged in a helix (or spiral) and is serviced by two actuators so that each actuator services one half of the character set. The spinning type wheel travels on a horizontal axis across the paper in unison with the six actuators moving behind the paper.

General Electric shares the spotlight with Printer Technology as another developer of a high-speed, full-character impact printer for use in typewriter-style terminals. GE's TermiNet 1200, a high-speed version of the successful TermiNet 300 terminal, employs a line printing approach to produce printed copy at speeds up to 120 characters per second. The TermiNet's printing arrangement consists of a type belt containing two symbol sets that moves horizontally in front of a row of print actuators. This "chain printer" technique has also been adopted by Teletype Corporation, which uses the technique in its new Model 40 printer.

Numerous typewriter terminals are currently available that feature full-character impact printing and range in speeds from 10 to 30 characters per second. Among the more popular terminals in this class are the IBM 2740 and 2741, which contain a version of the ubiquitous IBM

All About Typewriter Terminals



Known as "the printer that broke 100," Printer Technology's Printec 100 is a full-character impact printer rated at 70 or 100 characters per second with 132 print positions.

Selectric typewriter, the GE TermiNet 300, the Teletype family of typewriters, and the UNIVAC DCT 500, to name a few. Each of these terminals employs a different printing technique. IBM uses a replaceable "golf ball" print element that permits the operator to change type styles rapidly by snapping out the existing element and snapping a new one into its place. General Electric employs a moving type belt and a row of actuators, one per print position. Teletype, in its Models 33 and 38, uses a rotating cylinder that contains the type face and, in principle, operates much the same as the IBM Selectric typewriter. In its Models 35 and 37, Teletype uses a type block with type pallets embedded in the block; a single actuator is used. Univac uses a helical print wheel and throw-away cartridge ink roller, a simplified version of the technique employed by Printer Technology.

The Diablo HyType printer, because of its novel approach to serial, full-character impact printing, represents a signficant contribution to the serial printer industry and a challenge to the IBM Selectric printer. With just nine moving parts, the servo-equipped HyType I printer prints at speeds up to 30 cps – twice the speed of the IBM Selectric. Printing can be performed either from left to right or from right to left, and the paper feeds up or down; character and line spacings are variable. The print element, called a Daisy, is constructed as a flat character disk with petal-like projections. Each type symbol of the 96-character set is located at the end of one petal-like projection. Thus, the HyType Daisy is quite similar to the character wheel used by the familiar Dymo labelers to emboss plastic tape.

The HyType printer offers good quality printing at a low noise level, easily changeable type fonts, and a higher speed than most other serial printers. It's a good bet that this unit will become a familiar item in the serial printer market, provided it receives proper support from its supplier.

NON-IMPACT PRINTING

Members of the other basic class of printers – the non-impact units – employ various electronic and chemical techniques to product printed images formed by solid lines or a matrix of dots. Some of the non-impact printing techniques have evolved from the development of facsimile communications; others were specifically developed for use in high-speed printing applications, where print speeds of better than 2000 lines per minute are not uncommon, or as low-cost alternatives to impact printing.

The electrothermal (or thermal) printing technique is the most commonly used of the non-impact techniques and is employed in the terminals produced by two leading manufacturers of non-impact printers, NCR and Texas Instruments.

The ink-jet technique, simultaneously developed by A. B. Dick and by Teletype Corporation for high-speed printing applications, sprays a stream of electrically charged ink droplets onto ordinary paper to produce printed characters. Character formation is performed by electrostatic deflection plates that control the direction of the charged ink droplets, in much the same manner as the electron beam movement is controlled within a cathode ray tube (CRT). The ink-jet technique is expensive (over $6,000 per unit) and has a limited market potential, as indicated by the small number of units delivered by both companies.

Another familiar non-impact printing technique is the xerographic principle used in the ubiquitous Xerox copiers. Although it is a comparatively expensive technique, xerographic printing has one major advantage over most other non-impact techniques: it uses ordinary plain paper. Recently, Xerox Corporation combined the xerographic principle with computer technology to produce a 4000-line-per-minute printer that prints on ordinary 8½ by 11 inch paper. The Xerox 1200 Computer Printing System is detailed in Report 70D-931-01.

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Reliability of most non-impact printers is comparatively high because they have few mechanical parts; 3000 hours or better between failures is not uncommon.

Silence is golden, so it has been said, and there are some quiet environments where the noise of an impact printer simply cannot be tolerated. The virtually silent non-impact printers are especially desirable in these locations.

The non-impact printers' ability to produce only one copy at a time might be a key disadvantage if you normally require several copies. But if you don't mind the additional time required to run off the needed extra copies on a nearby copying machine, the limitation of one copy may not be detrimental.

USER EXPERIENCE

To access the current level of user satisfaction with typewriter terminals, Datapro Research Corporation conducted a survey of users of this equipment in July 1973. A typewriter terminal survey form was included in the July supplement to DATAPRO 70 and mailed to all subscribers.

By the response cut-off data of September 1, usable responses had been received from 181 users with a total of 6,475 installed terminals. This represents an average of 36 terminals per user – but there was one user with 1,400 of the special-purpose IBM 1980 units and another with 775 IBM 2970-8 teller terminals. Without these two large IBM users, the average terminal usage drops to 24 per responding user.

IBM terminals were the most numerous, with 2,991 of them among 70 reporting users. This is an average of 43 terminals per user, with the average bolstered by the large-quantity users of the IBM 1980 and 2970-8 units noted above. Without these two users, the IBM responses amount to 816 terminals among 68 users, an average of 12 per user. Among the general-purpose IBM "production" terminals, the popularity leader was the 2741, with 33 reporting users, and the most numerous was the 2740, with 448 installed.

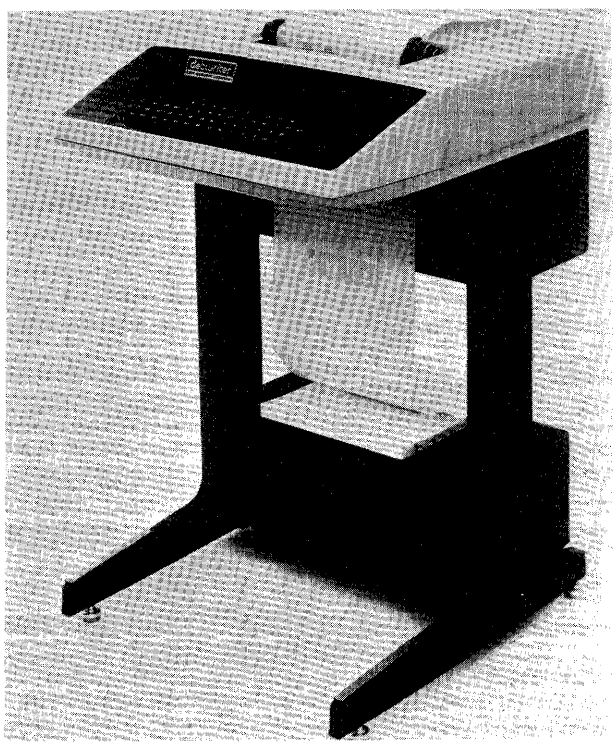
Teletype terminals were the most popular, as expected, with 115 users reporting. They were using 2,583 Teletype terminals among them, for an average of 22 terminals per user. The single most popular and also the most numerous unit was the Teletype Model 33 ASR, with 75 users reporting on their experience with 1,464 of these units, an average of 20 per user.

The survey asked the users to classify their terminals according to their characteristics, and also asked for responses – excellent, good, fair, or poor – to these six questions: How would you rate each type of terminal you're using with respect to: (1) overall performance, (2) ease of use, (3) keyboard feel and usability, (4) print quality, (5) hardware reliability, and (6) maintenance service? The detailed user responses to all these questions are presented in the "Users' Ratings" table on the next page.

To clarify the crucial factor of overall performance, a "weighted average" or "grade point average" is also reported in the table. That is, the "excellent" answers were totalled and multiplied by 4, the "good" answers totalled and multiplied by 3, and so on. These weighted averages should be considered in the light of the numbers of responses involved in each case; some of the samples are obviously too small to be regarded as conclusive.

Deserving, we think, of special mention are the five terminals that earned a weighted overall performance average of 3.5 or more from at least 5 responding users. They were: the Anderson-Jacobson 841 (3.5 with 9 respondents), the Computer Devices 1030 (3.6 with 5 respondents), the CTSI Execuport 300 (3.6 with 9 respondents), the Data Products Portacom (3.9 with 7 respondents), and the GE TermiNet 300 (3.5 with 24 respondents).

To see how the Teletype and IBM terminals compared with those of their numerous competitors, totals of the excellent, good, fair, and poor responses to all six questions were computed for the Teletype units, the IBM



The futuristic-looking DECwriter, produced by Digital Equipment Corporation, contains an impact matrix printer rated at 10, 15, or 30 characters per second. Available as a communications terminal, the DECwriter can also be connected directly to the popular DEC minicomputers.

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USERS' RATINGS OF TYPEWRITER TERMINALS

Terminal Supplier and Model*	No. of User Replies	No. of Terminals in Use	Overall Performance, Wtd. Avg.	Users' Ratings**																							
				Overall Performance				Ease of Use				Keyboard Feel and Usability				Print Quality				Hardware Reliability				Maintenance Service			
				E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P
Acrodyne Vernitron VDTG	2	5	1.5	0	0	1	1	0	1	1	0	0	0	1	1	0	0	1	1	0	0	0	2	0	0	0	2
Anderson-Jacobson 630	5	11	3.0	3	1	1	0	4	1	0	0	2	3	0	0	4	1	0	0	3	1	1	0	3	2	0	0
Anderson-Jacobson 841	9	42	3.5	4	4	0	0	4	5	0	0	5	4	0	0	5	2	0	0	2	4	2	0	3	3	1	1
Anderson-Jacobson Selectric	2	2	3.0	0	2	0	0	1	1	0	0	1	1	0	0	1	1	0	0	0	1	1	0	1	1	0	0
Carterfone (all models)	2	3	2.0	0	1	0	1	0	0	1	1	0	0	2	0	0	1	1	0	1	0	1	0	1	1	0	0
Computer Devices 1030	5	5	3.6	3	2	0	0	3	2	0	0	2	2	1	0	0	4	1	0	2	2	1	0	2	2	0	0
CTSI Execuport 300	9	67	3.6	5	4	0	0	5	2	2	0	4	2	3	0	1	4	4	0	3	4	2	0	2	3	4	0
Data Products Portacom	7	19	3.9	6	1	0	0	3	4	0	0	3	3	1	0	2	3	2	0	5	2	0	0	1	4	0	0
GE TermiNet 300	24	123	3.5	12	11	1	0	8	14	2	0	8	12	4	0	2	3	2	1	8	12	3	1	9	9	6	0
GTE IS/5541	8	41	3.1	2	4	1	0	2	4	0	0	2	4	0	0	5	2	0	0	2	2	2	0	1	3	1	1
GTE IS/5550	4	5	2.8	1	2	0	1	1	3	0	0	2	2	0	0	1	2	0	1	1	2	0	1	1	1	0	1
Harris CSI 1030	7	44	3.1	1	3	1	0	2	3	0	0	3	2	0	0	3	1	1	0	0	3	2	0	1	1	2	0
Harris CSI 1035	10	10	2.3	0	2	2	0	0	1	3	0	0	2	2	0	0	1	1	2	0	2	0	2	0	1	0	3
IBM 1050	6	27	3.2	1	5	0	0	2	1	3	0	2	3	1	0	3	3	0	0	1	3	1	1	0	6	0	0
IBM 2740	21	448	3.3	6	15	2	0	10	8	3	0	7	12	2	0	8	9	4	0	6	10	4	1	5	13	2	1
IBM 2741	33	242	3.0	9	20	3	1	11	19	3	0	15	13	3	0	15	11	3	1	10	16	3	2	8	19	4	1
IBM 3735	4	58	3.3	1	3	0	0	3	1	0	0	2	2	0	0	2	2	0	0	1	2	1	0	1	2	1	0
IBM MCST	2	2	3.5	1	1	0	0	1	1	0	0	2	0	0	0	2	0	0	0	2	0	0	0	1	0	0	0
IBM Totals	66	777	3.1	18	44	5	1	27	30	9	0	28	30	6	0	30	25	7	1	20	31	9	4	15	40	7	2
Memorex 1240	4	24	3.3	1	3	0	0	1	3	0	0	1	2	1	0	0	3	1	0	0	3	1	0	0	2	2	0
Memorex 1242	2	30	2.5	0	1	1	0	0	1	1	0	1	1	0	0	0	1	1	0	0	1	0	1	0	1	0	1
Memorex 1280	6	7	3.2	1	4	0	0	2	2	1	0	1	4	0	0	0	4	0	1	0	4	1	0	0	4	1	0
NCR 260	7	27	3.1	2	4	1	0	2	4	1	0	1	5	0	0	1	2	3	0	2	3	1	0	4	2	1	0
Olivetti TE 318	2	121	3.0	0	2	0	0	0	2	0	0	0	1	1	0	0	1	1	0	0	2	0	0	1	1	0	0
Teletype:																											
Model 28 ASR/KSR	3	18	3.0	0	3	0	0	0	1	0	2	0	1	0	2	0	2	1	0	2	1	0	0	0	3	0	0
Model 33 ASR	75	1464	3.1	20	43	12	0	21	38	14	2	10	25	27	6	11	31	25	2	25	30	19	4	19	31	19	2
Model 33 KSR	10	56	3.4	4	5	0	0	2	6	1	0	1	4	3	0	2	3	3	1	3	6	0	0	3	3	2	0
Model 35 ASR	13	352	3.2	3	9	1	0	2	10	1	0	1	8	3	0	2	8	2	0	4	7	2	0	2	7	4	0
Model 35 KSR	3	10	2.7	0	2	0	0	0	2	1	0	0	2	0	0	0	2	0	0	1	1	0	1	1	0	2	0
Model 37 ASR	2	4	3.0	0	2	0	0	1	1	0	0	1	1	0	0	1	1	0	0	0	1	1	0	0	1	1	0
Model 38 ASR	3	6	3.3	1	2	0	0	1	2	0	0	2	1	0	0	1	2	0	0	0	2	1	0	1	0	0	1
Teletype Totals	109	1910	3.1	28	66	13	0	27	60	17	4	15	42	33	8	17	49	31	3	35	48	23	5	26	45	28	3
Texas Instruments 700 Series	30	92	3.4	19	8	0	3	17	12	0	0	11	16	0	0	5	12	11	0	16	8	2	3	11	8	9	1
UNIVAC DCT 500	17	39	2.8	3	9	4	0	2	11	3	0	3	9	1	1	6	7	4	0	2	9	5	1	2	10	3	1
Western Union EDT 33	4	5	2.8	0	3	1	0	0	2	2	0	0	1	2	0	0	2	2	0	1	2	1	0	0	4	0	0
Western Union EDT 300	4	8	3.0	1	2	1	0	1	3	0	0	1	3	0	0	3	0	1	0	2	1	1	0	2	0	2	0

*Only those terminals rated by at least two users are listed here; 28 other terminals were rated by only one user each.

**Ratings are expressed in terms of number of user responses. The legend is E for Excellent, G for Good, F for Fair, and P for Poor.

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units, and all other makes. The results are tabulated below; they show little difference among the overall user ratings of the Teletype, IBM, and competitive terminals.

Totalled Responses for Teletype Terminals

Rating	No. of Responses	% of Total
Excellent	151	23
Good	326	50
Fair	150	23
Poor	23	4
Weighted Average	2.9	

Totalled Responses for IBM Terminals

Rating	No. of Responses	% of Total
Excellent	145	33
Good	218	50
Fair	57	13
Poor	19	4
Weighted Average	3.1	

Totalled Responses for All Other Terminals

Rating	No. of Responses	% of Total
Excellent	342	33
Good	482	47
Fair	167	16
Poor	41	4
Weighted Average	3.1	

TYPEWRITER TERMINAL CHARACTERISTICS

The accompanying comparison charts summarize the characteristics of 77 commercially available typewriter terminals from 34 suppliers. Nearly all of the information was received from the suppliers during the months of August and September 1973. Their cooperation is acknowledged and greatly appreciated.

Datapro sent repeated requests for information to more than 50 companies known or believed to be in the typewriter terminal business. The 34 usable responses summarized in our charts provide a comprehensive picture of the commercial terminals that are currently available in the United States and Canada. *The absence of any specific company from our charts means that the company either failed to respond to our repeated information requests or was unknown to us.*

The Trendata Model 1500, an IBM Selectric-based terminal that features an added tape cassette unit and acoustic telephone coupler, is a replacement for IBM's own 2740-1 Communications Terminal.

The chart entries and their significance are explained in the following paragraphs.

COMPATIBILITY

Most of the communications terminals currently on the market are designed as direct replacements for other popular terminals. In the typewriter terminal market, replacement terminals generally fall into three categories: those designed to replace a Teletype Model 33 or 35 teletypewriter, those designed to replace an IBM 2740 Model 1 or Model 2 Communications Terminal, and those designed to replace an IBM 2741 Communications Terminal. Datapro included these three entries to define the category of *compatibility.*

MODEL CONFIGURATIONS

Typewriter terminals are available in any of three basic *model configurations:* Receive-Only (RO), which includes a *printer only*; Keyboard Send-Receive (KSR), which includes a *keyboard and printer*; and Automatic Send-Receive (ASR), which includes a *keyboard, printer, and punched tape reader and punch.*

There are three commonly used punched tape widths and four standard code levels. The tape widths are 11/16-inch, 7/8-inch, and 1-inch; the code levels are 5, 6, 7, and 8. Five-level code is associated with the narrowest of the three tape widths and is used with terminals that employ the Baudot code, such as earlier Teletype units including the Model 28. Six and seven-level codes are associated with the 7/8-inch tape width. The most common punched tape format for computer usage, however, is the eight-level code associated with one-inch tape.

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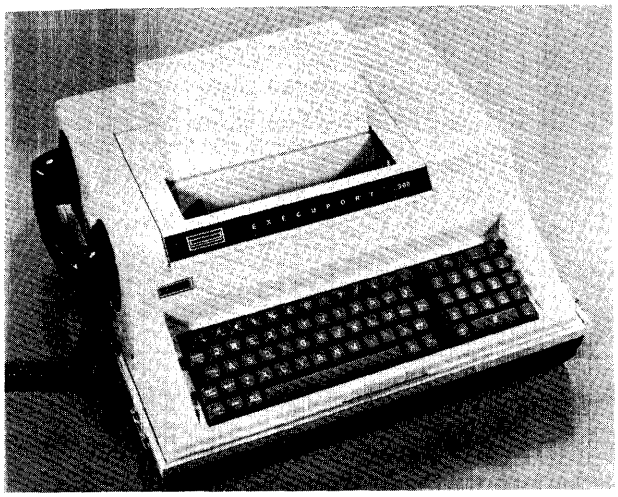

The Execuport 300, produced by Computer Transceiver Systems, Inc., is a portable typewriter terminal that weighs 29 pounds, contains an acoustic coupler, and features a non-impact matrix printer rated at 10, 15, or 30 characters per second. CTSI boasts that over 3000 of these units have been delivered. Respondents to Datapro's user survey were well pleased with the Execuport 300's performance.

In recent years, magnetic tape cassette and cartridge recorders have been replacing punched tape equipment on computer terminals as a result of increasing availability of quality components, decreasing prices, and rising popular demand for the magnetic tape cassette or cartridge recorders based on their ease of usage and operating flexibility. Hence, the entry: *Keyboard, printer, and magnetic tape recorder.*

To enhance the operating flexibility of these basic terminal configurations, some manufacturers have added *other devices* such as punched card readers, auxiliary printers, and computer-compatible magnetic tape drives. These devices may be offered as either standard or optional components of the terminals.

FEATURES

Typewriter terminals are available with a variety of potentially useful features and capabilities. No one terminal has them all, however, and some stripped-down economy models offer very few of them.

Many of these equipment features are essentially self-explanatory, and the unique features of specific terminals are thoroughly explained and evaluated in the individual DATAPRO 70 Peripheral Reports on those terminals. For these reasons, only the typewriter terminal features which are of general interest and which do not readily explain themselves are described in the paragraphs that follow.

The term *programmable* can be defined in several different ways. Datapro defines the term as operating under the direction of a program stored within the terminal, such as a user's application program or an emulation program that simulates the operation of a different terminal (usually one produced by another manufacturer). Most terminals included in the current generation of typewriter terminals have not reached this level of sophistication, primarily because of the often-prohibitive cost which accompanies such a degree of sophistication.

The use of a *buffer* between the terminal and communications facility promotes communications economy through increased transmission speeds and enhances terminal flexibility through additional capabilities such as message editing prior to transmission. Buffering can be performed by input/output media such as punched or magnetic tape and often is (e.g., in the Teletype ASR terminals). However, some manufacturers provide an *internal buffer* (usually composed of a semiconductor shift register), which is used to gather keyed or received data prior to transmitting or printing, respectively. The *internal buffer capacity* in characters is presented where applicable.

Editing, by line and/or character, featured only on terminals that provide some form of buffering, allows the operator to correct data that has been erroneously keyed prior to transmission. Some terminals, such as those that include a punched tape capability, provide editing by character only. Those that contain an internal buffer, however, usually permit the entire buffer to be erased so that a line containing an error at the beginning can be quickly retyped instead of having to backspace character-by-character to reach the erroneous entry. On some of the more flexible terminals, such as those that contain dual cassette recorders, the editing facilities include the ability to update an existing tape. Keyed data can be merged with data read from the existing tape to produce a new, updated tape.

Parity checking and/or generation are important terminal features that safeguard the integrity of transmitted data. Some terminals only perform parity checking on received data, while others only generate character parity for each transmitted character. Still others provide both checking and generation. Many terminals allow the operator to select odd or even parity or to inhibit the parity functions.

Terminals that are designed to operate in a multistation environment (i.e., multidropped from a leased line) must include a *polling and addressing capability* so that computer messages can be directed to a specific terminal and terminal messages can be selectively transmitted to the computer; otherwise, the multidropped terminals would be required to contend with one another for the computer by "bidding" for use of the line.

The *automatic answer* feature permits the terminal to respond automatically to a call via the dial network from

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the remote computer. The terminal responds by readying itself to receive and print the incoming message.

PRINTER CHARACTERISTICS

Printer *type* and printing *technique* for serial printers are detailed in the preceding section titled Serial Printers. *Type* categorizes the printer as an impact or non-impact printer; *technique* specifies the printed character image as full character or dot matrix and describes the printing technique in a concise, simplified manner.

The total number of print positions that the printer can print per line is specified by the entry, *character positions per line.*

Print rate specifies the maximum rated printing speed of the printer in characters per second. Some terminals offer more than one rated printing speed to facilitate matching the communications characteristics of the remote device. In most cases, manual selection is provided to switch among the available speeds.

Character set specifies the total number of print symbols provided by the printer. Typically, the character set is composed of upper case alphabetics, numerics, and special symbols including punctuation. *Lower case alphabetics* are usually available as an option, if at all, since they are not required in many cases and tend to reduce printing speed. Where more than one character set is available, the entries distinguish between standard and optional sets.

Horizontal pitch defines the spacing between the centers of successive characters printed in the same line, and is presented in characters per inch. *Vertical spacing* defines the spacing between print lines, and is presented in lines per inch.

Forms feed specifies the type of paper-feed mechanism employed by the printer, usually as friction feed or pin feed. Some terminals are available with either type, but typically offer pin feed as an option. Some non-impact printers feed paper without the need for conventional friction or pin feed mechanisms.

Horizontal tabulation and *vertical formatting* facilitate control of the format of the printed output. In most cases, this level of sophistication is not required to handle received messages, which is the prime function of a typewriter terminal. However, some manufacturers provide the capabilities as an option.

Features other than those listed in the standard comparison chart entries, such as tractor feed or split platen, are presented as *other features.*

KEYBOARD CHARACTERISTICS

The style of *keyboard arrangement* defines the key/symbol relationships. There are two basic keyboard arrangements, typewriter and keypunch style. Teletypewriter keyboards, such as those provided with the Teletype terminals, can generally be categorized as typewriter arrangements. The keypunch arrangement is often referred to as a data entry keyboard. Some terminals are available with more than one keyboard style to permit the user to satisfy his particular need.

Character set refers to the total number of character codes and the code set that the keyboard is designed to generate. Each keytop symbol, represented by a corresponding bit pattern, is independent of its corresponding character code and can be interchanged with other symbols without affecting keyboard operation.

Keyboard *features* include such entries as numeric pad or character repeat. Some terminals offer these features as standard capabilities; others make them available as options only.

TRANSMISSION

Each typewriter terminal contains a communications interface that enables communications between the terminal and the central computer site. *Mode* and *technique* define the operating mode and the method in which data is transmitted. There are three operating modes: simplex (transmission in one direction only), half

The IS/5741 is a recent addition to the GTE (formerly Novar) family of typewriter terminals. This model includes the Diablo HyType printer mechanism, which features full-character impact printing in both upper and lower case at 30 characters per second. An integral acoustic coupler or wired modem can be added.

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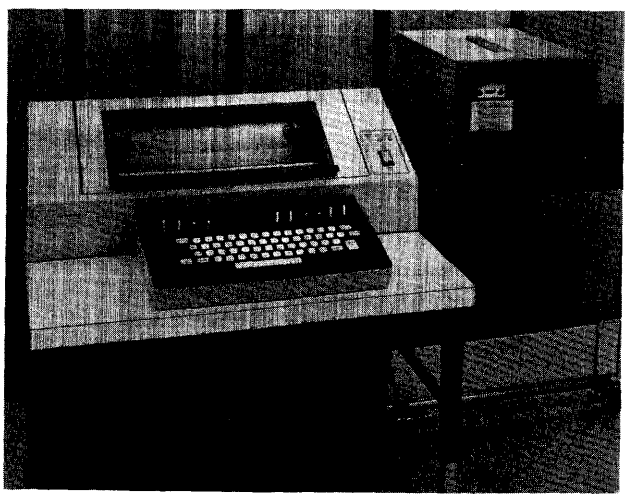
duplex (transmission in both directions, but not simultaneously), and full duplex (simultaneous transmission in both directions).

Data is transmitted synchronously or asynchronously. Asynchronous transmission is characterized by the transmission of data in irregular spurts, where the duration of time can vary between successive transmitted characters; the transmission from an unbuffered teletypewriter is a good example. Synchronous transmission implies the transmission of data in a steady stream. Each transmitted character is clocked and, the time interval between successive characters is always precisely the same. The communications interface either provides clocking or accepts external clocking signals from the data set.

The transmission *speed* of the terminal is specified in bits per second and is usually limited by the speed of the printer or other I/O device unless the terminal contains an internal buffer. Buffered operation permits printing to be performed at the rated speed of the printer, although the transmission speed may be much greater. Most typewriter terminals are unbuffered due to cost considerations and therefore operate at low transmission speeds.

The transmission *code* refers to the bit pattern of the transmitted characters. The ASCII code is prominent and has been accepted as an industry and government standard; it is now by far the most commonly used code. Other transmission codes popularly employed by typewriter terminals include Correspondence (a Selectric terminal code introduced by IBM) and two paper tape transmission codes, PTTC/BCD and PTTC/EBCD. Correspondence, PTTC/BCD, and PTTC/EBCD are all 7-level codes (including character parity); ASCII is an 8-level code, which also includes character parity.



The System 4150 from Data Access Systems is a UNIVAC DCT 500 equipped with a Techtran 4100 tape cassette unit. The Teletype-compatible DCT 500 employs a full-character impact printer with 132 print positions and operator-selectable speeds of 10, 15, or 30 characters per second.

The *unit code structure* specifies the total number of bits transmitted for each character. Asynchronous operating conventions require a single start bit and one or two stop bits to be combined with the character code for each transmitted character; therefore, an 8-level code such as ASCII is transmitted as a 10- or 11-unit code. Following Teletype's lead, the 11-unit code structure has been generally adopted for transmission at 10 characters per second; 10-unit codes are typically used at higher operating speeds.

Terminals that are capable of operating at more than one transmission speed typically feature *operator selectable speeds* via switch selection.

Block size refers to the length in characters of a transmitted message. Unbuffered typewriter terminals transmit each character as it is keyed; therefore, the entry reads "character-by-character." Buffered terminals transmit data in multi-character blocks whose length is usually limited by the buffer capacity.

The terminal's interface generally meets the standard *EIA RS-232B/C* specification and connects to a modem or acoustic telephone coupler. Teletype terminals and their independent replacements are also available with a dc current-loop interface designed for use on telegraph-grade or private-wire facilities.

Some terminals contain an *integral modem* that can be connected directly to a communications line via a Bell System Data Access Arrangement. In some cases the manufacturer also provides an acoustic and/or inductive *telephone coupler* so that the terminal can be connected to a conventional telephone handset.

PRICING AND AVAILABILITY

The comparison charts show the per-terminal *one-year lease, two-year lease*, and *purchase prices* where applicable. Single entries generally indicate the price of the basic unit without options; price ranges show the price of the basic unit and the price of an expanded unit with all options. In some cases, the terminal supplier offers a lease term other than those shown, such as 30- or 60-day lease. In such cases the lease prices and terms appear under the Comments entry at the bottom of the charts.

Date of first production delivery indicates when the first production model of each typewriter terminal was delivered (or is scheduled to be delivered) to a customer.

Terminals installed to date shows how many typewriter terminals of each type had been delivered to customers as of September 1, 1973. All figures were supplied by the manufacturers themselves, and a number of companies chose not to release this information.

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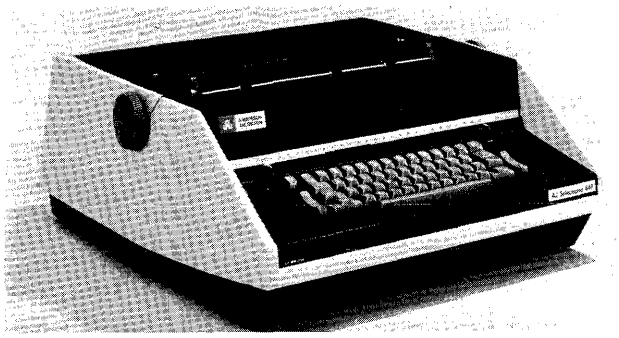
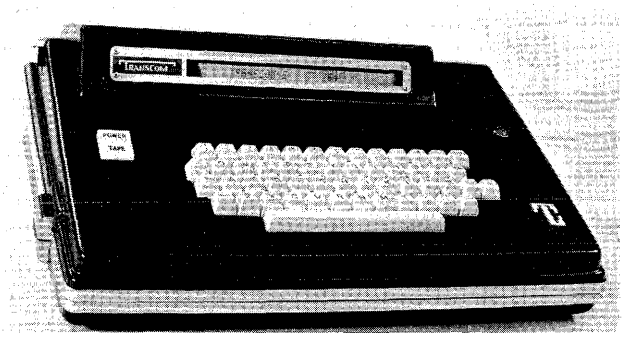


One of the terminals that received top user ratings in Datapro's survey is the AJ Selectronic 841. Produced by Anderson Jacobson the unit uses an IBM Selectric printing mechanism and can serve as a replacement for the IBM 2741 Communications Terminal.



Transcom's portable CT 264 terminal features a non-impact strip printer that provides a low-cost visual record of the keyed data.

> *Serviced by* specifies the party responsible for maintaining the terminal. In some cases the manufacturer provides total service; in others, a national service organization is responsible. Service is sometimes rendered under the combined efforts of both the supplier and an independent service organization.

Comments at the bottom of the charts describe significant or unusual features, capabilities, or applications which are not reflected in the standard entries.

TYPEWRITER TERMINAL SUPPLIERS

Listed below, for your convenience in obtaining additional information, are the full names and addresses of the suppliers whose products are summarized in the comparison charts.

Anderson Jacobson, Inc., 1065 Morse Avenue, Sunnyvale, California 94086. Telephone (408) 734-4030.

Carterfone Communications Corporation, 2639 Walnut Hill Lane, Suite 223, Dallas, Texas 75229. Telephone (214) 350-7011.

ComData, 7544 W. Oakan Street, Niles, Illinois 60648. Telephone (312) 692-6107.

Compro Corporation, Building 6-103, 3001 Red Hill Avenue, Costa Mesa, California 92626. Telephone (714) 540-7153.

Computer Devices, Inc., 9 Ray Avenue, Burlington, Massachusetts 01803. Telephone (617) 273-1550.

Computer Transceiver Systems, Inc., 317 Route 17, Paramus, New Jersey 07652. Telephone (201) 261-6800.

Data Access Systems, Inc., 100 Route 46, Mountain Lake, New Jersey 07046. Telephone (201) 335-3322.

Data Interface Associates, 4 W. Kenosia Street, Brookfield Center, Connecticut 06805. Telephone (203) 792-0290.

Data Products Co., Telecommunications Division, 17 Amelia Place, Stamford, Connecticut 06902. Telephone (203) 325-4161.

Di/An Controls, Inc., 944 Dorchester Avenue, Dorchester, Massachusetts 02125. Telephone (617) 288-7700.

Digital Equipment Corporation, 146 Main Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.

Extel Corporation, 310 Anthony Trail, Northbrook, Illinois 60062. Telephone (312) 272-8650.

General Electric Company, Data Communications Division, Waynesboro, Virginia 22980. Telephone (703) 942-8161.

GTE Information Systems, Inc., 1 Stamford Forum, Stamford, Connecticut 06904. Telephone (203) 357-2000.

Harris Communications Systems, Inc., 11262 Indian Trail, Dallas, Texas 75234. Telephone (214) 241-0551.

International Business Machines Corporation (IBM), Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

International Business Machines Corporation (IBM), Office Products Division, Franklin Lakes, New Jersey 07417. Telephone (201) 848-1900.

I/O Devices, Inc., 100 Route 46, Mountain Lake, New Jersey 07046. Telephone (201) 335-2935.

Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-3412. >

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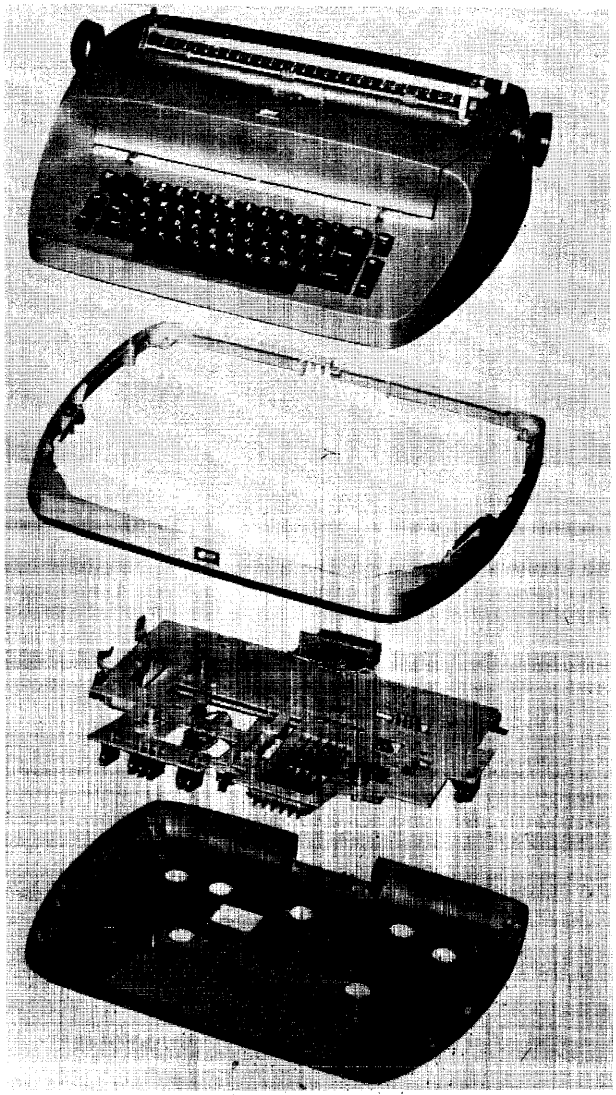

The Holmes Tycom Baseplate converts an ordinary IBM Selectric typewriter into an input/output printer. Tycom offers several Baseplate models with different interface specifications. This exploded view shows the Baseplate beneath the Selectric typewriter.

The National Cash Register Company, Data Entry Products and Systems, Main & K Streets, Dayton, Ohio 45409. Telephone (513) 449-2000.

Printer Technology Inc., Sixth Road, Woburn Industrial Park, Woburn, Massachusetts 01801. Telephone (617) 935-4246.

RCA Service Company, A Division of RCA Corporation, Camden, New Jersey 08101. Telephone (609) 779-4129.

Redactron Corporation, 100 Parkway Drive South, Hauppage, New York 11787. Telephone (516) 543-8700.

SCM/Kleinschmidt, Division of SCM Corporation, Lake Cook Road, Deerfield, Illinois 60015. Telephone (312) 945-1000.

Scope Data Inc., 5870 S. Tampa Avenue, Orlando, Florida 32809. Telephone (305) 859-1410.

The Singer Company, International Teleprinter Division, 493 Washington Avenue, Carlstadt, New Jersey 07072. Telephone (201) 438-1770.

Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2500.

Texas Instruments, 12203 Southwest Freeway, Stafford, Texas 77477. Telephone (713) 494-5115.

Transcom Incorporated, 580 Spring Street, Windsor Locks, Connecticut 06096. Telephone (203) 243-1486.

Trendata Computer Systems, 610 Palomar Avenue, Sunnyvale, California 94086. Telephone (408) 732-1790.

Typagraph Corporation, 7547 Convoy Court, San Diego, California 92112. Telephone (714) 279-5690.

UNIVAC Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

Western Union Data Services Company, 16 McKee Drive, Mahwah, New Jersey 07430. Telephone (201) 529-1170.

Wiltek, Inc., Glover Avenue, Norwalk, Connecticut 06852. Telephone (203) 853-7400. □

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SUPPLIER AND MODEL	Anderson Jacobson AJ 630	Anderson Jacobson AJ 841	Carterfone 33 ASR Data Terminal	Carterfone 33 ASR/1200 Data Terminal	Carterfone 515 Selectric Data Terminal
COMPATIBILITY					
Teletype 33/35	Yes	No	Yes	Yes	No
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	Yes	No	No	Yes
MODEL CONFIGURATIONS					
Printer only (RO)	Yes	No	No	No	No
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	Yes; 8-level	Yes; 8-level	No
Keyboard, printer, and magnetic tape recorder (ASR)	Yes	Yes	No	No	No
Other devices	None	None	None	None	None
Portable	Yes; 37 lbs.	Yes; 65 lbs.	Opt.; 56 lbs.	Opt.; 70 lbs.	Opt.; 54 lbs.
TERMINAL FEATURES					
Programmable	No	No	No	Yes	No
Internal buffer	No	No	No	Yes	No
Internal buffer capacity, chars.	—	—	—	8K or 16K bytes	—
Editing, line and/or character	No	No	No	Line and char.	No
Parity checking/generation	Both	Both	Generation opt.	Both opt.	Generation only
Polling/Addressing capability	No	No	Opt.	Std.	No
Automatic answer	No	No	Opt.	Std.	No
PRINTER CHARACTERISTICS					
Type	Non-impact	Impact	Impact	Impact	Impact
Technique	5 x 8 dot matrix	Full char. printing via IBM Selectric mechanism	Full char. printing via type cylinder	Full char. printing via type cylinder	Full char. printing via IBM Selectric mechanism
Character positions per line	140	130/156	72	72	130 std.; 156 opt.
Print rate, char/second	10, 15, or 30	15	10	10	15
Character set	95 ASCII	96 EBCD/Corr.	64 ASCII	64 ASCII	96 EBCDIC
Lower case alphabetic	Std.	Std.	No	No	Std.
Horizontal pitch, char/inch	10	10/12	10 std.; 12 opt.	10 std.; 12 opt.	10 std.; 12 opt.
Vertical spacing, lines/inch	6	6	3 or 6	3 or 6	6
Forms feed	Friction	Friction	Pin feed	Pin feed	Frict. std.; pin opt.
Horizontal tabulation	Std.	Std.	Opt.	Opt.	Std.
Vertical formatting	No	No	Opt.	Opt.	No
Other features	None	Tractor feed and print suppress	None	None	None
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	68-key typewriter	53-key typewriter	53-key teleprinter	53-key teleprinter	58-key typewriter
Character set	128 ASCII	96 EBCD/Corr.	64 ASCII	64 ASCII	64 BCD/Corr.
Features	Character repeat and manual CR/LF	Typamatic and reverse break both standard	Character repeat std.; numeric pad opt.	Character repeat std.; numeric pad opt.	APL character set opt.
TRANSMISSION					
Mode	Half/full duplex	Half duplex	Half/full duplex	Half duplex	Half duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110, 150, or 300	135	110	110 to 1200	150
Code	8-level ASCII	6-level EBCD/Corr.	8-level ASCII	8-level ASCII	BCD/Corr.
Unit code structure	10/11 bits/char.	9 bits/char.	11 bits/char.	11 bits/char.	7 bits/char.
Operator selectable speeds	Std.	No	No	No	No
Block size	Char. by char.	Char. by char.	Char. by char.	Char.; block opt.	Char. by char.
Communications interface	RS-232C, acoustic, or DAA	RS-232C, acoustic, or DAA	20 or 60 ma dc current std.; RS-232C opt.	20 ma dc current or RS-232C	RS-232C
Integral modem	Opt.	Opt.	Opt.	No	No
Telephone coupler	Opt.	Opt.	Opt.	No	Opt.
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	141-161	102-128	See Comments	See Comments	See Comments
Two year lease, $	128-147	102-128	See Comments	See Comments	See Comments
Purchase price, $	2,700-4,395	4,230-4,725	NA	1,885-2,485	1,750-2,000
Date of first production delivery	November 1971	August 1970	—	June 1973	June 1971
Terminals installed to date	1,100	2,000	6,000	100	1,000
Serviced by	Anderson Jacobson	Anderson Jacobson	Carterfone	Carterfone	Carterfone
COMMENTS	Answer-back option available	Special keytops available, such as APL and CALL/360	Made by Teletype as Model 33 ASR; month-to-month rental ranges from $42 to $82 per month	Teletype 33 ASR with Fairchild core buffer; month-to-month rental ranges from $105 to $192 per month	Month-to-month rental ranges from $95 to $102 per month

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SUPPLIER AND MODEL	Carterfone 300 Data Terminal	ComData Model 33 Series	Compro Corp. Model 6000	Compro Corp. Model 1030	Compro Corp. Model 3500
COMPATIBILITY					
Teletype 33/35	Yes	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	Yes	Yes	No
IBM 2741	No	No	Yes	Yes	No
MODEL CONFIGURATIONS					
Printer only (RO)	No	No	Yes	Yes	No
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	Yes; 8-level	Opt.	Opt.	No
Keyboard, printer, and magnetic tape recorder (ASR)	No	No	Yes; cassette	Yes; cassette	Yes; cassette
Other devices	None	None	None	None	None
Portable	No	Opt.	No	Yes; 25 lbs.	Yes; 12 lbs.
TERMINAL FEATURES					
Programmable	No	No	Yes	Yes	No
Internal buffer	No	No	Opt.	Opt.	No
Internal buffer capacity, chars.	—	—	—	—	—
Editing, line and/or character	No	No	Opt.	Opt.	No
Parity checking/generation	Gen. std.; chk. opt.	Gen. std.	Yes	Yes	Yes
Polling/Addressing capability	Opt.	No	Opt.	Opt.	Opt.
Automatic answer	Opt.	Opt.	Opt.	Opt.	Opt.
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Impact
Technique	Full char. printing via type belt and hammers	Full char. printing via type cylinder	Full char. printing via type belt	Full char. printing via type belt	Full char. printing via helical type wheel
Character positions per line	118	74	132	80	See Comments
Print rate, char/second	10, 15, or 30	10	30	30	30
Character set	94 ASCII	64 ASCII	96 ASCII	64 ASCII	64 ASCII
Lower case alphabetic	Std.	No	Yes	Opt.	No
Horizontal pitch, char/inch	10	10	10/12	10/12	10
Vertical spacing, lines/inch	6	6	6	6	—
Forms feed	Friction; pin opt.	Pin	Friction	Friction	—
Horizontal tabulation	Opt.	No	Opt.	Opt.	—
Vertical formatting	Vertical tab	No	Opt.	Opt.	—
Other features	None	None	Proportional spacing optional	None	None
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	Typewriter	53-key teleprinter	61-key typewriter	53-key typewriter	53-key typewriter
Character set	128 ASCII	128 ASCII	128 ASCII	128 ASCII	64 ASCII
Features	Character repeat; numeric pad opt.	Character repeat; numeric pad opt.	Character repeat	Character repeat	Character repeat
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300	110	110/150/300	110/150/300	110/150/300
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	11 bits/char.	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.
Operator selectable speeds	Std.	No	Yes	Yes	Yes
Block size	Char. by char.	Char. by char.	Char.; block opt.	Char.; block opt.	Char. by char.
Communications interface	RS-232C	20/60 ma. dc current; RS-232C opt.	RS-232C	RS-232C; 60 ma dc opt.	RS-232C; 60 ma dc opt.
Integral modem	No	Opt. some models	Opt.	Opt.	Opt.
Telephone coupler	No	Opt. some models	Std.	Std.	Std.
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	See Comments	73-137	300-375	240	150
Two year lease, $	See Comments	40-74	200-250	180	70
Purchase price, $	1,675	817-1,535	4,000-6,000	2,950-3,600	1,100
Date of first production delivery	1970	—	September 1973	September 1973	August 1973
Terminals installed to date	About 200	—	—	—	—
Serviced by	Carterfone	Not specified	Compro	Compro	Compro
COMMENTS	Made by GE as TermiNet 300; 30-day rental only, at approx. $150 per month	Teletype 33 KSR or ASR with ComData acoustic coupler or modem			Prints on paper tape strip; battery powered

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SUPPLIER AND MODEL	Computer 4Devices CDI 830	Computer Devices CDI 930	Computer Devices CDI 1030 Series	CTSI Execuport 300	CTSI Execuport 1200
COMPATIBILITY					
Teletype 33/35	Yes	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No	Opt.
IBM 2741	No	No	Yes	No	Opt.
MODEL CONFIGURATIONS					
Printer only (RO)	No	No	No	No	Yes
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	8-level opt.	8-level opt.	5- to 8-level opt.	5- to 8-level opt.
Keyboard, printer, and magnetic tape recorder (ASR)	No	RS-232 interface for cassette unit	RS-232 interface for cassette unit	Optional cassette unit	Optional cassette unit
Other devices	None	None	None	None	None
Portable	No	No	Yes; 22 lbs.	Yes; 29 lbs.	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	Opt.	No	No	No	Opt.
Internal buffer capacity, chars.	240	–	–	–	132
Editing, line and/or character	No	No	No	No	No
Parity checking/generation	No	Selectable check.	Selectable check.	Generation only	Generation only
Polling/Addressing capability	No	No	No	No	No
Automatic answer	No	No	No	Opt.	Opt.
PRINTER CHARACTERISTICS					
Type	Non-impact	Non-impact	Non-impact	Non-impact	Impact
Technique	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix	5 x 7 dot matrix
Character positions per line	80	80	80	80	132
Print rate, char/second	10/15/30	10/15/30	10/15/30	10/15/30	10/15/30/60/120
Character set	96	96	94/96/188/192	96 ASCII	96 ASCII
Lower case alphabetic	Opt.	Opt.	Yes	Std.	No
Horizontal pitch, char/inch	10	10	10	10	10
Vertical spacing, lines/inch	6	6	6	6	6
Forms feed	Friction	Friction	Friction	Friction	Pin
Horizontal tabulation	No	No	No	No	Opt.
Vertical formatting	No	No	No	No	Opt.
Other features	None	None	None	None	None
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	54-key typewriter	53-key typewriter	53-key typewriter	58-key typewriter	58-key typewriter
Character set	64 ASCII	96 ASCII	64/94/96/188/192	128 ASCII	128 ASCII
Features	Answerback opt.	Lower case opt.	Numeric pad opt.	Numeric pad, char. repeat std.	Numeric pad, char. repeat std.
TRANSMISSION					
Mode	Half/full duplex	Hall/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150 300	110/150/300	110/150/300	110/150/300	110/150/300
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.
Operator selectable speeds	Yes	Yes	Yes	Yes	Yes
Block size	Char; block opt.	Char. by char.	Char. by char.	Char. by char.	Char.; block opt.
Communications interface	Four wire	RS-232C or 20 ma dc current	RS-232C or CCITT	RS-232C	RS-232C
Integral modem	No	No	Std.	Std.	No.
Telephone coupler	No	No	Std.	Std.	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	125-130	125-130	135-180	135	221
Two year lease, $	112-116	112-116	120-155	125	200
Purchase price, $	2,700-4,285	2,600-2,685	3,100-4,000	3,190	5,000
Date of first production delivery	–	March 1972	March 1973	January 1968	August 1973
Terminals installed to date	1,500 (all models)	1,500 (all models)	1,500 (all models)	4,000	–
Serviced by	Honeywell	Honeywell	Honeywell	Honeywell	Honeywell
COMMENTS	For internal use only	–	Available with ASCII or APL character sets	See Report 70D-222-01 for details	See Report 70D-222-02 for details

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SUPPLIER AND MODEL	Data Access System DCT 500 & System 4150	Data Access System 725 & System 4125	Data Interface DI-240 Series	Data Products PortaCom	DI-AN Controls Model 9030
COMPATIBILITY					
Teletype 33/35	Yes	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	No	No	No	No
MODEL CONFIGURATIONS					
Printer only (RO)	Yes	Yes	Yes	No	No
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	Yes; 8-level	No	No	No	No
Keyboard, printer, and magnetic tape recorder (ASR)	Yes; cassette recorder	System 4125	No	Yes; cassette recorder	No
Other devices	None	None	None	None	None
Portable	No	Yes; 37 lbs.	Yes; 33-40 lbs.	Yes; 30 lbs.	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	No	Yes	No	No
Internal buffer capacity, chars.	—	—	120	—	—
Editing, line and/or character	4150 only	char. and line	Line	No	No
Parity checking/generation	Both	No	Checking only	Both	—
Polling/Addressing capability	Opt.	No	No	No	No
Automatic answer	Opt.	Opt.	Opt.	No	No
PRINTER CHARACTERISTICS					
Type	Impact	Non-impact	Non-impact	Impact	Impact
Technique	Full char. printing via helical typewheel	Thermal; 5 x 7 dot matrix	Magnetic; 10 x 12 dot matrix	Full char. printing	5 x 7 dot matrix
Character positions per line	132	80	72/80/132	80	132
Print rate, char/second	10/15/30	10/15/30	240	10	10/15/30
Character set	64 ASCII	64 ASCII	96 ASCII	64 ASCII	96 ASCII
Lower case alphabetic	No	Opt.	Std.	No	Yes
Horizontal pitch, char/inch	10	10	10-17	10.8	10
Vertical spacing, lines/inch	6	6	6	6	6
Forms feed	Pin	Friction	Friction/pin	Pin	Pin
Horizontal tabulation	No	No	No	No	No
Vertical formatting	No	No	Opt.	No	Opt.
Other features	Tractor feed	—	—	—	Tractor feed
KEYBOARD CHARACTERICS					
Keyboard arrangement	61-key typewriter	61-key typewriter	58-key typewriter	58-key typewriter	66-key data entry
Character set	128 ASCII	128 ASCII	128 ASCII	128 ASCII	128 ASCII
Features	Automatic carriage return	Char. repeat; numeric pad opt.	N-key rollover	Numeric pad std.	Character repeat std., numeric pad opt.
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300	110/150/300	2400	300	110/150/300
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	10/11 bits/char.	11 bits/char.	11 bits/char.	10/11 bits/char.
Operator selectable speeds	Std.	Std.	No	No	Std.
Block size	Char. by char.	100 char./block	Block	Char. by char.	Char. by char.
Communications interface	RS-232C	RS-232C	RS-232C	Acoustic	RS-232C
Integral modem	No	Std.	No	No	No
Telephone coupler	Opt.	Std.	No	Std.	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	120-215	125-225	—	—	—
Two year lease, $	110-200	120-215	—	—	—
Purchase price, $	3,705-6,000	2,780-5,600	2,300-4,700	1,695-3,145	3,330
Date of first production delivery	1965	1969	March 1973	March 1970	January 1973
Terminals installed to date	Over 150	Over 500	—	Over 2,000	150
Serviced by	DAS	DAS	Data Interface	Sorbus	Leasco
COMMENTS	UNIVAC DCT 500; System 4150 combines Techtran 4100 cassette unit			Uses Mite printer mechanism; see Report 70D-318-01 for details	

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SUPPLIER AND MODEL	Digital Equipment LA30 DECwriter	Extel AE Series	Extel AF Series	General Electric TermiNet 300	General Electric TermiNet 1200
COMPATIBILITY					
Teletype 33/35	Yes	No	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	No	No	No	No
MODEL CONFIGURATIONS					
Printer only (RO)	Yes	Yes	Yes	Yes	Yes
Keyboard and printer (KSR)	Yes	No	No	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	Yes; 5, 6, or 8-level	Yes; 8-level	yes; 8-level
Keyboard, printer, and magnetic tape recorder (ASR)	No	No	No	Yes; cassette recorder	Yes; cassette recorder
Other devices	None	None	None	None	None
Portable	No	Yes; 17-32 lbs.	Yes; 23-32 lbs.	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	No	No	No	No
Internal buffer capacity, chars.	–	–	–	–	–
Editing, line and/or character	No	No	No	No	No
Parity checking/generation	No	Generation opt.	Generation opt.	Gen. Std.; chk. opt.	Gen. std.; chk. opt.
Polling/Addressing capability	No	Opt	Opt.	Opt.	Opt.
Automatic answer	No	Opt.	Opt.	Opt.	Opt.
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Impact
Technique	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	Full character printing via type belt	Full character printing via type belt
Character positions per line	80	50	80	75 std.; 80/118 opt.	80; 120 opt.
Print rate, char/second	10/15/30	30	30	10/15/30; 20 opt.	10/30/120; 20/60 opt.
Character set	64 ASCII	64 ASCII	64 ASCII	94 ASCII	94 ASCII
Lower case alphabetic	No	Opt.	Opt.	Std.	Std.
Horizontal pitch, char/inch	10	10	10	10	10
Vertical spacing, lines/inch	6	4.5	4.5	6/3	6/3
Forms feed	Pin	Friction	Friction	Frict.; pin opt.	Pin
Horizontal tabulation	Yes	No	No	Opt.	Opt.
Vertical formatting	–	No	No	Opt.	Opt.
Other features	Tractor feed	–	–	Tractor feed	Tractor feed, copy holder opt.
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	57-key typewriter	63-key typewriter	53-key typewriter	Typewriter	Typewriter
Character set	96/128 ASCII	128 ASCII/ Baudot/TTS	128 ASCII/ Baudot/TTS	128 ASCII	128 ASCII
Features	–	N-key rollover	N-key rollover	Character repeat, numeric pad std.	Numeric pad opt.
TRANSMISSION					
Mode	Half duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300	300	300	110/150/300	110/300/1200; 200/600 opt.
Code	8-level ASCII	See Comments	See Comments	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	7.5/8.5/10/11 bits/char.	7.5/8.5/10/11 bits/char.	10/11 bits/char.	10/11 bits/char.
Operator selectable speeds	Std.	Std.	Std.	Std.	Std.
Block size	Char. by char.	Char. by char.	Char. by char.	Char. by char.	100-char. block
Communications interface	RS-232C; 20 ma dc current, or CCITT	RS-232C; 20 or 60 ma dc, or CCITT	RS-232C, 20 or 60 ma dc, or CCITT	RS-232C or 20 ma dc current	RS-232C or 20 ma dc current
Integral modem	No	Opt.	Opt.	Opt.	Opt.
Telephone coupler	No	Opt.	Opt.	Opt.	300 bps only opt.
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	–	–	–	103-322	179-397
Two year lease, $	–	–	–	–	–
Purchase price, $	3,195	1,200-1,600	1,260-2,360	2,080-6,990	4,050-8,895
Date of first production delivery	July, 1971	April 1971	May 1971	July 19691	October 1972
Terminals installed to date	Over 2,000	3,000	7,000	–	–
Serviced by	DEC	Extel	Extel	General Electric	General Electric
COMMENTS		Codes include 5-level Baudot, 6-level TTS, or 8-level ASCII; leased by RCA, Translux, and others	Codes include 5-level Baudot, 6-level TTS, or 8-level ASCII; leased by RCA, Translux, and others		

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SUPPLIER AND MODEL	GTE Information Systems IS/5560 & IS/5561	GTE Information Systems IS/5550 & IS/5551	GTE Information Systems IS/5553	GTE Information Systems IS/5543	GTE Information Systems IS/5541
COMPATIBILITY					
Teletype 33/35	Yes	No	No	No	No
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	Yes	No	No	Yes
MODEL CONFIGURATIONS					
Printer only (RO)	No	No	No	No	No
Keyboard and printer (KSR)	No	No	No	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	No	No	No
Keyboard, printer, and magnetic tape recorder (ASR)	Yes; cartridge	Yes; cartridge	Yes, cartridge	No	No
Other devices	Up to 9 cartridge recorders per IS/5561	Up to 9 cartridge recorders per IS/5551	None	None	None
Portable	No	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	Yes	Yes	Yes	Yes	Yes
Internal buffer capacity, chars.	350	350	350	160; exp. to 790	5
Editing, line and/or character	Both std.	Both std.	Both std.	Character only	No
Parity checking/generation	Generation std.	Both std.	Both std.	Both std.	Both std.
Polling/Addressing capability	No	Opt.	Opt.	Std.	No
Automatic answer	Opt.	Opt.	Opt.	Opt.	Opt.
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Impact
Technique	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism
Character positions per line	130; 156 opt.	130	104	130/156	130
Print rate, char/second	15	15	15	15	15
Character set	88 ASCII	88	88 MICR	88	88
Lower case alphabetic	Std.	Std.	Std.	Std.	Std.
Horiztonal pitch, char/inch	10;12 opt.	10	8	10/12	10
Vertical spacing, lines/inch	6	6	6	6	6
Forms feed	Friction	Friction	Friction	Friction	Friction
Horizontal tabulation	Std.	Std.	Std.	No	No
Vertical formatting	No	No	No	No	No
Other features	Copy holder std.	Copy holder std.	Copy holder std.	Copy holder and split platen std.	Copy holder std.
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	53-key typewriter	53-key typewriter	53-key typewriter	53-key typewriter	53-key typewriter
Character set	128 ASCII	64	64	64	64
Features	Character repeat std.	Character repeat std.	Character repeat std.	Character repeat std.	Character repeat std.
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	Up to 2400	134.5/300; 2400 opt.	134.5/300; 2400 opt.	75/134.5	134.5
Code	8-level ASCII		6-level Corres.	6-level Corres.	6-level Corres.
Unit code structure	10/11 bits/char.	9 bits/char.	9 bits/char.	9 bits/char.	9 bits/char.
Operator selectable speeds	Std.	Std.	Std.	Std.	No
Block size	Variable	Variable	Variable	Variable	Char. by char.
Communications interface	RS-232C, CCITT acoustic	RS-232C, CCITT acoustic	RS-232C, CCITT acoustic	RS-232C or current	RS-232C, CCITT DAA, or acoustic
Integral modem	Opt.	Opt.	Opt.	Opt.	Opt.
Telephone coupler	Opt. (to 300 bps)	Opt. (to 300 bps)	Opt. (to 300 bps)	Opt.	Opt.
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	See Comments	See Comments	See Comments	See Comments	See Comments
Two year lease, $	See Comments	See Comments	See Comments	See Comments	See Comments
Purchase price, $	6,950	6,715	7,215	4,800	2,990
Date of first production delivery	—	—	—	—	—
Terminals installed to date	—	—	—	—	—
Serviced by	GTEIS	GTEIS	GTEIS	GTEIS	GTEIS
COMMENTS	30-day rental is $199/mo. (incl. maint.)	30-day rental is $195/mo. (incl. maint.)	Prints MICR encoded chars. for financial applications; 30-day rental is $231/mo. (incl. maint.)	Designed for on-line financial transactions; 30-day rental is $120/mo. (incl. maint.)	Can use PTTC/BCD or/EBCD code as alternative; 30-day rental is $195/mo. (incl. maint.)

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SUPPLIER AND MODEL	IBM 2740 Models 1 and 2	IBM 2741	IBM MT/ST with Remote Record	IBM CMC/ST Magnetic Card Selectric Typewriter	I/O Devices Series 200
COMPATIBILITY					
Teletype 33/35	No	No	No	No	Yes
IBM 2740-1/2740-2	—	—	No	No	Opt.
IBM 2741	—	—	No	No	Opt.
MODEL CONFIGURATIONS					
Printer only (RO)	No	No	No	No	Yes
Keyboard and printer (KSR)	Yes	Yes	No	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	No	No	Yes; 8-level
Keyboard, printer, and magnetic tape recorder (ASR)	No	No	Yes; single (Mdl II) or dual (Mdl IV) recorder	No	RS-232 interface
Other devices	IBM 2760 optical Image Unit	None	No	Magnetic card recorder	No
Portable	No	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	2740-2 only	No	No	Yes	Yes
Internal buffer capacity, char.	120;248/440 opt.	—	—	8,000	30
Editing, line and/or character	Opt.	No	Both	Both	Opt.
Parity checking/generation	Both	Both	Both	Both	Generation opt.
Polling/Addressing capability	Yes	No	No	No	Opt.
Automatic answer	No	No	No	No	Opt.
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Impact
Technique	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism	Full char. printing via type cylinder
Character positions per line	130	130	130/156	130/156	132; 256 opt.
Print rate, char/second	14.8	14.8	14.8-15.5	14.8-15.5	30-50
Character set	88	88	88	88	96 ASCII
Lower case alphabetic	Std.	Std.	Std.	Std.	Std.
Horizontal pitch, char/inch	10/12	10/12	10; 12 opt.	10/12 opt.	Std.
Vertical spacing, lines/inch	6/8	6/8	6; 8 opt.	6 ; 8 opt.	6/12
Forms feed	Frict.; pin opt.	Frict.; pin opt.	Frict.; pin opt.	Frict.; pin opt.	Frict./pin
Horizontal tabulation	No	No	Std.	Std.	Opt.
Vertical formatting	No	No	Std.	Std.	Opt.
Other features	Split friction platen & ledger card handler opt.	—	—	—	—
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	55-key typewriter	55-key typewriter	44-key typewriter	44-key typewriter	63-key typewriter
Character set	88	88	88	88	96 ASCII
Features	Character repeat Std.	Character repeat Opt.	—	—	Numeric pad Opt.
TRANSMISSION					
Mode	Half duplex	Half duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	134.5; see Com.	134.5	135	135	110/150/300
Code	See Comments	See Comments	7-level MTST	Correspondence	8-level ASCII
Unit code structure	9 bits/char.	9 bits/char.	9 bits/Char.	9 bits/char.	10/11 bits/Char.
Operator selectable speeds	NO	No	No	No	Std.
Block size	1 to 440 chars.	Char. by char.	Char. by char.	char. by Char.	30 chars.
Communications interface	RS-232C	RS-232C	RS-232C	RS-232C	RS-232C
Integral modem	No	No	No	No	Opt.
Telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	95-282(30-day)	95-140 (30-day)	See Comments	See Comments	135-160
Two year lease, $	—	—	—	215	125-150
Purchase price, $	3,930-11,806	3,930-4,900	8,550(II); 10,350 (IV)	10,575	4,000-5,000
Date of first production delivery	—	—	April 1968	October 1971	November 1972
Terminals installed to date	—	—	—	—	200
Serviced by	IBM	IBM	IBM	IBM	GTEIS
COMMENTS	Model 2 can also operate at 75 or 600 bps (opt.); available with correspondence, PTTC/BCD,or PTTC/EBCD code see Report 70D-491-02 for details	Available with Correspondence, PTTC/BCD, or PTTC/EBCD code; see Report 70D-491-03 for details	For word processing use; each IBM tape cartridge stores 23,140 char. 6-mo. rental is $285/mo. (Mdl II) and $345/mo. (Mdl IV); available as returned	For word processing use; each card stores 5,000 chars.; 6-mo. rental is $245/mo.	

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SUPPLIER AND MODEL	GTE Information Systems IS/5540 I	GTE Information Systems IS/5540 II	GTE Information Systems IS/5741	Harris CSI COPE 1030 and 1035	Harris CSI COPE 1040
COMPATIBILITY					
Teletype 33/35	No	No	No	No	No
IBM 2740-1/2740-2	No	2740-2	No	No	2740-1
IBM 2741	No	No	No	Yes	Yes
MODEL CONFIGURATIONS					
Printer only	No	No	No	No	No
Keyboard and printer (KSR)	Yes	Yes	Yes	1030	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	No	No	No
Keyboard, printer, and magnetic tape recorder (ASR)	No	No	No	1035 has cartridge recorder	No
Other devices	None	None	None	None	None
Portable	No	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	Yes	Yes	No	No
Internal buffer capacity, chars.	–	160; exp. to 790	32	–	–
Editing, line and/or character	No	Character only	No	1035 only	No
Parity checking/generation	Std.	Generation std.	Both opt.	Both std.	Both std.
Polling/Addressing capability	Opt.	Std.	No	No	Opt.
Automatic answer	Opt.	No	Opt.	No	No
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Impact
Technique	Full char. printing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechansim	Full char. printing via Diablo HyType mechanism	Full char. print. ing via IBM Selectric mechanism	Full char. printing via IBM Selectric mechanism
Character positions per line	130	130; 156 opt.	132; 156 opt.	130	130
print rate, char/second	15	15	30	15	15
Character set	88	88	94 ASCII	88	88
Lower case alphabetic	No	No	Std.	Std.	Std.
Horizontal pitch, char/inch	10	10; 12 opt.	10; 12 opt.	10/12	10/12
Vertical spacing, lines/inch	6	6	6	6/8	6/8
Forms feed	Friction	Friction	Pin	Priction or pin	Friction or pin
Horizontal tabulation	No	No	Opt.	No	No
Vertical formatting	No	No	Opt.	No	No
Other features	Copy holder std.	Copy holder std.; split platen opt.	–	Forms aligner opt.	Forms aligner opt.
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	53-key typewriter	53-key typewriter	65-key typewriter	55-key typewriter	55-key typewriter
Character set	64	64	94 ASCII	88	88
Features	Character repeat std.	Character repeat std.	Numeric key pad std.	Character repeat std.	Character repeat std.
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Full duplex	Half duplex	Half duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	134.5	134.5 to 1800	300	134.5	134.5
Code	PTTC/EBCD	PTTC/EBCD	8-level ASCII	6-level corr./EBCD	6-level corr./EBCD
Unit code structure	9 bits/char.	9 bits/char.	10/11 bits/char.	9 bits/char.	9 bits/char.
Operator selectable speeds	No	Std.	No	No	No
Block size	Char. by char.	–	32 characters	Char. by char.	Char. by char.
Communications interface	RS-232C	RS-232C, DAA, or accoustic	RS-232C or DAA	RS-232C, DAA, or acoustic	RS-232C, DAA, or acoustic
Integral modem	No	Opt.	Opt.	Opt.	Opt.
Telephone coupler	Opt.	Opt.	No	Opt.	Opt.
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	See Comments	See Comments	See Comments	96-175	90
Two year lease, $	See Comments	See Comments	See Comments	90-160	88
Purchase price, $	4,400	5,500	3,995	2,580-4,945	2,580
Date of first production delivery	–	–	–	August 1969	July 1971
Terminals installed to date	–	–	–	4,000 (all models)	4,000 (all models)
Serviced by	GTEIS	GTEIS	GTEIS	Harris CSI	Harris CSI
COMMENTS	30-day rental is $125/mo. (incl. maint.)	30-day rental is $155/mo. (incl. maint.); two speeds available	30-day rental is $115/mo. (incl. maint.)	Model 1030 is available on an "as returned" basis; see Report 70D-468-02 for details	Available on an "as returned" basis; see Report 70D-468-02 for details

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SUPPLIER AND MODEL	Memorex 1240/1250	Memorex 1242/1252	Memorex 1280	NCR 260	Printer Technology Printec 100 Series
COMPATIBILITY					
Teletype 33/35	No	No	Yes	Yes	Yes
IBM 2740-1/2740-2	No	2740-2	No	No	No
IBM 2741	Yes	No	No	No	No
MODEL CONFIGURATIONS					
Printer only (RO)	Model 1250	Model 1252	No	260-1	Yes
Keyboard and printer (KSR)	Model 1240	Model 1242	No	260-2	No
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	No	No	No
Keyboard, printer, and magnetic tape recorder (ASR)	No	No	Yes; cassette recorder	260-6; 1 or 2 cassette recorders	No
Other devices	None	None	None	No	No
Portable	No	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	Yes	No	260-6 only	Opt.
Internal buffer capacity, chars.	–	256/512	–	256	266
Editing, line and/or character	No	Std.	Std.	Both in 260-6	No
Parity checking/generation	Checking opt.	Checking opt.	Checking opt.	Both	Checking opt.
Polling/Addressing capability	No	Std.	No	No	No
Automatic answer	Opt.	Model 1252	Opt.	Opt.	No
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Non-impact	Impact
Technique	Full char. printing via moving type belt	Full char. printing via moving type belt	Full char. printing via moving type belt	Thermal; 5 x 6 dot matrix	Full char. printing via split-helix type wheel
Character positions per line	120	120	120	80	132
Print rate, char/second	10/15/30/60	30/60	10/15/30	10,30, or 15 (260-6)	70/100
Character set	94 ASCII	94 ASCII	94 ASCII	94 ASCII	96/64 ASCII
Lower case alphabetic	Std.	Std.	Std.	Std.	Std. with 96 ASCII
Horizontal pitch, char/inch	10	10	10	10	10
Vertical spacing, lines/inch	6	6	6	3 to 6	6; 8 opt.
Forms feed	Friction or pin	Friction or pin	Friction or pin	Friction	Pin
Horizontal tabulation	Opt.	Opt.	Opt.	Opt. on 260-6	No
Vertical formatting	Opt.	Opt.	Opt.	Std.	2-chan.; 8-chan. opt.
Other features	–	–	–	None	Tractor feed
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	60-key typewriter	60-key typewriter	60-key typewriter	57-key typewriter	–
Character set	128 ASCII	128 ASCII	128 ASCII	128 ASCII	–
Features	Two-key rollover; numeric pad opt.	Two-key rollover; numeric pad opt.	Two-key rollover; numeric pad opt.	Numeric pad std. with 260-6	–
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300/600	1200	110/150/300/600/1200	110/150/300	110-4800
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	10 bits/char.	10/11 bits/char.	10/11 bits/char.	10 bits/char.
Operator selectable speeds	–	–	–	Std.	No
Block size	Char. by char.	256 chars.	char. by char.	80-256 on 260-6	Char. by char.
Communications interface	RS-232C	RS-232C	RS-232C	RS-232C, CCITT, or accoustic	RS-232C, TTL, or 20 ma dc current
Integral modem	Opt.	Std.	Opt.	Std. on 260-6	No
Telephone coupler	Opt.	Opt.	Opt.	Opt.	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	115(RO); 145(KSR)	170(RO); 195(KSR)	215	75-150	RPQ only
Two year lease, $	–	–	–	70-130	RPQ only
Purchase price, $	4,025(RO); 4,200(KSR)	7,650(RO); 8,775(KSR)	6,575	1,960-5,000	2,500-3,000
Date of first production delivery	2nd qtr. 1972	2nd qtr. 1972	October 1971	5/71; 9/73 (260-6)	October 1971
Terminals installed to date	–	–	–	--	1,080
Serviced by	Memorex	Memorex	Memorex	NCR	Honeywell
COMMENTS				Model 260-6 operates at any of 3 speeds; see Report 70D-656-01 for details	Printing technique developed by Printer Technology

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SUPPLIER AND MODEL	RCA Service Co. Extel Teleprinter	RCA Service Co. Teletype 33	RCA Service Co. Teletype 35	RCA Service Co. Teletype 38	Redactron Comm./ Editing Typewriter
COMPATIBILITY					
Teletype 33/35	Yes	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	No	No	No	Yes
MODEL CONFIGURATIONS					
Printer only (RO)	Yes	Yes	Yes	Yes	No
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	No
Keyboard, printer, and punched tape reader/punch (ASR)	No	Yes; 8-level	Yes; 8-level	Yes; 8-level	No
Keyboard, printer, and magnetic tape recorder (ASR)	No	No	No	No	Yes; 1 or 2 cassette recorders
Other devices	None	None	None	None	Single or dual mag. card unit
Portable	Yes, 26 lbs.	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	No	No	No	Yes
Internal buffer capacity, char.	–	–	–	–	160
Editing, line and/or character	No	Char. only	Char. only	Char. only	Full editing
Parity checking/generation	Checking opt.	Checking opt.	Checking opt.	Checking opt.	Both
Polling/Addressing capability	Opt.	Opt.	Opt.	Opt.	–
Automatic answer	Opt.	Opt.	Opt.	Opt.	Opt.
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Impact
Technique	5 x 7 dot matrix	Full char. printing via type cylinder	Full char. printing via type box	Full char. printing via type cylinder	Full char. printing IBM Selectric mechanism
Character positions per line	72	72/88	72/88	72/132	130/156
Printer rate, char/second	10/15	10	10	10	14.7
Character set	64 ASCII	64 ASCII	64 ASCII	128 ASCII	88 Corres.
Lower case alphabetic	No	No	No	Std.	Std.
Horizontal pitch, char/inch	10	10/12	8/10/12	10	10/12
Vertical spacing, lines/inch	4	4/6	4/6	4/6	6
Forms feed	Friction	Friction or pin	Friction or pin	Friction or pin	Friction and pin
Horizontal tabulation	No	No	No	No	Std.
Vertical formatting	No	No	No	No	Std.
Other features	–	–	–	–	–
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	53-key typewriter	53-key typeprinter	53-key teleprinter	53-key typeprinter	44-key typewriter
Character set	64 ASCII	64 ASCII	64 ASCII	128 ASCII	88 Corres.
Features	Char. repeat std.; numeric pad opt.	Char. repeat std.; numeric pad opt.	Char. repeat std.; numeric pad opt.	Char. repeat and numeric pad opt.	–
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150	110	110	110	110-2400
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII	See Comments
Unit code structure	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.	9/10 bits/char.
Operator selectable speeds	No	No	No	No	Opt.
Block size	Char. by char.	Char. by char.	Char. by char.	Char. by char.	Variable
Communications interface	RS-232C or 20/60 ma dc current	RS-232C, 20/60 ma dc current, or CCITT	RS-232C, 20/60 ma dc current, or CCITT	RS-232C or 20/60 ma dc current	RS-232C or 20/60 ma dc Current
Integral modem	Opt.	Opt.	Opt.	Opt.	Std.
Telephone coupler	Opt.	Opt.	Opt.	Opt.	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	See Comments	See Comments	See Comments	See Comments	225-350
Two year, lease, $	See Comments	See Comments	See Comments	See Comments	–
Purchase price, $	–	–	–	–	6,700-10,000
Date of first production delivery	–	–	–	–	First qtr. 1974
Terminals installed to date	–	–	–	–	–
Serviced by	RCA Service Co.	RCA Service Co.	RCA Service Co.	RCA Service Co.	Third party
COMMENTS	Made by Extel; available under 30-day lease for $47/mo. (printer only) or $60/mo. (KSR version)	Made by Teletype; available under 30-day lease for $37/mo. (RO), $39/mo. (KSR), or $53/mo. (ASR)	Made by Teletype; available under 30-day lease for $70/mo.(RO), $75/mo. (KSR), or $122/mo. (ASR)	Made by Teletype; available under 30-day lease for $48/mo. (RO), $59/mo. (KSR), or $70/mo. (ASR)	Designed for word processing applications; uses ASCII, EBCDIC, or Correspondence Code

SUPPLIER AND MODEL	SCM-Kleinschmidt 7300 Series Teleprinters	SCM-Kleinschmidt Datascripter	Scope Data Series 200	Singer International Teleprinter Model 30	Teletype Model 33
COMPATIBILITY					
Teletype 33/35	Yes	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	No	Yes	No	No
MODEL CONFIGURATIONS					
Printer only (RO)	Yes	Yes	Yes	Yes	Yes
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	Yes, 5-8 level	Yes, 5-8 level	No	Yes	Yes, 8-level
Keyboard, printer, and magnetic tape recorder (ASR)	Yes	Yes	No	No	Yes, cartridge
Other devices	None	None	None	None	None
Portable	No	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	No	Opt.	No	No
Internal buffer capacity, chars.	–	–	64	–	–
Editing, line and/or character	Char. only	Char. only	No	No	Char. only
Parity checking/generation	Yes	Yes	Yes	Both std.	Gen. std.; chk. opt.
Polling/Addressing capability	Yes	Yes	No	Opt.	Opt.
Automatic answer	Opt.	Opt.	No	Opt.	Std.
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Non-impact	Impact	Impact
Technique	Full char. printing via rotating type cylinder	5 x 7 dot matrix	Thermal printing via 7 x 9 dot matrix	5 x 7 dot matrix	Full char. printing via rotating type cylinder
Character positions per line	72	80	80	80/132	72
Print rate, char/second	30	30	240	10/15/30	10
Character set	64 ASCII	64 ASCII	96 ASCII	64; 128 opt.	64 ASCII
Lower case alphabetic	No	Opt.	Std.	Opt.	No
Horizontal pitch, char/inch	10	10	10	10	10
Vertical spacing, lines/inch	6	6	6	6	6/3
Forms feed	Frict.; pin opt.	Pin	Motor driven roll	Frict.; pin opt.	Friction or pin
Horizontal tabulation	Opt.	Opt.	No	Opt.	No
Vertical formatting	Opt.	Opt.	No	Opt.	No
Other features	–	–	–	–	Prints lower case alphabetics as upper case equivalents
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	53-key typewriter	53-key typewriter	53-key typewriter	Typewriter	53-key teleprinter
Character set	128 ASCII	128 ASCII	128 ASCII	128 ASCII	64 ASCII
Features	Character repeat std.	Character repeat std.	Character repeat std.	–	–
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	50 to 300	50 to 300	2400	110/150/300	110
Code	8-level ASCII	8-level ASCII	Any 5-8 level	8-level/ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.	10/11 bits/char.	11 bits/char.
Operator selectable speeds	Std.; 7 speeds	Std.; 7 speeds	No	Std.	No
Block size	Char. by char.	Char. by char.	Char. by char.	Char. by char.	Char. by char.
Communications interface	RS-232C, CCITT, 20/60 ma dc current, or TTL	RS-232C, CCITT, 20/60 ma dc current, or TTL	RS-232C, 20/60 ma dc current, or TTL	RS-232C, 20/60 ma dc current, or TTL	RS-232C or 20/60 ma dc current
Integral modem	No	No	No	No	Opt.
Telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	–	–	–	–	–
Two year lease, $	–	–	–	–	–
Purchase price, $	See Comments	Not specified	1,800-2,055	1,200-3,200	595-1,061
Date of first production delivery	–	–	September 1973	1973	1962
Terminals installed to date	–	–	–	200	–
Serviced by	SCM-Kleinschmidt	SCM-Kleinschmidt	National Service Co.	Singer ITC	Teletype
COMMENTS	Purchase prices are: RO, $1,975; KSR, $2,275; ASR, $3,950				Standard-duty unit; also available from third-party lessors; see Report 70D-830-01 for details

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SUPPLIER AND MODEL	Teletype Model 35	Teletype Model 37	Teletype Model 38	Teletype Model 40 RO	Texas Instruments Model 715
COMPATIBILITY					
Teletype 33/35	Yes	No	Yes	No	No
IBM 2740-1/2740-2	No	No	No	No	No
IBM 2741	No	No	No	No	Yes
MODEL CONFIGURATIONS					
Printer only (RO)	Yes	Yes	Yes	Yes	no
Keyboard and printer (KSR)	Yes	Yes	Yes	No	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	Yes; 8-level	Yes; 8-level	Yes; 8-level	No	No
Keyboard, printer, and magnetic tape recorder (ASR)	Yes; cartridge recorder	Yes; cartridge recorder	Yes; cartridge recorder	No	No
Other devices	None	None	None	CRT display and keyboard	None
Portable	No	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	No	No	Std.	No
Internal buffer capacity, char.	–	–	–	1000	–
Editing, line and/or character	char. only	Char. only	Char. only –	–	No
Parity checking/generation	Gen. std.; chk. opt.	Gen. std.; chk. opt.	Gen. std.; chk. opt.	Checking only	No
Polling/Addressing capability	Opt.	Opt.	Opt.	Opt.	No
Automatic answer	Std.	Std.	Std.	Std.	No
PRINTER CHARACTERISTICS					
Type	Impact	Impact	Impact	Impact	Non-impact
Technique	Full char. printing via moving type box	Full char. printing via moving type box	Full char. printing via rotating type cylinder	Full char. printing via type belt & multiple actuators	Thermal; 5 x 7 dot matrix
Character positions per line	72	72-80	132	80	80
Print rate, char/second	10	15	10	296-416	30
Character set	64 ASCII	96/128 ASCII	96 ASCII	64/96 ASCII	96 ASCII
Lower case alphabetic	No	Std.	Std.	Opt.	Opt.
Horizontal pitch, char/inch	10	10/12	10	10	10
Vertical spacing, lines/inch	6/3	6/3	6/3	6/3	6/3
Forms feed	Friction or pin	Friction or pin	Friction or pin	Friction	None or friction
Horizontal tabulation	Std.	Opt.	No	No	No
Vertical formatting	Vert. tab std.	Vert. tab opt.	No	No	No
Other features	Prints lower-case alphabetics as upper case equivalents		Two-color printing	–	–
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	50-key typeprinter	63-key teleprinter	63-key teleprinter	–	55-key typewriter
Character set	64 ASCII	128 ASCII	128 ASCII	–	72 PTTC/BCD
Features	–	Repeatable keys std.	APL set and numeric pad opt.	–	–
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half duplex	Half duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110	150	110	1200	134.5
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII	6-level PTTC/BCD
Unit code structure	11 bits/char	10 bits/char	11bits/char	10 bits/char	9 bits/char.
Operator selectable speeds	No	No	No	No	No
Block size	Char. by char.	Char. by char.	Char. by char.	Char. by char.	Char by char.
Communications interface	RS-232C or 20/60 ma dc current	RS-232B	RS-232C or 20/60 ma dc current	RS-232C	RS-232C
Integral modem	Opt.	No	Opt.	No	Opt.
Telephone coupler	No	No	No	No	No
PRICING AND AVAILABILITY					
Lease price:					
One-year lease, $	–	–	–	–	95-117
Two year lease, $	–	–	–	–	90-112
Purchase price, $	1,578-3,598	2,200-4,995	937-1,496	2,340-2,925	2,540-3,000
Date of first production delivery	1962	1966	1972	1973	1970
Terminals installed to date	–	–	–	–	–
Serviced by	Teletype	Teletype	Teletype	Teletype	TI
COMMENTS	Heavy-duty unit; also available from third-party lessors; see Report 70D-830-02 for details	Heavy-duty unit; also available from third-party lessors; see Report 70D-830-03 for details	Standard-duty unit; also available from third-party lessors; see Report 70D-830-05 for details	Hard-copy output unit for Teletype's new Model 40 display system; see Report 70D-830-06 for details	See Report 70D-840-02 for details

All About Typewriter Terminals

SUPPLIER AND MODEL	Texas Instruments Model 725	Texas Instruments Model 732	Texas Instruments Model 733	Texas Instruments Models 720/730	Texas Instruments Models 721/731
COMPATIBILITY					
Teletype 33/35	Yes	Teletype 28/32	Yes	Yes	Yes
IBM 2740-1/4720-2	No	No	No	No	No
IBM 2741	No	No	No	No	No
MODEL CONFIGURATIONS					
Printer only (RO)	No	No	Yes	No	Yes
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes	No
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	No	No	No
Keyboard, printer, and magnetic tape recorder (ASR)	No	Yes; 1 or 2 cassette recorders	Yes; 1 or 2 cassette recorders	No	No
Other devices	–	–	–	–	–
Portable	Yes; 38 lbs.	No	No	No	No
TERMINAL FEATURES					
Programmable	No	No	No	No	No
Internal buffer	No	No	No	No	No
Internal buffer capacity, char.	–	–	–	–	–
Editing, line and/or character	No	Both; ASR only	Both; ASR only	No	No
Parity checking/generation	Generation only	No	Generation only	Generation only	Generation only
Polling/Addressing capability	No	No	No	No	No
Automatic answer	No	No	Opt.	No	No
PRINTER CHARACTERISTICS					
Type	Non-impact	Non-impact	Non-impact	Non-impact	Non-impact
Technique	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix	Thermal; 5 x 7 dot matrix
Character positions per line	80	80	80	80	80
Print rate, char/second	10/15/30	13.3	30	10/15/30	10/15/30
Character set	96/128 ASCII	57 Baudot	96 ASCII	64 ASCII	64 ASCII
Lower case alphabetic	Opt.	No	Opt.	Opt.	Opt.
Horizontal pitch, char/inch	10	10	10	10	10
Vertical spacing, lines/inch	6	6/3	6/3	6	6
Forms feed	None or friction	None or friction	None or friction	Friction	Friction
Horizontal tabulation	No	No	No	No	No
Vertical formatting	No	No	No	No	No
Other features	–	–	–	–	–
KEYBOARD CHARACTERISTICS					
Keyboard arrangement	53-key typewriter	32-key typewriter	55-key typewriter	53-key typewriter	–
Character set	96/128 ASCII	Baudot	96/128 ASCII	96/128 ASCII	–
Features	Character repeat Std.	Character repeat Std.	Character repeat Std.	Character repeat Std.	–
TRANSMISSION					
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300	50/75/100	110/150/300	110/150/300	110/150/300
Code	8-level ASCII	5-level Baudot	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	7.5 bits/Char.	10/11 bits/Char.	10/11 bits/Char.	10/11 bits/char.
Operator selectable speeds	Std.	Std	Std.	Std.	Std.
Block size	Char. by char.	Char. by char.	Char. by char.	char. by char.	Char. by char.
Communications interface	Acoustic; RS-232C opt.	RS-232C; 20/60 ma dc current opt.	RS-232C; 20/60 ma dc current opt.	RS-232C (720); 20/60 ma dc current (730)	RS-232C (721); 20/60 ma dc current (731)
Integral modem	No	Opt.	Opt.	Opt.	Opt.
Telephone coupler	Std.	No	No	No	No
PRICING AND AVAILABILITY					
Lease price:					
One year lease, $	125-142	80-141	75-166	75-106	75-96
Two year lease, $	115-132	70-131	65-156	70-101	70-91
Purchase price, $	2,780-3,040	1,575-3,145	1,500-3,795	2,115-2,820	1,660-2,205
Date of first production delivery	1971	January 1973	January 1973	1970	1970
Terminals installed to date	–	–	–	–	–
Serviced by	TI	TI	TI	TI	TI
COMMENTS	See Report 70D-840-02 for details	See Report 70D-840-03 for details	See Report 70D-840-03 for details	See Report 70D-840-02 for details	See Report 70D-840-02 for details

All About Typewriter Terminals

SUPPLIER AND MODEL	Transcom CT 264	Transcom CT 364	Trendata Models 900, 1000, 1500, and 2000	Typagraph DP-30
COMPATIBILITY				
Teletype 33/35	Yes	Yes	No	Yes
IBM 2740-1/2740-2	No	No	2740-1	No
IBM 2741	No	No	Yes	No
MODEL CONFIGURATIONS				
Printer only (RO)	No	No	No	Yes
Keyboard and printer (KSR)	Yes	No	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	No	No	No	Opt.; 8-level
Keyboard, printer, and magnetic tape recorder (ASR)	No	Yes; cassette recorder	Yes; cassette recorder; Mdl 1500	Yes
Other devices	None	None	None	None
Portable	Yes; 27 lbs.	No	No	No
TERMINAL FEATURES				
Programmable	No	No	No	No
Internal buffer	No	No	No	Std.
Internal buffer capacity, chars.	–	–	–	128
Editing, line and/or character	No	No	Both; Md. 1500	No
Parity checking/generation	Generation only	Generation only	Both; all models	Generation only
Polling/Addressing capability	No	No	Mdl 2000 only	No
Automatic answer	No	Opt.	Opt.	Opt.
PRINTER CHARACTERISTICS				
Type	Non-impact	Non-impact	Impact	Impact
Technique	Electrostatic; 5 x 7 dot matrix; strip printer	Electrostatic; 5 x 7 dot matrix; strip printer	Full char. printing via IBM Selectric mechanism	Full char. printing via rotating type wheel
Character positions per line	–	–	130/156	132
Print rate, char/second	10	10	15	10/15/30
Character set	64 ASCII	64 ASCII	96 EBCOIC	94 ASCII
Lower case alphabetic	No	No	Std.	Std.
Horizontal pitch, char/inch	5	5	10/12	10
Vertical spacing, lines/inch	–	–	6	6
Forms feed	–	–	Friction/pin	Pin
Horizontal tabulation	No	No	Std.	Opt.
Vertical formatting	–	–	No	Opt.
Other features	–	–	–	Tractor feed
KEYBOARD CHARACTERISTICS				
Keyboard arrangement	53-key typewriter	53-key typewriter	Typewriter	58-key typewriter
Character set	96 ASCII	96 ASCII	Corr./BCD	128 ASCII
Features	Numeric pad or 16-key keyboard opt.	Numeric pad or 16-key keyboard opt.	Character repeat std.; numeric pad opt.	Numeric pad opt.
TRANSMISSION				
Mode	Half duplex	Half duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110	110/150/300	14.8-270	110/150/300
Code	8-level ASCII	8-level ASCII	6-level Corr./BCD	8-level ASCII
Unit code structure	11 bits/char.	10/11 bits/char.	9 bits/char.	10/11 bits/char.
Operator selectable speeds	No	Std.	Std. some mdls.	Std.
Block size	Char. by char.	Char. by char.	Char. by char.	Char. by char.
Communications interface	DDA or acoustic	DAA or acoustic	RS-232C	RS-232C or 20/60 ma dc current
Integral modem	Yes	Yes	Opt.	Opt.
Telephone coupler	Opt.	Opt.	Opt.	Opt.
PRICING AND AVAILABILITY				
Lease price:				
One year lease, $	–	–	95-252	125-160
Two year lease, $	–	–	88-237	110-140
Purchase price, $	1,300-1,430	2,120-2,395	2,990-7,350	3,500-4,500
Date of first production delivery	December 1971	February 1972	1971	March 1972
Terminals installed to date	–	–	1,260	300
Serviced by	Transcom	Transcom	Trendata/SCM	Typagraph
COMMENTS	Prints 1/4-inch high chars. on 1/2-inch paper tape strip	Prints 1/4-inch high chars. or 1/2-inch paper tape strip		

All About Typewriter Terminals

SUPPLIER AND MODEL	UNIVAC DCT 500	UNIVAC DCT 1000	Western Union Data Services EDT 33	Western Union Data Services EDT 35
COMPATIBILITY				
Teletype 33/35	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No
IBM 2741	No	No	No	No
MODEL CONFIGURATIONS				
Printer only (RO)	Yes	No	No	No
Keyboard and printer (KSR)	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	Yes; 5- to 8-level	Yes; 5 to 8-level	Yes; 8-level	Yes
Keyboard, printer and magnetic tape recorder (ASR)	No	No	Yes; cartridge recorder	Yes
Other devices	No	Card reader, key-punch.(1701/1710), and aux. printer	None	None
Portable	No	No	No	No
TERMINAL FEATURES				
Programmable	No	No	No	No
Internal buffer	No	Yes, 2	No	No
Internal buffer capacity, chars.	–	160 each	–	–
Editing, line and/or character	Char. only	Char. only	Char. only	Char. only
Parity checking/generation	Both	Both	Gen. Std.;chk. opt.	Gen. std.; chk. opt.
Polling/Addressing capability	Opt.	Yes	No	No
Automatic answer	Opt.	Yes	Opt.	Opt.
PRINTER CHARACTERISTICS				
Type	Impact	Impact	Impact	Impact
Technique	Full char. printing via rotating helical type wheel	Full char. printing via rotating helical type wheel	Full char. printing via rotating type cylinder	Full char. printing via moving type box
Character positions per line	132	132	72	72
Print rate, char/second	10/15/30	10/15/30	10	10
Character set	63 ASCII	63 ASCII	64 ASCII	64 ASCII
Lower case alphabetic	No	No	No	No
Horizontal pitch, char/inch	10	10	10	10
Vertical spacing, lines/inch	6	6	6/3	6/3
Forms feed	Pin	Pin	Friction or pin	Friction or pin
Horizontal tabulation	No	Opt.	No	Std.
Vertical formatting	No	Opt.	No	Yes
Other features	–	–	–	–
KEYBOARD CHARACTERISTICS				
Keyboard arrangement	Typewriter	Typewriter	53-key teleprinter	53-key teleprinter
Character set	128 ASCII	128 ASCII	128 ASCII	128 ASCII
Features	Three keyboards avail. for ASCII, EBCDIC, or A/H	–	Character repeat std.; numeric pad opt.	Character repeat std.; numeric pad opt.
TRANSMISSION				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300	300-4800	110	110
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	8/10 bits/char.	11 bits/char.	11 bits/char.
Operator selectable speeds	Std.	No	No	No
Block size	Char. by char.	160 chars.	Char. by char.	Char. by char.
Communications interface	RS-232C	RS-232C	RS-232C and 20 ma dc current	RS-232C or 20 ma dc current
Integral modem	Opt	No	Opt.	Opt.
Telephone coupler	No	No	Opt.	Opt.
PRICING AND AVAILABILITY				
Lease price:				
One year lease, $	101-207	176-728	37 (KSR); 50 (ASR)	70-110
Two year lease, $	–	–	–	–
Purchase price, $	3,320-6,495	8.300-27,745	–	–
Date of first production delivery	July 1970	May 1971	March 1971	March 1971
Terminals installed to date	–	–	7,188	1,407
Serviced by	UNIVAC	UNIVAC	WU Data Services	WU Data Services
COMMENTS	See Report 70D-877-02 for details	See Report 70D-877-03 for details	Teletype Model 33; available under 30-day lease for $39/mo (KSR) or $53/mo. (ASR)	Teletype Model 35; available under 30-day lease for $74/mo. (KSR) or $117/mo. (ASR)

All about typewriter Terminals

SUPPLIER AND MODEL	Western Union Data Services EDT 300	Wiltek 300	Wiltek 350	Wiltek 400
COMPATIBILITY				
Teletype 33/35	Yes	Yes	Yes	Yes
IBM 2740-1/2740-2	No	No	No	No
IBM 2741	No	No	No	No
MODEL CONFIGURATIONS				
Printer only	No	No	No	No
Keyboard and printer	Yes	Yes	Yes	Yes
Keyboard, printer, and punched tape reader/punch (ASR)	Yes	Yes; 8-level	Yes; 8-level	No
Keyboard, printer, and magnetic tape recorder (ASR)	Yes	No	No	No
Other devices	None	None	None	None
Portable	No	No	No	No
TERMINAL FEATURES				
Programmable	No	No	No	No
Internal buffer	No	Yes	Yes	Yes
Internal buffer capacity, chars.	–	50K bytes	50K bytes	50K bytes
Editing, line and/or character	Char. only	Both	Both	Both
Parity checking/generation	Gen. std.; chk. opt.	Both	Both	Both
Polling/Addressing capability	No	Std.	Std.	Std.
Automatic answer	Opt.	Std.	Std.	Std.
PRINTER CHARACTERISTICS				
Type	Impact	Impact	Impact	Impact
Technique	Full char. printing via actuator per char. position	Full char. printing via rotating type cylinder	Full char. printing via moving type box	Full char. printing
Character positions per line	75/118	72	72	75/80/118
Print rate, char/second	10/15/30	10	10	10/15/30
Character set	96 ASCII	64 ASCII	64 ASCII	94 ASCII
Lower case alphabetic	Std.	No	No	Std.
Horizontal pitch, char/inch	10	10	10	10
Vertical spacing, lines/inch	6/3	6/3	6/3	6/3
Forms feed	Friction or pin	Friction or pin	Friction or pin	Pin
Horizontal tabulation	Opt.	Opt.	Std.	Opt.
Vertical formatting	Yes	Opt.	Vert. tab std.	Vert. tab std.
Other features	–	–	–	Tractor feed
KEYBOARD CHARACTERISTICS				
Keyboard arrangement	53-key teleprinter	53-key teleprinter	50-key teleprinter	Typewriter
Character set	128 ASCII	64 ASCII	64 ASCII	128 ASCII
Features	Character repeat std.; numeric pad opt.	Character repeat std.	–	Character repeat
TRANSMISSION				
Mode	Half/full duplex	Half/full duplex	Half/full duplex	Half/full duplex
Technique	Asynchronous	Asynchronous	Asynchronous	Asynchronous
Speed, bits/second	110/150/300	1200; 2400 opt.	1200; 2400 opt.	1200; 2400 opt.
Code	8-level ASCII	8-level ASCII	8-level ASCII	8-level ASCII
Unit code structure	10/11 bits/char.	11 bits/char.	11 bits/char.	10 bits/char.
Operator selectable speeds	Std.	No	No	Std.
Block size	Char. by char.	160/360 chars.	160/360 chars.	160/360 chars.
Communications interface	RS-232C	RS-232C or CCIIT	RS-232C or CCIIT	RS-232C or CCIIT
Integral modem	Opt.	Std.	Std.	Std.
Telephone coupler	Opt.	No	No	No
PRICING AND AVAILABILITY				
Lease price:				
One year lease, $	110 (KSR); 195 (KSR)	Not specified	Not specified	Not specified
Two year lease, $	–	Not specified	Not specified	Not specified
Purchase price, $	–	Not specified	Not specified	Not specified
Date of first production delivery	March 1971	–	–	–
Terminals installed to date	1,819	–	–	–
Serviced by	WU Data Services	Not specified	Not specified	Not specified
COMMENTS	Also available under 90-day lease for $125/mo. (KSR) or $215/mo. (ASR)	Uses teletype 33 teleprinter, BSC line discipline, and endless-loop mag. tape buffer; see Report 70D-918-01 for details.	Uses Teletype 35 teleprinter, BSC line discipline, and endless-loop mag. tape buffer; see Report 70D-918-01 for details	Uses GE TermiNet 300, BSC line discipline, and endless-loop magnetic tape buffer

All about Plug-Compatible Disk Drives

Compatible replacements for IBM's 2311, 2314, and 3330 families of disk subsystems abound. They promise worthwhile savings in cost and/or improvements in performance. This report analyzes the pros and cons of acquiring disk equipment from a source other than IBM, presents the specifications of 31 subsystems from 11 vendors, and summarizes the results of an extensive user survey.

Independent peripheral manufacturers introduce disk drives compatible with IBM System/360 mainframes at lower cost and with higher performance than IBM's own. IMB introduces improved models. Independents introduce new models with similar capabilities. IBM lowers its prices through extended leasing plans. Independents cut their prices. IBM repackages its disks to give lower prices. Independents shave their prices again. IBM acts. Independents react. IBM reacts in turn. And so the story goes on and on. Pity the data processing manager who must keep up with all these events if he is to remain aware of the equipment that will most economically serve his constantly changing needs.

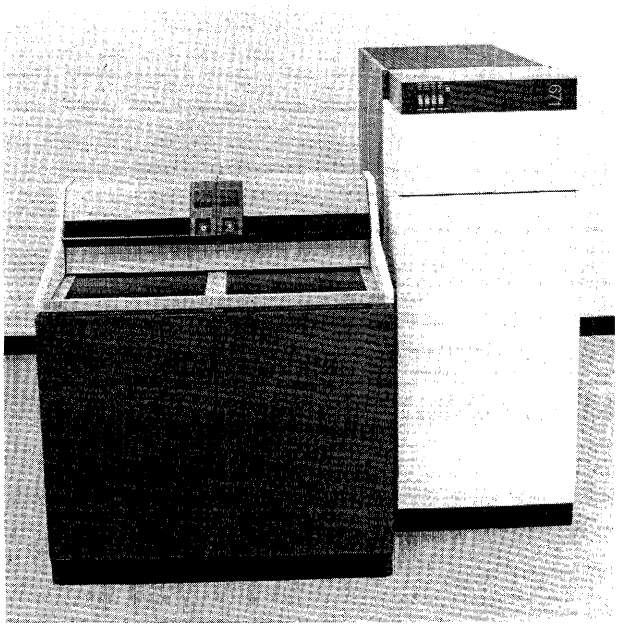
Have we overstated the situation? Consider these events that have occurred during the last few years and have significantly affected the selection of disk equipment:

- IBM 2314–disk-based processing "arrives."
- Independents provide many alternatives to the 2314.
- IBM 3330–lots more bang for the buck.
- Double density–independents offer an alternative that requires more than just price-tag comparisons.
- IBM 2319–a thinly disguised price cut for the 2314.
- Independents announce "3330" drives.
- Integrated attachments–IBM moves part of the disk controller inside the mainframe.
- Growing evidence that independents' drives work well.
- IBM adds virtual storage to the System/370–and more disk storage is called for.
- Expanded attachments–the controller portion of many IBM disk subsystem configurations is reduced in cost.
- IBM 3340–new concept in disk pack drives.
- Technological announcements by AT&T, IBM, and others hint that disks may be obsolete in 3, 5, or 10 years.

Add to these items the constant price adjustments by the independents, elimination of overtime charges and long-term leases by IBM (read *price cuts*), complex and changing configuration possibilities, etc., and you begin to draw a true picture of the position an EDP manager has been forced into.

The development and growth of the plug-compatible peripheral market has removed one of the security blankets formerly available to those responsible for selecting a company's EDP gear. To many, selection of an IBM computer is comforting because it works and because so many others have done it that it must be right. However, even with this point of view, a user today cannot ignore the presence of plug-compatible peripherals. He must again make a decision to stay with IBM or try someone else's devices. Just as there are viable alternatives to IBM computer systems, there are viable alternatives to IBM peripherals. They are widely available, their prices are generally lower – and they work.

This report sorts out the alternatives that independent manufacturers offer for IBM disk products, summarizes users' experiences with more than 1700 non-IBM drives, and provides some sound buying advice.



The Memorex 3670, a direct replacement for IBM's high-performance 3330 subsystem, has been well received by users.

All About Plug-Compatible Disk Drives

The Game Begins

The concept of independent peripherals—those units designed to replace or complement the peripheral devices offered by the mainframe manufacturers—is far from new. Companies such as Ampex, CalComp, Memorex, Potter, and Telex, to mention a few, have supplied computer peripheral equipment for years. Until 1968, however, most of their products were sold to mainframe manufacturers rather than directly to end users of computers.

Typically, only large users ever acquired peripherals other than terminals from a source other than the mainframe manufacturer—and even then, these "foreign" peripherals were generally confined to specialized systems. A few hardy individuals with specialized needs played around with special peripherals such as digital plotters, and the scientific community experimented with unusual types of input devices. But by and large, to the great majority of users, a computer system was an entity put together exclusively from the building blocks furnished by the mainframe manufacturer. Use of peripherals from sources other than the mainframe manufacturer normally involved special "black box" interfaces and costly adaptations of the standard software.

Though IBM's share of the computer market has changed little since 1960, a variety of systems, each with its own special input/output logic and structure, characterized IBM's product line prior to 1964, the year of the 360. Since then, with about three-quarters of the computer users drawing from a common pool of peripheral devices and with IBM's reliance on its own resources, at least for all conventional peripherals, the attractiveness of selling only to the mainframe manufacturers has greatly decreased for the independent peripheral makers. The OEM (original equipment manufacturer) market, though large, was only a drop in the bucket compared to the potential of serving the whole data processing community. In addition, IBM has no monopoly on technical talent. Many peripheral companies have proven that they can design and build first-rate equipment—and that they can deliver and maintain the equipment at lower prices than IBM's. There is every reason to believe that they can continue to do so in the face of stiffer competition from IBM.

The attraction to a company to produce products for a known market is strong. And this points up one edge that the peripheral companies had on IBM: they were not developing a new market. They did not have to convince anybody that magnetic tape units or disk drives are a good idea. This work had already been done for them by IBM and the other mainframe manufacturers. So with this proven market waiting, and with the example of what aggressive marketing had done for the key-to-tape and minicomputer concepts, the door was open to big money.

The subject of peripheral devices is a broad one that encompasses many concepts, the old and proven as well as the new and exciting. The independent peripheral manufacturers—those who do not also produce mainframe—have concentrated on two of the relatively old and proven devices: magnetic tape drives and disk pack drives. The reason is simple. The other two staple types of on-site peripheral devices are punched card units and line printers—and in these categories IBM's products are extremely well engineered and hard to surpass on a price/performance basis. By contrast, when the independents began their assault on magnetic tape and disk drives in System/360 computer installations, IBM was vulnerable on both a technical and a price basis. (Developments since then, however, have greatly reduced IBM's vulnerability on both these grounds.)

The decision of several peripheral manufacturers to concentrate on the IBM replacement market bore fruit in 1970, the first big year for the independents.

In late 1970, when the independents had usurped an estimated 8 to 12 percent of its tape and disk drive market, IBM began reacting. Following the announcement of new IBM peripherals that effectively beat the prices of the independent manufacturers' products, the independents quickly reacted in turn. Some lowered prices on existing units. Some announced new product lines. And some bemoaned at great length and in public the audacity of IBM to prick their great balloon. As outlined previously, this was just the beginning of many rounds of product and pricing announcements by both IBM and the independents throughout 1971 and 1972. And the game is still going on.

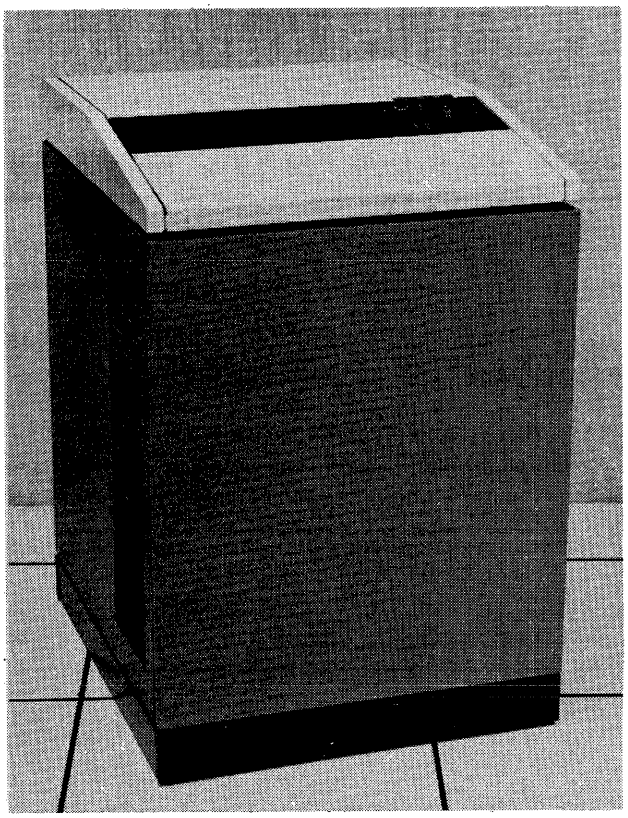
The net result for the user is more processing power per dollar. However, the fattest days of the independent peripheral market have passed, just as they did for OCR, CRT display terminals, key-to-tape data recorders, and time-sharing, to mention some of the computer product concepts that have attracted large amounts of venture capital and trade press headlines during the past few years. From now on it's going to be a tough, competitive market—and this is to the advantage of the computer user, if he stays aware of *who, what,* and *how much.*

Just Step Up and Plug It In

Plug-compatible disk drives are widely available, have been installed and put into successful operation, and are saving their users money.

A plug-compatible peripheral device is one that can replace an existing unit made by the mainframe manufacturer (or, for that matter, by another independent maker) by the simple process of unplugging the old unit, wheeling it out, wheeling in the new unit, plugging it in,

All About Plug-Compatible Disk Drives



This Memorex box represents the only attempt by the independents to come directly to grips with the IBM internal storage control features in the System/370 computer family. It can be used to connect Memorex 3330-compatible drives via the IBM Model 125 DDA, Model 135 IFA, and Model 145, 158, and 168 ISC's. Single-density and/or double-density drives can be attached, although IBM software does not support double-density drives on the Model 125.

Just Step Up and Plug It In

Plug-compatible disk drives are widely available, have been installed and put into successful operation, and are saving their users money.

A plug-compatible peripheral device is one that can replace an existing unit made by the mainframe manufacturer (or, for that matter, by another independent maker) by the simple process of unplugging the old unit, wheeling it out, wheeling in the new unit, plugging it in, testing it, and resuming operations. No change to existing software, either systems or application programs, is required. (In actual practice, some "plug-compatibles" are not this easy to install.)

Actually, there are two types of plug compatibility. One we will refer to as subsystem compatibility, and the other as component compatibility. A subsystem is compatible if it will interface directly with the computer's I/O channel and function in the same manner as the subsystem it replaces. A component is compatible if it will interface directly with the appropriate controller. Other manufacturers cannot obtain detailed IBM device-to-controller interface specifications (ethically, anyway) until three months following the first delivery. Consequently, a manufacturer cannot be absolutely sure of achieving direct component compatibility until then.

Although the interface specifications for the input/output channels of IBM's System/360 and System/370 have long been known, subsystem compatibility is not necessarily an automatic procedure. The exact command structure must be known in order for the plug-compatible devices to function within the framework of IBM-supplied software without changes.

Therefore, plug-compatible devices will normally lag behind IBM's products. Thus far, the independent disk drive makers have elected to imitate the hardware/software interfaces of IBM's products, with two noteworthy exceptions. One of these occurred between the announcement and delivery of IBM's 3330 drives (about 14 months). The independents tried to steal a march with double capacity 2314-style drives that were not directly software-compatible; this approach met with some success and a couple of notable failures. The other software incompatibility is current. Two vendors, Itel and Memorex, are marketing 3330-style drives for System/360 Model 65's. This requires provision of the equivalent of a block multiplexer channel, which IBM does not make available for the 65. Itel uses a software approach, and Memorex uses a combination of software and control unit microcode; all require some modification of the standard operating system. In a recent development, Itel announced the availability of full-speed 3330-type drives for the IBM 360/50. Previously, the company offered a reduced-speed version. Itel states that engineering changes over the life of the 360/50 increased the I/O rate capability to the point of its being able to accept the full-speed 3330 data stream. According to reports, the company is now looking at the 360/40.

At present, the independents are taking dead aim on IBM's 3330 product line. Plug-compatible 2311's and 2314's are still available, including double-density 2314's, but new production and development of these devices have essentially stopped.

There Goes the Old Ball Game

IBM revolutionized auxiliary storage concepts when it introduced the first disk pack drive, the 1311, in 1962. IBM revolutionized the disk pack drive concept when it introduced the first high-capacity subsystem, the 2314, in the mid-60's. IBM revolutionized the cost/performance characteristics of disk pack drives when it introduced the 3330 in 1970, and again in July 1973 with the announcement of the double density 3330-11. In between, IBM announced the curious 3340 system. Other computer vendors during this period generally accepted the inevitable and offered 2314 and 3330-style drives in place of or in addition to their other products.

The most outstanding feature of the IBM 3340 is the inclusion of the moving arm, the read/write heads, and at

least some of the electronics directly in the 3348 Data Module (disk pack). This feature has two notable effects. One is the increased reliability of a sealed container, which eliminates any danger of damage due to airborne particles and enhances read/write reliability because the same head always serves the same track. The second is the increased cost of the pack. An IBM 3330 pack costs $775 (100 megabyte capacity) or $1,150 (200 megabyte capacity). The 3348 Data Module costs $1,600 (35 megabyte capacity) or $2,200 (70 megabyte capacity). With the fixed-head option, the 70-megabyte module costs $4,400.

True, the drive portion of the 3340 subsystem is reduced in complexity and cost. But if your application needs require many packs (a service bureau is an extreme example), the overall costs are going to be high. As of this writing, 3M and BASF have announced compatible Data Modules for use with the 3340, and Memorex is also expected to enter this market.

If you couple IBM's 3340 announcement with the expansion of integrated attachments for the 3330, the double-density 3330-11, and IBM's statement that it has become practical to hold an installation's entire data base on-line at the same time, you come up with a curious anomaly. Is it possible that we are working ourselves full circle, back to fixed-disk units and away from the pack concept? This question is intensified by the 1974 IBM announcement of an additional storage segment on the 3348 Data Module that is served by fixed heads; i.e., no arm positioning is required to retrieve data from the 0.5-million-byte portion consisting of 5 cylinders of 12 tracks each. The only delay is rotational. This feature, although expensive, improves access to frequently referenced data such as indexes.

By removing the head mechanisms from the drive and moving the controller inside the mainframe, IBM has certainly left little for the independents to play with in terms of profitable items, except for those who also build packs. Is the improved environment of the sealed 3348 Data Module required for reliable recording at the higher density? (The 3330-11's operate at 3340 densities without sealed packs.)

The Game's Not Over Yet

How important is it to you to save money on 2314 and 3330 drives? When, if at all, do you plan to convert to 3340's, or to 370's for that matter? IBM's planned migration strategy to move its users from the System/360 to the 370 has resulted in something less than an overwhelming tide. The 3340's and the 3330's are not available for the System/360 (except for the large and rare Model 85's and 195's). And there are restrictions on the number of 3340's in System/370 models and on software support. (Details on configuration and support are contained in the Computer section; see Report 70C-491-03 for the System/360 and Report 70C-491-04 for the System/370.) Such restrictions can, of course, be modified at any time, as they were for the 2319 modules.

Is the 3340 the modern equivalent of the 2314 and a lower member than the 3330 in a hierarchical group of devices? Or is it the precursor of a new family of devices that will obsolete the 3330 and all others? Will such a family include models with access times sufficiently fast to support large-scale virtual memory processing in a really effective manner? And how does IBM's newest mass storage device, the 3850, fit in? The 3850 uses magnetic tape technology to provide low-cost bulk storage of data. It is coupled with 3330 drives to form a two-tier hierarchy of storage. Data files are called to the 3330's as needed and returned when processing is completed, when they are no longer needed, or when superseded by a higher-priority task. (You can now visualize a computer system with both virtual main memory and virtual disk memory, but visualizing a virtual magnetic tape facility takes some doing.)

One last question: are we raising more questions than we can answer? Only the answer to the last question is definite: Yes. Only time will bring full and accurate answers to the other questions raised.

For many computer users, buying from an equipment vendor other than IBM is a new experience that has some disquieting ramifications. Datapro recognizes the need for a practical guide through the conflicting claims, technical jargon, and marketing ballyhoo to the goal of best use of your data processing dollars. Accompanying this report is a comprehensive set of comparison charts listing both IBM's products and the alternatives from the independents for IBM, Honeywell, Univac, and Xerox products. The convenient side-by-side format allows quick, meaningful comparisons. Also in this report are the results of an extensive survey of our subscribers' experience; this will give you a quick insight into the luck that others have had with particular products. In addition, we will continue to publish individual reports on important devices that need closer scrutiny; at present this group consists mainly of IBM 3330 replacements. If 3340-type devices are announced by the independents, they will also get individual coverage.

The Almighty Dollar

The principal reason for considering the acquisition of peripheral devices from a source other than the manufacturer of the mainframe is cost. Secondary reasons include improved performance and shorter delivery time.

There are two ways of looking at savings: the actual number of dollars saved and the percentage of the total system price saved. Both ways are relevant. The ultimate cost figure that an installation must be concerned with is, of course, the cost per item processed. The percentage figure becomes important when evaluating several alternatives for spending a fixed number of dollars.

For the majority of computer users, disk subsystems represent an appreciable part of their total equipment costs. Any significant reduction in the cost of these subsystems is clearly a worthwhile goal.

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USERS' RATINGS OF DISK SUBSYSTEMS

Disk Subsystem	Number of User Responses	Number of Spindles Represented	Weighted Averages and Response Counts*																				Problem Counts**					
			Overall Performance					Ease of Operation					Hardware Reliability					Maintenance Service					Installation			Operation		
			WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	None	Min.	Maj.	None	Min.	Maj.
IBM 2311 Replacements (all makes)	9	33	3.8	7	2	0	0	3.9	8	1	0	0	3.7	6	3	0	0	3.3	3	6	0	0	7	2	0	3	6	0
IBM 2314	5	65	3.2	1	4	0	0	3.0	1	3	1	0	3.0	1	3	1	0	3.2	1	4	0	0	4	1	0	3	2	0
IBM 2314 Replacements:																												
Ampex 312/314	6	30	2.8	2	1	3	0	3.2	2	3	1	0	2.8	2	1	3	0	2.5	1	2	2	1	1	5	0	0	5	1
CalComp 12/14, 22/14	18	161	3.5	10	7	1	0	3.6	11	6	1	0	3.3	8	7	3	0	3.1	8	5	4	1	7	7	4	8	8	2
Control Data 23121/23141	3	18	3.7	2	1	0	0	4.0	3	0	0	0	3.0	1	1	1	0	2.7	0	2	1	0	0	1	2	0	2	1
Itel 3101	5	27	3.0	1	3	1	0	3.4	2	3	0	0	2.6	1	2	1	1	2.2	0	2	2	1	1	3	1	0	3	2
Memorex 3660	22	165	3.6	13	9	0	0	3.7	16	6	0	0	3.5	12	9	1	0	3.5	11	11	0	0	11	7	3	14	7	1
Mohawk M2700	10	63	2.5	1	5	2	2	3.4	4	6	0	0	2.4	1	4	3	2	2.5	2	3	3	2	2	7	0	1	7	2
Potter 4314	4	58	2.3	0	1	3	0	2.8	0	3	1	0	2.0	0	1	2	1	2.3	0	1	2	0	0	2	2	0	3	1
Telex 5314	14	152	3.7	9	4	0	0	3.5	7	6	0	0	3.4	9	1	2	1	2.9	3	8	0	2	9	4	1	8	5	1
Subtotals, independents	82	674	3.3	38	31	10	2	3.5	45	33	3	0	3.1	34	26	16	5	3.0	25	34	14	7	31	36	13	31	40	11
IBM 2314 Replacements (double density):																												
Ampex 322/324	4	31	3.5	3	0	1	0	3.8	3	1	0	0	3.5	3	0	1	0	3.0	1	2	1	0	1	3	0	1	3	0
CalComp 1015/215/213	11	83	3.5	6	5	0	0	3.5	7	3	1	0	3.3	6	2	3	0	3.3	5	4	2	0	3	8	0	3	5	1
Control Data 23122/23142	13	119	3.5	6	6	0	0	3.3	4	6	1	0	3.4	4	7	0	0	3.0	4	3	4	0	5	6	1	5	7	1
Mohawk M2900	7	48	2.7	2	2	2	1	3.4	3	4	0	0	2.4	2	2	0	3	2.9	3	2	2	0	1	3	2	1	3	3
Subtotals, independents	35	281	3.5	17	13	3	1	3.5	17	14	2	0	3.2	15	11	4	3	3.1	13	11	9	0	10	20	3	10	18	5
IBM 3330	8	120	3.6	5	3	0	0	3.5	5	2	1	0	3.8	6	2	0	0	3.4	4	3	1	0	4	4	0	2	4	0
IBM 3330 Replacements:																												
CalComp 230/1130	8	41	3.4	3	5	0	0	3.4	4	3	1	0	3.0	2	5	0	1	3.3	3	4	1	0	4	2	2	3	3	1
Control Data 33301	4	68	3.3	2	1	1	0	3.0	2	0	2	0	3.0	2	1	0	1	2.8	1	2	0	1	1	2	1	2	1	1
Itel 7330	16	290	3.1	4	9	3	0	3.4	7	8	1	0	2.8	2	9	5	0	3.1	4	9	3	0	2	8	6	7	6	3
Memorex 3670	20	303	3.6	13	6	1	0	3.6	13	6	1	0	3.5	10	9	1	0	3.4	9	10	0	1	5	14	1	5	14	1
STC 3335	2	88	3.5	1	1	0	0	4.0	2	0	0	0	3.0	0	2	0	0	3.5	1	1	0	0	0	3	0	0	2	0
Telex 6330	5	50	2.6	0	4	0	1	3.6	3	2	0	0	2.8	1	2	2	0	2.8	2	1	1	1	1	2	2	1	2	2
Others	2	44	1.5	0	0	1	1	3.5	1	1	0	0	1.5	0	0	1	1	1.5	0	0	1	1	0	0	2	0	1	1
Subtotals, independents	57	884	3.2	23	26	6	2	3.5	32	20	5	0	3.0	17	28	9	3	3.1	20	27	6	4	13	31	14	18	29	9
IBM 3330-11	4	34	4.0	4	0	0	0	4.0	4	0	0	0	4.0	4	0	0	0	4.0	4	0	0	0	2	2	0	1	3	0
IBM 3330-11 Replacements:																												
Memorex 3675	2	32	3.5	1	1	0	0	4.0	2	0	0	0	3.0	0	2	0	0	3.5	1	1	0	0	0	2	0	0	2	0
All Others	8	111	3.6	5	3	0	0	3.9	7	1	0	0	3.5	4	4	0	0	3.4	4	3	1	0	4	3	1	3	5	0
Totals by Vendor:																												
Ampex	10	61	3.1	5	1	4	0	3.4	5	4	1	0	3.1	5	1	4	0	2.7	2	4	3	1	2	8	0	1	8	1
CalComp	37	285	3.5	19	17	1	0	3.5	22	12	3	0	3.2	16	14	6	1	3.2	16	13	7	1	14	17	6	14	16	4
Control Data	20	205	3.5	10	8	1	0	3.3	9	6	3	0	3.2	7	9	1	1	2.9	5	7	5	1	6	9	4	7	10	3
Itel	21	317	3.0	5	12	4	0	3.4	9	11	1	0	2.8	3	11	6	1	2.9	4	11	5	1	3	11	7	7	9	5
Memorex	44	500	3.6	27	16	1	0	3.7	31	12	1	0	3.5	22	20	2	0	3.4	21	22	0	1	16	23	4	19	23	2
Mohawk	17	111	2.6	3	7	4	3	3.4	7	10	0	0	2.4	3	6	3	5	2.8	5	5	5	2	3	10	2	2	10	5
Potter	4	58	2.3	0	1	3	0	2.8	0	3	1	0	2.0	0	1	2	1	2.3	0	1	2	0	0	2	2	0	3	1
STC	2	88	3.5	1	1	0	0	4.0	2	0	0	0	3.0	0	2	0	0	3.5	1	1	0	0	0	3	0	0	2	0
Telex	19	202	3.4	9	8	0	1	3.6	10	8	0	0	3.1	10	3	4	1	2.9	5	9	1	3	10	6	3	9	7	3
Others	19	188	3.5	12	5	1	1	3.8	16	3	0	0	3.4	10	7	1	1	3.2	7	9	2	1	11	5	3	6	12	1
Subtotals, independents	193	2,015	3.3	91	76	19	5	3.5	111	69	10	0	3.1	76	74	29	11	3.1	66	82	30	11	65	94	31	65	100	25
IBM Totals	17	219	3.6	10	7	0	0	3.5	10	5	2	0	3.6	11	5	1	0	3.5	9	7	1	0	10	7	0	6	9	0
Grand Totals	210	2,234	3.3	101	83	19	5	3.5	121	74	12	0	3.2	87	79	30	11	3.1	75	89	31	11	75	101	31	71	109	25

* All Response Counts are expressed in terms of the number of user responses. The legend is E for Excellent, G for Good, F for Fair, and P for Poor. The weighted averages (WA) are derived by giving each response equal weight and assigning a numerical value of 4 (Excellent), 3 (Good), 2 (Fair), or 1 (Poor) to each rating. Cross totals may not sum to the number of responses because not all responses included a rating in every category.

**All Problem Counts are expressed in terms of the number of user responses. The legend is Min. for Minor and Maj. for Major. Cross totals may not sum to the number of responses because not all responses included a reply in every category.

User Experience

In February 1975, DATAPRO 70 included a questionnaire with the regular monthly supplement to solicit information about the experiences its subscribers have had with plug-compatible disk and tape drives and their degree of satisfaction. By April 10, usable responses had been received from 197 users of plug-compatible drives. The total number of responses on non-IBM disk drives, counting each disk product separately, was 193. In addition, a total of 17 responses were obtained with information about users' experience with IBM disk units.

The results of Datapro's survey are tabulated in the accompanying table of Users' Ratings. With the footnotes, the information in the table is largely self-explanatory.

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Users were asked to rate the equipment in four categories: Overall Performance, Ease of Operation, Hardware Reliability, and Maintenance Service. To derive the Weighted Averages, a numerical value of 4 was assigned to Excellent, 3 to Good, 2 to Fair, and 1 to Poor. Each response was given equal weight regardless of the number of spindles represented. Prospective buyers should note that the very small sample size for some of the products makes it unwise to draw firm conclusions from the indicated ratings.

Users were also asked to rate difficulties encountered in installing the disk subsystems, as well as any difficulties encountered in diagnosing problems and obtaining service, in one of three categories: None, Minor, and Major. A detailed count of the responses by product and vendor can be found in the accompanying chart. A summary of the results follows.

Difficulties encountered in installation:

Independent vendors–
- None – 65 responses, or 34%
- Minor – 94 responses, or 50%
- Major – 31 responses, or 16%

IBM–
- None – 10 responses, or 59%
- Minor – 7 responses, or 41%
- Major – 0 response, or 0%

Difficulties encountered in operation:

Independent vendors–
- None – 65 responses, or 34%
- Minor – 100 responses, or 53%
- Major – 25 responses, or 13%

IBM–
- None – 6 responses or 40%
- Minor – 9 responses or 60%
- Major – 0 responses or 0%

Other questions were included in the Reader Survey Form about method of acquisition, whether the acquisition represented an upgrade or equivalent, and what computer system the drives were used with. The users' responses are summarized below by type of disk drive.

	2314 type	2314 (dbl. dens.)	3330 type	Other types
Method of acquisition–				
Purchased	20%	9%	20%	50%
Leased from tape/disk manufacturer	70%	85%	69%	30%
Leased from 3rd party as part of system	8%	3%	3%	10%
Leased from 3rd party, drives only	2%	3%	7%	10%
Number of responses	86	34	59	20

	2314 type	2314 (dbl. dens.)	3300 type	
Upgrade or equivalent–				
Upgrade	79%	100%	29%	–
Equivalent	21%	0%	71%	–
Number of responses	19	12	17	–
Computer system–				
IBM System/360	79%	82%	23%	83%
IBM System/370	21%	18%	77%	17%
Number of responses	82	34	56	18

A further question was posed to investigate the amount of time it took to install the disk systems. Reported here are only the results for the IBM 2314, 2314 double-density, and 3330 replacement drives, which formed the bulk of the responses.

	No. of Responses	Average Hours On-Line	No. of Responses	Average Days Total
Replacements for:				
2314	49	7.8	47	3.7
2314 dbl. dens.	21	7.8	23	2.5
3330	40	7.2	44	7.1

The reported average figures for the 3330 exclude two "disaster" cases, each of which required over 1000 hours on-line to install. Of the two, one has finally smoothed out to a large degree, but the second user is still unhappy. These two cases may reflect a lack of proper training of the CE's. One user also mentioned serious OS interface problems.

Users are relatively happy with the equipment they have used, although there are some exceptions which can be seen in the accompanying table. The overall results can only serve to support the concept that plug-compatible disk drives (for IBM systems, anyway) are viable alternatives to the mainframe manufacturer's own products.

A Three-Point Replacement Plan

It's clear that the independent disk drives offer a number of significant attractions. But before rushing out to order replacements for all of your disk drives, we suggest you pause for a brief analysis of two highly significant questions: Are independent peripherals really a wise choice for your installation? If so, which of the dozens of available models represent the best overall value for you?

In considering the replacement of existing disk drives with the products of an independent peripheral manufacturer, there are three basic steps that should lead you to the best overall strategy for your own particular case.

1. *Evaluate your present system.* Although nearly everyone recognizes that equipment configurations should be evaluated periodically to determine the effects of changes in the processing workload, many installations let this function slide in favor of more immediate problems. Now, while you're considering peripheral equipment from other suppliers, is an excellent time to

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take stock and determine the number and model of peripheral devices that you really need. For example, if you are now using a disk-based sort, do you really need the complement of tape drives that you have? Do you really need a bigger data base on-line, but just haven't gotten around to determining how many more 2314's you need? Or whether a 3330 would be a better buy? This is a good time to answer these questions and get the system you need instead of just replacing existing components to get a cheaper system that is either inadequate or overpowered.

2. *Determine the conversion costs.* Installing different peripheral devices is not, unfortunately, quite as simple as just switching plugs. The devices must be tested once they are in, and this takes machine time, which interferes with your normal flow of work. Part of your staff will also be occupied with the selection procedure and installation. In discussions with potential independent suppliers, be sure to get estimates of the installation time and check what they say against the experience of previous customers.

3. *Investigate the alternatives.* First, be sure to compare the costs of acquiring and using independent peripherals, and the expected savings, with those of other alternatives for improving your system—such as a report writer to reduce the cost of all those one-shot reports you've been preparing, or a second printer that would allow you to do effective multiprogramming. If peripheral equipment still looks like a worthwhile area for achieving significant savings, consider these two ways of reducing the effective costs of your present peripheral units: using accumulated purchase credits to buy the equipment you've been renting, or negotiating a purchase/leaseback arrangement with a leasing company. Both of these alternatives require a willingness to continue using your present equipment for some time to come. And, in general, long-term leasing of IBM peripherals will be more costly than leasing independent peripherals for a similar period of time because of the higher IBM purchase prices. But you may feel more confident about making a long-term commitment to use an IBM peripheral unit than an equivalent unit from an independent supplier.

A particularly difficult problem is placing a dollar value upon the effects of future IBM announcements. There's little doubt that future IBM disk drives—as well as those from the independent suppliers—will offer higher performance at lower cost than the currently available models, as borne out by the introduction of the double-density 3330-11. But nobody can tell you the quantitative details as to how much and how soon. This is a problem you face when evaluating virtually any product, and it becomes particularly significant when you consider a long-term commitment such as outright purchase or a long-term lease.

A Checklist for Selection

When evaluating the independent disk equipment as replacements for existing peripherals, the type, model applications, and specific functions will in most cases be pretty well determined by your workload and existing software. Although some of the disk drives do offer increased performance, the principal reason for going to the independent suppliers is lower overall costs.

The following checklist will help you determine which, if any, of the available independent peripherals will be the best choice for your installation.

1. *Availability.* This includes not only the delivery time from date of order, but the geographical availability as well. The regions in which the various manufacturers' units are available depend upon servicing considerations. Few of the independents have yet established complete coverage of the nation, and it is unlikely that any of them will *ever* develop the scope of coverage that IBM has. If your order is large enough, some of the independents will furnish an on-site service representative and back-up devices. The minimum size of installation that can obtain this type of service is typically about 15 drives, but this appears to be negotiable to some extent. Most of the independents have service forces in the major metropolitan areas, so in these areas even small installations can take advantage of the potential savings. The major marketing thrust of most of the independents, however, is understandably toward the larger users.

2. *Cost.* Potential cost savings are the principal reason for considering independent peripherals. To maximize these savings, analyze the costs in these three areas: equipment cost (purchase or rental), installation cost, and maintenance cost.

   Equipment costs can be greatly affected by the manner of acquisition. The basic choices, in order of increasing annual cost, are outright purchase, long-term leasing (for more than one year), and rental under a one-year lease. The trade-off is length of commitment and, therefore, your flexibility to adjust to changing requirements and the availability of improved equipment. Third-party leasing firms often offer cancellation privileges. For example, a three-year lease might be arranged to be cancellable after two years; in this case, the penalty charges might run about 3 to 5 percent of the rental paid during the two-year period, or about one month's rental. In general, independent peripheral units are not metered, and the leasing arrangements permit unlimited usage.

   Installation cost, as discussed earlier, consists of the personnel and machine time required to select, install, and check out the new equipment.

   Many vendors include full-time (24 hours per day, 7 days per week) maintenance coverage under their

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standard leasing plans; but some charge extra for coverage beyond one shift per day. Be sure to nail down any extra charges for the period you need.

3. *Reliability.* In addition to the survey of users' experience in this report, there are three practical ways for determining the reliability of individual devices. The experience and reputation of the company building the units is one. Talking to users of the unit is another. Testing the unit yourself is the third. All three have drawbacks and are far from infallible. Any unit that is produced in quantity shows variability. Good companies have been known to produce bad products. The advantage of dealing with an established company is that, normally, design deficiencies will be corrected and bad products will be fixed or replaced. But good products are also produced by a number of small, new companies as well. Previous users can inform you of problems they have had with particular devices in installation or operation. Testing the product yourself usually means installing one or a few of the devices you are interested in and observing their performance in your environment. The three possibilities have been listed in the order of increasing assurance and difficulty. Don't confuse good maintenance service with product reliability. A unit that needs service frequently is a bad deal no matter how quickly the company fixes it each time.

Select, Then Negotiate

Once you've decided whose disk units you want, don't just sign the supplier's standard contract or order form. If you do, you're likely to end up with a lot less security and support than the user who's willing to take the time and trouble to indulge in some old-fashioned haggling. What's more, you may even be able to shave some more dollars off the price-tag.

Here are some of the points you'll want included in the written agreement you sign: a guarantee of complete functional compatibility with the equivalent unit in the mainframe manufacturer's own product line; a promise by the vendor to assume full liability for any damage to the mainframe maker's equipment; and a promise that the vendor will perform all phases of the installation process at no extra charge.

Payment for the unit should be contingent upon the satisfactory completion of a carefully defined acceptance test. It would be reasonable, for example, to require at least 95 percent availability of the unit over a 30-day period, with complete functional compatibility under all operating conditions.

Finding What's Best for You

Thus, a good overall plan for minimizing your disk drive costs can be summarized as follows:

- Re-examine your installation to see how many of which types of disk devices you really need.
- Survey the field to find the devices that are suitable for your needs and available (with full maintenance service) in your area. A request for proposals that solicits directly comparable bids from all the prospective suppliers is strongly recommended.
- Analyze all costs (equipment, installation, and maintenance) and anticipated savings.
- Investigate the alternatives–including outright purchase or purchase/leaseback of your present IBM equipment and the three ways of acquiring independent peripherals (one-year lease, long-term lease, or purchase).
- Assure yourself of the reliability of the equipment by checking the supplier's reputation, talking to other users, and/or testing the equipment in your installation.
- Choose the equipment that offers the lowest overall costs while meeting your requirements for availability, reliability, and maintenance.
- Negotiate a sound contract.

Disk Subsystem Characteristics

The accompanying comparison charts summarize the characteristics of 47 commercially available disk subsystems from 14 manufacturers that can function as replacements for the IBM 2311, 2314, 2319, 3330, and 5445 (for the System/3), and for various subsystems from Honeywell, Univac, and Xerox. The IBM disk subsystems are included in the charts for reference purposes. Also included are double-density subsystems that use the IBM 2316 Disk Pack. To the best of our knowledge, the charts are comprehensive and list all known products as of this date, except for some 2311 and 2314-type products which are no longer being manufactured but may be available on an "as returned" basis. The information in the charts was largely supplied by the vendors during March and April 1975. Their cooperation is acknowledged and greatly appreciated.

The chart entries and their significance are explained in the following paragraphs.

For your convenience, a list of the vendors, along with their addresses and telephone numbers, immediately precedes the charts.

Products are listed in the charts under the name of the firm that *markets* them.

The computer manufacturer and the disk product that is the target for replacement are clearly specified. Additional information on the disk product lines of Honeywell, Univac, and Xerox can be found in the appropriate Computer report in DATAPRO 70 Binder 1.

All About Plug-Compatible Disk Drives

For your convenience, the equivalent IBM or other mainframe maker's disk pack is listed. A summary of the various IBM packs is as follows:

Disk Pack	Used on IBM Disk Drives
1316	2311
2316	2314, 2319, 2312, 2313, 2318, 5445
3336-1	3330-1/2, 3333-1
3336-11	3330-11, 3333-11
3348	3340

The 2315 Disk Packs, used on the IBM 1131 and 2310 drives, and the 5440 Disk Packs, used on the IBM 5444 drives, are not used by any plug-compatible devices, although a number of drives are built for the minicomputer market that employ these packs.

Configuration

The physical layout and connection to the system of the disk drives are important because they govern the space required, the operating convenience, and the operational flexibility and power. They also introduce confusion in naming and identifying the components in a subsystem. For this report, we have used the generally accepted approach of calling the component that mounts a single disk pack a *spindle.* Some units, such as some models within IBM's 2314 and 3330 families, incorporate two spindles in a single cabinet. This physical layout is defined under *spindles per cabinet.*

The many attachment possibilities of the IBM 3330 subsystems have given rise to other complexities of naming. In general, a *string* of drives is a group of spindles that function together. *String switch options* identify the number of data paths between a string and multiple controllers and the string size. This option is also called dual port or dual path. A special variation called dynamic dual path provides simultaneous read/write within a string. It is also frequently used as a subsystem expansion technique to maintain logical continuity in a group of drives. *Channel switch options* refer to multiple data paths between controllers and a processor or multiple processors; the basic identifying feature is the number of data paths provided.

IBM introduced integrated control logic that precludes the need for a separate disk controller box, while continuing to market the separate controllers as an alternative. The independents can potentially attach their drives through either of these facilities or through a separate controller they provide. Each of these possibilities is treated separately.

A final identifying element is the *storage capacity.* To maintain compatibility, recording formats must be duplicated. Therefore, this entry is by way of identification rather than a selection criterion.

Performance

Because of the limitations imposed on changing storage layouts, and because the independents wanted more than just a price advantage in competing with IBM, they attacked the performance aspect. Changing the *rotational time* and *data transfer rate* introduced too many possibilities for incompatibilities between time-sensitive application and control coding; this left only the *head positioning time* and the *start-up* and *stop times* for the independents to work with to gain performance advantages. While the independents offer performance advantages for all styles of IBM drives, the advantages are most pronounced for the 2314-style drives.

The independent manufacturers' statements about improved positioning time seem reasonable and valid, but they are virtually impossible for the user to verify without elaborate test procedures (as are most other computer timings). Gross checks can be made simply by comparing run times with a file on first the 2314, for example, and then on the independent drive. But this may not tell the whole story. Overlapped operations and operating system overhead can mask much of the improvement, which leads up to IBM's rebuttal that in many cases the positioning time is not particularly important. But there's one thing you can count on: faster positioning times certainly won't reduce your processing speeds.

As a guideline, keep in mind that the more truly random your file look-up task is, the more the decreased positioning time will help, especially if your file is spread over just one disk pack. Multiple drives with simultaneous seeks tend to mask the positioning time, while small files contained in just a few cylinders don't require much positioning.

The second performance aspect, the start-up/shut-down time, is easy to measure to check the manufacturer's claim, but more complex to evaluate. The reason for large differences in shut-down time is actually very simple; it represents the difference between dynamic braking and coasting to a stop.

The IBM 2314 start-up cycle takes about 60 seconds from the time a disk pack is mounted until the drive is ready to come on-line. During this period, several things are happening. A brush is run across the disk surfaces to pick up particles too small to be thrown off by centrifugal force. (Most independents follow this practice, but some, notably Memorex, depend on additional stages of filtration.) Also during this period, the heads are extended and the disk comes up to operating speed—and here is where the fun begins. Keep in mind that the distances between the disks and the heads, which are being supported by the aerodynamic action of the air stream generated by the moving disk because of the viscosity of the air, are very small—typically about 0.000085 inches (85 microinches) for the 2314 and even less for the 3330.

IBM says that the full 60 seconds are required for thermal equilibrium to be established between the 95° interior of

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the drive and the 70° pack, and that if a shorter time is used, there is a chance that the disks might not be flat enough. If this is the case, variances, even very minute ones, in the flatness would cause variations in the head-to-disk distance. Even if these differences were not enough to cause a head crash, they could cause variations in signal strength which might result in misrecording or misreading. One independent manufacturer replied that this is not really a problem—but that if it were, IBM's 60 seconds would not be enough to accommodate normal extremes such as walking in off the street in January with a disk pack under your arm and immediately loading it onto a drive. User experience so far has not indicated that this is a significant problem. But, to paraphrase an old saying, keep your disk packs warm if you want to be sure.

But how important is start-up/shut-down time? It depends, obviously, on how many times you change packs. Because most smaller disk-oriented installations don't have extra drives on line (as is typically the case in a tape installation due to sorting requirements), every second of lost time while changing packs adds directly to total processing time. The typical start-up or shut-down time for those independent drives that have a shortened time—and not all do—is on the order of 15 to 20 seconds. To get just a 5 percent improvement in throughput during one eight-hour shift with 2314's, you would have to change disk packs about 20 times. There is no gain, in general, with 3330's.

There are other aspects to performance besides timing parameters. One is the interchangeability of disk packs among drives. The minimum normal expectation is that you can read a pack written on any one drive in a subsystem on any other drive in the same subsystem. The subsystem is not really functional if this criterion is not met. However, all devices are variable and are adjustable to some extent to take care of manufacturing variations. If you expect to use the same packs on both independent and IBM drives, you should inform your vendor and get his service people to set up the drives accordingly. If that is outside the range of adjustments, there is some possibility of getting IBM to readjust its drives toward the independents, but don't count on it. This may be raising a false alarm, because not a single user in our survey mentioned the problem; however, it is not known what percentage of the users attempted to swap packs between independent and IBM drives. All vendors at least paid lip service to guaranteeing that their drives could read IBM-recorded packs.

Pricing and Maintenance

This is the most important section of the charts and needs no technical explanation beyond the entries themselves. However, some editorial comment is called for. The prices as stated are list. There are strong indications that they have about the same permanence and firmness as list prices for automobiles. A fair statement is that they are about the highest prices (at the time of this writing) that a vendor will let you pay. Quantity discounts are common, and, in most cases, the vendors are willing to negotiate. The prices as stated are for the basic equipment. Special features may add a little to the cost. IBM's prices are firm, as you well know.

Disk Subsystem Vendors

Listed below, for your convenience in obtaining additional information, are the full names, addresses, and telephone numbers of the 14 vendors listed in the comparison charts.

Ampex Corporation, Computer Products Division, 13031 West Jefferson Boulevard, Marina del Rey, California 90291. Telephone (213) 821-8933.

Business Systems Technology, Inc. (BST), 1215 West Katella Avenue, Orange, California 92667. Telephone (714) 997-1450.

California Computer Products, Inc. (CalComp), 2411 W. La Palma Avenue, Anaheim, California 92801. Telephone (714) 812-2011.

Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-8100.

Formation Inc., One Computer Drive, Cherry Hill, New Jersey 08003. Telephone (609) 424-1713.

Itel Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 989-4220.

Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-3847.

Mohawk Data Sciences Corporation, World Headquarters, Utica, New York 13503. Telephone (315) 792-2202.

Peripherals General, Inc., 1724 Marlton Pike East, Cherry Hill, New Jersey 08003. Telephone (609) 424-2008.

Potter Instrument Company, Inc., 532 Broad Hollow Road, Melville, New York 11746. Telephone (516) 694-9000.

Randolph Computer Company, Division of Firstbank Financial Corporation, a subsidiary of The First National Bank of Boston, 537 Steamboat Road, Greenwich, Connecticut 06830. Telephone (203) 661-4200.

Storage Technology Corporation, 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

Telefile Computer Products, Inc., 1713 Daimler, Irvine, California 92705. Telephone (714) 557-6660.

Telex Computer Products, Inc., 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111. □

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MANUFACTURER AND MODEL	Ampex DS 314 Disk System	Ampex DS 324 Disk System	Ampex DS 330 Disk Subsystem	Ampex DS 331 Disk Subsystem	Business Systems Technology BST/45
REPLACEMENT FOR					
Disk vendor	IBM	IBM	IBM	IBM	IBM (System/3)
Disk product and model numbers	2314	2314	3330-1/2	3330-11	5445
Equivalent original-vendor disk pack	IBM 2316	IBM 2316	IBM 3336-1	IBM 3336-11	IBM 2316
CONFIGURATION					
Spindles per cabinet	1	1	1	1	1
Spindles per string	1 to 9	1 to 8	1 to 8	1 to 8	1 to 4
Strings per channel	1	1	2	2	1
String switch options	None	None	—	—	—
Channel switch options	2 channels	2 channels	2/4 channels	2/4 channels	—
Attachment via integrated controllers	No	No	No	No	—
Attachment via mainframe controllers	No	No	No	No	—
Attachment via independent controllers	Ampex DC 314	Ampex DC 324	Ampex DC 830	Ampex DC 831	BST/45 Controller
Storage capacity, bytes per spindle	29.2M	58.4M	100M	200M	20.48M
PERFORMANCE					
Head movement time:					
1 track, msec.	8	8	10	10	12
Average, msec.	32	32	28	28	35
All tracks, msec.	58	58	55	55	60
Rotational time, msec.	25	25	16.7	16.7	25
Average access time, msec.	44.5	44.5	36.3	36.3	47.5
Transfer rate, bytes per sec.	312,000	312,000	806,000	806,000	312,000
Start-up time, sec.	15	15	15	15	30
Stop time, sec.	15	15	15	15	15
PRICING AND MAINTENANCE					
Purchase price	Contact vendor	Contact vendor	Contact vendor	Contact vendor	$10,400 per drive; $14,350 per controller
Monthly lease charges (for a 2-year lease including maintenance)	Contact vendor	Contact vendor	Contact vendor	Contact vendor	$300 per drive; $410 per controller
Alternate leasing plans	Contact vendor	Contact vendor	Contact vendor	Contact vendor	1 and 5 years; 7% more to 6% less
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	—	—	—	—	9 hrs./day, 5 days/week
Alternate maintenance plans	—	—	—	—	24 hrs./day, 7 days/week
Leased by	Ampex	Ampex	Ampex	Ampex	BST
Maintenance performed by	Ampex	Ampex	Ampex	Ampex	Memorex
First delivery	1/71	6/71	10/73	—	10/74
Number installed	900	500	—	—	Over 500
COMMENTS			Also see Report 70D-047-07		Memorex makes the BST disk drives; also see Report 70D-115-02

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MANUFACTURER AND MODEL	CalComp CD22/14 Disk System	CalComp 1015A Disk System	CalComp 1030 Disk Facility	CalComp 1035 Disk Facility	CalComp 1160 Disk File Subsystem
REPLACEMENT FOR					
Disk vendor	IBM	IBM	IBM	IBM	UNIVAC
Disk product and model numbers	2314	2314	3330-1/2	3330-1/2/11	8460
Equivalent original-vendor disk pack	IBM 2316	IBM 2316	IBM 3336-1	IBM 3336-1/11	—
CONFIGURATION					
Spindles per cabinet	1 or 2	1 or 2	1 or 2	2	1 or 2
Spindles per string	1 to 9	1 to 9	1 to 8	2 to 16	1 to 5 or 10
Strings per channel	1 to 8	1 to 8	1 to 8	1 to 8	
String switch options	—	—	None	2 x 16	—
Channel switch options	2 channels	2 channels	2 channels	2/4 channels	—
Attachment via integrated controllers	—	—	No	No	—
Attachment via mainframe controllers	—	—	No	No	—
Attachment via independent controllers	CalComp CD14	CalComp 1015A	CalComp 1030	CalComp 1035	CalComp 1160
Storage capacity, bytes per spindle	29M	58.34M	100M	100M/200M	88M 36-bit words per 5 spindles
PERFORMANCE					
Head movement time:					
1 track, msec.	12	12	10	10	10
Average, msec.	35	35	30	30	32.5
All tracks, msec.	65	55	55	55	55
Rotational time, msec.	25	25	16.7	16.7	12.5
Average access time, msec.	47.5	47.5	38.3	38.3	45
Transfer rate, bytes per sec.	312,000	312,000	806,000	806,000	138.8M words
Start-up time, sec.	—	90	15	15	—
Stop time, sec.	12	12	15	15	—
PRICING AND MAINTENANCE					
Purchase price	$12,650 per spindle; $15,400 per controller	$14,850 per spindle; $17,600 per controller	$13,750 per spindle; $26,400 per controller	$38,500 per std.-density drive; $49,500 per double-density drive; $49,500 per controller	$14,960 per spindle; $66,000 per sngl.-chan. controller; $99,000 per dual-chan. controller
Monthly lease charges (for a 2-year lease including maintenance)	$252 per spindle; $1,119 per controller	$252 per 214; $370 per 215; $1,210 per controller	$459 per spindle; $1,620 per controller	$918 per std.-density drive; $1,382 per double-density drive; $1,620 per controller	$648 per spindle; $1,782 per single-chan. controller; $2,840 per dual-chan. controller; $520 per spare spindle
Alternate leasing plans	Contact vendor	Contact vendor	Contact vendor	1, 3, 4, 5 yrs.	1, 3, 4, 5 yrs.
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	8 hrs./day, 5 days/week
Leased by	CalComp	CalComp	CalComp	CalComp	CalComp
Maintenance performed by	CalComp	CalComp	CalComp	CalComp	CalComp
First delivery	3/70	6/71	12/72	1st qtr. 75	1/75
Number installed	—	—	—	—	—
COMMENTS	CD22S is a single-spindle unit; CD22 is a dual-spindle unit	214 is a single-density unit and 215 is a dual-density unit; both include 2 spindles per cabinet	Also see Report 70D-118-05	Also see Report 70D-118-06	Also see Report 70D-118-02

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MANUFACTURER AND MODEL	CalComp 8840 Disk Storage Facility	CalComp 8924 Dual Density Disk System	Control Data 33301 Disk System	Control Data 33302 Disk Subsystem	Formation F7330
REPLACEMENT FOR					
Disk vendor	UNIVAC	UNIVAC	IBM	IBM	UNIVAC
Disk product and model numbers	8440	8424/8425	3330-1/2	3330-11	70/590
Equivalent original-vendor disk pack	—	—	3336-1	3336-11	3336-1
CONFIGURATION					
Spindles per cabinet	1 or 2	1 or 2	1	1	1
Spindles per string	1 to 8 or 16	1 to 8	1 to 8	1 to 8	1 to 8
Strings per channel	1 or 2	1	1/2/3/4	1/2/3/4	1/2/3/4
String switch options	2 x 16	None	2 x 8	2 x 8	None
Channel switch options	2/3 channels	2 channels	2/4 channels	2/4 channels	2 channels
Attachment via integrated controllers	—	—	No	No	No
Attachment via mainframe controllers	—	—	No	No	No
Attachment via independent controllers	CalComp 8840	CalComp 8924	CDC 38301	CDC 38302/33332	F3335
Storage capacity, bytes per spindle	100M	58.34M	100M	200M	89M
PERFORMANCE					
Head movement time:					
1 track, msec.	7	12	10	10	7
Average, msec.	27	35	30	30	27
All tracks, msec.	48	55	55	55	50
Rotational time, msec.	8.4	12.5	16.7	16.7	17.3
Average access time, msec.	35.4	47.5	46.7	38.35	35.6
Transfer rate, bytes per sec.	806,000	312,000	806,000	806,000	806,000
Start-up time, sec.	—	—	15	15	15
Stop time, sec.	—	—	15	15	15
PRICING AND MAINTENANCE					
Purchase	$19,250 per spindle; $89,760 per controller per channel	$14,850 per spindle; $27,500 per controller	$12,000 per drive; $40,000 per controller	$22,600 per drive; $69,800 per controller	$17,500 per drive; $80,000 per controller
Monthly lease charges (for a 2-year lease including maintenance)	Contact vendor	Contact vendor	$415 per drive; $1,383 per controller (3-yr. lease)	$615 per drive; $1,754 per controller (3-yr. lease)	$370 per drive; $2,400 per controller
Alternate leasing plans	Contact vendor	Contact vendor	1 year; 13.7% and 12.1% more	1 year; 15.2% and 10.8% more	3, 4, 5 yrs.
Overtime charges	—	—	None	None	None
Maintenance included in basic 2-year lease plan	—	—	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week
Alternate maintenance plans	Contact vendor	Contact vendor	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Leased by	CalComp	CalComp	CDC	CDC	Formation
Maintenance performed by	CalComp	CalComp	CDC	CDC	Formation
First delivery	1/75	1/75	5/73	6/74	10/73
Number installed	—	—	—	—	50
COMMENTS	Also see Report 70D-118-02	Also see Report 70D-118-02	Also see Report 70D-263-06	CDC 38302 Controller can accommodate any mix of 33301 and 33302 drives; also see Report 70D-236-12	

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MANUFACTURER AND MODEL	IBM 2305 Model 1	IBM 2305 Model 2	IBM 2311 Model 1	IBM 2311 Model 11	IBM 2311 Model 12
REPLACEMENT FOR					
Disk vendor	—	—	—	—	—
Disk product and model numbers	—	—	—	—	—
Equivalent original-vendor disk pack	Fixed disk unit	Fixed disk unit	1316	1316	1316
CONFIGURATION					
Spindles per cabinet	1	1	1	1	1
Spindles per string	2	2	1 to 8	1 to 2 or 4	1 to 2 or 4
Strings per channel	1	1	1	1	1
String switch options	None	None	None	None	None
Channel switch options	2 channels	2 channels	2 channels	2 channels	2 channels
Attachment via integrated controllers	No	No	No	No	No
Attachment via mainframe controllers	2835 Mod 1	2835 Mod 2	2841	No	No
Attachment via independent controllers	—	No	No	No	No
Storage capacity, bytes per spindle	5.4M	11.2M	7.25M	5.4M	2.7M
PERFORMANCE					
Head movement time:					
1 track, msec.	—	—	25	25	25
Average, msec.	—	—	75	75	60
All tracks, msec.	—	—	135	135	90
Rotational time, msec.	5.0	10.0	25	25	25
Average access time, msec.	2.5	5.0	87.5	87.5	72.5
Transfer rate, bytes per sec.	3,000,000	1,500,000	156,000	156,000	156,000
Start-up time, sec.	—	—	—	—	—
Stop time, sec.	—	—	—	—	—
PRICING AND MAINTENANCE					
Purchase price	$199,000 per drive; $122,000 per controller	$158,000 per drive; $101,000 per controller	$22,670 per drive; $23,500 per controller	$22,670 per drive	$19,820 per drive
Monthly lease charges (for a 2-year lease including maintenance)	$4,444 per drive; $2,726 per controller	$3,536 per drive; $2,272 per controller	$517 per drive; $476 per controller	$517 per drive	$317 per drive
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	10% (over 176 hrs./mo.) under 30-day rental only	10% (over 176 hrs./mo.) under 30-day rental only	10% (over 176 hrs./mo.) under 30-day rental only	10% (over 176 hrs./mo.) under 30-day rental only	10% (over 176 hrs./mo.) under 30-day rental only
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenace plans	None	None	None	None	None
Leased by	IBM	IBM	IBM	IBM	IBM
Maintenance performed by	IBM	IBM	IBM	IBM	IBM
First delivery	1971	1971	1965	—	—
Number installed	—	—	—	—	—
COMMENTS	See Report 70C-491-04 for details	See Report 70C-491-04 for details	See Report 70C-491-03 for pricing and configuration details	See Report 70C-491-02 (S/360 Model 20) for pricing and configuration details	See Report 70C-491-02 (S/360 Model 20) for pricing and configuration details

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MANUFACTURER AND MODEL	IBM 2314 A Series	IBM 2314/2319 B Series	IBM 2319 A Series	IBM 3330 Channel Attachment	IBM 3330 Integrated Attachment
REPLACEMENT FOR					
Disk vendor	—	—	—	—	—
Disk product and model numbers	—	—	—	—	—
Equivalent original-vendor disk pack	2316	2316	2316	3336-1 or -11	3336-1 or -11
CONFIGURATION					
Spindles per cabinet	1, 2, or 4/module	3/module	1 to 4/module	1 or 2	1 or 2
Spindles per string	1 to 9	3, 6, or 9	3 to 9	2 to 8	2 to 8
Strings per channel	1	1	1	1/2/3/4	1/2/3/4
String switch options	None	None	None	2 x 8	2 x 8
Channel switch options	2 channels	2 channels	2 channels	2/4 channels	2/4 channels
Attachment via integrated controllers	No	No	S/370 IFA	No	DDA/IFA/ISC
Attachment via mainframe controllers	2314-A1	2314-B1	No	3830 Model 2	No
Attachment via independent controllers	No	No	No	No	No
Storage capacity, bytes per spindle	29.2M	29.2M	29.2M	100M/200M	100M/200M
PERFORMANCE					
Head movement time:					
1 track, msec.	25	25	25	10	10
Average, msec.	60	60	60	30	30
All tracks, msec.	130	130	130	55	55
Rotational time, msec.	25	25	25	16.7	16.7
Average access time, msec.	72.5	72.5	72.5	38.3	38.3
Transfer rate, bytes per sec.	312,000	312,000	312,000	806,000	806,000
Start-up time, sec.	60	60	60	15	15
Stop time, sec.	60	60	60	15	15
PRICING AND MAINTENANCE					
Purchase price	$22,050(2312-A1); $72,400(2313-A1); $36,000(2318-A1); $61,370 (2314-A1)	$39,000 (2319-B1 or B2); $61,370 (2314-B1)	$39,000 or $39,200 per 3-spindle module; $27,350 (370/135) or $31,100 (370/145) per IFA	$66,300 (3333-1); $88,700(3333-11); $52,900 (3330-1); $31,600 (3330-2); $75,400(3330-11); $82,600 (3830-2)	$66,300 (3333-1); $88,700(3333-11); $52,900 (3330-1); $31,600 (3330-2); $75,400(3330-11); 0 to $273,290 for integrated attachment
Monthly lease charges (for a 2-year lease including maintenance)	$485 (2312-A1); $1,575 (2313-A1); $834 (2318-A1); $1,336 (2314-A1)	$907 (2319-B1 or B2); $1,336 (2314-B1)	$907 or $953 per 3-spindle module; $551 (370/135) or $649 (370/145) per IFA (30-day only)	$1,485 (3333-1); $1,990 (3333-11); $1,176 (3330-1); $707 (3330-2); $1,676 (3330-11); $1,835 (3830-2)	$1,485 (3333-1); $1,990 (3333-11); $1,176 (3330-1); $707 (3330-2); $1,676 (3330-11); $0 to $5,671 for integrated attachment
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	Controller only, 10% under 30-day rental only	Controller only, 10% under 30-day rental only	Controller only, 10% under 30-day rental	Controller only, 10% under 30-day rental	None for drives
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	IBM	IBM	IBM	IBM	IBM
Maintenance performed by	IBM	IBM	IBM	IBM	IBM
First delivery	1970	1971	1971	4th qtr. 1971	4th qtr. 1971
Number installed	—	—	—	—	—
COMMENTS	See Reports 70C-491-03 (S/360) and 70C-491-04 (S/370) for pricing and configuration details	See Reports 70C-491-03 (S/360) and 70C-491-04 (S/370) for pricing and configuration details	See Report 70C-491-04 for pricing and configuration details	3333-1 and -11 include first 2 drives; 3330-1 and -11 include 2 drives; 3330-2 includes 1 drive; up to three 3330's can be attached to a 3333. All -11 models are double density. See Report 70C-491-04 for details	

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MANUFACTURER AND MODEL	IBM 3340 Channel Attachment	IBM 3340 Integrated Attachment	Itel 3100/3101 & 3200/3101	Itel 7830/7330-2 Disk System	Itel 7830/7330-1 Disk System
REPLACEMENT FOR					
Disk vendor	—	—	IBM	IBM	IBM
Disk product and model numbers	—	—	2314	2314	3330-1/2
Equivalent original-vendor disk pack	3348-35/-70/-70F	3348-35/-70/-70F	2316	IBM 3336-1	IBM 3336-1
CONFIGURATION					
Spindles per cabinet	1 or 2	1 or 2	1	1	1
Spindles per string	1 to 8	1 to 8	1 to 8	1 to 8	1 to 16
Strings per channel	1 to 4	1 to 8	1 to 8	1	1
String switch options	2 x 8	2 x 8	None	None	None
Channel switch options	2/4 channels	2/4 channels	2 channels	2 channels	4 channels
Attachment via integrated controllers	No	DDA/IFA/ISC	No	No	No
Attachment via mainframe controllers	3830 Mod. 2	No	No	No	No
Attachment via independent controllers	No	No	3100/3200	7830-2	7830-1
Storage capacity, bytes per spindle	34.9M/69.8M	34.9M/69.8M	58.4M	100M	100M
PERFORMANCE					
Head movement time:					
1 track, msec.	10	10	7	7	7
Average, msec.	25	25	29	27	27
All tracks, msec.	50	50	55	50	50
Rotational time, msec.	20.2	20.2	25	21.4	16.7
Average access time, msec.	35.1	35.1	41.5	37.7	35.3
Transfer rate, bytes per sec.	885,000	885,000	312,000	625,000	806,000
Start-up time, sec.	20	20	20	15	15
Stop time, sec.	—	—	20	15	15
PRICING AND MAINTENANCE					
Purchase price	$40,000(3340-A2); $22,000(3340-B1); $28,000(3340-B2); $82,600 (3830-2)	$40,000(3340-A2); $22,000(3340-B1); $28,000(3340-B2); $0 to $273,290 for integrated attachment	$19,500 per drive; $32,500 per controller	$29,550 per drive; $84,700 per controller	$22,480 per drive; $75,600 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$901 (3340-A2); $504 (3340-B1); $636 (3340-B2); $1,835 (3830-2)	$901 (3340-A2); $504 (3340-B1); $636 (3340-B2); $0 to $5,671 for integrated attachment	$685 per drive; $1,075 per controller	$700 per drive; $1,770 per controller	$570 per drive; $1,750 per controller
Alternate leasing plans	30-day (19% more)	30-day (19% more)	3 or 4 years; up to 15% less	3 or 4 years; up to 15% less	3 or 4 years; up to 15% less
Overtime charges	Controller only. 10% under 30-day rental only	None for drives	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenace plans	None	None	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week
Leased by	IBM	IBM	Itel	Itel	Itel
Maintenance performed by	IBM	IBM	Itel	Itel	Itel
First delivery	11/73	11/73	4/72	—	9/72
Number installed	—	—	Over 500	Over 200	Over 5,000
COMMENTS	3340-A2 includes first 2 drives; 3340-B1 includes 1 drive; 3340-B2 includes 2 drives; up to 3 3340-B1 or B2 per 3340-A2; 3330's and 3340's can be intermixed. The 3348-70F Data Module provides 502,080 bytes of fixed-head storage. See Report 70C-491-04 for pricing and configuration details		Double-density disk system provides 1 (3100 controller) or 2 (3200 controller) logical files per drive	Can be attached to IBM 360/50 via Itel software support	Can be attached to IBM 360/65 and above via Itel software support

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MANUFACTURER AND MODEL	Itel 7833/7330-11 Disk System	Itel 7833/7330-DP Disk System	Memorex 630/620 Disk Drives	Memorex 3660 Disk System	Memorex 3670 Channel Attachment
REPLACEMENT FOR					
Disk vendor	IBM	IBM	IBM	IBM	IBM
Disk product and model numbers	3330-11	3330-1/2	2311-1/2311-11	2314	3330-1/2/11
Equivalent original-vendor disk pack	IBM 3336-11	3336-1	IBM 1316	IBM 2316	3336-1/11
CONFIGURATION					
Spindles per cabinet	1	1	1	1	1 or 2
Spindles per string	1 to 16	1 to 16	1 to 8	1 to 9	1 to 8
Strings per channel	1	1	1	1	2/4
String switch options	2 x 16	2 x 16	None	None	2/3/4 x 8
Channel switch options	4 channels	4 channels	—	—	2/3/4 channels
Attachment via integrated controllers	No	No	None	None	No
Attachment via mainframe controllers	No	No	IBM 2841	None	No
Attachment via independent controllers	7833	7833	None	Memorex 3661	3671/3672
Storage capacity, bytes per spindle	200M	100M	7.25M/5.4M	29.2M	100M/200M
PERFORMANCE					
Head movement time:					
1 track, msec.	7	7	20	20	7
Average, msec.	27	27	50	50	27
All tracks, msec.	50	50	80	80	50
Rotational time, msec.	16.7	16.7	25	25	16.67
Average access time, msec.	35.3	35.3	62.5	62.5	35.7
Transfer rate, bytes per sec.	806,000	806,000	156,000	312,000	806,000
Start-up time, sec.	15	15	45 to 60	45 to 60	20
Stop time, sec.	15	15	15	15	20
PRICING AND MAINTENANCE					
Purchase price	$34,700 per drive; $85,000 per controller	$26,480 per drive; $85,000 per controller	$11,500 per 620; $12,000 per 630	$15,000 per drive; $54,500 per controller	$39,500 (3670-1); $23,700 (3670-2); $56,300 (3675); $10,500 (3673)
Monthly lease charges (for a 2-year lease including maintenance)	$895 per drive; $2,015 per controller	$625 per drive; $2,015 per controller	$300 per 620 or 630	$300 per drive; $970 per controller	$1,040 (3670-1); $625 (3670-2); $1,510 (3675); $280 (3673)
Alternate leasing plans	3 or 4 years; up to 15% less	3 or 4 years; up to 15% less	Contact vendor	Contact vendor	1, 3, 4, 5 yrs. from 5% more to 20% less
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	None	None	9 hrs./day, 5 days/week
Leased by	Itel	Itel	Memorex	Memorex	Memorex
Maintenance performed by	Itel	Itel	Memorex	Memorex	Memorex
First delivery	4/75	8/74	1968	1969-1970	10/72
Number installed	—	Over 500	—	—	5,000
COMMENTS	Includes dual port feature; standard-density and double-density drives can be mixed on same controller	Includes dual port feature	These drives are no longer produced and are available "as returned" only		3670-1: 2 drives; 3670-2: 1 drive; 3675: 2 double-density drives. Connects to S/360 Mod. 65 up or S/370 channel via 3671 or 3672/3. Also see Report 70D-625-06

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MANUFACTURER AND MODEL	Memorex 3670 Integrated Attachment	Mohawk M2500 Discdrive	Mohawk M2700 Disk System	Mohawk M2900 Disk System	Peripherals General (PGI) Model 844
REPLACEMENT FOR					
Disk vendor	IBM	IBM	IBM	IBM	Honeywell
Disk product and model numbers	3330-1/2/11	2311-1	2314	2314	DDS 160/167/180
Equivalent original-vendor disk pack	3336-1/11	IBM 1316	IBM 2316	IBM 2316	IBM 2316
CONFIGURATION					
Spindles per cabinet	1 or 2	1	1	1	2
Spindles per string	1 to 8	1 to 8	1 to 9	1 to 9	1 to 9
Strings per channel	2/4	1	1	1	2
String switch options	2/3/4 x 8	None	None	None	None
Channel switch options	2/3/4 channels	None	2 channels	2 channels	2 channels
Attachment via integrated controllers	DDA/IFA/ISC	No	No	No	Yes
Attachment via mainframe controllers	No	IBM 1841	No	No	No
Attachment via independent controllers	No	No	M2800	M2800	No
Storage capacity, bytes per spindle	100M/200M	7.25M	29.2M	58.4M	31.2M (6 bits)
PERFORMANCE					
Head movement time:					
1 track, msec.	7	18	12	12	7
Average, msec.	37	48	30	40	29
All tracks, msec.	50	65	60	60	50
Rotational time, msec.	16.67	25	25	25	25
Average access time, msec.	35.7	60.5	42.5	52.5	12.5
Transfer rate, bytes per sec.	806,000	156,000	312,000	312,000	426,666
Start-up time, sec.	20	13	13	12	30
Stop time, sec.	20	13	13	10	12
PRICING AND MAINTENANCE					
Purchase price	$39,500 (3670-1); $23,700 (3670-2); $56,300 (3675); $85,600 (3671); $61,550 (3672); $10,500 (3673)	$6,500 per drive	$9,000 per drive; $34,000 per controller	$14,000 per drive; $29,000 per controller	$9,500 per spindle; $18,500 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$1,040 (3670-1); $625 (3670-2); $1,510 (3675); $2,320 (3671); $1,465 (3672); $280 (3673)	$242 per drive	$255 per drive; $963 per controller	$302 per drive; $963 per controller	Contact vendor
Alternate leasing plans	1, 3, 4, 5 yrs.; from 5% more to 20% less	1 to 5 years; fixed or variable terms; 11% more to 22% less	1 to 5 years; fixed or variable terms; 11% more to 22% less	1 to 5 years; fixed or variable terms; 11% more to 22% less	Contact vendor
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	9 hrs./day, 5 days/week
Alternate maintenance plans	9 hrs./day, 5 days/week	None	None	None	24 hrs./day, 7 days/week
Leased by	Memorex	Mohawk	Mohawk	Mohawk	Third party
Maintenance performed by	Memorex	Mohawk	Mohawk	Mohawk	Sorbus
First delivery	10/72	9/68	10/70	6/71	5/74
Number installed	5,000	—	—	—	60
COMMENTS	3670-1: 2 drives; 3670-2: 1 drive; 3675: 2 double-density drives. Connects to S/370 DDA, IFA, or ISC via 3673. Also see Report 70D-625-06		Hydraulic positioning mechanism was used on early models		For Honeywell Series 200, 400, 600, & 6000 computers

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MANUFACTURER AND MODEL	Peripherals General (PGI) Model 84/60-1	Peripherals General (PGI) Model 84/60-2	Potter DD 4311 Disk Drive	Potter DD 4314/ DC 5314 Disk System	Potter DD 4314-1/ DC 5314-1 Disk System
REPLACEMENT FOR					
Disk vendor	Honeywell	Honeywell	IBM	IBM	IBM
Disk product and model numbers	DDS 180/190	DDS 180/190	2311-1	2314	2314
Equivalent original-vendor disk pack	IBM 3336-1	IBM 3336-11	IBM 1316	IBM 2316	IBM 2316
CONFIGURATION					
Spindles per cabinet	1	1	1	1	1
Spindles per string	1 to 9	1 to 9	1 to 8	1 to 9	1 to 9
Strings per channel	2	2	1	1	1
String switch options	2 x 8	2 x 8	None	None	None
Channel switch options	2 channels	2 channels	None	2 channels	2 channels
Attachment via integrated controllers	Yes	Yes	—	No	No
Attachment via mainframe controllers	No	No	IBM 2841	No	No
Attachment via independent controllers	No	No	No	Potter DC 5314	Potter DC 5314
Storage capacity, bytes per spindle	133M (6 bits)	266M (6 bits)	7.25M	29.2M	29.2M
PERFORMANCE					
Head movement time:					
1 track, msec.	10	10	19	19	6
Average, msec.	30	30	52	55	30
All tracks, msec.	55	55	104	110	60
Rotational time, msec.	8.33	8.33	25	25	25
Average access time, msec.	34.2	34.2	64.5	67.5	42.5
Transfer rate, bytes per sec.	1,075,166	1,075,166	156,000	312,000	312,000
Start-up time, sec.	15	15	60	30	15
Stop time, sec.	18	18	22	15	15
PRICING AND MAINTENANCE					
Purchase price	Contact vendor	Contact vendor	$4,800 per drive	$7,400 per drive; $11,500 per controller	$9,400 per drive; $11,600 per controller
Monthly lease charges (for a 2-year lease including maintenance)	Contact vendor	Contact vendor	$230 per drive	$210 per drive; $720 per controller	$290 per drive; $720 per controller
Alternate leasing plans	Contact vendor	Contact vendor	1 year; 10% more	1 year; 10% more	1 year; 10% more
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week
Alternate maintenance plans	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	Contact vendor	Contact vendor	Contact vendor
Leased by	Third party	Third party	Potter	Potter	Potter
Maintenance performed by	Sorbus	Sorbus	Potter	Potter	Potter
First delivery	Not delivered	Not delivered	1st qtr. 69	6/70	1971
Number installed	—	—	850	900	1,000
COMMENTS	For Honeywell Series 60 computers	For Honeywell Series 60 computers			

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MANUFACTURER AND MODEL	Randolph Computer RCC/7330*	Randolph Computer RCC/7330**	STC 8400/8800/8000 Disk Subsystem	STC 8100/8000	STC 8200/8000
REPLACEMENT FOR					
Disk vendor	IBM	IBM	IBM	IBM	IBM
Disk product and model numbers	3330-1/-2/-11	3330-1/-2/-11	3330-1/-2/-11	3330-1/-2	3330-11
Equivalent original-vendor disk pack	3336-1/-11	3336-1/-11	Fixed-disk units	3336-1	IBM 3336-11
CONFIGURATION					
Spindles per cabinet	1	1	1	1	1
Spindles per string	16	16	1 to 8	1 to 8	1 to 8
Strings per channel	8	8	4	16	16
String switch options	4 x 16	4 x 16	2 x 1 to 2 x 8	2 x 1 to 2 x 8	2 x 1 to 2 x 8
Channel switch options	2/4 channels	2/4 channels	2/4 channels	2/4 channels	2/4 channels
Attachment via integrated controllers	No	No	No	No	No
Attachment via mainframe controllers	Yes	Yes	No	No	No
Attachment via independent controllers	Randolph 7830	Randolph 7830	STC 8000	STC 8000 & 8001	STC 8000 & 8001
Storage capacity, bytes per spindle	100/200M	100/200M	400M/800M	100M	200M
PERFORMANCE					
Head movement time:					
1 track, msec.	7	10	7	7	7
Average, msec.	27	28	27	28	28
All tracks, msec.	50	55	50	55	55
Rotational time, msec.	16.7	16.7	16.6	16.6	16.6
Average access time, msec.	35.3	36.3	35.3	34.3	36.3
Transfer rate, bytes per sec.	806,000	806,000	806,000	806,000	806,000
Start-up time, sec.	15	15	45	15	15
Stop time, sec.	15	15	—	15	15
PRICING AND MAINTENANCE					
Purchase price	$12,000 to $23,000 per spindle; $28,000 to $54,000 per controller	$12,000 to $23,000 per spindle; $28,000 to $54,000 per controller	$69,300 (8800); $44,550 (8400); $52,720 per 8000 controller	$22,770 per disk unit; $12,625 per 8001 controller; $52,720 per 8000 controller	$34,155 per disk unit; $12,625 per 8001 controller; $52,720 per 8000 controller
Monthly lease charges (for a 2-year lease including maintenance)	$440 to $780 per spindle; $1,200 to $2,250 per controller	$440 to $780 per spindle; $1,200 to $2,250 per controller	$1,485 (8800); $955 (8400); $1,130 per 8000 controller	$490 per disk unit; $270 per 8001 controller; $1,130 per 8000 controller	$730 per disk unit; $270 per 8001 controller; $1,130 per 8000 controller
Alternate leasing plans	4 or 5 years; up to 30% less	4 or 5 years; up to 30% less	1 or 5 years; 10% more to 10% less	1 or 5 years; 10% more to 10% less	1 or 5 years; 10% more to 10% less
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	None	None	None
Leased by	Randolph	Randolph	STC	STC	STC
Maintenance performed by	Telex	Sorbus	STC	STC	STC
First delivery	11/74	6/75	12/75	4/75	3/76
Number installed	—	—	—	—	—
COMMENTS	*Drives in first col. are mfrd. by ISS (Univac) for attachment to IBM 370/135 to 370/168 and 360/50-65; drives in second col. are mfrd. by Ampex for attachment to 370/135 to 370/168. Both provide Dynamic Dual Port string switching for simultaneous read/write in same string		Storage capacities are: 8400, 400M bytes; 8800, 800M bytes. Also see Report 70D-789-04	Also see Report 70D-789-04	Also see Report 70D-789-04

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MANUFACTURER AND MODEL	Telefile T7270 System	Telefile T7295 System	Telefile T7275 System	Telefile T7240/T7242 System	Telex 5311 Disk Drive
REPLACEMENT FOR					
Disk vendor	Xerox	Xerox	Xerox	Xerox	IBM
Disk product and model numbers	7270 System	7295 System	7275 System	7240/7242	2311-1
Equivalent original-vendor disk pack	2316	2316	3336-1	2316	IBM 1316
CONFIGURATION					
Spindles per cabinet	1 or 2	1 or 2	1	1 or 2	1
Spindles per string	8	8	8	8	8
Strings per channel	1	1	1	1	1
String switch options	2/4 x 8	2/4 x 8	2/4 x 8	2/4 x 8	None
Channel switch options	2 channels	2 channels	2 channels	2 channels	None
Attachment via integrated controllers	No	No	No	No	360/20, 25 IFA
Attachment via mainframe controllers	No	No	No	No	IBM 2841
Attachment via independent controllers	Yes	Yes	Yes	Yes	No
Storage capacity, bytes per spindle	49M	99M	86M	24M	7.25M
PERFORMANCE					
Head movement time:					
1 track, msec.	10	10	10	10	10
Average, msec.	32.5	32.5	32.5	37.5	30
All tracks, msec.	55	55	55	65	60
Rotational time, msec.	25	25	16.7	25	25
Average access time, msec.	45	45	40.8	50	42.5
Transfer rate, bytes per sec.	312,000	625,000	806,000	312,000	156,000
Start-up time, sec.	90	90	15	90	15
Stop time, sec.	11	20	18	11	15
PRICING AND MAINTENANCE					
Purchase price	$46,805 for system incl. 2 spindles and controller; $12,065 per additional spindle	$69,370 for system incl. 3 spindles and controller; $13,565 per additional spindle	$89,040 for system incl. 3 spindles and controller; $18,563 per additional spindle	$36,525 for system incl. 2 spindles and controller; $12,375 per additional spindle	$10,500 per disk unit
Monthly lease charges (for a 2-year lease including maintenance	$1,470 for system incl. 2 spindles and controller; $524 per additional spindle	$1,883 for system incl. 3 spindles and controller; $399 per additional spindle	$2,416 for system incl. 3 spindles and controller; $544 per additional spindle	$1,222 for system incl. 2 spindles and controller; $430 per additional spindle	$274 per disk unit
Alternate leasing plans	1, 4, or 6 yr.; 4% more to 18% less	1, 4, or 6 yr.; 4% more to 18% less	1, 4, or 6 yr.; 4% more to 18% less	1, 4, or 6 yr; 4% more to 18% less	Basic (18% more) and 1 year (9% more)
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	Up to 24 hrs./day, 7 days/week	Up to 24 hrs./day, 7 days/week	Up to 24 hrs./day, 7 days/week	Up to 24 hrs./day, 7 days/week	9/16 hrs./day, 5 days/week
Leased by	Telefile	Telefile	Telefile	Telefile	Third party
Maintenance performed by	Telefile	Telefile	Telefile	Telefile	Telex
First delivery	12/72	5/74	—	2/72	10/69
Number installed	100	140	—	20	89
COMMENTS	Similar units have been delivered for non-Xerox computers	Similar units have been delivered for non-Xerox computers	Double density (172M-byte) T7285 also available with similar performance and configuration; monthly lease and purchase costs are 165% more for basic system and 3.5% more for additional spindle	Similar units have been delivered for non-Xerox computers	

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MANUFACTURER AND MODEL	Telex 5314 Disk System	Telex 5600 Disk System	Telex 6330 Disk Subsystem	Telex 8330 Disk Subsystem
REPLACEMENT FOR				
Disk vendor	IBM	IBM	IBM	IBM
Disk product and model numbers	2314	2314	3330-1/-2/-11	3330-1/-2/-11
Equivalent original-vendor disk pack	IBM 2316	IBM 2316	IBM 3336-1/-11	IBM 3336-1/-11
CONFIGURATION				
Spindles per cabinet	1	1	1	1
Spindles per string	1 to 9	1 to 9	1 to 16	1 to 16
Strings per channel	1	1	2	2
String switch options	None	None	2 x 16	2 x 16
Channel switch options	2/4 channels	2/4 channels	2/4 channels	2/4 channels
Attachment via integrated controllers	No	No	No	No
Attachment via mainframe controllers	No	No	No	No
Attachment via independent controllers	Telex 5328	Telex 5650	Telex 6830	Telex 8830
Storage capacity, bytes per spindle	29.9M	58.8M	100M/200M	100M/200M
PERFORMANCE				
Head movement time:				
1 track msec.	10	7	7	10
Average, msec.	32	29	27	28
All tracks, msec.	60	55	50	55
Rotational time, msec.	25	25	16.7	16.7
Average access time, msec.	44.5	41.5	38.3	38.3
Transfer rate, bytes per sec.	312,000	312,000	806,000	806,000
Start-up time, sec.	20	20	15	15
Stop time, sec.	20	20	15	15
PRICING AND MAINTENANCE				
Purchase price	$11,370 per 5312 disk unit; $55,155 per controller	$14,220 (per disk unit; $53,100 per controller	$13,000 (6316-1); $14,500 (6316-2); $18,000 (6316-11); $35,000 (6833-1); $43,000 (6833-11); $30,000 (6830-1); $13,500 (6316-50); $30,000 (6830-50)	$13,000 per drive (std. density) $16,000 per drive (dbl. density); $35,000 per controller (std. density); $45,500 per controller (dbl. density)
Monthly lease charges (for a 2-year lease including maintenance)	$230 per 5312 disk unit; $1,000 per controller	$380 per disk unit; $1,315 per controller	$470 (6316-1); $605 (6316-2); $815 (6316-11); $1,660 (6833-1); $1,880 (6833-11); $1,780 (6830-1); $435 (6316-50); $1,820 (6830-50)	$470 per drive (std. density); $665 per drive (dbl. density); $1,555 per controller std. density); $1,680 per controller (dbl. density)
Alternate leasing plans	Basic (34% more) and 1 year (19% more)	Basic (20% more) and 1 year (11% more)	3 year; 6% to 10% less	3 year; 6% to 8% less
Overtime charges	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	9/16 hrs./day, 5 days/week	9/16 hrs./day, 5 days/week	9/16 hrs./day, 5 days/week	9/16 hrs./day, 5 days/week
Leased by	Third party	Third party	Third party	Third party
Maintenance performed by	Telex	Telex	Telex	Telex
First delivery	4/70	10/71	8/72	3/75
Number installed	343	101	444	27
COMMENTS			6316-1: 1 drive; 6316-2: 1 dual port drive; 6316-11: 1 double-density drive. Connects to S/360 50 and up and S/370 via 6833-1/-11 and 6830-1/-50	Options include dual port, 2 or 4 channel switch, and 16-drive addressing

All About Plug-Compatible Tape Drives

Cost savings with equivalent or superior performance characterize the plug-compatible tape drive market. The characteristics and prices of 48 models that can replace your IBM, Honeywell, and Univac magnetic tape units are presented in this report, along with straightforward buying guidance and users' ratings of 1,500 drives.

Fads constitute a highly significant but seldom discussed phenomenon in the computer field. Just as fashion styles strike the clothing industry, technological styles strike the computer industry. Time and again, an "idea whose time has come" promises (according to the innovator) to revolutionize the data entry segment, the data computation segment, the data output segment, data communications, file inquiry, or some other aspect of EDP.

It is unwise, however, to scoff at either the new ideas or the resurrections of old ideas. Developments in logic organization and production have made many formerly "impractical" ideas not only feasible but thoroughly practical. This explains why fads are seldom discussed under that name. It is usually difficult to distinguish between a truly innovative development and an impractical dream. Often the distinction between wishful thinking and practical reality is being eliminated on the design tables just when you're having your biggest laugh.

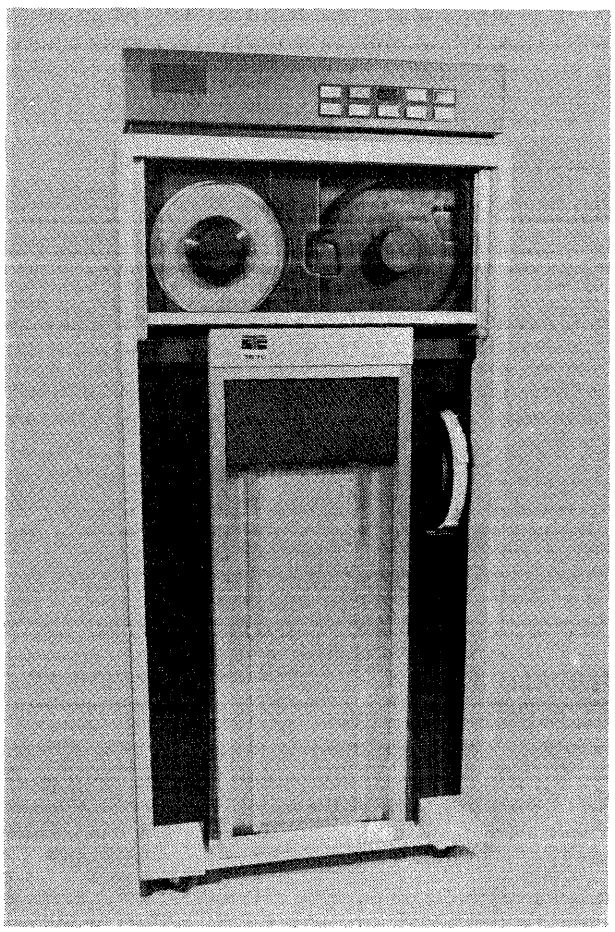
One such fad—or innovative development—began in the early 1960's with IBM's introduction of disk pack storage units. The unlimited-storage concept enjoyed by magnetic tape could now be shared by disk storage. It could be shown then, as it can be shown now, that for most file update processing, magnetic tape provided a more cost-effective medium.

There are several reasons why disk pack drives have attained a dominant position over magnetic tape drives in the face of that performance disadvantage. The important ones are:

- File updating plays a less dominant role in data processing now.
- Disk packs provide a recording medium that is more convenient to maintain in good condition.

Applications which use the information base represented by a data file for other than detail and summary reporting of transactions as files are updated are not easily implemented with magnetic tape. Single-item inquiry or selective report generation often cannot wait for the next update run. In addition, extensive system software support requires something besides the sequential access mode in which magnetic tape can function efficiently. Right now, that random access is provided by disk units, and usually by removable-pack disk drives.

The second factor heavily involves human nature. For tape operations to function effectively, constant vigilance is required to keep the magnetic tape itself in good condition. Installations that have large tape libraries measuring in the thousands of reels report that daily attention needs to be given to maintaining drive adjustment and tape cleanliness. (They report that the use of wraparound hanging seals and self-loading cartridges are very helpful in maintaining cleanliness, and the use of outside services for cleaning tapes has also been mentioned favorably.) Even if less attentive care results only in skipped areas on tape rather than data loss, much of the efficiency of high-performance drives can be lost through multiple retries and space loss. Such attention requires manpower that seemingly might be better used in other areas. And human nature is such that proper tape care is ▷



STC (Storage Technology Corporation) has emerged as the leading independent producer of high-performance magnetic tape drives. The company has generated a strong financial position and a loyal group of well-satisfied users. STC's 6250-bpi Model 3670 tape drive, shown above, was the first independent unit to challenge IBM's state-of-the-art advance in magnetic tape recording for computers. Not only is the performance very high (up to 1250K bytes per second), but the Group Coded Recording (GCR) method appears to provide superior reading of degraded tapes due to the more extensive error recover technique.

All About Plug-Compatible Tape Drives

often eliminated in the interest of developing new applications. Consequently, high-performance tape drives can be greatly reduced in effectiveness.

Disk storage, on the other hand, requires less attention. Performance degradation, although present, is not so evident as with magnetic tape. Convenience is a powerful incentive to going entirely with disk units—which are usually required anyway to accommodate new applications and systems software.

What makes the disk/tape comparison more than an academic exercise is the existence of large tape libraries in many organizations. Conversion costs in terms of machine time, manpower, and media are substantial.

Tape drives will continue to be with us for some time to come. And while they are around, many vendors will provide attractive alternatives to the mainframe vendors' own offerings. The beginnings of the plug-compatible peripheral market are detailed in a companion Datapro report, *All About Plug-Compatible Disk Drives* (70D-010-40). The early emphasis in this market was on replacements for IBM magnetic tape drives; it has now shifted to disk drive replacements. And there is a rudimentary market for plug-compatible peripheral products for use with mainframes other than IBM's.

The Big Picture

There are a host of IBM tape drive models in the field—over 30 if you count the 729 models for the second-generation 1400 and 7000 series computers and the three new high-density models of the 3420. Every one of these IBM models has been imitated by one or more manufacturers, and most of these replacement drives are still on the market, although some of the older models are in limited supply. IBM System/360 and System/370 users are concentrating on two families of drives today: the low-performance, low-cost 3410/3411 family and the high-performance, high-cost 3420 family. Not surprisingly, these are the same families that are currently receiving maximum attention from the independents.

Accompanying this report are comparison charts showing the product lines offered by the independents. For your convenience in comparison, the IBM product lines are also shown. The IBM 729 family and its independent replacements are not shown, however, because IBM has discontinued the availability of these units for new acquisitions. Replacements for the 729 drives can be obtained from Ampex, Potter, and Telex.

Not only have the independents produced tape drives with the same performance as the various IBM models, but they have plugged some gaps with additional models. This gives you a broad choice in selection but makes the decision more difficult; care in matching your needs with the performance of the various models will yield greater economy. To assist you in making your selection, the following table presents a set of "performance and storage factors" for different combinations of block sizes and tape formats.

Performance and Storage Factors

Block size, bytes	Format, bytes per inch/interblock gap		
	800/0.6	1600/0.6	6250/0.3
80	114.4	123.0	255.6
500	408.0	547.2	1318.8
1000	540.8	816.0	2175.0
2000	644.8	1081.6	3225.0
4000	714.4	1289.6	4256.3

Here's how to use these factors:

To determine a tape drive's *effective transfer rate in bytes per second,* multiply the appropriate factor by the *tape speed in inches per second.*

To determine a tape reel's *storage capacity in bytes,* multiple the appropriate factor by the *tape length in inches.*

The State of the Market

An overall view of the plug-compatible market (or PCM, as it is now frequently called) is presented in the companion report on plug-compatible disk drives immediately preceding this report.

The legal problems for plug-compatible manufacturers in combination with the waning importance of magnetic tape have caused some changes in the tape drive market. Some formerly significant vendors are not present in this year's charts, including Texas Instruments and CIG. Ampex, an early leader in the field, has cut back its end-user marketing efforts, and Potter's well-publicized financial difficulties had not been resolved at press time. One new vendor has been added: Formation, which supplies tape units for Honeywell and Univac mainframes.

STC (Storage Technology Corporation) has emerged as the leader in the field of high-performance tape drives among the independents, and is doing very well indeed. Telex maintains a strong installed position, and CalComp also makes its presence known in the market.

Companies that study computer markets, such as International Data Corporation (IDC), are not optimistic about the growth of the plug-compatible field. And tape drives are more vulnerable than disk drives. The future of the market may well depend on the outcome of pending legal suits as much as on marketing and technical developments. PCM is seen by market researchers as only a small portion of the overall independent peripherals market (IDC estimates 30 percent), which is considered to have sizable positive growth potential.

All About Plug-Compatible Tape Drives

USERS' RATINGS OF MAGNETIC TAPE DRIVES

Magnetic Tape Drive	Number of User Responses	Number of Drives Represented	Weighted Averages and Response Counts**																			Problem Counts**					
			Overall Performance					Ease of Operation					Hardware Reliability					Maintenance Service					Installation			Operation		
			WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	None	Min.	Maj.	None	Min.	Maj.
IBM 2401	5	11	2.8	0	4	1	0	3.0	0	5	0	0	2.6	0	3	2	0	3.3	2	1	1	0	1	3	1	2	1	1
IBM 2401 Replacements:																												
Ampex 1624 series	3	18	2.3	0	2	0	1	3.5	1	1	0	0	1.5	0	0	1	1	2.0	0	0	2	0	0	2	1	1	2	0
Potter/MAI 2400 series***	18	143	2.5	1	8	8	1	2.7	4	9	4	1	2.3	2	5	7	4	2.1	1	4	8	4	5	9	3	1	6	9
Telex 4862	10	35	3.1	3	4	2	0	3.2	3	5	1	0	2.8	2	4	2	1	2.8	3	2	3	1	6	2	2	5	4	0
Texas Instruments 924	3	10	2.7	1	0	2	0	4.0	1	0	0	0	4.0	1	0	0	0	4.0	1	0	0	0	0	3	0	0	3	0
Subtotals, independents	34	206	2.7	5	14	12	2	3.1	9	15	5	1	2.4	5	9	10	6	2.4	5	6	13	5	11	16	6	7	15	9
IBM 3410/3411	2	5	3.5	1	1	0	0	3.0	0	2	0	0	3.5	1	1	0	0	3.5	1	1	0	0	1	1	0	2	0	0
IBM 3410/3411 Replacements:																												
Telex 6410/6411	2	4	2.5	0	1	1	0	3.0	1	0	1	0	1.5	0	0	1	1	2.0	0	1	0	1	0	2	0	0	1	1
IBM 3420	17	158	3.7	12	5	0	0	3.6	11	6	0	0	3.6	10	7	0	0	3.5	8	9	0	0	11	5	1	7	6	0
IBM 3420 Replacements:																												
CalComp 345	12	47	2.9	4	4	3	1	3.5	6	6	0	0	2.6	3	5	0	4	3.1	5	3	4	0	5	2	3	4	3	6
Control Data 34201	5	26	3.2	2	2	1	0	3.6	3	2	0	0	3.0	1	3	1	0	2.8	0	4	1	0	0	2	3	2	3	0
Mohawk 8420	4	31	3.3	2	1	1	0	3.5	3	0	1	0	3.7	2	1	0	0	3.5	2	2	0	0	2	2	0	1	3	0
Potter	2	13	2.5	0	1	1	0	3.5	1	1	0	0	2.5	0	1	1	0	3.0	0	2	0	0	1	1	0	1	1	0
STC–																												
3430	12	115	3.9	11	1	0	0	3.9	11	1	0	0	3.8	9	3	0	0	3.6	7	5	0	0	9	3	0	10	2	0
3450	16	188	3.8	13	3	0	0	3.8	13	3	0	0	3.5	9	6	1	0	3.5	9	6	1	0	4	11	0	10	5	0
3470	9	131	3.7	6	3	0	0	3.9	8	1	0	0	3.6	6	2	1	0	3.6	5	3	0	0	4	5	1	6	3	1
3650	3	64	4.0	2	0	0	0	3.5	1	1	0	0	4.0	2	0	0	0	4.0	2	0	0	0	0	2	0	0	2	0
Other STC drives	9	360	3.6	5	4	0	0	3.3	3	6	0	0	3.4	4	5	0	0	3.3	4	4	1	0	2	7	0	2	7	0
Telex 6420 series	18	143	2.8	2	10	6	0	3.6	11	7	0	0	2.6	3	6	7	2	2.6	3	7	6	2	5	9	4	6	6	6
Subtotals, independents	90	1,118	3.4	47	29	12	1	3.7	60	28	1	0	3.2	39	32	11	6	3.2	37	36	13	2	32	44	11	42	35	13
Totals by Vendor:																												
Ampex	3	18	2.3	0	2	0	1	3.5	1	1	0	0	1.5	0	0	1	1	2.0	0	0	2	0	0	2	1	1	2	0
CalComp	12	47	2.9	4	4	3	1	3.5	6	6	0	0	2.6	3	5	0	4	3.1	5	3	4	0	5	2	3	4	3	6
Control Data	5	26	3.2	2	2	1	0	3.6	3	2	0	0	3.0	1	3	1	0	2.8	0	4	1	0	0	2	3	2	3	0
Mohawk	4	31	3.3	2	1	1	0	3.5	3	0	1	0	3.7	2	1	0	0	3.5	2	2	0	0	2	2	0	1	3	0
Potter	20	156	2.5	1	9	9	1	3.0	5	10	4	1	2.3	2	6	8	4	2.2	1	6	8	4	6	10	3	2	7	9
STC	49	858	3.8	37	11	0	0	3.8	36	12	0	0	3.6	30	16	2	0	3.5	27	18	2	0	19	28	1	28	19	1
Telex	30	182	2.9	5	15	9	0	3.4	15	12	2	0	2.6	5	10	10	4	2.6	6	10	9	4	11	13	6	11	11	7
Texas Instruments	3	10	2.7	1	0	2	0	4.0	1	0	0	0	4.0	1	0	0	0	4.0	1	0	0	0	0	3	0	0	3	0
Subtotals, independents	126	1,328	3.2	52	44	25	3	3.5	70	43	7	1	3.0	44	41	22	13	3.0	42	43	26	8	43	62	17	49	51	23
IBM Totals	24	174	3.5	13	10	1	0	3.5	11	13	0	0	3.4	11	11	2	0	3.4	11	11	1	0	13	9	2	11	11	1
Grand Totals	150	1,502	3.2	65	54	26	3	3.5	81	56	7	1	3.0	55	52	24	13	3.1	53	54	27	8	56	71	19	60	62	24

* All Response Counts are expressed in terms of the number of user responses. The legend is E for Excellent, G for Good, F for Fair, and P for Poor. The Weighted Averages (WA) are derived by giving each response equal weight and assigning a numerical value of 4 (Excellent), 3 (Good), 2 (Fair), or 1 (Poor) to each rating. Cross totals may not sum to the number of responses because not all responses included a rating in every category.

** All Problem Counts are expressed in terms of the number of user responses. The legend is Min. for Minor and Maj. for Major. Cross totals may not sum to the number of responses because not all responses included a reply in every category.

User Experience

Part of any conscientious selection program is talking with existing users of the products under consideration. To assess the current level of user satisfaction with plug-compatible tape drives, Datapro recently conducted an extensive survey of its subscribers. A Reader Survey Form was included in the February 1975 Supplement to Datapro 70 and mailed to all subscribers. By April 10, usable responses had been received giving experience with 126 different cases, representing a total of 1,328 independently supplied tape drives. In addition, we elicited 24 responses representing experience with 174 IBM tape drives.

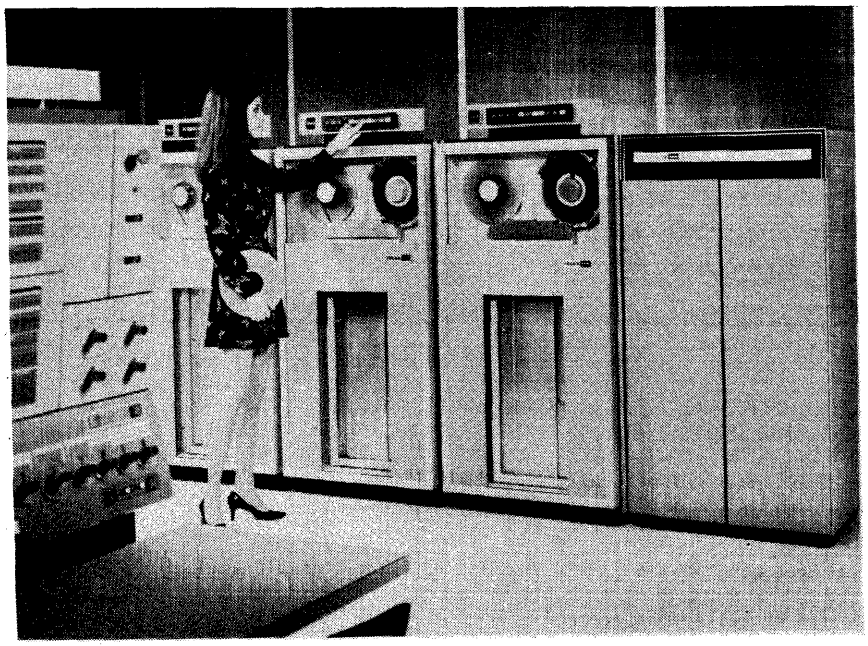
Users were asked to rate their tape drives in four categories: Overall Performance, Ease of Operation, Hardware Reliability, and Maintenance Service. In addition, they were asked to indicate any problems encountered in the installation and/or operation of the tape drives.

The results are presented in the accompanying table; with the footnotes, the table is self-explanatory. A further analysis of the Problem Counts is useful, however. On a percentage basis, the users' experience with independent drives breaks down this way:

Installation Problems:
None–35%
Minor–51%
Major–14%

Operational Problems:
None–40%
Minor–41%
Major–19%

All About Plug-Compatible Tape Drives



The early leader in the plug-compatible disk drive marketplace, Telex has used much of its energies in recent months to pursue legal action against IBM. The Telex 6420 drives shown here are replacements for IBM's 3420 line.

Negative comments by the users centered mainly on controller problems and field service personnel. Positive comments were almost exclusively of the type: "It works and is cheaper than IBM's."

How to Buy

The comparison charts tell you what is available. The users' responses tell you about others' experience with particular equipment. But this is not enough. You need a logical plan to help you determine: (1) whether to replace your tape drives with equipment from one of the independents, (2) which drives to select if you decide to go ahead, and (3) how to implement that selection.

The preceding report, *All About Plug-Compatible Disk Drives* (70D-010-40), contains a detailed discussion of just such a plan of attack. Summarized, it goes like this:

- Re-examine your installation to see how many of which tape drives you really need.
- Survey the field to find the devices that are suitable for your needs and available (with full maintenance service) in your area. Sending a request for proposals to the pertinent vendors is a good way to tie down exactly what each vendor is willing to do for you, and may help to reduce the cost if each vendor knows he is in a competitive bidding position.
- Analyze all costs (equipment, installation, and maintenance) and anticipated savings.
- Investigate the alternatives–including outright purchase or purchase/leaseback of your present IBM equipment and the three ways of acquiring independent peripherals (one-year lease, long-term lease, or purchase).
- Assure yourself of the reliability of the equipment by checking the supplier's reputation, talking to other users, and/or testing the equipment in your installation.
- Choose the equipment that offers the lowest overall costs while meeting your requirements for availability, reliability, and maintenance.
- Negotiate a sound contract. Be sure to spell out exactly what the vendor is responsible for and what you are taking the responsibility for.

Plug-Compatible Tape Drive Characteristics

The accompanying comparison charts summarize the characteristics of 48 commercially available tape drives for replacing IBM, Honeywell, and Univac tape units. The information was supplied by the manufacturers during the months of March and April 1975. Their cooperation is acknowledged and greatly appreciated.

The chart entries and their significance are explained in the following paragraphs.

Each model of each family is listed separately to permit better presentation of format options and cost information.

When a designated model of an independent drive is an exact replacement, in terms of format and speed, for a particular IBM or other model, the manufacturer and model number are stated. Some models of the independent drives are not exact replacements, having a tape speed that falls between the values for two IBM models. For such units, no IBM model is designated. Within families of tape drives (e.g., the IBM 3420 family of six drives), different models can normally be intermixed on

All About Plug-Compatible Tape Drives

the same controller if appropriate density and format features are added. In addition, do not lose sight of the fact that lower- and higher-speed models constitute valid replacements for a particular IBM model as long as you stay in the same family. To go to a different family, a different controller is generally required.

Configuration

The method of attaching the drives to the mainframe is clearly stated. If the drives can be attached via the mainframe vendor's controller, the controller model number is stated. If the independent drive manufacturer also markets a controller, it is identified. If only one methods is specified in the charts, this identifies restrictions on whose controller you can or must use.

Controller switch options provide a capability that used to be called "pooling." This permits a degree of flexibility by switching a group of drives among several controllers. In a mixed-format or mixed-speed environment, controller switch options permit reconfiguration to take advantage of the computer's input/output paths. Conventional notation of the form 2 x 16 identifies the number of controllers that can be in the switch group (the first number) and the maximum number of drives that can be switched (the second number).

Channel switch options permits a tape subsystem (controller plus attached drives) to be switched under program control between multiple processors. Tape subsystems are expensive. Definite operating economies can sometimes be achieved by sharing tapes among multiple processors in the same facility. With disk units, such a switch is frequently attractive in implementing a data base. For tape, it is primarily an economy feature where full-time tape drives are not required on each processor.

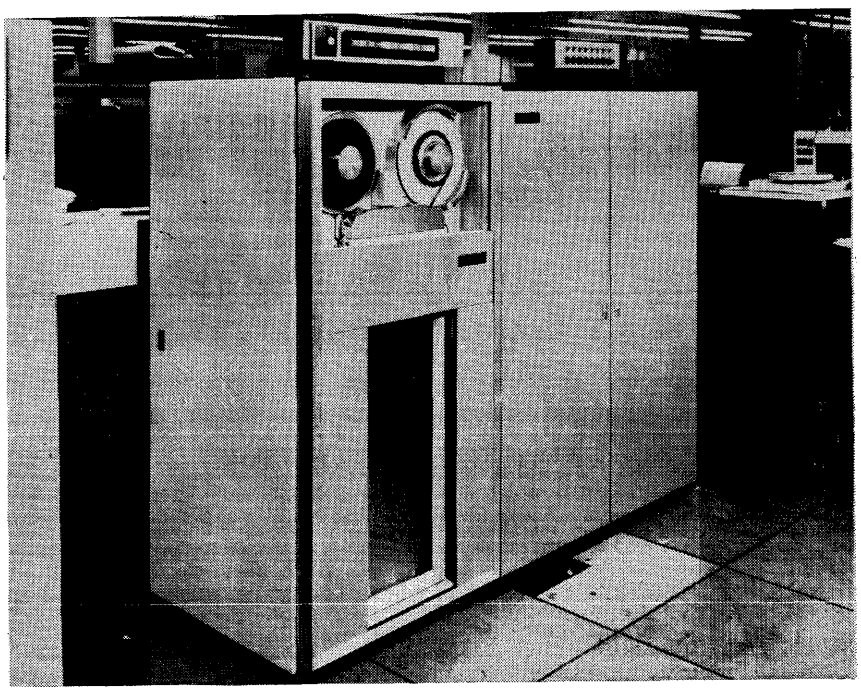
Recording Characteristics

Each combination of formats—the number of tracks and the recording density—is listed separately for each model. The almost universal acceptance and adherence to IBM-established recording practices permits great shortcuts to be taken in what could otherwise be a difficult technical discussion. The four accepted standards are:

- 7-track, 200, 556, and/or 800 bits per inch
- 9-track, 800 bits per inch
- 9-track, 1600 bits per inch
- 9-track, 6250 bits per inch

The 7-track format is a carry-over from second-generation IBM computers. It was superseded when IBM introduced the System/360, which is oriented toward an eight-bit data character (byte). However, some users have not converted all their files. The 7-track capability is retained for exactly the same reason that emulation of the IBM 1400 and 7000 series computers is retained.

Terms such as NRZI (non-return to zero on ones), PE (phase encoded), and GCR (group coded recording, IBM's latest) are great for impressing your friends as to the extent of your knowledge about electronic and magnetic phenomena, but are unnecessary. All the independents adhere to IBM's standards. However, this does not guarantee in and of itself that the tapes recorded on an IBM drive can be read on an independent drive, nor the converse. It does not even guarantee that tapes recorded on one drive can be read by another drive in the same subsystem. This is where your maintenance personnel come into the picture. All drives that use a particular



Users of non-IBM computer systems have long looked at the plug-compatible peripheral market with envious eyes. Formation, among others, is doing something about it. The tape subsystem at left is directed toward Honeywell computer users. Formation also serves the Univac/RCA user.

All About Plug-Compatible Tape Drives

recording format can normally be adjusted to be compatible with one another, but you may have to request or demand it specifically. If this type of compatibility is critical to your operations, it is a worthwhile point to include in the contract.

Features

The availability of certain features is spelled out clearly for all tape drives listed. Simultaneous read/write and read backward features are self-explanatory. *Mode compatibility* permits mixing 7- and 9-track tape drives on the same controller.

Performance

Tape speed and *transfer rate* are self-explanatory. The *rewind time* is also self-evident, but its effect is sometimes overlooked in estimating performance. As it affects performance, rewind time corresponds to the stop time of a disk pack drive. Its importance is a direct function of the frequency with which you change tape reels.

The *tape slack buffer* entry identifies the technique used for managing the length of tape pulled off the tape reel ahead of reading or writing. This is a necessary operation for reducing the time it takes to bring the tape up to speed and stop it, as well as permitting better speed control. Slower units can use mechanical arrangements called dancer arms; higher-speed units generally use vacuum columns.

The *tape transport* also plays a role in the speed and gentleness with which tape can be handled. Slow-speed units can use pinch rollers; higher-speed units generally use a single capstan (drive roller), with the friction force generated as a result of tape tension or a vacuum arrangement.

Pricing and Maintenance

The entries here are quite self-evident. It is here that the bottom line is totaled and decisions are made on replacing IBM equipment. Unfortunately for our information gathering purposes, but fortunately for users, the prices shown must be treated as list prices which are subject to change. Especially with older models of equipment, significant reductions from the prices shown can often be achieved by hard negotiation, particularly if you are in a geographical area that is easy to service or represent a prestige account. IBM prices, conversely, are firm.

Plug-Compatible Tape Drive Manufacturers

Presented below for your convenience in obtaining additional information are the full names, addresses, and telephone numbers of the eight manufacturers represented in the comparison charts.

Ampex Corporation, Computer Products Division, 13031 West Jefferson Boulevard, Marina del Rey, California 90291. Telephone (213) 821-8933.

California Computer Products, Inc. (CalComp), 2411 W. La Palma Avenue, Anaheim, California 92801. Telephone (714) 821-2011.

Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-8100.

Formation Inc., One Computer Drive, Cherry Hill, New Jersey 08003. Telephone (609) 424-1713.

Mohawk Data Sciences Corporation, Utica, New York 13503. Telephone (315) 792-2202.

Potter Instrument Company, Inc., 532 Broad Hollow Road, Melville, New York 11746. Telephone (516) 694-9000.

Storage Technology Corporation, 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

Telex Computer Products, Inc., 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111. □

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MANUFACTURER AND MODEL	Ampex TM-1624-II	Ampex TM-1624-III	Ampex TM-1624-V	Ampex TM-1624-VI	CalComp 345/1040A
REPLACEMENT FOR:					
Tape drive vendor	IBM	IBM	IBM	IBM	IBM
Tape drive product and model numbers	2401-2	2401-3	2401-5	2401-6	3420-5 or 2401-5
CONFIGURATION					
Attachment via mainframe controllers	Yes	Yes	Yes	Yes	No
Attachment via independent controllers	Ampex TC-38	Ampex TC-38	Ampex TC-38	Ampex TC-38	1040/1040-A
Tape drives per controller	—	—	—	—	1 to 8
Controller switch options	—	—	—	—	2/3/4 x 16
Channel switch options	—	—	—	—	2 channels
RECORDING CHARACTERISTICS	7 or 9 track, 800 bpi	7 or 9 track, 800 bpi	9 track, 1600/800 bpi	9 track, 1600/800 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi
FEATURES					
Simultaneous read/write	Opt.	Opt.	Opt.	Opt.	Opt. switch
Read backwards	Yes	Yes	Yes	Yes	Std.
Mode compatibility	—	—	Opt.	Opt.	Std.
PERFORMANCE					
Tape speed, inches/sec.	75	112.5	75	112.5	125
Transfer rate, Kbytes/sec.	60	60	120/60	120/60	25/69.5/100 (7-tk); 100/200 (9-tk)
Rewind time, sec. (for 2400 feet)	90	90	90	90	60
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan	Vacuum capstan
PRICING AND MAINTENANCE					
Purchase price	Contact vendor	Contact vendor	Contact vendor	Contact vendor	$11,880 per drive; $12,650 (1040); $14,520 (1040A)
Monthly lease charges (for a 2-year lease including maintenance)	Contact vendor	Contact vendor	Contact vendor	Contact vendor	$423 per drive; $510 per controller
Alternate leasing plans	Contact vendor	Contact vendor	Contact vendor	Contact vendor	1-, 2-, 3-, and 4-year leases
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	Contact vendor	Contact vendor	Contact vendor	Contact vendor	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	Ampex	Ampex	Ampex	Ampex	CalComp
Maintenance performed by	Ampex	Ampex	Ampex	Ampex	CalComp
First delivery	1/69	1/69	1/69	1/69	4/72
Number installed	Ampex has delivered about 1000 tape drives of all models, including IBM 729 replacements				
COMMENTS	Dual density is optional on TM 1624-III and -V. The 1624 line is no longer produced, but can be obtained on an "as available" basis				Dual density is optional; 7-track operation requires 1040A. Also see Report 70D-118-04

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MANUFACTURER AND MODEL	CalComp 347/1040A	CalComp 8820 Magnetic Tape System	CalComp 8916 Magnetic Tape System	Control Data 34201 Model 4	Control Data 34201 Model 5
REPLACEMENT FOR:					
Tape drive vendor	IBM	UNIVAC	UNIVAC	IBM	IBM
Tape drive product and model numbers	3420-7 or 2420-7	Uniservo VI C, VIII C, 12, 16, 20	Uniservo 12, 16, 20	3420 Model 4	3420 Model 5
CONFIGURATION					
Attachment via mainframe controllers	No	No	No	Yes	No
Attachment via independent controllers	1040/1040-A	CalComp 8820	CalComp 8916	CDC 38031	CDC 38031
Tape drives per controller	1 to 8	1 to 8/16	1 to 8	1 to 8	1 to 8
Controller switch options	2/3/4 x 16	2 x 8/16	None	2/3/4 x 16	2/3/4 x 16
Channel switch options	2 channels	2/3 channels	None	2 channels	2 channels
RECORDING CHARACTERISTICS	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	7 track, 556/800 bpi; 9 track, 800/1600 bpi	7 track, 556/800 bpi; 9 track, 800/1600 bpi
FEATURES					
Simultaneous read/write	Opt. switch	—	—	No	No
Read backwards	Std.	—	—	Std.	Std.
Mode compatibility	Std.	Opt.	Opt.	Std.	Opt.
PERFORMANCE					
Tape speed, inches/sec.	200	125/200	125/200	100	125
Transfer rate, Kbytes/sec.	40/111.2/160(7 tk) 160/320 (9 tk)	25/69.5/100 (7 tk, 125 ips); 40/111.2/160 (7 tk, 200 ips); 100/200 (9 tk, 125 ips); 160/320 (9 tk, 200 ips)		55.6/80 (7 tk); 80/160 (9 tk)	69.5/100 (7 tk); 100/200 (9-tk)
Rewind time, sec. (for 2400 feet)	45	—	—	60	60
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Vacuum capstan	Single capstan	Single capstan	Vacuum capstan	Vacuum capstan
PRICING AND MAINTENANCE					
Purchase price	$14,520 per drive; $12,650 (1040); $14,520 (1040A)	$16,434 per Mdl. 316 drive; $18,898 per Mdl. 320 drive; $39,534 per controller	$16,434 per Mdl. 316 drive; $18,898 per Mdl. 320 drive; $17,600 per controller	$14,700 per drive; $23,600 per controller	$15,500 per drive; $23,600 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$506 per drive; $510 per controller	$502 per Mdl. 316 drive; $578 per Mdl. 320 drive; $1,167 per controller (1 yr.)	$551 per Mdl. 316 drive; $664 per Mdl. 320 drive; $632 per controller (1 yr.)	$310 per drive; $499 per controller (3-year lease)	$348 per drive; $499 per controller (3-year lease)
Alternate leasing plans	1, 2, 3, and 4 year leases	2, 3, 4, and 5 year leases	2, 3, 4, and 5 year leases	1-year; 14.6% and 14% more	1 year; 14.5% and 14% more
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	8 hrs./day, 5 days/week	8 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week
Alternate maintenance plans	None	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Leased by	CalComp	CalComp	CalComp	CDC	CDC
Maintenance performed by	CalComp	CalComp	CalComp	CDC	CDC
First delivery	4/72	1st. qtr. 1974	1/75	1st. qtr. 1974	1st. qtr. 1974
Number installed	—	—		—	—
COMMENTS	Dual Density is optional; 7-track operation requires 1040A. Also see Report 70D-118-04	Model 316 drives are rated at 125 ips, and Model 320 drives are rated at 200 ips. Also see Report 70D-118-01		Each series includes four models: 9-track 800, 1600, or 800/1600 bpi and 7-track. Also see Report 70D-263-07	

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MANUFACTURER AND MODEL	Control Data 34201 Model 7	Formation F6420	Formation F6420	IBM 2401 Model 1	IBM 2401 Model 2
REPLACEMENT FOR:					
Tape drive vendor	IBM	UNIVAC	Honeywell	—	—
Tape drive product and model numbers	3420 Model 7	Most models	Most models	—	—
CONFIGURATION					
Attachment via mainframe controllers	No	No	No	IBM 2803/2804	IBM 2803/2804
Attachment via independent controllers	CDC 38031	F380	F383	—	—
Tape drives per controller	1 to 8	1 to 16	1 to 8	1 to 8	1 to 8
Controller switch options	2/3/4 x 16	2 x 8/16	2 x 8	Opt. via 2816	Opt. via 2816
Channel switch options	2 channels	None	None	Opt., 2 channels	Opt., 2 channels
RECORDING CHARACTERISTICS	7 track, 556/800 bpi; 9 track, 800/1600 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	9 track, 800 bpi	9 track, 800 bpi
FEATURES					
Simultaneous read/write	No	Opt.	Opt.	2804 only	2804 only
Read backwards	Std.	Std.	Std.	Yes	Yes
Mode compatibility	Opt.	Opt.	Opt.	Opt.	Opt.
PERFORMANCE					
Tape speed, inches/sec.	200	75/100/125	70/100/125/150	37.5	75
Transfer rate, Kbytes/sec.	111.2/160 (7 tk); 160/320 (9 tk)	16 to 160 (7 tk); 60 to 320 (9 tk)	14 to 120 (7 tk); 56 to 240 (9 tk)	30	60
Rewind time, sec. (for 2400 feet)	45	60	60	180	84
Tape slack buffer	Vacuum columns	Vacuum columns	Vacuum columns	Vacuum columns	Vacuum columns
Tape transport	Vacuum capstan	Vacuum capstan	Vacuum capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE					
Purchase price	$17,600 per drive; $23,600 per controller	$16,000 to $21,000 per drive; $35,000 per controller	$16,000 to $21,000 per drive; $50,000 per controller	$13,890 per drive; $28,090 per 2803-1; $40,280 per 2804-1	$20,140 per drive; $28,090 per 2803-1; $46,280 per 2804-1
Monthly lease charges (for a 2-year lease including maintenance)	$414 per drive; $499 per controller (3-year lease)	$365 to $450 per drive (3-yr.); $1,000 per controller (3-yr.)	$365 to $450 per drive; $1500 per controller (3-yr.)	$303 per drive; $590 per 2803-1; $844 per 2804-1	$440 per drive; $590 per 2803-1; $844 per 2804-1
Alternate leasing plans	1 year; 14.5% and 14% more	30-day or 4 year	—	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	None	None	None	10% on 30-day rental only	10/ on 30-day rental only
Maintenance included in basic 2-year lease plan	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	None	None
Leased by	CDC	Formation	Formation	IBM	IBM
Maintenance performed by	CDC	Formation	Formation	IBM	IBM
First delivery	1st. qtr. 1974	4/72	—	1965	1965
Number installed	—	500	—	—	—
COMMENTS	Series includes four models: 9-track 800, 1600, or 800/1600 bpi, and 7-track. Also see Report 70D-263-07	Microprogrammed controller with diagnostics	Microprogrammed controller with diagnostics	2804 Tape Controller provides two channel interfaces and features simultaneous read/write	

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MANUFACTURER AND MODEL	IBM 2401 Model 3	IBM 2401 Model 4	IBM 2401 Model 5	IBM 2401 Model 6	IBM 2401 Model 8
REPLACEMENT FOR:					
Tape drive vendor	—	—	—	—	—
Tape drive product and model numbers	—	—	—	—	—
CONFIGURATION					
Attachment via mainframe controllers	IBM 2803/2804	IBM 2803/2804	IBM 2803/2804	IBM 2803/2804	IBM 2803/2804
Attachment via independent controllers	—	—	—	—	—
Tape drives per controller	1 to 8	1 to 8	1 to 8	1 to 8	1 to 8
Controller switch options	Opt. via 2816	Opt. via 2816	Opt. via 2816	Opt. via 2816	None
Channel switch options	Opt., 2 channels	None	None	None	None
RECORDING CHARACTERISTICS	9 track, 800 bpi	9 track, 1600/800 bpi	9 track, 1600/800 bpi	9 track 1600/800 bpi	7 track, 200/556/800 bpi
FEATURE					
Simultaneous read/write	2804 only	2804 only	2804 only	2804 only	2804 only
Read backwards	Yes	Yes	Yes	Yes	Yes
Mode compatibility	Opt.	No	No	No	No
PERFORMANCE					
Tape speed, inches/sec.	112.5	37.5	75	112.5	75
Transfer rate, Kbytes/sec.	90	60/30	120/60	180/90	15/41.7/60
Rewind time, sec. (for 2400 feet)	60	180	84	60	84
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE					
Purchase price	$32,650 per drive; $28,090 per 2803-1; $40,280 per 2804-1	$15,900 per drive; $34,660 per 2803-2; $46,850 per 2804-2	$22,260 per drive; $34,660 per 2803-2; $46,850 per 2804-2	$34,770 per drive; $34,660 per 2803-2; $46,850 per 2804-2	$14,630 per drive; $16,640 per 2803-3; $22,900 per 2804-3
Monthly lease charges (for a 2-year lease including maintenance)	$712 per drive; $590 per 2803-1; $844 per 2804-1	$349 per drive; $726 per 2803-2; $979 per 2804-2	$486 per drive; $726 per 2803-2; $979 per 2804-2	$758 per drive; $726 per 2803-2; $979 per 2804-2	$362 per drive; $407 per 2803-3; $567 per 2804-3
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	IBM	IBM	IBM	IBM	IBM
Maintenance performed by	IBM	IBM	IBM	IBM	IBM
First delivery	1965	1966	1966	1966	1971
Number installed	—	—	—	—	—
COMMENTS	2804 Tape Controller provides two channel interfaces and features simultaneous read/write				

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MANUFACTURER AND MODEL	IBM 2415 Model 1	IBM 2415 Model 2	IBM 2415 Model 3	IBM 2415 Model 4	IBM 2415 Model 5
REPLACEMENT FOR:					
Tape drive vendor	—	—	—	—	—
Tape drive product and model numbers	—	—	—	—	—
CONFIGURATION					
Attachment via mainframe controllers	Integral	Integral	Integral	Integral	Integral
Attachment via independent controllers	—	—	—	—	—
Tape drives per controller	2	4	6	2	4
Controller switch options	—	—	—	—	—
Channel switch options	—	—	—	—	—
RECORDING CHARACTERISTICS	9 track, 800 bpi; 7 or 9 track, 800 bpi	9 track, 800 bpi; 7 track, 800 bpi	9 track, 800 bpi; 7 track, 800 bpi	9 track, 1600 bpi; 7 or 9 track, 800 bpi	9 track, 1600 bpi; 7 or 9 track, 800 bpi
FEATURES					
Simultaneous read/write	—	—	—	No	No
Read backwards	Yes	Yes	Yes	Yes	Yes
Mode compatibility	—	—	—	No	No
PERFORMANCE					
Tape speed, inches/sec.	18.75	18.75	18.75	18.75	18.75
Transfer rate, Kbytes/sec.	15	15	15	30/15	30/15
Rewind time, sec. (for 2400 feet)	240	240	240	240	240
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE					
Purchase price	$31,690 (2 drives)	$50,670 (4 drives)	$69,640 (6 drives)	$38,480 (2 drives)	$61,800 (4 drives)
Monthly lease charges (for a 2-year lease including maintenance)	$680 (2 drives)	$1,088 (4 drives)	$1,495 (6 drives)	$822 (2 drives)	$1,319 (4 drives)
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	IBM	IBM	IBM	IBM	IBM
Maintenance performed by	IBM	IBM	IBM	IBM	IBM
First delivery	1966	1966	1966	1966	1966
Number installed	—	—	—	—	—
COMMENTS					

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MANUFACTURER AND MODEL	IBM 2415 Model 6	IBM 2420 Model 5	IBM 2420 Model 7	IBM 3420 Model 3	IBM 3420 Model 5
REPLACEMENT FOR:					
Tape drive vendor	—	—	—	—	—
Tape drive product and model numbers	—	—	—	—	—
CONFIGURATION					
Attachment via mainframe controllers	Integral	IBM 2803-2	IBM 2803-2	IBM 3803-1	IBM 3803-1
Attachment via independent controllers	—	—	—	—	—
Tape drives per controller	6	1 to 8/16	1 to 8/16	1 to 16	1 to 16
Controller switch options	None	Opt. via 2816	Opt. via 2816	2/3/4 x 8/16	2/3/4 x 8/16
Channel switch options	None	None	None	Opt., 2 channels	Opt., 2 channels
RECORDING CHARACTERISTICS	9 track, 1600 bpi; 7 or 9 track, 800 bpi	9 track, 1600 bpi	9 track, 1600 bpi	7 track, 556/800 bpi; 9 track, 1600 bpi; 9 track, 1600/800 bpi	7 track, 556/800 bpi; 9 track, 1600 bpi; 9 track, 1600/800 bpi
FEATURES					
Simultaneous read/write	No	No	No	No	No
Read backwards	Yes	Yes	Yes	Yes	Yes
Mode compatibility	No	No	No	No	No
PERFORMANCE					
Tape speed, inches/sec.	18.75	100	200	75	125
Transfer rate, Kbytes/sec.	30/15	160	320	41.7/60 (7 tk); 60/120 (9 tk)	69.5/100 (7 tk); 100/200 (9 tk)
Rewind time, sec. (for 2400 feet)	240	72	60	60	60
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE					
Purchase price	$85,120 (6 drives)	$26,820 per drive; $34,660 per 2803-2	$48,650 per drive; $34,660 per 2803-2	$17,120 per drive; $26,300 per 3803-1	$21,820 per drive; $26,300 per 3803-1
Monthly lease charges (for a 2-year lease including maintenance)	$1,814 (6 drives)	$513 per drive; $726 per 2803-2	$924 per drive; $726 per 2803-2	$398 per drive; $612 per 3803-1	$507 per drive; $612 per 3803-1
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	IBM	IBM	IBM	IBM	IBM
Maintenance performed by	IBM	IBM	IBM	IBM	IBM
First delivery	1966	1969	1968	10/71	10/71
Number installed	—	—	—	—	—
COMMENTS				Dual Density and 7-Track features are optional	Dual Density and 7-Track features are optional

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MANUFACTURER AND MODEL	IBM 3420 Model 7	IBM 3420 Model 4	IBM 3420 Model 6	IBM 3420 Model 8	IBM 3410/3411 Model 1
REPLACEMENT FOR:					
Tape drive vendor	—	—	—	—	—
Tape drive product and model numbers	—	—	—	—	—
CONFIGURATION					
Attachment via mainframe controllers	IBM 3803-1	IBM 3803-2	IBM 3803-2	IBM 3803-2	IBM 3411-1
Attachment via independent controllers	—	—	—	—	—
Tape drives per controller	1 to 16	1 to 16	1 to 16	1 to 16	4
Controller switch options	2/3/4 x 8/16	2/3/4 x 8/16	2/3/4 x 8/16	2/3/4 x 8/16	None
Channel switch options	Opt., 2 chan.	Opt., 2 chan.	Opt., 2 chan.	Opt., 2 chan.	None
RECORDING CHARACTERISTICS	7 track, 556/800 bpi; 9 track, 1600 bpi; 9 track, 1600/800 bpi	9 track, 6250/1600 bpi	9 track, 6250/1600 bpi	9 track, 6250/1600 bpi	9 track, 1600 bpi; 7 track, 200/556/800 bpi
FEATURES					
Simultaneous read/write	No	No	No	No	No
Read backwards	Yes	Yes	Yes	Yes	Yes
Mode compatibility	No	No	No	No	Opt.
PERFORMANCE					
Tape speed, inches/sec.	200	75	125	200	12.5
Transfer rate, Kbytes/sec.	111.2/160 (7 tk); 160/320 (9 tk)	469/120	781/200	1250/320	2.5/7/10 (7 tk); 20 (9 tk)
Rewind time, sec. (for 2400 feet)	45	60	60	45	180
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE					
Purchase price	$26,120 per drive; $26,300 per 3803-1	$26,950 per drive; $43,800 per 3803-2	$31,050 per drive; $43,800 per 3803-2	$34,150 per drive; $43,800 per 3803-2	$10,400 per drive; $17,300 per 3411-1
Monthly lease charges (for a 2-year lease including maintenance)	$606 per drive; $612 per 3803-1	$625 per drive; $1,025 per 3803-2	$712 per drive; $1,025 per 3803-2	$788 per drive; $1,025 per 3803-2	$216 per 3410-1; $367 per 3411-1
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)
Overtime charges	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only	10% on 30-day rental only
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	IBM	IBM	IBM	IBM	IBM
Maintenance performed by	IBM	IBM	IBM	IBM	IBM
First delivery	10/71	10/73	10/73	10/73	12/72
Number installed	—	—	—	—	—
COMMENTS	Dual Density and 7-Track features are optional	Dual Density is optional; 7- and 9-Track features are available with 3803-2		Dual Density (6250/1600 bpi) is optional	Dual Density is optional but mutually exclusive with 7-track operation; 3411 includes one drive and control for up to 3 or 5 3410 drives

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MANUFACTURER AND MODEL	IBM 3410/3411 Model 2	IBM 3410/3411 Model 3	Mohawk 2007	Mohawk 8420-3	Mohawk 8420-5
REPLACEMENT FOR:					
Tape drive vendor	—	—	IBM	IBM	IBM
Tape drive product and model numbers	—	—	2401-5	3420-3	3420-5
CONFIGURATION					
Attachment via mainframe controllers	IBM 3411-2	IBM 3411-3	No	No	No
Attachment via independent controllers	—	—	8803	8803	8803
Tape drives per controller	6	6	1 to 8	1 to 8 or 16	1 to 8 or 16
Controller switch options	None	None	2 x 8/16	2 x 8/16	
Channel switch options	None	None	None	Opt.	Opt.
RECORDING CHARACTERISTICS	9 track, 1600 bpi; 7 track, 200/556/800 bpi	9 track, 1600 bpi; 7 track, 200/556/800 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi
FEATURES					
Simultaneous read/write	No	No	No	Std.	Std.
Read backwards	Yes	Yes	No	Std.	Std.
Mode compatibility	Opt.	Opt.	Opt.	Opt.	Opt.
PERFORMANCE					
Tape speed, inches/sec.	25	50	75	75	175
Transfer rate, Kbytes/sec.	5/13.9/20 (7 tk); 40 (9 tk)	10/27.8/40 (7 tk); 80 (9 tk)	15/41.7/60 (7 tk); 60/120 (9 tk)	15/41.7/60 (7 tk); 60/120 (9 tk)	35/97.3/140 (7 tk); 140/280 (9 tk)
Rewind time, sec. (for 2400 feet)	180	180	180	41	41
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Vacuum capstan	Vacuum capstan	Vacuum capstan
PRICING AND MAINTENANCE					
Purchase price	$13,050 per 3410-2; $21,900 per 3411-2	$15,550 per 3410-3; $26,700 per 3411-3	$9,000 per drive; $23,200 per controller	$15,600 per drive; $23,200 per controller	$18,400 per drive; $27,200 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$271 per 3410-2; $468 per 3411-2	$326 per 3410-3; $567 per 3411-3	$252 per drive; $496 per controller	$315 per drive; $496 per controller	$391 per drive; $496 per controller
Alternate leasing plans	30-day (19% more) and 12-23 mo. (9.5% more)	30-day (19% more) and 12-23 mo. (9.5% more)	1 to 5 years; fixed or variable term; 11% more to 28% less	1 to 5 years; fixed or variable term; 11% more to 28% less	1 to 5 years; fixed or variable term; 11% more to 28% less
Overtime charges	10% on 30-day rental only	10% on 30-day rental only	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	IBM	IBM	Mohawk	Mohawk	Mohawk
Maintenance performed by	IBM	IBM	Mohawk	Mohawk	Mohawk
First delivery	12/72	12/72	1st qtr. 1972	1st qtr. 1973	1st qtr. 1973
Number installed	—	—	—	—	—
COMMENTS	Dual Density is optional, but is mutually exclusive with 7-track operation; 3411 includes one drive and control for up to 3 or 5 3410 drives		Dual Density is standard	Dual Density is standard	Dual Density is standard

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	Potter SC 2402 & AT 2402	Potter SC 2403 & AT 2403	Potter SC 2405 & AT 2405	Potter SC 2406 & AT 2406	Potter AT 3423-1
REPLACEMENT FOR:					
Tape drive vendor	IBM	IBM	IBM	IBM	IBM
Tape drive product and model numbers	2401-2	2401-3	2401-5	2401-6	3420-3
CONFIGURATION					
Attachment via mainframe controllers	No	No	Yes	Yes	No
Attachment via independent controllers	TC 5803-2	TC 5803-2	TC 5803-2	TC 5803-2	TC 5805
Tape drives per controller	1 to 8	1 to 8	1 to 8	1 to 8	1 to 8
Controller switch options	None	None	None	None	2/3/4 x 16
Channel switch options	None	None	None	None	2 channels
RECORDING CHARACTERISTICS	7 track, 200/ 556/800 bpi; 9 track, 800 bpi	7 track, 200/ 556/800 bpi; 9 track, 800 bpi	9 track, 800/1600 bpi	9 track, 800/1600 bpi	7 track, 200/ 556/800 bpi; 9 track, 800/ 1600 bpi
FEATURES					
Simultaneous read/write	Opt.	Opt.	Opt.	Opt.	No
Read backwards	Std.	Std.	Std.	Std.	Std.
Mode compatibility	Opt.	Opt.	No	No	Opt.
PERFORMANCE					
Tape speed, inches/sec.	75	112.5	75	112.5	75
Transfer rate, Kbytes/sec.	15/41.7/60 (7 tk); 60 (9 tk)	22.5/62.6/90 (7 tk); 90 (9 tk)	60/120	90/180	15/41.7/60 (7 tk); 60/120 (9 tk)
Rewind time, sec. (for 2400 feet)	100	97	100	97	70
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Vacuum capstan	Vacuum capstan	Vacuum capstan	Vacuum capstan	Vacuum capstan
PRICING AND MAINTENANCE					
Purchase price	$5,500 per SC 2402; $6,300 per AT 2402; $10,800 per controller	$5,700 per SC 2403; $6,600 per AT 2403; $10,800 per controller	$6,100 per SC 2405; $7,400 per AT 2405; $13,300 per controller	$6,300 per SC 2406; $7,700 per AT 2406; $13,300 per controller	$8,550 per drive; $13,200 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$190 per SC 2402; $220 per AT 2402; $350 per controller	$200 per SC 2403; $220 per AT 2403; $350 per controller	$225 per SC 2405; $250 per AT 2405; $435 per controller	$235 per SC 2406; $260 per AT 2406; $435 per controller	$345 per drive; $490 per controller
Alternate leasing plans	1 year; 10% more	1 year; 10% more	1 year; 10% more	1 year; 10% more	1 year; 10% more
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	9 hrs./day 5 days/week	9 hrs./day 5 days/week	9 hrs./day 5 days/week
Alternate maintenance plans	Contact vendor	Contact vendor	Contact vendor	Contact vendor	Contact vendor
Leased by	Potter	Potter	Potter	Potter	Potter
Maintenance performed by	Potter	Potter	Potter	Potter	Potter
First delivery	5/68	5/68	5/68	5/68	12/72
Number installed	500 units among all models		750 units among all models		
COMMENTS	AT series drives feature automatic threading	AT series drives feature automatic threading	AT series drives feature automatic threading	AT series drives feature automatic threading	AT 3400 series drives feature auto thread and auto load with or without a tape cartridge

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	Potter AT 3425-1	Potter AT 3427	STC 3430	STC 3440	STC 3450
REPLACEMENT FOR:					
Tape drive vendor	IBM	IBM	IBM	IBM	IBM
Tape drive product and model numbers	3420-5	3420-7	IBM 3420-3	—	3420-5
CONFIGURATION					
Attachment via mainframe controllers	No	No	No	No	No
Attachment via independent controllers	TC 5805	TC 5805	STC 3800-III	STC 3800-III	STC 3800-III
Tape drives per controller	1 to 8	1 to 8	1 to 8	1 to 8	1 to 8
Controller switch options	2/3/4 x 16	2/3/4 x 16	2/3/4 x 8	2/3/4 x 8	2/3/4 x 8
Channel switch options	2 channels	2 channels	2 channels	2 channels	2 channels
RECORDING CHARACTERISTICS	7 track, 200/ 556/800 bpi; 9 track, 800/ 1600 bpi	7 track, 200/ 556/800 bpi; 9 track, 800/ 1600 bpi	7 track, 200/ 556/800 bpi; 9 track, 800/ 1600 bpi	7 track, 200/ 556/800 bpi; 9 track, 800/ 1600 bpi	7 track, 200/ 556/800 bpi; 9 track, 800/ 1600 bpi
FEATURES					
Simultaneous read/write	No	No	No	No	No
Read backwards	Std.	Std.	Std.	Std.	Std.
Mode compatibility	Opt.	Opt.	Opt.	Opt.	Opt.
PERFORMANCE					
Tape speed, inches/sec.	125	200	75	100	125
Transfer rate, Kbytes/sec.	25/69.5/100 (7 tk); 100/200 (9 tk)	40/111.2/160 (7 tk); 160/320 (9 tk)	15/41.7/60 (7 tk); 60/120 (9 tk)	20/55.6/80 (7 tk); 80/160 (9 tk)	25/69.5/100 (7 tk); 100/200 (9 tk)
Rewind time, sec. (for 2400 feet)	60	45	65	60	55
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Vacuum capstan	Vacuum capstan	Vacuum capstan	Vacuum capstan	Vacuum capstan
PRICING AND MAINTENANCE					
Purchase price	$10,980 per drive; $13,200 per controller	$13,180 per drive; $13,200 per controller	$16,840 per drive; $25,740 per controller	$19,625 per drive; $25,740 per controller	$21,105 per drive; $25,740 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$365 per drive; $490 per controller	$470 per drive; $490 per controller	$389 per drive; $552 per controller	$435 per drive; $552 per controller	$457 per drive; $552 per controller
Alternate leasing plans	1 year; 10% more	1 year; 10% more	1, 3, and 5 years; 9.5% more to 7.4% less	1, 3, and 5 years; 9.4% more to 8% less	1, 3, and 5 years; 9% more to 8% less
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	9 hrs./day, 5 days/week	9 hrs./day, 5 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	Contact vendor	Contact vendor	None	None	None
Leased by	Potter	Potter	STC	STC	STC
Maintenance performed by	Potter	Potter	STC	STC	STC
First delivery	4/73	4/73	1/72	1/72	1/72
Number installed	—	—	—	—	—
COMMENTS	AT 3400 series drives feature auto thread and auto load with or without a tape cartridge		Dual Density is optional; also see Report 70D-789-02	Dual Density is optional; also see Report 70D-789-02	Dual Density is optional; also see Report 70D-789-02

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	STC 3470	STC 3480	STC 3630	STC 3650	STC 3670
REPLACEMENT FOR:					
Tape drive vendor	IBM	IBM	IBM	IBM	IBM
Tape drive product and model numbers	3420-7	—	3420-4	3420-6	3420-8
CONFIGURATION					
Attachment via mainframe controllers	No	No	No	No	No
Attachment via independent controllers	STC 3800-III	STC 3800-III	STC 3800-IV	STC 3800-IV	STC 3800-IV
Tape drives per controller	1 to 8	1 to 8	1 to 8	1 to 8	1 to 8
Controller switch options	2/3/4 x 8	2/3/4 x 8	2/3/4 x 8	2/3/4 x 8	2/3/4 x 8
Channel switch options	2 channels	2 channels	2 channels	2 channels	2 channels
RECORDING CHARACTERISTICS	7 track, 200/556/800 bpi; 9 track, 800/1600 bpi	9 track, 1600 bpi	9 track, 6250/1600 bpi	9 track, 6250/1600 bpi	9 track, 6250/1600 bpi
FEATURES					
Simultaneous read/write	No	No	No	No	No
Read backwards	Std.	Std.	Std.	Std.	Std.
Mode compatibility	Opt.	Opt.	Opt.	Opt.	Opt.
PERFORMANCE					
Tape speed, inches/sec.	200	250	75	125	200
Transfer rate, Kbytes/sec.	40/111.2/160 (7 tk); 160/320 (9 tk)	400	469/120	781/200	1250/320
Rewind time, sec. (for 2400 feet)	45	45	65	55	45
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Vacuum capstan	Vacuum capstan
PRICING AND MAINTENANCE					
Purchase price	$24,525 per drive; $24,740 per controller	$32,000 per drive; $25,740 per controller	$24,000 per drive; $42,940 per controller	$28,000 per drive; $42,940 per controller	$31,000 per drive; $42,940 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$526 per drive; $552 per controller	$650 per drive; $552 per controller	$555 per drive; $552 per controller	$622 per drive; $925 per controller	$688 per drive; $925 per controller
Alternate leasing plans	1, 3, and 5 years; 9.5% more to 8% less	1, 3, and 5 years; 9.5% more to 6.9% less	1, 3, and 5 years; 9.4% more to 7.2% less	1, 3, and 5 years; 9.3% more to 6.7% less	1, 3, and 5 years; 9.3% more to 6.9% less
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	STC	STC	STC	STC	STC
Maintenance performed by	STC	STC	STC	STC	STC
First delivery	1/72	1/72	7/75	3/74	9/75
Number installed	—	—	—	—	—
COMMENTS	Dual Density is optional; also see Report 70D-789-02	Dual Density is optional; also see Report 70D-789-02	Dual Density is optional; also see Report 70D-789-03	Dual Density is optional; also see Report 70D-789-03	Dual Density is optional; also see Report 70D-789-03

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	STC 3685	STC 3400/3820	STC 3600/3821	Telex 4811 & 4812	Telex 4821 & 4822
REPLACEMENT FOR:					
Tape drive vendor	IBM	UNIVAC	UNIVAC	IBM	IBM
Tape drive product and model numbers	—	Uniservo VI C,VIII C, 12, 16, 20	Uniservo VI C,VIII C, 12, 16, 20	2401-1	2401-2
CONFIGURATION					
Attachment via mainframe controllers	No	No	No	IBM 2803	IBM 2803
Attachment via independent controllers	STC 3800-IV	STC 3820	STC 3821	Telex 6803-3	Telex 6803-3
Tape drives per controller	1 to 8	1 to 16	1 to 8/16	1 to 8	1 to 8
Controller switch options	2/3/4 x 8	2 x 8/16	2 x 8/16	None	None
Channel switch options	2 channels	2 channels	2 channels	2 channels	2 channels
RECORDING CHARACTERISTICS	9 track; 6250/1600 bpi	7 track, 200/556/800 bpi; 9 track, 1600/800 or 800 bpi	9 track, 6250/1600 bpi	4811: 7 tk, 200/556/800 bpi; 4812: 9 tk, 800 bpi	4821: 7 tk, 200/556/800 bpi; 4822: 9 tk, 800 bpi
FEATURES					
Simultaneous read/write	No	No	No	Opt.	Opt.
Read backwards	Std.	Std.	Std.	No	No
Mode compatibility	Opt.	Opt.	Opt.	Opt.	Opt
PERFORMANCE					
Tape speed, inches/sec.	125/250	125; 200; 250	125; 200; 125/250	37.5	75
Transfer rate, Kbytes/sec.	781 (6250); 400 (1600)	25 to 160 (7 tk); 100 to 400 (9 tk)	780/1250 (6250); 200/320/400/1600	7.5/20.9/30 (7 tk); 30 (9 tk)	15/41.7/60 (7 tk); 60 (9 tk)
Rewind time, sec. (for 2400 feet)	45	45/55	45/55	—	—
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Vacuum capstan	Single capstan	Vacuum capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE					
Purchase price	$37,500 per drive; $42,940 per controller	$32,000 (3480); $24,525 (3470); $21,105 (3450); $31,600 (3820)	Contact vendor	$6,500 per drive; $12,500 per controller	$6,500 per drive; $12,500 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$780 per drive; $925 per controller	$650 (3480); $526 (3470); $457 (3450); $1,285 (3820)	Contact vendor	$250 per drive; $350 per controller	$250 per drive; $350 per controller
Alternate leasing plans	1, 3, and 5 years; 7.6% more to 8% less	1, 3, and 5 years; 9.5% more to 7% less	Contact vendor	Basic (24% more) and 1 year (20% more)	Basic (74% more) and 1 year (20% more)
Overtime charges	None	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	Contact vendor	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None	None
Leased by	STC	STC	STC	Telex; 3rd party	Telex; 3rd party
Maintenance performed by	STC	STC	STC	Telex	Telex
First delivery	—	9/73	—	6/68	6/68
Number installed	—	—	—	—	—
COMMENTS	Dual Density is optional; also see Report 70D-789-03	Includes STC 3480, 3470, and 3450 drives; Dual Density is optional. Also see Report 70D-789-06	Includes STC 3685, 3670, and 3650 drives; Dual Density is optional. Also see Report 70D-789-06	Options are priced as follows: Simultaneous Read/Write, $6/mo. or $180; Dual Density, $13/mo. or $480	

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	Telex 4831 & 4832	Telex 4852	Telex 4862	Telex 5420-5
REPLACEMENT FOR:				
Tape drive vendor	IBM	IBM	IBM	IBM
Tape drive product and model numbers	2401-3	2401-5	2401-6	2420-5
CONFIGURATION				
Attachment via mainframe controllers	IBM 2803	IBM 2803	IBM 2803	No
Attachment via independent controllers	Telex 6803-3	Telex 6803-3	Telex 6803-3	Telex 6803-2
Tape drives per controller	1 to 8	1 to 8	1 to 8	1 to 8
Controller switch options	None	None	None	None
Channel switch options	2 channels	2 channels	2 channels	2 channels
RECORDING CHARACTERISTICS	4831: 7 tk, 200/ 556/800 bpi; 4832: 9 tk, 800 bpi	9 track, 800/1600 bpi	9 track, 800/1600 bpi	9 track, 1600 bpi
FEATURES				
Simultaneous read/write	Opt.	Opt.	Opt.	No
Read backwards	No	No	No	Yes
Mode compatibility	Opt.	Opt.	Opt.	No
PERFORMANCE				
Tape speed, inches/sec.	112.5	75	112.5	100
Transfer rate, Kbytes/sec.	22.5/62.5/90 (7 tk); 90 (9 tk)	60/120	90/180	160
Rewind time, sec. (for 2400 feet)	—	—	—	—
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Dual capstan	Dual capstan	Single capstan
PRICING AND MAINTENANCE				
Purchase price	$6,500 per drive; $12,500 per controller	$6,500 per drive; $12,500 per controller	$6,500 per drive; $12,500 per controller	$8,500 per drive; $15,200 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$260 per drive; $350 per controller	$255 per drive; $350 per controller	$280 per drive; $350 per controller	$320 per drive; $385 per controller
Alternate leasing plans	Basic (203% more) and 1 year (15% more)	Basic (88% more) and 1 year (18% more)	Basic (93% more) and 1 year (7% more)	Basic (20% more) and 1 year (11% more)
Overtime charges	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None
Leased by	Telex; 3rd party	Telex; 3rd party	Telex; 3rd party	Telex
Maintenance performed by	Telex	Telex	Telex	Telex
First delivery	6/68	6/68	6/68	2/71
Number installed	—	—	—	—
COMMENTS	Options are priced as follows: Simultaneous Read/Write, $6/mo. or $180; Dual Density, $13/mo. or $480			

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	Telex 5420-7	Telex 6420-3	Telex 6420-4	Telex 6420-5
REPLACEMENT FOR:				
Tape drive vendor	IBM	IBM	IBM	IBM
Tape drive product and model numbers	2420-7	3420-3	—	3420-5
CONFIGURATION				
Attachment via mainframe controllers	No	No	No	No
Attachment via independent controllers	Telex 6803-2	Telex 6803-1	Telex 6803-1	Telex 6803-1
Tape drives per controller	1 to 8	1 to 8/16	1 to 8/16	1 to 8/16
Controller switch options	None	2/3/4 x 16	2/3/4 x 16	2/3/4 x 16
Channel switch options	2 channels	2 channels	2 channels	2 channels
RECORDING CHARACTERISTICS	9 track, 1600 bpi	7 track, 556/800 bpi; 9 track, 800/1600 bpi	7 track, 556/800 bpi; 9 track, 800/1600 bpi	7 track, 556/800 bpi; 9 track, 800/1600 bpi
FEATURES				
Simultaneous read/write	No	No	No	No
Read backwards	Yes	Yes	Yes	Yes
Mode compatibility	No	Opt.	Opt.	Opt.
PERFORMANCE				
Tape speed, inches/sec.	200	75	100	125
Transfer rate, Kbytes/sec.	320	41.7/60 (7 tk); 60/120 (9 tk)	55.6/80 (7 tk); 80/160 (9 tk)	69.5/100 (7 tk); 100/200 (9 tk)
Rewind time, sec. (for 2400 feet)	—	60	60	60
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE				
Purchase price	$10,000 per drive; $15,200 per controller	$11,000 per drive; $13,000 per controller	$11,600 per drive; $13,000 per controller	$12,900 per drive; $13,000 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$375 per drive; $385 per controller	$430 per drive; $525 per controller	$430 per drive; $525 per controller	$435 per drive; $525 per controller
Alternate leasing plans	Basic (48% more) and 1 year (9% more)	3 year; 16% less	3 year; 16% less	3 year; 16% less
Overtime charges	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week	24 hrs./day, 7 days/week
Alternate maintenance plans	None	None	None	None
Leased by	Telex	Telex	Telex	Telex
Maintenance performed by	Telex	Telex	Telex	Telex
First delivery	11/70	11/71	11/71	11/71
Number installed	—	—	—	—
COMMENTS		Also see Report 70D-831-06	Also see Report 70D-831-06	Also see Report 70D-831-06

All About Plug-Compatible Tape Drives

MANUFACTURER AND MODEL	Telex 6420-6	Telex 6420-7	Telex 6420-44	Telex 6420-66
REPLACEMENT FOR:				
Tape drive vendor	IBM	IBM	IBM	IBM
Tape drive product and model numbers	—	3420-7	3420-4	—
CONFIGURATION				
Attachment via mainframe controllers	No	No	No	No
Attachment via independent controllers	Telex 6803-1	Telex 6803-1	Telex 6803-11	Telex 6803-11
Tape drives per controller	1 to 8/16	1 to 8/16	1 to 8/16	1 to 8/16
Controller switch options	2/3/4 x 16	2/3/4 x 16	2/3/4 x 16	2/3/4 x 16
Channel switch options	2 channels	2 channels	2 channels	2 channels
RECORDING CHARACTERISTICS	7 track, 556/800 bpi;	7 track, 556/800 bpi	9 track, 6250/1600 bpi	9 track, 6250/1600 bpi
FEATURES				
Simultaneous read/write	No	No	No	No
Read backwards	Yes	Yes	Yes	Yes
Mode compatibility	Opt.	Opt.	Opt.	Opt.
PERFORMANCE				
Tape speed, inches/sec.	150	200	75	125
Transfer rate, Kbytes/sec.	83.4/120 (7 tk); 120/240 (9 tk)	111.2/160 (7 tk) 160/320 (9 tk)	469/120	781/200
Rewind time, sec. (for 2400 feet)	60	45	60	60
Tape slack buffer	Vacuum column	Vacuum column	Vacuum column	Vacuum column
Tape transport	Single capstan	Single capstan	Single capstan	Single capstan
PRICING AND MAINTENANCE				
Purchase price	$13,700 per drive; $13,000 per controller	$14,900 per drive; $13,000 per controller	$13,500 per drive; $20,000 per controller	$16,000 per drive; $20,000 per controller
Monthly lease charges (for a 2-year lease including maintenance)	$470 per drive; $525 per controller	$505 per drive; $525 per controller	$600 per drive; $925 per controller	$685 per drive; $925 per controller
Alternate leasing plans	3 year; 13% less	3 year; 11% less	3 year; 12% less	3 year; 14% less
Overtime charges	None	None	None	None
Maintenance included in basic 2-year lease plan	24 hrs./day 7 days/week	24 hrs./day 7 days/week	24 hrs./day 7 days/week	24 hrs./day 7 days/week
Alternate maintenance plans	None	None	None	None
Leased by	Telex	Telex	Telex	Telex
Maintenance performed by	Telex	Telex	Telex	Telex
First delivery	11/71	1/71	2nd qtr. 1975	2nd qtr. 1975
Number installed	—	—	—	—
COMMENTS	Also see Report 70D-831-06	Also see Report 70D-831-06	Dual Density is optional at $20/mo. or $820 per drive; 7 and 9 track drives can be mixed on 6803-11. Also see Report 70D-831-06	

How to Select and Use Add-On Main Memory

Despite the continued economic crunch and an overcrowded, highly competitive market, add-on main memory continues to thrive as an attractive, cost-effective alternative to the mainframe manufacturers' own memory. According to recent market studies, prospects are good for continued growth in this market through the early 1980's.

What motivates computer users to buy main memory units from sources other than their mainframe suppliers? There are a number of good reasons.

First and foremost, add-on memory offers the greatest dollar savings of all the "plug-compatible" products, such as disk and tape drives. For example, add-on memory vendors offer their wares at prices up to 70 percent (under extended lease plans) below the cost of the mainframe makers' memory. By contrast, disk or tape drives leased from independent vendors are seldom priced more than 10 to 15 percent below the drives supplied by the mainframe vendors.

What's more, add-on memory is usually the first "plug-compatible" device that a user will see fit to incorporate. Users feel more relaxed about attaching independent memory than any other device because of its established track record (see the User Reaction section of this report) as the most reliable peripheral attachment—a direct result of its totally electronic construction. Once installed, the add-on units function in exactly the same manner as the mainframe manufacturer's own memory, and normally run for months at a time without any need for service.

Another motivating factor is the user's continuing need for more memory to satisfy the ever-increasing demands of his business environment. With a tighter operating budget than was available prior to the current economic slowdown, the user is more apt to go with independent memory in order to get the most for his money.

Another motivating factor is the probable extension of the System/370's effective lifespan that resulted from IBM's apparent postponement of its major new computer systems architecture (FS) announcement. This seems to have sparked a renewed interest in the System/360 add-on market, as some vendors currently report a strong increase in sales in this market segment. A number of System/370 users have downgraded to System/360 models with large amounts of add-on memory in order to reduce their equipment costs.

In summary, the key motivating factors that currently form the major thrust behind the add-on main memory market are: large dollar savings, high product reliability, strong user acceptance, a recessive economy, and the probable extension of the System/370's lifespan.

Add-on main memory from independent vendors can substantially improve the performance and cost-effectiveness of computers from IBM and other mainframe makers. This report—used in conjunction with the individual product reports in DATAPRO 70—will help you evaluate the pros and cons of add-on memory, benefit from the experience of 185 users who reported on 167.4 million bytes of independent memory, and select the unit that's best for you.

Prior to mid-1974, most of the action in the add-on memory market had involved units designed for the IBM System/360 computers. Add-on memory for the IBM System/370 now dominates the market. The most active segment of this market belongs to Models 145, 155, and 158, with increasing activity in the Model 135 area. Though some vendors had announced add-ons for the System/370 Model 168 as early as 1973, no Model 168 memory is known to be available at this writing. Some vendors plan to introduce add-ons for the 168 in late 1975 and early 1976. Other market segments are also under attack, though to a much smaller degree. These include UNIVAC and DEC large-scale computers and numerous minicomputers. Honeywell was still another target for the independent memory vendors until it announced that it would discontinue service on modified systems.

This report focuses primarily upon the add-on memories for IBM computers: their advantages, disadvantages, economics, maintenance considerations, selection criteria, and user experience. Most of the facts and guidelines, however, also apply to the add-on memories for computers produced by the other mainframe manufacturers, such as UNIVAC and DEC.

Add-On, Replacement, or Enhancement

The market for IBM-compatible main memory can be divided into three distinct submarkets:

- *Add-on* memory for purchased or leased IBM computers.
- *Replacement* of leased IBM memory.
- *Enhancement* (extension) of main memory to capacities beyond the maximum available from IBM.

To date, the great majority of sales have been in the *add-on* category. The computer leasing companies, as well as many organizations that own their own computers, are understandably anxious to extend the useful lives of their ▷

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equipment. In many installations, the most cost-effective technique for improving a computer's performance is to increase its main memory capacity. More memory enables the user to utilize larger input/output buffer areas, to take advantage of more powerful compilers and other sophisticated software facilities, and to use more and/or larger partitions in a multiprogramming environment. Increased memory capacity also reduces the need for time-consuming overlays and makes it possible to keep frequently used systems programs in core rather than on disk or tape.

Clearly, expanded memory capacities can be of significant value in bringing the price/performance of the System/360 computers more nearly into line with the System/370 and other current computers. But IBM is not currently willing to lease add-on memories for use with purchased IBM equipment, and most users are understandably reluctant to purchase the units outright at this stage of the System/360's life cycle. Thus, the door is wide open for the independents to satisfy the demand for add-on memories for purchased System/360 computers.

System/360 users who are renting their equipment have more options open. They can obtain significantly increased performance by moving up to a System/370 or some other computer, often at little or no increase in rental cost. Even so, the ability to expand their System/360 main memory capacities at prices well below IBM's represents an attractive proposition for many installations that are seeking a quick, economical way to increase their throughput.

System/370 users who need additional main memory capacity for either rented or purchased systems can get it from independent suppliers at prices well below IBM's. Users of IBM System/3, DECsystem-10, and various UNIVAC computers can similarly benefit by turning to the independents when they need more memory.

Replacement of leased IBM main memory can be accomplished by simply replacing your current System/360 or 370 processing unit with one having a smaller main memory capacity (or, in some models, no IBM memory at all), and then adding plug-compatible memory from an independent supplier to bring the capacity back to (or above) its original level. Although this move will undoubtedly lead to strained relations with your IBM salesman, it can also lead to hard-to-ignore savings. For example, a System/370 Model 155 user upgrading from 512K to 2048K bytes who obtains 1536K bytes of main memory from Memorex rather than IBM can save $11,857 per month on a 3-year lease or $689,100 on outright purchase. Similar savings are available from other independent memory suppliers. What's more, there are no extra-use charges on the plug-compatible replacement memories.

Enhancement is the term used by the independent memory suppliers for extensions of main memory beyond the IBM-specified maximum capacities. IBM supplies a maximum of 64K bytes for the System/360 Model 30 (or 96K bytes on an RPQ basis), 256K bytes for the Model 40, and 512K bytes for the Model 50. Similarly, IBM offers a maximum of 2 million bytes for the System/370 Model 145, 2 million bytes for the Model 155, and 3 million bytes for the Model 165. It has long been clear that these limits are imposed by marketing considerations rather than technical considerations; from IBM's point of view, it was comforting to know that a Model 40 user whose memory requirements expanded beyond 256K would have to moe up to the considerably more expensive Model 50 Processing Unit.

But that's no longer true. Most of the independent main memory suppliers now offer enhancement capacities up to twice the IBM-specified limits (i.e., up to 64K bytes for Model 22, 128K bytes for Model 30, 512K bytes for Model 40, and 1024K bytes for Model 50). A few suppliers have gone even farther (e.g., CHCS offers up to 512K bytes for the Model 30, and Intermem offers up to 16 million bytes for Models 65 through 75. As a result, a lot of System/360 and 370 users whose systems are now memory-bound can get the increased capacities they need without moving up to a faster, more expensive processing unit.

Extended Core Memories

It is important to distinguish between the add-on or replacement main memories, which are the principal subject of this report, and the extended or "bulk" core memories designed as replacements for IBM 2361 Large Core Storage.

IBM developed the 2361 LCS units to provide auxiliary core storage, in multi-million-byte capacities, for System/360 Model 50, 65, and 75 computers. The contents of LCS are directly addressable, but cycle time is a comparatively slow 8 microseconds per 8-byte access.

IBM 2361-compatible memories have been produced by Ampex, Data Products, and Fabri-Tek. All three deliver complete functional compatibility with the 2361 plus considerably higher speeds.

The 2361 replacement market, however is a limited one. The 2361 was never widely accepted by users and is no longer in production; a total of about 250 reportedly were built. No device analogous to the 2361 is offered by IBM for use with the newer System/370 computers. In January 1971 IBM slashed the 2361 purchase prices by 40 percent in an apparent effort to clean out its inventory. But the much faster independently supplied units still offer significant price/performance advantages over the 2361, and their use has led to major improvements in throughput for many large-scale System/360 installations.

Because of the comparatively limited interest in the 2361-compatible extended core memories, the remainder of this report addresses itself exclusively to the add-on main memory units.

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TABLE 1: SUPPLIERS OF ADD-ON MEMORY FOR IBM AND UNIVAC COMPUTERS

Supplier	Manufacturer	Storage Medium*	Compatible with: IBM System/370 Model						IBM System/360 Model										IBM	UNIVAC		
			135	145	155	158	165	168	20	22	25	30	40	44	50	65	67	75	195	S/3	494	1106	1108
Ampex	Ampex	Core			●		●			●		●	●		●	●	●	●			●	●	●
Business Systems Technology	Business Systems Technology	Core																		●			
Cambridge Memories	Cambridge Memories	Core			●		●			●		●	●		●	●	●						
	Cambridge Memories	SC	●	●		●																	
CFI Memories	CFI Memories	SC																		●			
CIG	Fabri-Tek	Core			●		●			●	●	●	●	●	●	●	●			●	●	●	●
	Intel	SC	●	●		●																	
CHCS	CHCS	Core										●	●		●								
Control Data	AMS	SC	●	●	●	●	●																
	Fabri-Tek	Core										●	●		●	●							
Econocom	Standard Memories	Core							●														
EM&M	EM&M	Core			●		●					●	●		●	●	●						
	EM&M	SC		●																			
Fabri-Tek	Fabri-Tek	Core			●		●			●	●	●	●	●	●	●	●	●		●	●	●	●
Information Control	Information Control	Core								●		●	●		●								
Intel	Intel	SC	●	●		●																	
Intermem	Intermem	Core														●	●	●	●				
Itel	AMS, NSC	SC	●	●	●	●	●			●		●	●		●	●	●						
Memorex	AMS	SC	●	●	●	●	●									●							
Standard Memories	Standard Memories	Core											●	●	●					●			

*SC—Semiconductor.

The Add-On Memory Market

When this report went to press in May 1975, a total of 16 companies were marketing add-on main memories for IBM and/or UNIVAC computers. Table 1 identifies these companies and shows which models they currently offer. You'll also find the full name and address of each company listed at the end of this report. *And, most important, you'll find detailed reports on their individual product lines in the Peripherals section of DATAPRO 70.*

According to a recent Frost & Sullivan study, the computer memory system market will climb from an estimated value of $415 million in 1974 to $525 million in 1975 and to $1 billion by 1983. Add-on memories for large-scale computers will account for most of the growth. The study projects that sales of magnetic core memories will drop from an estimated $200 million in 1974 to $85 million in 1983. According to the study, semiconductor memories will become cost-competitive with core in 1975. The study also forecasts that add-on memories for the IBM 370 market are to be "the most lucrative market of all." Overseas markets are described as promising for U.S. vendors, with Europe developing as "a huge, continuing market" but the Japanese market lasting "for the short term only."

Firms which integrate their production will be the most successful, says F & S, citing Cambridge Memories (CMI) as an example. CMI established two semiconductor facilities and hired IBM semiconductor production experts to enter the component business. F & S observed that while Cambridge was "integrating downward," semiconductor producer Intel Corp. was "integrating upward" into system production. Two other semiconductor houses are producing add-on memory systems besides Intel. These are Advanced Memory Systems (AMS) and National Semiconductor Corporation (NSC); however, both of these firms market their add-on memories to end users through a third-party arrangement. F & S warns that "it is uncertain whether the traditional semiconductor suppliers will have the necessary expertise with which to market memory systems directly to end users."

Semiconductor technology, specifically N-channel MOS static 4K-bit RAM's, dominates the current add-on memory industry. Memory production from now on will

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be largely composed of MOS semiconductor arrays, while production of traditional core memories will decrease sharply. Bipolar semiconductor memories (which are more expensive to produce and which exhibit higher power consumption and heat dissipation than the MOS technique) will eventually give way to the new N-channel MOS memories once production rates are up. New memory technologies such as charge-coupled devices (CCD's) and magnetic bubble memories are in the wings, but it is unlikely that these devices will significantly impact the currently dominant semiconductor technology for several years.

The leading producer of semiconductor add-on memories is Advanced Memory Systems, with over 800 delivered units (500 System/370 installations and 300 System/360 installations) totaling some 500 million bytes. AMS began delivering its Monolithic Main Memory for the System/360 in June 1971, and it now offers models for System/360 Models 30 through 67 and System/370 Models 135 through 158. AMS-built memories are currently being marketed to end users by Itel Corporation (for both the System/360 and System/370) and by Control Data Corporation and Memorex Corporation (for the System/370 only). Itel alone has already made more than 500 installations with a total of about 300 million bytes of memory. Memorex, which entered the market in January 1975, produces the memory boards used in the AMS memories that it markets.

Other major suppliers include Cambridge Memories, with about 500 million bytes of installed memory for the System/360 and 370 computers; CIG, with 250 million bytes of installed memory for the System/360 and 370, including over 800 System/360 installations; and Electronic Memories and Magnetics (EM&M), with 400 installed units totaling about 300 million bytes.

Seven companies are currently offering add-on main memories for the System/370 computers, all at prices significantly below IBM's. To date, the great majority of the installations have been on System/370 Model 145, 155, and 165 computers, and their users are generally well pleased with the reliability and performance of these units. Add-on main memories have also been introduced for the System/370 Model 135 and 158 and announced for the 168, but the smaller Model 115 and 125 systems have not yet attracted any attention from the independent memory makers.

The IBM System/3 represents a potentially large but not necessarily lucrative market for the add-on memory suppliers. IBM has already installed more than 20,000 of its small-scale System/3 computers, and at least three companies currently offer add-on units that can replace most of the IBM memory and/or increase its capacity. One of these companies, Business Systems Technology, has already delivered 1,000 of its System/3 add-ons.

Aside from many of the popular minicomputers, the only non-IBM computers for which add-on memory units can currently be obtained from independent suppliers are the large-scale UNIVAC and Digital Equipment mainframes. Both Ampex and CIG currently supply add-on memories for the UNIVAC 494, 1106, and 1108, and Ampex also has units for the UNIVAC 418 III and the DECsystem-10. In general, though, the marketing prospects for add-on memories for most other computer systems are simply not large enough to be nearly as attractive as the vast System/360 and 370 markets.

The pioneer and early leader in add-on main memories was Data Recall Corporation. The first Data Recall unit was installed on a System/360 computer in February 1970, and by mid-1972 nearly 300 installations had been made. A major factor in Data Recall's early success was its exclusive marketing tie-in with Computer Investors Groups (CIG), a leasing firm that owns over $45 million worth of System/360 equipment. Most of the early Data Recall installations were on CIG-owned computers, providing the two companies with an enviable opportunity to demonstrate the feasibility of the add-on memory concept in user installations throughout the country.

CIG reinforced its claim to the title of leading marketer of add-on main memory through a complex series of transactions announced in October 1973. First, CIG purchased Fabri-Tek's entire installed base of IBM-compatible memories. Second, Fabri-Tek announced an agreement in principle, which has since been consummated, to acquire Data Recall Corporation. Third, CIG and Fabri-Tek signed a marketing agreement under which CIG purchased, marketed, and serviced the Fabri-Tek and Data Recall add-on core memories in the United States, Canada, and Western Europe. As a result of these transactions, CIG now boasts over 800 add-on memory installations on System/360 computers, as well as a growing number of installations on System/370 and UNIVAC computers. CIG also markets semiconductor memories producted by Intel Corporation for the 370/135 and 370/145. In mid-1974, the marketing agreement between CIG and Fabri-Tek was terminated (probably because of the declining System/360 market), and Fabri-Tek once again markets directly to end users.

Core vs. Semiconductor

Current magnetic core memories are the products of a comparatively old and well-established technology that has been refined to a high degree of reliability. By contrast, semiconductor memory technology is a young and highly promising one that had been largely ignored in commercial computers until late 1970, when IBM gave semiconductor main memories its stamp of approval by using them in the System/370 Model 145 and in all subsequently announced models. Though most vendors use core memory for their System/360 add-ons, only six vendors offer core memories for the System/370, and these are for Models 155 and 165 only, in which IBM also uses core memory.

The principal advantages of semiconductor memories are their potentially higher speeds and lower costs. Other Σ

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notworthy potential advantages include reduced space requirements, lower power consumption, nondestructive readout, and simplified maintenance. (A single card, containing perhaps 8K to 128K bits of semiconductor memory, can readily be slipped out and replaced.)

Two distinct types of LSI (large-scale integration) technology are being used in today's semiconductor memories: bipolar and MOS (metal-oxide semiconductor). The chief advantage of bipolar memory (which IBM chose for the System/370 Models 135 and 145) is higher potential operating speed, but this is currently achieved at the expense of higher cost, higher power consumption, and higher heat dissipation. (In fact, some of the current bipolar memories require more power and more air conditioning than equivalent core memories.) For most applications, the MOS technique (used in System/370 Models 115, 125, 158, and 168) shapes up as a more cost-effective storage technique than either bipolar LSI or core, though manufacturing and quality control problems caused its commercial acceptance to lag somewhat behind that of the bipolar technology. MOS memories deliver moderately high speeds along with compact size, low power consumption, and minimal heat dissipation.

The only noteworthy functional disadvantage of semiconductor memory is its volatility; the stored data is lost whenever the power supply is interrupted. However, this characteristic will not pose a serious problem for most installations, since it is normal operating practice to reload all data after a power failure when using core memory, too.

Purchase or Lease?

Most of the independent main memory suppliers are willing to sell their equipment outright or lease it. A few suppliers offer one-year leases, but two years is the minimum lease term for most.

For users who are renting their IBM equipment, the lease-or-purchase choice will usually be clear-cut. Unless there are very special circumstances, it would be hard to justify purchasing an add-on memory unit for use with a rented computer.

Users who have purchased their IBM equipment may still find it desirable to lease the add-on memory units unless they are firmly committed to using their present computer systems for several more years. In these cases, the usual lease-or-purchase guidelines should be applied.

User Experience

To assess the current level of user satisfaction with add-on main memory, Datapro conducted an extensive user survey. A Reader Survey Form was included in the March 1975 supplement to DATAPRO 70. In addition, the same form was mailed to a number of known users of particular vendors' products to supplement the returns for several manufacturers not well represented in the returns from our subscribers. (These supplemental returns from non-subscribers accounted for only about 10 percent of the total.)

By the editorial cutoff date of May 9, a total of 185 users had responded, reporting their experience with and ratings of a total of 210 products. This sample represented a total of 167.4 million bytes of add-on main memory for IBM System/360, IBM System/370, IBM System/3, and a few other assorted large computers and minicomputers.

The users were asked to rate the overall performance, equipment reliability, maintenance service, and ease of installation of each unit by assigning a rating of Excellent, Good, Fair, or Poor. These ratings are summarized in Table 2. Prospective buyers should note that the small sample sizes for some of these product lines make it unwise to draw firm conclusions from the indicated ratings. An add-on memory user's degree of satisfaction may depend heavily upon the service and support provided by his local branch office, as well as upon the reliability and performance of the computer system with which the add-on memory is used. In your evaluations of prospective suppliers, Datapro suggests that you obtain local account references where possible.

In January 1974, Datapro, in summing up the users' experience reported at that time, said, "All things considered, it would be difficult to find a more satisfied group of users of any computer-related product or service." That statement still applies, even though the ratings slipped a bit from 1974 to 1975. The following chart summarizes the essential ratings differences between the two surveys.

	Percent of Users Giving a Rating of:			
	Excellent or Good		Fair or Poor	
	1975	1974	1975	1974
Overall performance	92	97	8	3
Equipment reliability	90	93	10	7
Maintenance service	78	82	22	18
Ease of installation	80	81	20	19

None of the differences is large enough to support a definite conclusion about a trend. The differences are within the range of variability that can be expected in surveys. Based on the distribution of ratings and several years' experience talking with users in this and other plug-compatible product areas, Datapro makes an intuitive comment that the differences can also be explained by the users raising their standards as they gain experience. In the beginning, the money savings available through the use of alternatives to IBM components caused the users to accept a lower level of product and service performance. As experience grew, the users began to expect more from the vendors. This is a very natural consequence. It is supported by the higher ratings given almost universally (see Table 2) to overall performance than to any of the three critical parameters: reliability, maintenance, and ease of installation. In addition, the gap between the ratings given to overall performance and to the other parameters narrowed in 1975. Taking this into account, add-on

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TABLE 2: USERS' RATINGS OF ADD-ON MAIN MEMORY

Computer System and Memory Supplier*	No. of User Replies	Amount of Memory Represented, megabytes	Users' Ratings**																			Problems in Installation & Testing**			Problems in Diagnosing Malfunctions**			Installation Time, hours		
			Overall Performance					Equipment Reliability					Maintenance Service					Ease of Installation													
			WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	N	M	S	N	M	S	Min.	Max.	Ave.
With IBM S/360																														
Ampex ECM	5	19.5	3.6	3	2	0	0	3.4	3	1	1	0	2.8	1	3	0	1	3.2	2	2	1	0	1	3	1	0	4	1	4	24	14
Ampex, other	8	3.8	3.8	6	2	0	0	3.4	4	3	1	0	2.8	3	1	3	1	3.0	3	2	3	0	3	4	1	4	4	0	8	24	14
AMS	9	4.6	3.6	6	2	1	0	3.2	4	4	0	1	3.7	6	3	0	0	3.0	2	6	0	1	2	6	1	5	2	2	2	8	6
Cambridge Memories	16	3.0	3.7	13	1	2	0	3.6	12	2	2	0	3.3	7	7	2	0	3.4	9	5	1	1	5	8	2	8	6	2	2	150	20
CHCS	7	1.6	3.8	5	1	0	0	3.8	5	1	0	0	3.0	1	3	1	0	3.4	3	1	1	0	0	5	2	4	3	0	6	168	38
CIG–																														
Data Recall	8	1.4	3.0	1	6	1	0	2.9	2	4	1	1	2.6	1	3	4	0	2.6	2	2	3	1	1	4	2	4	2	2	3	26	12
Fabri-Tek	2	1.0	4.0	2	0	0	0	4.0	2	0	0	0	2.5	1	0	0	1	2.0	0	0	2	0	0	0	2	1	0	1	48	60	54
Unspecified	3	0.4	4.0	3	0	0	0	4.0	3	0	0	0	2.7	0	2	1	0	2.7	0	2	1	0	0	3	0	1	2	0	4	48	25
Control Data–																														
Fabri-Tek	3	0.5	4.0	3	0	0	0	4.0	3	0	0	0	4.0	3	0	0	0	3.7	2	1	0	0	2	1	0	3	0	0	10	12	11
EM&M	19	16.2	3.8	15	4	0	0	3.5	10	7	1	0	3.1	6	7	4	0	3.0	4	10	4	0	4	11	4	6	11	1	1	128	23
Fabri-Tek	11	2.4	3.6	7	2	1	0	3.4	6	3	0	1	3.2	5	3	1	1	3.5	6	3	1	0	5	4	2	4	3	3	1	24	10
ICC	12	1.1	3.7	9	2	1	0	3.8	9	3	0	0	3.1	4	5	3	0	3.3	4	7	1	0	1	8	3	5	5	2	6	72	17
Itel–																														
AMS	4	2.7	4.0	4	0	0	0	3.8	3	1	0	0	3.8	3	1	0	0	3.3	1	2	0	0	1	3	0	4	0	0	8	18	13
Standard Memories	9	2.0	3.8	7	2	0	0	3.7	6	3	0	0	3.6	5	3	0	0	3.4	4	5	0	0	3	5	1	7	1	1	2	30	12
Others	5	12.6	3.4	2	3	0	0	3.6	3	2	0	0	2.4	0	3	1	1	2.6	0	4	0	1	0	4	1	0	2	2	6	30	18
Subtotals	121	72.8	3.7	86	27	6	0	3.5	75	34	6	3	3.1	46	44	20	5	3.1	42	52	18	4	28	69	22	56	45	17	1	168	17
With IBM S/370																														
AMS	7	10.7	3.4	4	2	1	0	3.4	4	2	1	0	3.4	4	2	1	0	3.1	4	1	1	1	3	1	3	4	2	1	12	72	32
Cambridge Memories	11	15.6	3.7	8	3	0	0	3.5	6	5	0	0	3.5	6	4	1	0	2.9	5	1	4	1	3	4	4	4	7	0	3	60	25
CIG–																														
Data Recall	3	7.7	3.7	2	1	0	0	3.7	2	1	0	0	3.7	2	1	0	0	3.0	1	1	1	0	0	3	1	0	2	0	18	48	38
Intel	4	4.1	3.0	1	2	1	0	2.3	1	0	2	1	2.5	1	0	3	0	2.5	1	1	1	1	2	1	1	2	1	1	2	10	6
Unspecified	3	4.0	3.3	2	0	1	0	3.3	2	0	1	0	3.0	1	1	1	0	2.7	0	2	1	0	0	3	0	2	0	1	8	10	9
Control Data–																														
AMS	11	9.1	3.3	4	5	1	0	3.1	3	6	0	1	2.9	3	4	2	1	3.2	3	6	1	0	0	7	2	2	6	1	6	24	14
EM&M	3	10.8	3.0	1	1	1	0	2.7	1	1	0	1	2.0	0	1	1	1	1.7	0	1	0	2	0	1	2	1	1	1	–	–	–
Itel–																														
AMS	7	11.9	3.3	3	3	1	0	3.3	3	3	1	0	3.0	1	5	1	0	3.3	2	4	0	0	0	7	0	1	6	0	4	35	16
Others	5	9.1	3.8	4	1	0	0	3.8	4	1	0	0	3.6	4	0	1	0	3.4	3	1	1	0	3	2	1	2	3	0	–	–	–
Subtotals	54	83.0	3.4	29	18	6	0	3.3	26	19	5	3	3.1	22	18	11	2	3.0	19	18	10	5	11	29	14	18	28	5	2	72	20
With IBM S/3																														
BST	10	0.25	4.0	10	0	0	0	4.0	10	0	0	0	3.9	7	1	0	0	3.9	9	1	0	0	8	2	0	10	0	0	2	6	4
CFI	5	0.06	4.0	5	0	0	0	3.8	3	1	0	0	3.8	3	1	0	0	3.5	2	2	0	0	3	2	0	3	0	1	2	8	4
Subtotals	15	0.31	4.0	15	0	0	0	3.9	13	1	0	0	3.8	10	2	0	0	3.8	11	3	0	0	11	4	0	13	0	1	4	14	8
With other computers																														
CDC 3300	1	0.39	4.0	1	0	0	0	3.0	0	1	0	0	3.0	0	1	0	0	2.0	0	0	1	0	0	1	0	1	0	0	–	–	16
DECsystem-10	2	0.96	3.5	1	1	0	0	3.5	1	1	0	0	3.5	1	1	0	0	3.5	1	1	0	0	0	2	0	1	1	0	4	6	5
UNIVAC 1108	2	9.7	1.5	0	0	1	1	1.5	0	0	1	1	1.5	0	0	1	1	2.0	0	1	0	1	0	1	1	0	0	2	12	50	31
Minicomputers	15	0.27	3.5	9	4	2	0	3.3	8	4	3	0	3.0	3	4	3	0	3.8	13	1	1	0	12	0	3	10	2	2	1	30	5
Subtotals	20	11.3	3.3	11	5	3	1	3.2	9	6	4	1	2.9	4	6	4	1	3.5	14	3	2	1	12	4	4	12	3	4	1	50	8
Grand Totals	210	167.4	3.6	141	50	15	1	3.5	123	60	15	7	3.2	82	70	35	8	3.2	86	76	30	10	62	106	40	99	76	27	1	168	16

*Name of memory manufacturer (where different from supplier and when determinable) is indented.

**Ratings are expressed in terms of the number of user responses. The legend is E for Excellent, G for Good, F for Fair, P for Poor, N for No Problems, M for Minor Problems, and S for Serious Problems; WA is the Weighted Average, based on assigning equal weight to each user and a weight of 4 for Excellent, 3 for Good, 2 for Fair, and 1 for Poor.

memory continues to demonstrate an outstanding level of user satisfaction.

In particular, note the ratings given by the 15 users of BST and CFI add-on memory for the IBM System/3. The lowest rating given for any parameter was Good, and most ratings were Excellent. Only one user experienced serious problems in diagnosing malfunctions and obtaining the necessary service, and that user rated equipment reliability and maintenance service Good. None of the users reported serious problems with installation, which averaged only four hours of on-line time. Vendors, in general, have been slow to invade the huge base of System/3 users. Reasons cited include the small incremental profit margin and the level of educational and marketing effort required. And there was the underlying assumption that the System/3 user was not sophisticated enough to be able to accept the concept of a mixed-vendor shop. These two companies (BST and CFI), along with a couple of others such as Decision Data (96-column card equipment) and Digital Associates (printers), are proving otherwise.

Datapro also asked the add-on memory users whether they encountered any problems in the installation and testing of their add-on memory units or in diagnosing malfunctions and obtaining the necessary service. Here's the breakdown of their responses:

Problems in installation and testing–

No problems:	30 percent
Minor problems:	51 percent
Serious problems:	19 percent

Problems in diagnosing malfunctions and obtaining service–

No problems:	49 percent
Minor problems:	38 percent
Serious problems:	13 percent

Installation times reported by the add-on memory users ranged from as little as 1 hour to as long as 168 hours, and the average installation time was 16 hours.

How to Select and Use Add-On Main Memory

The questionnaire also elicited information about the manner of acquisition and whether the add-on memory acquired was an upgrade or was equivalent in size to the mainframe maker's memory.

A total of 217 responses included information about the manner of acquisition, with the following breakdown:

Purchased:	33 percent
Leased from memory manufacturer:	40 percent
Leased from third-party leasing company, memory only:	14 percent
Leased from third-party leasing company as part of computer system:	13 percent

Of the 168 users who replied to the upgrade/equivalent question, precisely half reported upgrading their computer system with independent add-on main memory, and the other half indicated replacement with no increase in overall memory size.

Whether you are looking to save a few dollars or to upgrade your computer system at the lowest cost, the independent memory vendors have demonstrated a capability for successful installation and operation. But it's still important to shop carefully for the memory unit that best fits your requirements–and the following sections will help you do just that.

Why Deal with an Independent?

Why should an IBM computer user buy main memory from a source other than IBM? Unquestionably, the primary justification is price. Purchase and lease prices for the independent memory units for System/370 range from about 10 to 50 percent below the equivalent IBM prices, while independent memory for System/360 is now going for as much as 80 percent below IBM's prices. Cost reductions depend upon vendor, model, capacity, lease term, and the buyer's bargaining skill. Installations that use leased equipment on a multiple-shift basis can derive worthwhile additional savings through the independents' unlimited-usage policies, which eliminate all extra-use charges.

Other frequently expressed reasons for dealing with the independents include: (1) their ability to supply memory capacities beyond the IBM-specified limits, and (2) their willingness to lease, as well as sell, add-on memories for use with purchased IBM equipment.

Performance of the independent main memory units is generally the same as that of the corresponding IBM memory units, since in nearly all cases the memories are forced to operate in synchronization with the IBM processing units. This means that many of the independent memories are cycling at only a fraction of their potential speeds–a factor that adds nothing to the system's performance but at least yields a reassuring extra margin of safety. For the System/370 Model 155, several companies offer "accelerated" memories that yield worthwhile improvements in CPU performance.

Several of the potential trouble spots that have kept some IBM users from switching to independent disk or tape drives simply do not apply to main memory units. Specifically:

- Main memory–both core and semiconductor–has been refined to a high level of reliability and should require a minimum of servicing once installed. Therefore, divided maintenance responsibility is a less significant concern for main memory than for the mechanically complex disk and tape drives.

- The independent main memory units promise–and deliver–complete functional compatibility with the corresponding IBM memories. Once the unit has been properly installed, you can virtually forget about it. Users agree that no changes are required in operating procedures or in any other significant phase of an installation's day-to-day operation.

- IBM is not a technological leader in main memory. The System/360 and System/370 memory speeds do not stretch the limits of present technology, and a number of independent manufacturers have had extensive experience in producing main memories which are similar and in some cases superior in performance to the ones manufactured by IBM.

Installation

Installation of the add-on main memories is generally a straightforward process–but one that must be performed carefully and correctly to guard against any possible damage to the processing unit. Installation is normally performed by the memory manufacturer's own field personnel or by his designated service organization.

The installation process naturally varies for different computer models and different memory capacities. Typically, here are the steps involved in installing a System/360 add-on memory unit that does not raise the total system capacity beyond the IBM-specified limits:

1. Changes are made in the background wiring within the IBM processing unit.

2. Several additional SLT logic cards, supplied by the add-on memory vendor, are slipped into slots which are already present in the IBM processing unit.

3. Certain changes are made in the read-only storage (ROS) that holds the control microprograms for the processing unit.

4. The add-on memory unit is set up and tested off-line.

5. The add-on memory unit is cable-connected to the processing unit.

6. Diagnostic programs and then job stream tests are executed to insure that the add-on memory unit has been satisfactorily integrated into the system.

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7. The on-site maintenance documentation is updated to reflect all changes to the IBM processing unit.

8. In most cases, the user will find it necessary to regenerate his operating system (i.e., perform a "sysgen") in order to take full advantage of the expanded memory capacity.

In cases where a system's memory is to be "enhanced" to a capacity beyond the IBM-defined upper limit, the necessary logic changes are considerably more extensive. In addition to all the steps listed above, enhancement usually involves expansion of the address register, expansion of the processing unit's auxiliary storage, and further changes to the microprograms in read-only storage.

The manufacturers typically quote installation time requirements of two to eight hours, but it's not unusual for various "glitches" to make the installations take considerably more time. The 185 add-on memory users who responded to Datapro's recent survey reported installation times ranging from 1 to 168 hours, and the overall average was 16 hours. (See the User Experience section of this report for details.) If you schedule your installation for a Saturday, as is usually done, it's a fairly safe bet that your system will be ready for action, with its newly expanded memory, long before Monday morning comes.

Maintenance

This is probably the area of greatest concern to most potential users of independent main memory units. How reliable are they? And who's going to repair them when troubles occur? The answers to both questions are quite reassuring.

Core memories have been in widespread use for more than 15 years, and the technology is now widely known and highly refined. What's more, core memories are non-mechanical units with no moving parts that can wear out or slip out of adjustment, and they have long been regarded as the most reliable elements in most computer systems.

Once installed and "shaken down", core memory units can be expected to function for months, or even years, at a time without hardware failures. In fact, a mean time between failures (MTBF) of 10,000 hours or more is being promised—and delivered—in many of the current core memories.

Though semiconductor main memories have a much shorter "track record" than core memories, they can reasonably be expected to deliver a similarly high level of reliability. Servicing of most of the semiconductor memories is greatly facilitated by the ability to slip out and replace individual storage cards, which typically contain from 8K to 128K bits each.

Another benefit of the non-mechanical nature of both core and semiconductor memories is that they require a minimum of preventive maintenance. In fact, in reasonably "clean" environments, about all that is required is a quarterly check of the fans, filters, and cables.

This minimal need for maintenance service should alleviate the user's natural concern about the implications of divided maintenance responsibility.

In addition, most of the independent main memory units include maintenance panels and diagnostic circuitry that permit a variety of testing and diagnostic operations to be performed independently of the central processing unit. In the CIG/Data Recall memories, for example, the power supply voltage can be switched between plus and minus five percent of the normal operating voltage to determine marginal operating conditions. Also, a specific data pattern designated as a "worst-case" pattern can be automatically written in all memory locations, then read and compared with the original pattern to pinpoint any errors. Indicator lamps display the current memory address, the data stored there, and any abnormal conditions.

As to the question of who'll provide the service you need, the answer depends on which independent memory supplier you choose to deal with. Some of the suppliers use their own field service organizations, while others have contracted with various independent service companies. In any case, the figures in the User Experience section of this report make it clear that most add-on memory users are well pleased with both the reliability of their equipment and the quality of the maintenance service they are receiving.

Effects upon IBM Maintenance

Another area of major concern to many potential users of add-on main memories is IBM's reaction to the required logic changes in the processing unit. Will IBM continue to maintain its equipment? Is the user liable for any damage to the IBM equipment that may be caused by the independent memory unit? Here, the answers may seem less reassuring, but the careful user can still ensure the protection of his interests.

Until February 1972, IBM willingly continued to maintain its equipment in all the installations that had added independent main memory units. Then IBM dropped a bombshell by informing users of 360/30 systems with enhanced main memories (beyond 64K bytes) supplied by CIG that it would not be practical for IBM to provide continued maintenance for those systems. IBM contended that extensive changes to the central processing units made it impractical for IBM customer engineers with standard training and experience to maintain the enhanced Model 30's. Moreover, IBM indicated that it was investigating the practicality of continued maintenance in other cases where add-on memory units necessitated changes in the parts, microcode, and wiring of IBM equipment.

Amidst the predictable cries of outrage from the independent memory suppliers, Advanced Memory Systems

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and two Itel Corporation subsidiaries took more concrete action by asking a Federal court to enjoin IBM from threatening to withdraw its maintenance on Model 30 computers using AMS add-on memories. The suit was settled in March 1972, when IBM agreed to maintain AMS-enhanced System/360 processing units under its standard maintenance agreement in installations where the total memory capacity is at or below a certain level, and on a "best efforts" basis in installations where the memory size exceeds that level. Normal IBM maintenance was promised for the Model 22 with up to 64K bytes, Model 30 with up to 64K bytes, Model 40 with up to 256K bytes, Model 50 with up to 512K bytes, and Model 65 with 256K bytes of IBM memory and up to 768K bytes of AMS memory.

IBM is treating the other add-on memory suppliers in the same manner in which it agreed to treat AMS/Itel under the court judgement. Thus, IBM reviews the alterations and additions made by each supplier to establish the maximum capacity levels at which normal IBM maintenance of the CPU with be practical. For systems which are beyond IBM's limits for its normal maintenance, such as Model 30's enhanced beyond 64K bytes, customers who want IBM to maintain their CPU must sign an amendment to the IBM Maintenance Agreement. The amendment limits IBM's oblication to servicing and maintaining the unaltered portions of the processing unit in a "best efforts" manner.

Most of the add-on memory suppliers and their customers seem reasonably pleased with the AMS/Itel settlement and the resulting IBM policies. In effect, the settlement simply confirmed and redefined IBM's standard policy toward maintenance of multiple-supplier systems: IBM will maintain the unaltered portions of its part of the machine or system. Users report few problems with IBM acceptance of their add-on memory units or maintenance of the associated processing units. To date, users say that IBM's "best efforts" on the enhanced Model 30's have been largely indistinguishable from its normal maintenance. Sales of the add-on memory units—which came to a near standstill after IBM's threatened withdrawal of maintenance in February 1972—are booming again.

Nonetheless, prospective users of the IBM-compatible memory units should keep in mind that IBM can, and probably will, take further actions to stem the increasing tide of add-on memory usage. In May 1972, for example, the IBM World Trade Corporation announced that it will not maintain overseas Model 30 processing units enhanced to 96K or 128K bytes unless the add-on memories were ordered before May 1 and installed before July 1, 1972. This decision, which clearly contradicted the spirit, if not the letter, of the AMS/Itel judgement, obviously limited the overseas market for add-on memories. Also, in the newer System/370 processing units, IBM acted to reduce the size and profitability of the add-on memory market by slashing the per-byte costs of its own main memories and (in Models 158 and 168) by integrating large amounts of memory into the mainframes.

Thus, IBM has repeatedly served notice that its battle against the add-on memory suppliers is far from over—and, at this writing, it seems unlikely that the eventual outcome of the long IBM-Telex lawsuit will give much aid or comfort to the independents.

On March 19, 1973, IBM issued a revised Multiple Supplier Systems Bulletin that clearly defines its maintenance practices, related charges, and IBM and customer responsibilities regarding systems in which IBM equipment is combined with that of other suppliers. This sternly worded but crystal clear document should be required reading for every prospective user of add-on main memory. One key paragraph from the bulletin reads as follows:

"When an alteration in or attachment to an IBM machine or system (a) interferes with the normal and satisfactory operation or maintenance of a machine in a manner which renders its maintenance and repair impractical for IBM's personnel having had the standard training and instruction provided for such personnel, or (b) creates a safety hazard, the Customer will be required in the case of a rental machine, upon written notice, to modify the alteration or attachment to achieve a practical maintenance condition, to remove the alteration or attachment and restore the machine or system to its normal and satisfactory operating condition or to purchase the machine and obtain maintenance from another source. In the case of a purchased machine, the Customer will be required, upon written notice, to modify the alteration or attachment to achieve a practical maintenance condition or to remove the alteration or attachment and return the machine to a practical maintenance condition as a requisite for continuation of IBM warranty and maintenance service."

Thus, before placing an order for add-on memory, users of rented IBM equipment should demand a guarantee from the memory supplier that the unaltered portions of their systems will still qualify for IBM maintenance service. Users of purchased IBM equipment should demand a similar guarantee or else be prepared to turn, if necessary, to one of the independent maintenance companies. In addition, users of either rented or purchased equipment should demand that the independent memory supplier assume full liability for any damage to or required restoration of the IBM equipment.

Finding What's Best for You

In selecting an add-on main memory unit, as in acquiring most other types of computer equipment, your chances of picking the unit that's best for your installation will be far greater if you're willing to take the time to go about it in a systematic, logical way. The following selection procedure should help you get the maximum gain in computer throughout per dollar spent.

1. *Make sure expanded memory is what you really need.* Although increased memory capacity is a real boon to

How to Select and Use Add-On Main Memory

most computer installations, it isn't necessarily the most cost-effective solution in every case. For example, if your computer is input/output-limited in most applications, you'll probably be better advised to invest in faster input/output units or more of them. Or, if your central processor simply isn't fast enough to handle your expanding workload, expanded memory capacity may not help enough to save the day. Make sure you have a pretty good understanding of just how–and how much–increasing your main memory capacity can improve your throughput.

2. *Find out who supplies the model and size you need.* For this purpose, you're not likely to find a better guide than Table 1 of this report plus the individual product reports in the Peripherals section of DATAPRO 70. (See the Index entries under "main memories.") Using this information, you'll probably be able to narrow down the list of potential suppliers to a few firms that have demonstrated their ability to supply and service, at competitive prices, the specific model and capacity of main memory you need.

3. *Issue a request for proposals and get competitive bids.* The add-on main memory market has quickly become a highly competitive and extremely price-sensitive one. Product differences tend to be comparatively small among competing brands, and the supplier who shaves his prices the farthest may well get the order. One marketing manager told Datapro: "Sure, we'll give you our list prices–but they don't really mean much." Thus, the value of getting competitive bids from several potential suppliers should be obvious. Send each supplier a request for proposals that defines your memory requirements as completely as possible and requests detailed information about the proposed memory characteristics, installation procedure, service provisions, warranty, etc.

4. *Check all effects upon your installation.* From an evaluation of the proposals, plus interviews with the suppliers' sales and technical personnel where necessary, determine the benefits, costs, and risks of each proposed memory unit in your installation. Among the factors to consider are the downtime required for installation, required changes in software and documentation, the supplier's willingness to assume liability for any damage to the mainframe or other equipment, the mainframe maker's willingness to continue maintaining its equipment (whether on a normal or "best efforts" basis), and, of course, the anticipated increased in system performance and throughput.

5. *Check the maintenance provisions.* Since maintenance is one of the key differentiating factors among the independent memory suppliers, you'll want to pay especially careful attention to this important area. Find out what organization supplies the maintenance service and learn all you can about it. Check the total size of the organization, the location and staffing of the closest service point, the promised response time for emergency service, the hours during which service is available, the nature and frequency of preventive maintenance, the size and location of the spare parts inventory, the procedure for handling engineering change orders, and the scope of the memory supplier's training program for his service technicians.

6. *Talk to users.* The memory units that appear most promising at this point should now be further investigated by conferring with present users. Ask each supplier for a list of his customers–and don't take no for an answer. Then, find out all you can from each user. Ask why he chose that unit, when it was installed, what problems were encountered in installing it, how many failures have occurred, how quickly they were corrected, and whether any incompatibilities have been detected. Finally, ask how he thinks the memory unit or the associated support could be improved. The answers to these questions are likely to be highly enlightening. Naturally, the User Experience section of this report contains a wealth of information of this type–but we still urge you to contract the users directly so you can relate their experience to your specific needs.

7. *Choose the vendor and model.* By now, you should have all the information you'll need to choose the memory unit that will satisfy your requirements at the lowest overall cost. Now that all the associated cost factors have been identified, it's a good idea to review your earlier decision that expanded main memory is the most cost-effective way to improve your computer. If so, it's just about time to place your order.

8. *Negotiate a sound contract.* Now that you know which memory unit you want, don't just sign the supplier's standard contract or order form. If you do, you're likely to end up with a lot less security and support than the user who's willing to take the time and trouble to indulge in some old-fashioned haggling. What's more, you may even be able to shave some more dollars off the price-tag. Here are some of the points you'll want included in the written agreement you sign: a guarantee of complete functional compatibility with the equivalent unit in the mainframe manufacturer's own product line; an assurance that the mainframe maker will continue to maintain the unaltered portions of his equipment if you so desire; a promise by the vendor to assume full liability for any damage to the mainframe maker's equipment and for any costs incurred in returning it to its original condition if necessary; and a promise that the vendor will perform all phases of the installation process at no extra charge, including the associated software and documentation changes. Payment for the unit should be contingent upon the satisfactory completion of a carefully defined acceptance test. It would be reasonable, for example, to require at least 95 percent availability of the unit over a 30-day period, with complete functional compatibility under all operating conditions.

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Suppliers

Listed below, for your convenience in obtaining additional information, are the full names and addresses of 18 companies that currently manufacture and/or market add-on main memory units. And remember, you can find detailed individual reports on their products in the Peripherals section of DATAPRO 70.

Advanced Memory Systems, Inc., 1276 Hammerwood Avenue, Sunnyvale, California 94086. Telephone (408) 734-4330.

Ampex Corporation, Memory Products Division, 13031 West Jefferson Boulevard, Marina del Rey, California 90291. Telephone (213) 821-8933.

Business Systems Technology, Inc., 1215 West Katella Avenue, Orange, California 92667. Telephone (714) 997-1450 or (800) 854-3111 (toll-free).

Cambridge Memories, Inc., 12 Crosby Drive, Bedford, Massachusetts 01730. Telephone (617) 271-6300.

CFI Memories, Inc., 305 Crescent Way, Anaheim, California 92801. Telephone (714) 776-8571 or (800) 854-3290 (toll-free).

CIG Computer Products, Inc. (a subsidiary of Computer Investors Group, Inc.), 1351 Washington Boulevard, Stamford, Connecticut 06902. Telephone (203) 359-2100.

Computer Hardware Consultants and Services (CHCS), Inc., Pheasant Run, Newtown, Pennsylvania 18940. Telephone (215) 968-5900.

Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55440. Telephone (612) 853-8100.

Econocom, Inc., 1255 Lynnfield Road, Memphis, Tennessee 38138. Telephone (901) 767-9130.

Electronic Memories & Magnetics Corporation, Computer Products Division, 12624 Daphne Avenue, Hawthorne, California 90250. Telephone (213) 644-9881.

Fabri-Tek, Inc., Memory Products Division, 5901 S. County Road 18, Minneapolis, Minnesota 55436. Telephone (612) 935-8811.

Information Control Corporation (ICC), 9610 Bellanca Avenue, Los Angeles, California 90045. Telephone (213) 641-8520.

Intel Corporation, Memory Systems Division, 1302 North Mathilda Avenue, Sunnyvale, California 94086. Telephone (408) 734-8102.

Intermem Corporation, Market Street, Wappingers Falls, New York 12590. Telephone (914) 297-5996.

Itel Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 983-0000.

Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-1000.

National Semiconductor Corporation, Memory Systems Division, 1177 Kern Avenue, Sunnyvale, California 94086. Telephone (408) 732-5000.

Standard Memories, Inc. (a subsidiary of Applied Magnetics Corporation), 2801 East Oakland Park Boulevard, Suite 307, Fort Lauderdale, Florida 33306. Telephone (305) 566-7611. □

How to Select and Use Data Entry Devices

In days of old
When the keypunch was bold,
Shared processors weren't invented.
You could pick any gem
Made by IBM,
And know you'd be contented.

Underneath the seeming nonsense of the preceding jingle lies considerable sense. A simpleton can make a proper decision when there is only one choice to make. In the embryonic days of computer technology, the punched card was the only effective data entry medium for commercial applications and paper tape was the preferrred method of input for scientific applications. Such was the extent of decision-making that anyone was called upon to perform.

We are all proud of the progress that data processing has made since the toddling period of the 50's and early 60's, but with progress comes a variety of options – and headaches. Today the data processing manager may still opt for an IBM product, but he should at least give serious consideration to whether it is really the best selection for his particular application environment. As the pressure of cost competitiveness grows fiercer, the likelihood of feeling totally content with any data entry decision grows smaller. One should have the feeling that something better lies just over the horizon. The guidelines appearing in this report are intended to put the analyst on the right track and increase his awareness of the overall data entry opportunities awaiting him.

Let us catalog the various data entry devices that now exist. In the context of this report, the term "data entry devices" refers to equipment or contrivances that capture data at its source and/or convert source data in human-readable form (handwriting or printing) into any of a variety of codes that can be interpreted by a computer system. These devices can either enter the data directly into a computer or record the data on an intermediate medium for subsequent entry into a computer. Certain data entry devices perform the subsidiary function of creating an audit trail, which is essentially a printed record of the data actually received by the data entry device.

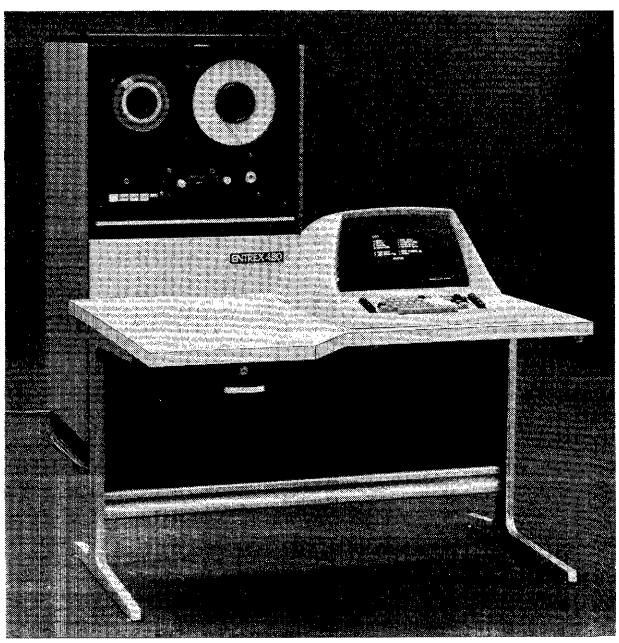
The current data entry devices can be categorized as follows:

- Card punches and verifiers.
- Keyboard to paper tape devices.
- MICR readers.
- Mark readers.

Selecting a system to resolve your computer input bottleneck should involve more than just trend-following. There are many different ways to feed a computer, and each has distinct advantages and disadvantages. This report presents a comprehensive look at all the available data entry devices and how to select and use them effectively.

- Optical character recognition (OCR) devices.
- Industrial data collection devices.
- Point of sale (POS) devices.
- Voice response systems.
- Interactive remote terminals (including CRT terminals, typewriter terminals, and "intelligent" terminals).
- Keyboard to tape/disk devices (including keyboard to compatible tape, keyboard to cartridge or cassette, keyboard to diskette, keyboard to disk, and multi-station keyboard to tape or disk).

The prospective user of data entry systems should attempt to familiarize himself with these basic types of equipment as his first step toward reaching a decision. In ≻



An Entrex System 480 CRT keystation is shown in front of the compact central control group. This multi-station key to disk system is well respected by data entry professionals.

How to Select and Use Data Entry Devices

addition to this report, an excellent way to learn about specific classes of data entry devices is to read the individual product reports in the Peripherals section of DATAPRO 70. The Index lists each product report under its specific name and under one or more generic headings (e.g., keypunches, key-to-tape recorders, programmable terminals, etc.). The feature reports on Optical Readers, CRT Display Terminals, Typewriter Terminals, and Voice Response Systems will prove informative as well.

Before discussing the various categories of equipment in the preceding list, let us first establish a background of available data entry media and their properties. Sometimes this knowledge alone suffices to dictate a particular equipment choice. For example, in a typical banking application, such as demand deposit accounting, the MICR-encoded document is the obvious input medium to use. This decision, in turn, determines the type of data entry device to select for that application (namely, an MICR sorter/reader, or perhaps an optical reader equipped to read the MICR font.)

Presented below are eight properties of media to consider when evaluating the type of data input media to use in particular applications. Following that is an evaluation of the more common types of input media in relation to these properties. Having a clear idea of the relative merits of the various kinds of media, the user can easily relate these media to the needs and overall characteristics of his particular applications. Then the user can begin evaluating the particular classes of data entry devices in terms of media which seem suitable for the selected applications.

Properties of Computer Input Media

These are eight principal properties to consider when evaluating computer input media.

1. *Sensibility.* Can the medium be read by machine only or by both machine and humans? For some applications, such as text copy or turnaround documents, it is advantageous for the data to be easily readable by human eyes.

2. *Reusability*. Can the data recorded on the medium be erased and replaced or changed by new data, as when correcting an entry error?

3. *Storage Restrictions*. Can the medium store more than one record? Is record length restricted to a fixed maximum number of characters?

4. *Speed Restrictions*. What is the maximum reading speed of the recorded medium?

5. *Sorting Capability*. Can the medium be sorted prior to computer input?

6. *Handling*. Can the medium be easily handled once removed from the machine? Does it easily sustain damage? Are there storage requirements to consider such as space (storage cabinet size), temperature, and humidity conditions?

7. *Cost*. What is the cost per character of storage?

8. *Applicability*. Does the medium exhibit unique characteristics suitable for special applications?

Common Input Media

How do the commonly used input media rate with respect to the listed entries?

Punched tape. Can be read by humans only if the reader is familiar with the specific data code. Punched tape cannot be erased and errors cannot be corrected, but known errors can be identified by delete codes punched into the tape. Standard data density is 10 characters per inch. Record length can vary up to 120,000 characters for a 1000-foot roll. Reading speed typically peaks at 1000 characters per second but can go as high as 3000 characters per second when reading strips. The punched tape cannot be sorted prior to computer intput, but merging can be performed.

Punched paper tape normally comes in 1000-foot rolls; standard tape widths are 11/16-, 7/8-, and 1-inch (the 1-inch size is used more heavily than the other sizes). Tape bases other than paper include Mylar and metal for special applications. There are no set environmental requirements for temperature and humidity. Based on prices quoted to Datapro, 1-inch paper tape costs about 0.83 cent per 1000 characters. Costs rise sharply for Mylar and metal tape.

Punched cards. Can be easily read by humans when interpreted (i.e., when the characters are printed above the punched codes). Punched codes cannot be erased except by affixing patches over the error punches. Record length is limited to 80, 90 (UNIVAC), or 96 (IBM System/3) characters. Card reading speeds currently range from about 20 to 2000 cards per minute, with most installations falling into the 200 to 1000 cpm range.

Cards can be sorted manually and by machine, and can be merged by machine prior to computer input. Cards are normally ordered in cartons of 10,000 cards each. There are set environmental requirements for temperature and humidity, and if they are violated, damaged cards and operating difficulties can result. Cost per thousand characters of storage is about 7.3 cents.

The uniqueness of punched cards lies in the discreteness of each card as a unit record and the convenience of manipulating it. This allows easy addition, deletion, and rearrangement of records, and provides a manual reference to individual items. When interpreted, the data punched into the card can be quickly read by humans.

How to Select and Use Data Entry Devices

Magnetic tape. Can be read by machine only. Magnetic tape can be easily erased and therefore must be carefully safeguarded against unintentional erasure. Errors can be corrected without disturbing adjacent data. Data recording densities commonly used are 200, 556, 800, and 1600 characters per inch. In March 1973 IBM introduced a new technique called Group-Coded Recording (GCR) that enables data to be written at a density of 6250 characters/inch. Record lengths are variable.

Typical reading speeds vary from 15,000 characters/second at the lowest density to 320,000 characters/second at a density of 1600 characters/inch and to 1,250,000 characters/second at 6250 characters/inch. The contents of magnetic tape cannot be sorted before serving as computer input, nor can individual tapes be merged. (Tape contents, of course, can be dumped to a disk and sorted under processor control, and partially recorded tapes can be played into a pooler that records a new merged tape.)

Standard magnetic tape reel sizes are 7-inch (600 feet), 8.5-inch (1200 feet), and 10.5-inch (2400 feet). Environmental restrictions are imposed for magnetic tape storage, but they allow wide temperature and humidity ranges.

Cost per character of storage varies according to the supplier and the quality of the type. In slow-moving, low-density tape applications, poorer grades of tapes may be quite satisfactory. Assuming the use of good-quality tape, and supposing that the tape is ordered in batches of 100 to 999 reels, the approximate cost of storing 1000 characters when the recording density is 200 bits/inch is 0.3 cent. Disregarding record-length and gap-size considerations, the cost of storing 1000 characters at a density of 1600 bits/inch is roughly 0.035 cent. At the new density of 6250 bits/inch, the cost can go down to about one-fourth as much.

Disk Packs. Can be read by machine only. Since magnetic disk packs can be easily erased, they must be safeguarded against accidental erasure. Errors can be corrected without disturbing other data.

At present users can choose from a number of disk drives and disk packs. The IBM 1316 Disk Pack or its non-IBM equivalents, for example, contains 6 disks and provides 10 recording surfaces; it can store up to 7.25 million bytes. The IBM 2316, or equivalent, contains 11 disks and provides 20 recording surfaces; it stores up to 29.17 million bytes. The IBM 3336, or equivalent, has 12 disks and provides 19 recording surfaces; Model 1 stores 100 million bytes and Model 11, which is constructed in exactly the same way except for a double density of cylinders compared with that of Model 1, stores up to 200 million bytes. The 3348 Data Module stores 34.9 million bytes in Model 35 and 69.8 million bytes in Model 70. A newcomer to mass storage, the floppy disk or diskette (23FD-11), stores 653 thousand bytes. It is simply a flexible Mylar disk, 8 inches in diameter, enclosed in a plastic envelope. This envelope remains stationary in the disk drive mechanism while the disk spins freely. Cutouts in the envelope allow access to the tracks for the read/write head and sector-sensing devices.

Based on IBM prices, the following figures show the variation of storage costs for each 1000 bytes. For the IBM 1316, which costs $360, the amount is 4.96 cents. For the IBM 2316, which costs $525, the amount is 1.8 cents. For the IBM 3336 Model 1, which costs $1000, the amount is 1 cent. For the 3336 Model 11, which costs $1150, the amount is 0.58 cent. For the IBM 3348 Model 35, which costs $1600, the amount is 4.6 cents. For the 3348 Model 70, which costs $2200, the amount is 3.1 cents. The price of a diskette is about $6, and the cost of storage per 1000 characters is 0.92 cent.

It should be recognized that the lengths of records stored on disks can vary in accordance with the formats imposed by the controlling software. The formatting may not make full use of the available capacity, in which case the cost of storage rises proportionately. Some sample disk reading speeds, exclusive of access times, are 156,000 bytes/second for the IBM 2311 Disk Drive, 312,000 bytes/second for the 2314, and 806,000 bytes/second for the 3330. Environmental constraints governing the use of disk packs are not stringent.

Once the user has determined the media requirements of his applications, he can begin to examine the many available classes of data entry devices. In the following discussion these classes are explored and evaluated. Special attention is given to classes or devices that are not fully treated elsewhere in DATAPRO 70.

Card Punches and Verifiers

Certainly the most common form of data entry device in use today is still the keypunch machine that produces the 80-column punched card. The keypunch began to be widely used as early as the 1920's and 1930's. During the 1950's its usage began to multiply dramatically, and by the mid-1960's, approximately 500,000 keypunches were busily producing mountains of punched cards. This rapid growth remained unchallenged until April 1965 when Mohawk delivered its first keyboard to magnetic tape data recorder.

Improvements, enhancements, and extensions to the basic Mohawk innovation, including the multiple-station key to disk concept, have since mushroomed in the form of diverse data entry products from at least 50 companies. Most of these keyboard to tape devices are aimed directly at the keypunch replacement market.

Even after receiving its first challenge, however, the keypunch has continued to be a heavily used data entry device, and will evidently remain so for years to come. Ultimately, its popularity should gradually decrease in

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terms of both the number of installations and the percentage of the total data entry devices in use.

The durability of keypunches is partly explained by the fact that they are "old friends" to most computer professionals. To many old-timers, the punched card and data processing are almost synonymous. The lengthy pre-computer years of electronic accounting machines (or "tab" equipment) makes this attitude understandable.

Punched cards are comfortable. To the average person (computer professionals included), it is natural that data be contained in punched holes on a card – holes can be seen. On the other hand, many people feel that magnetic patterns in tape or disks or cores (of all things) are intangible and therefore disquieting. Besides, there is both psychological pleasure and operational reassurance in actually seeing cards speed through the machines.

The death knell for punched cards has sounded many times. First OCR rang the bell, and more recently key-to-tape and its off-shoots have also sounded the bell. Nevertheless, throughout all of this tolling card manufacturers continued to make more cards. They are still making them.

Consequently, Datapro does not hold with data entry experts who dismiss the punched card as obsolete and profess contempt for anyone who chooses it. But our support of cards is qualified. We contend just as strongly that, for many data entry environments, punched cards are in fact outmoded and a processor-controlled method of data entry would be much more productive. Clearly, a paradox exists. We have no doubt that in many environments the keypunch and the punched card remain the wisest possible choice. We also have no doubt that in many other situations their choice is poor and reveals backwardness of outlook.

The widely used UNIVAC 1710 VIP keypunch is one of several units on the market today that boast of electronic operation and data buffering. In addition to its role as a keypunch, the 1710 also acts as a verifier and an interpreter.

When is the keypunch a wise choice? The following characteristics would seem to favor keypunches: (1) need for a small number of data entry stations; (2) need for a relatively small number of program formats, say, no more than about 10; (3) ability to work effectively with 80- or 96-character records; (4) availability of strong editing procedures in the central computer; (5) acceptability of subsequent discovery of errors by the central computer rather than early discovery in the data entry process; (6) absence of a need for rapid and systematic search of the recorded data records; (7) absence of a need for immediate printouts; and (8) absence of any outstanding personnel disciplinary problem.

These are a lot of conditions, but part of the data entry paradox is that probably more environments exist that satisfy these conditions than that do not. What these conditions really say is that if the data entry activity is relatively straightforward and not overly voluminous, then the tried and true keypunch with its directness and simplicity might well be the best choice to make. (By the "best" choice, we mean the most cost-effective.)

This rally to the defense of keypunches is not meant to be all-inclusive. Certain keypunches have recently been outfitted with buffers and electronic functions that bestow in elementary form many of the basic advantages of processor-controlled data entry systems. To be sure, when sophisticated editing and validation procedures must be imposed upon the entered data, the keypunch cannot compete. Nevertheless, in many straightforward situations the cost of processor/controlled systems is prohibitive and the latest electronic keypunches can serve quite effectively.

An impressive example is the Tab Products Punch-Verifiers and Interpreters. The keying of these devices is electronic and silent. As characters are keyed, they are stored in a data input buffer, and no action is performed on the card. Prior to the keying of the 80th character, the operator can backspace and make any desired corrections to the data in the buffer. When the 80th character is keyed, the entire record is transferred to a data output buffer and the card is automatically punched. Without waiting, the operator proceeds to the keying of the next record. The previously keyed record is retained in the output buffer so that duplications can be made from it. In short, all of the familiar keypunch characteristics are retained.

The Tab Punch-Verifier also incorporates a program buffer, which can store 5, 10, or 31 levels, depending on the model. Hence, the Tab device can store many more than the two program levels of the old-fashioned mechanical keypunches that rely on drum cards. The formats, furthermore, can be automatically sequenced. This feature is

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extremely valuable when a business form with successive lines that differ in organization must be entered. The Tab device permits such a form to be entered in sequence without manual intervention by the operator.

Another useful feature of the Tab Punch-Verifier is constant emitting. Up to 240 constants can be stored in a special buffer, depending on the model, and each can be automatically inserted into a character position as called for by the format program. This provision saves keystrokes.

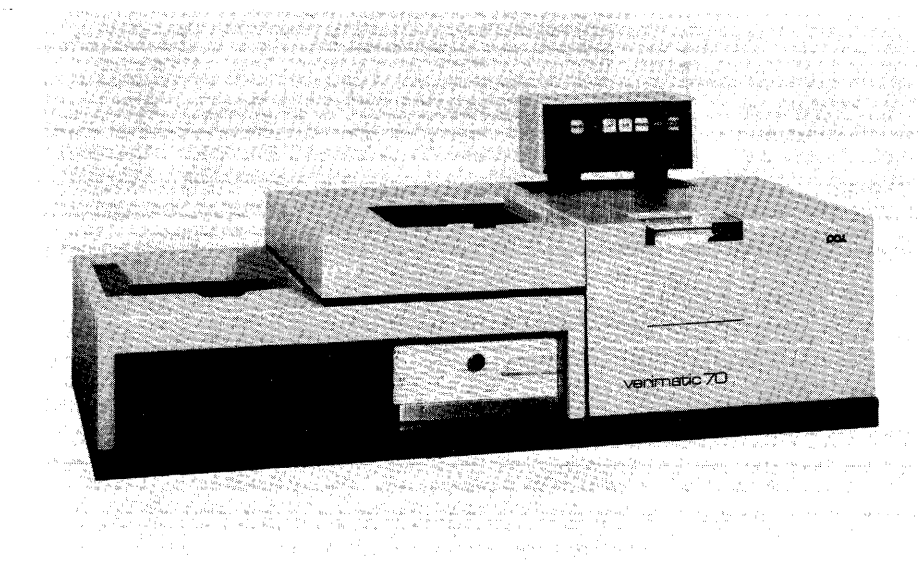
The data buffers are also useful in verification, which is performed by the same Tab unit. The contents of the card to be verified are entered in the data output buffer. Keyed data is entered into the other buffer and compared, character by character, with the card image in the first buffer. Necessary corrections can be made within the buffer before any new card punching takes place.

Another line of keypunch-verifiers that boasts of data buffers is the widely used UNIVAC 1700 Series VP and VIP Card Keypunches. A new 80-column keypunch made by Decision Data is also in this category and is distinguished by its high speeds. Decision Data has had 96-column data recorders on the market for some time.

IBM, long the only important supplier of keypunch equipment with its old-fashioned Model 24, 26, and 29 units, is countering its new competition with the 129 Card Data Recorder. In addition to offering data buffers and some useful new features, the 129 can store six programs. Sequencing must be manual. One interesting option of this device is the Production Statistics feature, which records total keystrokes, cards processed, and the number of verify corrections. Figures for these totals can be recorded and punched upon demand. Another option, Accumulate, accrues totals on any of three fields and, under program control, punches the accumulated totals. Crossfooting can also be performed (accumulations within a record itself). Each field count can contain up to 14 digits. Still another option is check digit verification, which can be performed for modulos 10 and 11. A similar IBM product for 96-column cards is the 5496 Data Recorder.

Users of keypunches might well profit from two relatively new punched card error detection devices made by Peripheral Sciences, the Verimatic Models 70 and 170. The company describes its products as balancing and editing control systems rather than automatic verifiers. Nevertheless, the Verimatic concept is to obviate the need for conventional verification, which is tedious and slow. These devices: (1) perform logical comparisons of the punched data with data supplied to the Verimatic, (2) confirm that the recorded data is consistent with the appropriate format conditions, (3) confirm the validity of duplications by detecting improper codes punched into the recorded card, and (4) perform check-digit verification of designated fields using modulo 7, 10, or 11. Examples of logical tests are table look-ups and range checks. In addition, the Verimatic detects many other errors by means of batch balancing. An audit trail on journal tape output is generated.

The Verimatic performs its functions at the rate of about 300 to 500 cards/minute without the cost of a keypunch operator. It is possible for some errors to slip through the Verimatic detection processes, so it follows that critical fields should be verified in the conventional way. Without question, however, most verification can be abridged if not totally eliminated by the Verimatic devices, with attendant savings in personnel and time costs. Users interviewed by Datapro stated that Verimatic action is much faster than keyed verification and has the advantage of locating errors prior to computer processing.



The Verimatic Balancing and Editing Systems perform a variety of tests on data punched into cards to eliminate the need for most standard verification.

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A parting word of caution should be given. Future growth, future proliferation of job complexity, and future competition should all be carefully assessed before deciding upon the punched card medium.

Keyboard to Paper Tape Devices

The most common form of such devices is the typewriter or teletypewriter-like device which produces punched paper tape as output, in addition to typed, hard-copy output. Examples of this kind of device are the old Friden Flexowriters (still in use) and the Teletype teleprinters. Paper tape is also produced as output by a variety of business-oriented devices, such as cash registers, small accounting machines, adding machines, etc.

Keyboard to paper tape devices should definitely be considered as data entry devices when the device which produces the paper tape is otherwise ideally suited for the particular application. For example, if a cash register is the most suitable transaction accounting device in a retail store, then the user should certainly consider using its paper tape output option as a way to automatically record the point-of-sale data for easy entry into a computer system.

Once paper tape has been created in an off-line mode, the data so captured can then be conveniently transmitted over data communications networks to a centralized computer system. This data transmission suitability of paper tape makes the concept of data entry via paper tape a very viable one in many applications requiring remote transmittal of data.

Keyboard to paper tape devices seem to be losing ground slowly. They will probably do no more than hold their own in certain small business and data transmission applications.

MICR Readers

Magnetic Ink Character Recognition (MICR) readers, and the entire MICR technology of encoding documents with magnetically charged alphanumeric information for optical recognition by an MICR reader, are used almost exclusively by commercial banks. The MICR characters are encoded on checks, deposit slips, and other banking documents both before issuance to customers (through an automatic printing operation) and after customer usage (through a manually operated keyboard device which also services to prove amount totals of these documents).

Despite frequently heard complaints from the banking community about the limitations of MICR, it probably will continue in use for some time. Ultimately, the development of inexpensive, flexible, fast, and reliable optical readers will probably displace MICR equipment and techniques.

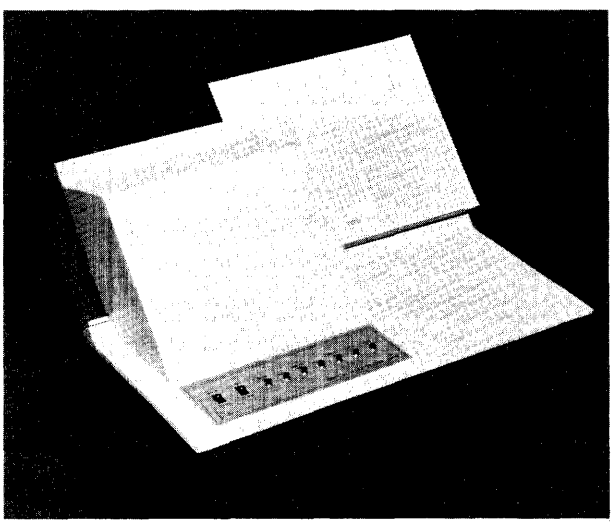
For banks today, MICR is the best form of data entry available for use with their voluminous turnaround documents.

Mark Readers

These devices optically read carefully controlled pencil marks on turnaround documents and so can enter data directly into a computer system without any form of intermediate data transcription. Mark readers are optical scanning devices which lack flexibility. They cannot read alphanumeric information; they can only sense marks. The computer must then correlate these marks with preprogrammed data to determine their significance.

The mark sensing technique has become very popular in the educational community in such applications as scoring test papers. In this case, the mark is entirely adequate in determining yes, no, true, and false selections, as well as others in which a relatively few choices are possible. Again, with the improvements in cost and performance occurring in OCR technology, there may eventually be little reason for the existence of mark readers. It is likely, however, that they will continue to be used for some time in simple applications as the most economical means for automatically entering certain types of data into a computer.

A particularly interesting product is marketed by the Datatype Corporation. Basically, the company produces a stylized typewriter typeface that makes a legible character impression and under it imprints a tiny bar code that is readily identified by the Datatype recognition system. This inexpensive approach to optical character recognition through mark sensing of the bar code has proved successful in a number of installations.



This compact Datum optical mark reader stakes its market success on cost-effectiveness.

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Optical Character Recognition (OCR) Devices

Through optical scanning techniques, these devices read printed or handwritten alphanumeric information from special-size documents, journal tapes, and standard pages. The information is then either recorded on magnetic tape (off-line mode) or transferred directly into a computer system for processing (on-line mode).

Such devices have been in use since the early 1960's, yet only about 2000 computer installations currently use OCR equipment. In many application areas, such as retail mechandising operations, utility bill processing, credit card processing, and any other application involving a turnaround document originally prepared by the computer's high speed printer, the optical character reader can be a highly suitable device for direct data entry. The data read by such devices is also legible by humans.

Optical character readers are still in rather limited use for several reasons. First, the type fonts that can be read by most units have been limited to a few highly stylized fonts. Secondly, reliability has not always been satisfactory, often resulting in high reject rates. And thirdly, cost has been relatively high.

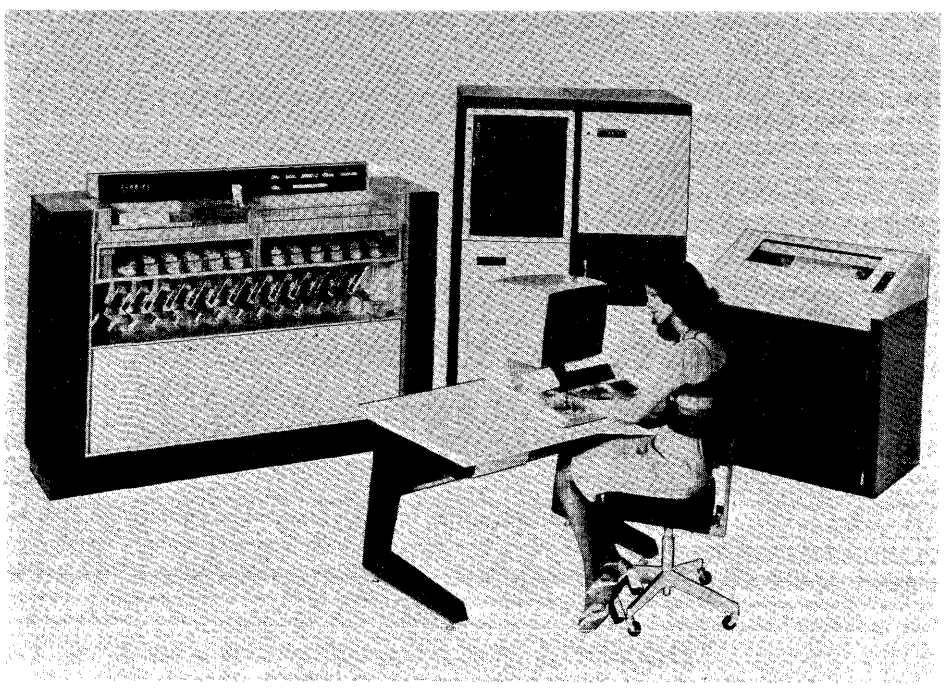
The OCR equipment manufacturers are desperately striving for improvements in each of these areas, and much progress is being made. Low-cost turnaround document readers, such as the UNIVAC 2703 Optical Document Reader and the Cognitronics System 71 are becoming more commonplace and reliable. However, a problem still exists in producing multi-font readers economically.

There are two basic types of optical character readers. One is the page reader, which handles forms that approximate the familiar 8-1/2 by 11 inches or greater, and the other is the document reader, which handles forms that do not usually exceed about 8 inches in the longest dimension. There are composite page and document readers, such as the Scan Optics 20/20, but these dual-purpose readers must have very elaborate transport systems.

Scanners can operate either on-line to a computer or off-line. In other words, the scanner can deliver its output directly to a computer mainframe or it can record this output on an intermediate medium, such as magnetic tape (the most common choice), paper tape, or cards. The IBM 1287 Document Reader, the IBM 1288 Document and Page Reader, and the Burroughs B 9134-1 Document Reader are examples of on-line scanners. The Control Data series, Models 915, 921, 936, and 955, are off-line readers. Some units such as the IBM 3881 can be operated in either mode.

Some of the more expensive readers, such as those produced by Scan-Data and Recognition Equipment, offer so-called multiple-font or multifont capabilities. A reader with multiple-font capability can store recognition patterns for more than one font but can accommodate only one font at a time. A multifont reader, on the other hand, can identify characters that appear in different fonts on the same document.

The latest trend in optical scanning is the evolution of mixed-media (also called multi-media) systems. Such systems combine a key to disk data entry system with an



One of the most extensively supported multi-media systems offered today is the Cummins-Allison 4400 Key-Scan System. In addition to the CRT keystation, shown in the foreground, and the Cummins Scanak Model 4216 optical and/or MICR scanner, shown to the left rear, several other scanning devices can be used to enter data into this system.

optical character reader in a single installation, with varying degrees of integration of the two sections into a single, unified system. In such unified installations, the shared processor of the key to disk section receives data output from the scanner section and treats it as if it had come from another keystation. Thus, scanned data can have the benefit of software originally prepared for keyed data. There are other advantages to these systems. One is the ability to store unrecognized characters on a disk and later to recreate their images on a keystation screen for operator identification and correction. Another is the ability to scan certain fields of a page or document by an optical device and to submit other fields of the same source to a keystation operator for manual entry. The system can reassemble these records in a desired sequence during a reformatting procedure. More typically, the keystation operator would call up the fields entered by the scanner with the aid of the search function of the system and key in the fields ignored by the scanner. At this point, then, the original source document is reconstructed and stored in sequence on the central disk file. Scan-Data, Recognition Equipment, and Cummins-Allison now have multimedia systems on the market.

The Inforex KeyScan Processing System is a special example of a mixed-media device. This system scans documents and permits an operator to key nonscannable data at the same time.

Industrial Data Collection Devices

Industrial data collection equipment represents an example of source data collection, or source data automation, as it is often called. Source data automation, or SDA, is simply the conversion of information about an event or transaction into machine-readable form at the time when the event or transaction takes place and at the site where it occurs. Industrial data collection is that type of source data automation that monitors employee attendance, gathers production control information, records labor distribution, collects inventory control data, and serves other related applications in an industrial environment. These systems usually consist of the following three classes of equipment:

- Input terminals that extract, format, and transmit both fixed data from prepunched cards, badges, or other previously prepared media and variable data from switches, dials, or keys.

- Cables, multiplexors, and/or communications equipment for transmitting data from the input terminal to an output unit located either within the plant or at a remote location.

- Output units that organize the data received from the remotely located input devices and record this data onto punched cards, punched tape, or magnetic tape for entry into a computer. (Some output units control the direct entry of formatted data into a computer system.)

Source data collection has two important advantages over alternative methods of input preparation. First, it reduces the number of times that data must be transcribed and the number of locations at which such procedures must take place. Hence, errors are avoided and many clerical costs are either reduced or eliminated. A more important advantage is the nearly instant availability of data. Data that describes the status of a plant, warehouse, or store can be kept current, and operating decisions can be based on actual conditions rather than on superseded statistics. Not to be overlooked is the possibility of implementing real-time control of industrial operations through the use of industrial data collection systems.

Industrial data collection devices are specifically designed to facilitate accurate data entry in the factory environment. They are comparatively low in cost, highly durable, and easily operated by non-skilled personnel. Such data entry devices will continue to be used for some time to come. There will undoubtedly be more progress in developing integrated data collection systems, rather than stand-alone devices. On-line systems will continue to increase.

Examples of off-line systems include the Wright Line 2600 Series, the Vari-Punch 404, and the Credex Corporation Model 2213, which all perform employee time recording. The Singer 30 Collectadata Network was designed originally as an off-line plant data collection system, but it can now be operated on-line with the Singer System Ten computer as part of a manufacturing information system. Standard Register's LCT Series is an on-line computer terminal employing ASCII code. A company long in the field, Data Pathing, Inc., produces various terminals for its 2104 source data acquisition system, which is on-line to the 2104 processor.

Point of Sale Devices

For many years the concept of capturing data at the time a transaction was executed, as a byproduct of the transaction itself, has excited the interest of systems designers and users. Manufacturers, however, were not so excited – at least, if they were, they found it difficult to come up with suitable equipment. True, various half measures, such as a cash register that printed a transaction journal in an OCR type style, have been used with some success, but the general-purpose unit that could capture all available data at transaction time was a long time coming. Enter POS.

POS equipment was developed as a result of many pressures and trends. Among these were:

- The need for product flow information to aid in inventory control and distribution.

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- The growing problems associated with training personnel to handle cash registers and sales checkout functions.
- The growing use of credit purchases and the need for performing credit checks accurately and quickly.
- The decreasing cost of logic circuitry.
- The growing acceptance of intelligent terminals.

These pressures and trends have coalesced into commercial products for two distinct industry areas, retail chains (department stores) and food chains (supermarkets), each with specific needs.

The significant features of the POS devices for retail use include:

- Capability for entering extensive information such as product code, credit card number, etc.
- Ease of use, with the operator being led through the many types of possible transactions by a series of lighted indicators or messages.
- Provision for transmission of data to a central computer for credit checking and/or collection of product flow statistics.
- Provision for local computational capability for price extensions, tax calculations, etc.

The devices for supermarkets generally have more specialized keyboards for quick product group entry and incorporate optical scanning devices for automatically capturing the manufacturer and product code from symbols on the food package itself. Once this information is captured, a central controller (minicomputer) can furnish the prices. The object of the supermarket POS equipment is to speed the physical checkout function as well as to capture product information.

More than two dozen companies compete in the already lucrative POS market. The big two are Singer and NCR. IBM will be delivering equipment in late 1974 and now looms large in this segment of data processing, as it does in virtually every other area.

In general, POS devices do not directly replace other data entry devices, for their functions were not accomplished using other devices. POS represents a whole new dimension in the creation of sets of data for computer manipulation.

Voice Response Systems

Most of the currently available voice response systems utilize frequencies generated by a Touch-Tone telephone to transmit input data to a remotely located computer. The computer then interprets the input information, formulates responses to it, and finally synthesizes voice responses to the inquiries. Hence, what the user obtains as output is a spoken reply heard through his telephone.

This synthesis of human speech is a truly remarkable process. Essentially, the computer processes the received data, generates the necessary output data, and then organizes the ouput into an ordered set of addresses. Each address corresponds to a particular recorded voice segment stored in the voice response unit. From the sequence of addresses, a sequence of voice segments is accessed, and the resultant sound composite is transmitted to the user as a spoken response.

Voice response can be considered when low-speed man/machine interaction is called for. So far, the banking industry has been the foremost proponent of this technique. Bank account status inquiries over tellers' phones constitute the principal application. Another fascinating application of voice response is made by the telephone company. When an operator intercepts calls for inoperative, disconnected, or changed telephone numbers, the operator simply keys the dialed number into a voice response system, and it proceeds to verbalize the proper reply to the caller.

Some of the companies in the voice response field are Applied Information Industries, Burroughs, Cognitronics, Datatrol Inc., Honeywell, IBM, Periphonics Corp., Qantel, and Wavetek Data Communications.

An objection to voice response at present is the absence of hard-copy output. (An obvious answer to this criticism is to combine voice response with data entry systems that employ printers when hard copy is needed, and to employ it in conjunction with alphanumeric displays when quick video response is required.) Another significant limitation is the rather small vocabularies (usually no more than 256 words or phrases) available in most of the current voice response systems. The pushbutton telephones used as input devices in most voice response systems restrict the input data to numeric digits unless multiple key depressions are used to enter each alphabetic character – an awkward procedure at best. Numerous alphanumeric data entry terminals are now available, but at a considerably higher cost.

A particularly exciting development of the past two years is voice input. A system offered by Threshold Technology Inc. of Cinnaminson, New Jersey, enables a cashier to enter price and commodity data into a terminal by voice instead of by operating keys. The terminal recognizes the numbers spoken by the operator and proceeds to perform arithmetic operations and produce a printed receipt, just as another system would do with similar data that was keyed. Still in its infancy, voice input holds great promise for the future.

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Interactive Remote Terminals

As mentioned earlier, key to tape devices have become extremely popular and highly publicized candidates in the keypunch replacement data entry market. As will be discussed in detail below, these devices are definitely here to stay, at least for most of the 1970's. By contrast, use of interactive remote terminals for data entry has really only begun to blossom. And yet, such devices and systems may ultimately displace not only the keypunch but also the key to tape devices as the most widely used data entry devices of the future.

The concept of the interactive remote terminal as a data entry device involves four distinct system elements:

- A keyboard, located at some distance from a central computer system, for entering alphanumeric data.
- A data communications network to transmit this data between the remotely located terminal and the central computer.
- A central computer to receive, pre-process, and store (usually on disk files) the data entered from many remote locations.
- A typewriter or CRT display screen at the remote location to receive responses and directions as output from the central computer.

Thus, the interactive remote terminal is an on-line input/output device designed for two-way transmission of data with a central computer. The interactive remote terminal becomes a data entry device as part of a larger data entry system by reason of the way the overall system is programmed (by software) in the central computer.

In its simplest form, the interactive remote terminal is used as a keyboard data entry device, with the central computer performing control, editing, verifying, and storing functions, in addition to acknowledging that the data has been successfully entered. The data so stored, for example, in disk storage, can later be processed by a specific user application program.

At a more sophisticated level, the interactive remote terminal can not only enter data, but can also receive immediately, or in "real time," the computer's response in the form of meaningful output data. This inquiry and response usage can be used in any application requiring an immediate response to a "status" query, such as in inventory control, credit, and reservations systems. Such usage, since it involves applicational processing of the entered data, together with an output data response, represents more than a pure data entry system. It involves on-line data entry plus real-time processing.

The best-equipped specific device to serve as an interactive remote terminal in a data entry system is the CRT display unit coupled with a keyboard. Such a CRT unit permits the operator to key in data much as she did with a keypunch, although the CRT's operation in this function will be faster than that of the keypunch since its action is largely electronic rather than mechanical. Also, the handling problems associated with punched cards are eliminated.

The entered data is simultaneously stored in the CRT's buffer memory and displayed on the face of the screen. This permits the operator to visually verify the correctness of the data before entering it into the central computer system. Depending on the way the system is programmed, large quantities of data, such as 1,000 or more characters, can be displayed on the screen as a single record prior to data transmission.

The central computer can perform routine edit checking or more detailed accuracy checking. The operator can be notified at once of the error and solicited for re-entry of the data. Thus, the error correction cycle can be compressed to its logical minimum.

Multiple CRT devices can be scattered about in the same or different facilities, simultaneously entering related or non-related data to the same central computer system for temporary disk storage and eventual processing. Thus, the relatively high costs of the central computer facility can be shared by a number of different users, both at the remote locations and also at the central location, where the computer can be concurrently performing local batch processing.

IBM has emphatically endorsed the concept of using interactive CRT devices in data entry systems. Its DATA/360

Surprise! IBM is in first place – this time in the CRT display terminal market with the 3270 Information Display System. The display is useful, but it's the keyboard that enables data to be transmitted directly to a computer via communications links. Hence, it's the keyboard that makes the CRT terminal an attractive data entry device.

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and VIDEO/370 Program Products provide impressive software support for installations of this type. This endorsement will go a long way toward ensuring the eventual popularity of this approach.

Numerous data entry systems have already been built around CRT display units. Probably the primary factor that has prevented this approach from achieving even more widespread use to date has been cost. Costs can be high, since a large number of hardware units comprise the overall system, including the CRT unit, the data communications network, and the central computer system. CRT units themselves are inexpensive enough, with many now renting for less than $100 per month, but the remote computer network can be quite expensive.

Costs will continue to drop over the next few years, and the usage of on-line data entry systems will rise significantly. Costs of the remote terminals themselves will decrease, but, more significantly, computer hardware and software improvements will make it operationally feasible and economically desirable to share the costs of the central computer among many concurrent users, both local and remote. Data communications networks will also decrease in cost while noticeably increasing in reliability, all encouraging the increased use of such data entry systems.

Intelligent Terminals

Intelligent, or programmable, terminals represent an increasingly significant class of data communications equipment. Some intelligent terminals are definitely data entry devices, while others, such as remote batch terminals, usually are not so considered. From a data entry viewpoint, therefore, the situation calls for clarification.

A remote batch terminal is really a controlled combination of a card reader, printer, and/or card punch that is used for transmitting large blocks of data to a central computer, without the expectation of immediate response, and for eventually receiving output from the computer and printing or punching it at the remote site. The card reader or its equivalent is the true data entry device. Remote batch terminals of the "intelligent" type are usually built around a minicomputer and may possess impressive data formatting, editing, and processing capabilities of their own.

Perhaps the outstanding examples of intelligent terminals that are clearly data entry devices are the terminals equipped with a keyboard and an internal processor. At one end of the market, some of these units serve solely as batch terminals – but, owing to their construction and intended use, they must definitely be regarded as data entry devices. Other, more sophisticated terminals can accept data, process it, store the data for printed release upon command, format the data into various business forms such as inventory lists, purchase orders, requisitions, sales records, etc., and present requested information either on a CRT screen or in a printout. Typically, these devices also produce an output tape, either in reel or cassette form, and transmit the recorded data to a central computer at a convenient time. Still more advanced terminals can control a cluster of unintelligent data entry terminals. Sometimes they can even perform multiple processing functions on the data at the same time.

These proliferating intelligent terminals offer many exciting possibilities in the data entry field today and promise even more for the future. For detailed reports on the currently available products in this class, please refer to the "programmable terminals" entry in the Index.

Key to Tape Devices

The key to tape concept has undergone many changes since its inception by Mohawk Data Sciences in 1964. Its original configuration was that of a buffered stand-alone unit consisting of a keypunch-style keyboard and a computer-compatible magnetic tape drive. Data keyed from the source document was temporarily gathered into a core buffer, where it remained until the record was completed and released to tape. Then the unit automatically backspaced to the beginning of the just-recorded record and performed a bit-for-bit comparison between each recorded character and its duplicate in core memory.

Its validation mode allowed the operator to key the source document on the same machine again, this time comparing the keyed data with that read from tape and returned to the core buffer. A validation error would lock the keyboard and alert the operator, who could re-key the same characters for comparison with those stored or for overwriting them.

The search mode permitted one out of a number of recorded records to be located by a key identifier entered at the keyboard. Tapes from all the stand-alone recorders could be consolidated or pooled on a common tape prior to computer processing. Data, record location, and program code were displayed by a group of indicator lamps. Two programs, base and alternate, could be selected at will by the operator. The magnetic tape reel was recorded in either the 7-track IBM 729 Series or the 9-track IBM 2400 Series tape format.

This was the basic key to tape concept prior to the Honeywell and IBM endorsements during the first half of 1968. The Honeywell Keytape entry was essentially a refined Mohawk unit. But IBM's entry, the Model 50 Data Inscriber, used an entirely different technique. It stored up to eight record formats and recorded on a unique magnetic tape cartridge. Since IBM supplied the reading device for the recorded magnetic tape cartridge (the Model 2495 Tape Cartridge Reader), the user was locked into the IBM System/360 computer.

How to Select and Use Data Entry Devices

The two large companies' entries into the key to tape market were of prime significance because they gave the necessary weight to the thrust that launched the key to tape industry. In the year that followed, over 25 new companies had entries of their own in this newly formed market. Some were copies of the Mohawk or IBM designs; others added refinements. Still others extended the basic design to include such features as CRT display of the entered data and/or record formats, multiple keyboards, magnetic tape clusters, disk storage, and internal processor control.

With all these variations on a theme, it becomes necessary to identify the basic similarities and differences among the many members of the key to tape family. Actually, all current key to tape equipment can be classed under two broad categories: stand-alone (single-station) and multi-station devices. The two key to tape categories are discussed in detail in the following paragraphs.

Stand-Alone Keystations

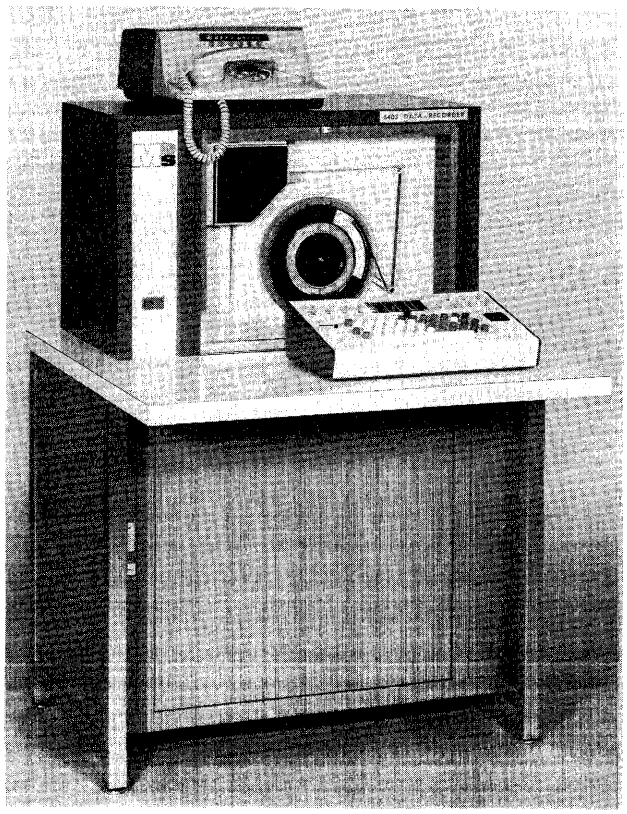
The stand-alone configuration includes all components necessary to produce a recorded tape from a keyed source document—all within a single unit.

Stand-alone units can be further characterized as belonging to one of two groups: those that are equipped with a conventional magnetic tape drive to handle standard computer tape reels and those that are equipped with a magnetic tape cartridge or cassette recorder. The former group typically provides the user with 7- or 9-track, computer-compatible tape recorded in the IBM 729 Series or 2400/3400 Series magnetic tape format. Tape densities are generally 200 or 556 bits per inch for the 7-track versions and 800 or 1600 bits per inch for the 9-track versions. The latter (cartridge recording) group requires a conversion process to translate the data recorded on the cartridge or cassette tape to a computer-compatible format prior to entry into a computer system. The cartridge variety generally uses either the IBM tape cartridge used by the IBM Model 50 Magnetic Data inscriber or the "Philips-type" cassette, although a number of unique tape cartridges are in existence. Most suppliers of cartridge keystations provide a cartridge converter to enable translation to a computer-compatible tape format.

Aside from their difference in output media, there is little difference in the operation of these two classes of keystations.

Data keyed from the source documents is written on tape in variable- or fixed-length records under control of a stored record format, which may be loaded automatically or entered from the keyboard, depending on the device. Normally, two format programs can be stored.

The format program is used to delimit alphabetic and numeric fields and to initiate automatic field skipping,



The Mohawk 6403 Data-Recorder is a stand-alone, 9-track key to tape station based on Mohawk's original 1100 Series 7-track product line that started the key to tape revolution in computer data entry. The 6403 includes a data communications capability.

duplicating, and right justification (left zero fill). Some devices include a validation check to be performed on the recorded data (check-digit verification).

The same device used for data entry can also be used for verifying the entered data. The source document is re-keyed in the verify mode and the device compares the recorded data with the entered data, halting when a verification error is encountered to allow for operator intervention.

A search mode allows the operator to find a specific record by keying an identification field or fields that compare with a field or fields within the record to be accessed. The location record can then be modified and/or verified.

Other operating modes sometimes include separate entry or verify modes for entry and verification of record formats, in addition to operating modes for unique job functions.

The operator display panel normally provides the operator with such information as current location within record, character stored at current location, program code stored at current location, and error status. Older devices display

How to Select and Use Data Entry Devices

the information in a binary format (which requires operator interpretation), while newer ones display the information directly in alphanumeric symbols.

The applicability of stand-alone keystations can be evaluated by considering the following criteria:

1. Cost. Does the size of the installation justify the cost of individual keystations? How does the cost per stand-alone keystation compare with the per-keystation cost of a multi-station key-entry system? (Multi-station systems are reviewed below.)

2. Duplication. Are the duplicated functions created by a large number of stand-alone keystations advantageous to the operation of the installation?

3. Operation. How simple is the keystation to operate? The more complex keystations require greater operator skill, and hence higher operator wages. Compare the simplicity of loading a tape cartridge with that of loading and threading a magnetic tape reel.

4. Reliability. The output of an installation composed of stand-alone keystations may be slowed as a result of one or two inoperative keystations, but it will not be completely disrupted.

5. Batching. The consolidation of record batches common to specific jobs on a single tape, commonly referred to as pooling, can be advantageous to the efficiency of an input preparation operation. Pooling is a typical function of an installation using keystations with computer-compatible tape drives. The same operation can be performed when converting the data recorded on tape cartridges to computer-compatible tape.

Two distinct trends have emerged in the stand-alone keystation market. One is toward increased reliance on the keystation as a remote data entry device with data communications equipment that links it to another remote site or to the central computer facility. If accompanied by a printer, the keystation can serve usefully as a combined data entry and communications terminal. The Tally Datascribe and the Honeywell Keytape stations are examples.

The second trend is toward wider use of cassette recording. Compact, inexpensive systems can be constructed with cassette drives substituted for standard reel-to-reel tape drives. If data is to be transmitted, there's really little need for the data entry device to produce an industry-compatible tape. On the other hand, if reels of industry-compatible tape are to be hand carried to a computer, several inexpensive stations can record data on cassette tape that can be transcribed to industry-compatible tape by another unit at a convenient time.

An example of an advanced cassette system is the Sycor 340 Terminal, a CRT/keyboard station with considerable formatting power. Editing by means of batch balancing and verification by check digits are performed. Extensive data communications techniques support the Sycor device. Batch mode and Automatic Unattended modes are implemented.

Multi-Station Key to Tape/Disk Systems

The most elaborate form of keyboard data entry available today is the multiple-keystation installation in which a common minicomputer processor and disk storage facility are shared among the various keystations. Nearly always, the primary output of such a system is industry-compatible 7- or 9-track magnetic tape with recorded densities ranging from 200 to 1600 bits/inch. The tapes are written from data records stored on the common disk pack drive, which serves as an intermediate storage medium. Data records on the disk can also be transmitted directly to the central computer over a communications line, and the use of this form of output is increasing.

The multi-station key to disk configuration is not bound by any universal set of configuration rules, but in nearly all such installations several keystations, usually at least four, are multiplexed into a common controller and disk storage complex. There may or may not be a supervisory station; when present, this station may be a teletypewriter or a special console, or even a standard keystation that is converted to supervisory use by keying in a special pass code. There may be auxiliary disk drives or only one. There may be a number of tape drives or only one. There may be line printers or none, depending on the user's application needs. A communications interface may or may not be present. Of great interest to many users is whether the keystations utilize a CRT display or offer a basic panel display. The common denominator of this class of systems, however, is the subjection of all system operations, expecially the formatting and manipulation of keyed data, to processor control.

Levels of program control can usually be divided into three categories. One is control over system operations and functions; these are managed by a body of executive programs. They include utilities that operate the various system components, such as the CRT displays, functioning of the keyboard, multiplexing of the keystations to the shared components, operation of the peripheral devices, etc. A second level of programming formats, edits, and performs tests on incoming data as it is being keyed. Many keying errors and discrepancies in the data are discovered at this time. Programs responsible for such functions are often said to be in the foreground partition. The third software control level performs operations upon data records already stored in the disk pack. End-of-batch balancing is an outstanding example of an editing check

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that can be applied at this time. Programs for the implementation of a data record search procedure, for reformatting of stored data records prior to writing them onto output magnetic tapes, and for blocking of records and the creation of headers and trailers are other examples. Programs of this class are often said to be in the background partition.

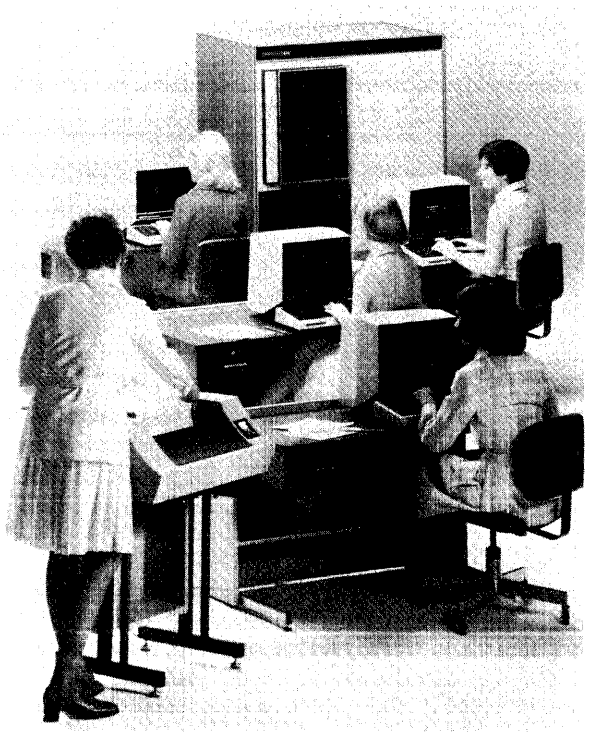
Order in the recorded data records is established by the assignment of unique job and batch numbers to identify all record batches associated with a specific job and all records within each batch. The keystation operator keys this information prior to an entry operation in order to identify the data about to be entered or verified. Job and batch numbers may also be used to access the record formats associated with the job to be entered.

Standard verification is conducted in the usual way. In the Verify mode, the operator summons the records to be verified by keying their batch and job number identities. Each successive data record is returned to the buffer of the keystation, and the operator keys from the source document. When a mismatch in a character position occurs, the operator is informed by disablement of the keyboard and by signals such as an error light or an error statement on the CRT screen. A correction is made simply by keying the proper character into the affected position. Usually, relatively little of this tedious kind of verification is required in key-to-disk facilities.

Some multi-station systems have a feature called dual or concurrent verification. A second keystation operator can call for a data record that has just been transferred to the processor by the operator who is keying this data originally. As long as the verifying operator remains a data record or two behind the original keying, a data record can be independently verified in this manner almost concurrently with its entry into the system. Although labor costs are not reduced by this procedure, rush jobs can be advantageously speeded through the data preparation cycles. Proponents of this technique do not appear to be numerous, but those who utilize it are enthusiastic.

Format programs can be specified in great detail and with considerable latitude. The limit to record length is really set by the available disk storage capacity, and lengths of over 500 characters are entirely feasible in a number of systems currently available. In some systems the record can be organized into fields numbering 100 or more. There is no difficulty about defining alpha fields, numeric fields, must-enter fields, duplication fields, skip fields, must-fill fields, and right- and left-justified fields. Fields can also be specified "must verify." Such fields will be recalled from the disk pack during verification, but other fields will be passed over.

Some systems allow for contingency fields. Such a field might accept a value lying within a defined range of values. Another field might allow entry only if the value entered in a preceding field surpassed or was less than a specified value. This type of formatting permits conditional editing of incoming data.



This view of a GTE IS/1511 Data Entry System illustrates the typical components of a multi-station key to disk system. Note the optional matrix printer at left foreground, the system control unit at center rear, and the comfortable working space between the CRT keystations for the convenience of the operators. The control unit houses a minicomputer, disk drive, magnetic tape drive, and power supply.

Format programs generally reside in disk storage and are placed in the main processor memory as summoned by the keystation operators. Any particular format can be accessed and used by any number of operators concurrently. Often, a string of format programs is associated with a particular job or batch, and the system automatically links or chains each successive format upon completion of a preceding record. Some systems have 4 such levels, but others can have up to 20 or 30. This feature allows the operator to key source material continuously without any concern for the appropriate format. The system automatically formats each record in the way it should be.

The supervisor directs and monitors the operation of the entire system. Through the supervisory keyboard, communication is maintained with all system components. Supervisory duties include assigning job and batch numbers, distributing tasks to the operators, designing new format programs to be entered into the system (usually

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entered by a keystation operator), deleting unwanted format programs and archaic data records from the disk, writing data records to magnetic tape, calling for system printout, and others.

Operator statistics constitute a particularly useful printout that the supervisor can request. Virtually all multi-station systems produce such statistics at the present time. These statistics typically consist of operator identification, batch and/or file identification, operator start and stop times, number of keyed records, number of source document errors that had been bypassed, number of operator keystrokes, and the operational mode of this activity.

In interpreting the statistics, the supervisor should weigh surrounding subjective considerations such as clarity of the source documents, freedom of the operator from external interference, and unusual emotional factors that might be involved. Users report high acceptance of the statistics by keystation operators, as they evidently feel that the impersonal nature of the statistics protects them from any personal bias on the part of the supervisor.

Multi-station key to tape/disk systems accentuate operator productivity in a way that no other type of data entry system can. They essentially strip the keystation operator of all responsibilities except the single-minded task of keying data. Apart from occasional entry of format programs, the keystation operator simply enters the assigned job and batch numbers to invoke the appropriate formats from the format program library. Then she simply keys the keys, stopping only in response to environmental distractions (break periods and the like). Proficient operators prefer simple panel displays that do not divert their concentration on the source document. Inexperienced operators like the assistance given by the information and instructions displayed on a CRT screen. But in either case, high production is the name of this game.

An interesting option in some systems is the availability of typewriter-style keyboards as well as keypunch-style keyboards. Operators lacking keypunching experience adapt quickly to the typewriter keyboards. Recourse to this type of personnel is advantageous in tight labor markets and also in source data environments, particularly those distant from the central data entry location. In these cases the remotely located keystations can be directly linked to the shared processor via communications lines. Nearby source data locations that are not more than one or two thousand feet away from the processor, depending on the system, can be directly connected by cables.

A prominent editing capability of processor-controlled data entry systems is totaling and zero balancing. Registers, either software or hardware, are set aside for the purpose of total accumulations. Accumulation of totals within a record is called crossfooting. Accumulations of totals from record to record is called subtotaling. Comparison of final totals compiled at the end of a batch with previously determined totals, sometimes called reference values, is called batch balancing or zero balancing. If zero balance is achieved, it is usually assumed that no verification of the records is necessary. If totals are out of balance, the records need be searched and verified only until ensuing corrections produce a balanced condition. Two important advantages are realized. The first is reduced need for formal verification. The second is discovery of errors in the recorded data at an early stage of the data processing cycle, when the source documents are close by and it is generally convenient to effect corrections.

Range checking and table lookups also eliminate much verification. Often it is safe to assume that if the contents of a field have been verified as lying between prescribed limits (ranges), the contents are reliable and need not be verified. Similarly, if field contents are shown to conform with a table of allowable values, further verification is again unnecessary. That is why, in the more advanced systems, the occasional critical field that must be verified is specially designated in the format program.

It is important to understand the benefits of multi-station key to tape/disk systems. Let us restrict ourselves to the particular advantages that distinguish this type of data entry from others. First, there is efficient utilization of system components through sharing. All of the data entry stations are served by one processor, one disk storage facility, and either one or a limited number of tape drives. Second, there is wide leeway with respect to record lengths and record formatting. Interruptions to keying arising from tape or card handling are minimal. Indeed, tape drive operation is independent of keying, except that the writing of a specific batch to tape usually does not overlap keying into the same batch. Keystation operators can concentrate on keying, with few diversions. Their efforts can be closely monitored by a supervisor. The keeping of operator statistics by the system maintains a continuous surveillance over their performance. The controlling format program can be tailored to expedite the fastest possible entry of data by the operator, and the desired output format can be structured by reformatting procedures in the background partition. Many keystroke-saving techniques are possible. Duplication of specially stored fields when certain logical conditions have been satisfied, such as greater than or less than, is an advanced example. The outstanding example, perhaps, is the intricate editing and validation procedures that can be imposed upon the incoming data. The assurance of delivering error-purged data to the computer and avoiding costly reruns and costly correction procedures is at a peak with a processor-controlled system.

In this connection, the recent trend toward editor languages from several vendors is significant. These languages which are usually simplified versions of COBOL, RPG, or

BASIC, give the user the ability to modify the system programming without vendor assistance in accordance with his own special editing and validation needs. For his trouble, the user enjoys the benefits of complex conditional test procedures that detect errors and save keystrokes. Companies offering equipment with editor languages include Logic (now a subsidiary of GTE), Entrex, Computer Machinery, Cummins-Allison, and Scan-Data.

It is also important to understand the disadvantages of shared-processor data entry. The most obvious is the catastrophic effect of a breakdown in any of the shared components, especially the processor. When the processor fails, everything stops. To offset this threat, many installations have two or more independent systems. Often these configurations are linked so that the processor in one system can assume control over the keystations of another whose processor has failed. This provision is called duplexing. User commentary indicates, however, that such catastrophes are fairly rare, so perhaps fears about them are exaggerated.

Another disadvantage, although a temporary one, is the need for a transition period in which to adapt to the new system. Certainly this requirement should not bar acceptance of a system that will eventually yield cost savings.

The most serious disadvantage of these multi-station systems is their high cost. Perhaps the second most serious disadvantage is the task of learning to exploit the power of these systems effectively. If the user buys features that he will not or cannot utilize, he is paying a steep price for nothing. This error, we believe, is often made. On the other hand, a fully exploited multi-station key to tape/disk system ranks high in cost-effectiveness.

Key to disk data entry is definitely not for everybody. If volume is modest and editing performed by the central computer is satisfactory, probably the EDP manager should select a modern electronic buffered keypunch-verifier, as discussed previously. But there is absolutely no doubt that when data entry is substantial in volume, when a variety of formats must be implemented, when test procedures can eliminate virtually all formal verification, and when a disciplined operator staff would be more productive, the manager should think in terms of shared processors. If even parts of some source documents are suitable for optical scanning, he should also think in terms of multi-media systems.

The manager should determine what editing procedures he needs and the number of accumulations he needs to maintain. He should match the capabilities of a prospective system with these needs and keep his costs at a minimum, while providing leeway for upgrading in the future.

Key to Diskette Systems

An important event of 1973 was the introduction by IBM of a key to diskette data recorder, the 3740 Data Entry System. The concept of this innovation is rather appealing. The diskette, of course, is the now-familiar "floppy disk", a flexible Mylar disk permanently housed in a plastic envelope. The diskette holds up to 1898 records. In terms of 128-character records, which is the maximum length accepted by the IBM system, almost 243K bytes of data can be stored. This capacity is adequate to retain a full day's output from the majority of operators.

Thus, the IBM 3740 system is an electronic means of recording data on a diskette as an alternative to punching cards. The most obvious advantage of this technique is that each diskette stores roughly the equivalent of a full box of cards although only 8 inches square and a fraction of an inch thick. Moreover, the diskette is reusable. Although there is an initial cost of roughly $8.00 each (IBM price), the durability of the diskette should result in long-term savings. When stored, the diskette is protected by its outer plastic envelope.

The keyboards are buffered, and CRT displays present the entered data and system status information. Search modes enable previously record records to be displayed on the screen and modified by the operator.

The IBM system includes a 3747 Data Converter that transcribes data from the diskette into 7- or 9-track magnetic tape at various recording densities. The system also has extensive data communications capabilities so that stored data on the diskettes can be transmitted efficiently to a central computer. The Potter System 85 is a similar diskette data station, but unless the compatible IBM converter is recruited to support it, the Potter system contemplates data transmission to a computer only.

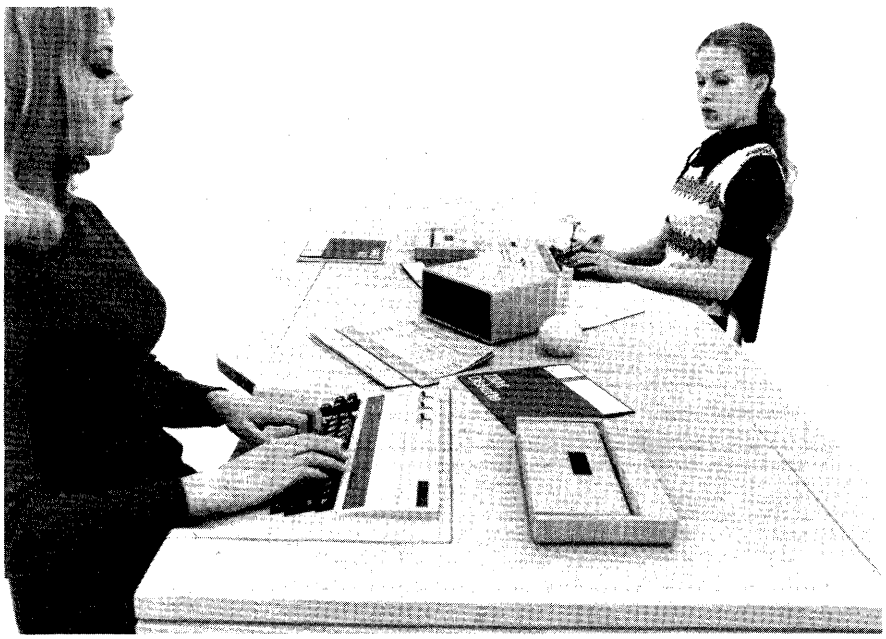
Fundamentally, the diskette data entry station is functionally similar to a stand-alone key to tape station. It does offer certain useful options such as production statistics, field total accumulations, and check-digit verification, as well as standard features such as skipping, duplication, zero insertion, etc. Three 19-position accumulators are provided.

The future of the diskette concept must be regarded as clouded at this time. Intermediate in price between keypunches and multi-station key to tape/disk systems, the diskette station must prove that there are a sufficient number of application environments in which it can outdo both in cost-effectiveness.

Closing Advice

In summary, the prospective user of a new data entry system should carefully study the data entry needs and

How to Select and Use Data Entry Devices



The IBM 3740 Data Entry System records data on a diskette instead of on cards. One diskette holds the equivalent of a full box of cards, but the diskette is only eight inches square and a fraction of an inch thick. Shown above is the 3742 Dual Data Entry Station, which accommodates two operators at the same desk. Each operator records data on a separate diskette.

characteristics of his present and proposed applications in light of the variety of input media and myriad of data entry devices and techniques available to him. It is entirely possible that he will choose different devices and systems for different classes of applications.

Before making the final selection decision, the user might consider the following tips:

1. Choosing two or more different types of systems imposes added training requirements and reduces available back-up equipment in time of system malfunctions. These problems can be alleviated to some extent if the different systems are physically situated in different locations within the company.

2. The suppliers of the entry equipment should commit themselves to a certain minimum amount of operator training. Similarly, with more complex systems, they should guarantee a certain minimum amount of systems design and installation assistance.

3. The suppliers of this equipment should also guarantee a minimum level of hardware maintenance, including a statement of maximum amount of time between service call and arrival of service personnel. Availability of replacement parts should also be clearly established.

4. Firm delivery schedules should be demanded as part of the contract. Such a demand will help sort out the serious and stable suppliers from the entrepreneurs with paper tigers.

5. On a similar note, the user should ask for a list of users of the selected equipment. They should be questioned about the reliability of the equipment, its ease of installation and daily use, and the amount of technical and systems support provided by the supplier.

6. Total systems costs should be carefully evaluated – not just hardware device costs. System costs above and beyond the hardware include personnel (operators and clerical support), training, media handling and storage, data conversions, back-up procedures, computer pre-processing time, and software programming. Each proposed device or system should be evaluated relative to the estimated costs of these elements.

7. In these days of unbundled prices, the prospective user should obtain a clear statement of exactly what is and is not furnished in return for his purchase or monthly lease payment.

The background information and selection guidelines contained in this report cannot guarantee a successful new data entry system, but they can guarantee a more informed, rational buying decision. The selected system will be *capable* of fulfilling the desired data entry requirements, but it will remain for the users, as always, to make the system work. □

User Ratings of Key Entry Equipment

January 1973—"IBM has endorsed the concept of key/disk data entry with the introduction of the 3740/key diskette family of products." Pause. "Well, not quite; there's a maximum of two keystations per 'processor.' "

December 1973—"IBM has endorsed the concept of key/disk data entry with the introduction of the 3790 Communication System." Pause. "Well, not quite; it's really a transaction processing system in a distributed processing environment. But you could make it a key/disk system with appropriate programming."

July 1975—"IBM has endorsed the concept of key/disk data entry with the introduction of the 3760 Dual Key Entry Station Configuration of the 3790 Communication System. Really, they have." Pause. "Well, haven't they?"

They have.

In the words of one respondent to last year's Datapro survey of user experience with key entry equipment, "Key/disk is the best thing that ever happened to the key entry field." With IBM's new and very competitive, but slightly different, market entry, additional public emphasis will be centered on key/disk systems. (For a detailed analysis of IBM's new 3790/3760 Data Entry Configuration, see Report 70D-491-43.)

But it should also be noted that during the last few years—in defiance of the apparent trend toward key/disk systems—numerous manufacturers have successfully introduced new keypunch models, intelligent terminals, key/cassette devices, key/diskette devices, on-line CRT's, typewriters for OCR data entry, and various combinations of these. In each case, claims were made that each was the "best" way to capture data for later processing by computers. And this list does not include the important POS concept of transaction-oriented devices that capture data as a by-product of regular business transactions.

Obviously, different systems problems can call for different solutions. Every class of product has its inherent strengths and weaknesses, apart from how well the manufacturer of each specific product executes the design, manufacture, and support functions.

Datapro Asks the Users

In April, May, and June of 1975, Datapro collected and analyzed the responses of its subscribers to a questionnaire that was published in the April supplement to DATAPRO 70. The results included in this report shed some light on the overall characteristics of the data entry function, in addition to presenting the users' ratings of a sizeable population of data entry devices and systems.

A key entry device can be considered to consist of three basic components: keyboard, control logic, and medium for recording. Various levels of sophistication of the control logic portion, a multitude of recording media, and many concepts of system organization lead to a diverse array of products available to handle your data entry problems. Keyboards can have a single-character display, a full CRT presentation, a printer or typewriter, or no means at all for displaying data as it is entered. Control logic can be organized to provide minimum or maximum (read "minicomputer") facilities for checking and manipulating data as it is entered. The recording medium can be punched cards, punched tape, magnetic tape in several varieties, magnetic disk (now also in several varieties), or the printed page. The media concept can even be stretched to include a communications line feeding a host computer, thereby bringing intelligent and non-intelligent terminals with no local means for permanently recording data into the purview of data entry devices as defined above.

This report sums up the experience of 400 users with 823 data entry devices and systems representing a total of 6,684 keying stations. Their collective experience should help you find effective solutions to your own data entry problems.

A separate DATAPRO 70 report, 70D-010-70, provides a thorough analysis of the various types of data entry devices and their inherent strengths and weaknesses. The questionnaire mentioned above and our subscribers' responses to it form the subject matter for this report.

The Users Respond

Before the publication cut-off date of June 15, 1975, Datapro received a total of 400 valid responses to the questionnaire, detailing our subscribers' experience with a total of 823 products representing 6,684 keying stations. (This compares with the results of a similar survey one year earlier that attracted 308 user responses on 637 products and 5,674 keying stations.) The users' 1975 ratings of these products are summarized in Table 1.

Readers are cautioned against extrapolating the results into market penetration figures. There are approximately 400,000 keypunches now installed (give or take a hundred thousand or so), compared with an estimated 120,000 key/disk keystations. (However, note that the keypunch base is declining while the key/disk keystation base is expected to grow by about 40 percent in 1975.) The reason why the proportion of key/disk keystations is so much higher in our survey is probably that many keypunch users felt they had little to share with other users, while key/disk users were much more missionary-minded.

User Ratings of Key Entry Equipment

TABLE 1. USER RATINGS OF KEY ENTRY DEVICES AND SYSTEMS

Key Entry Device Type, Supplier, and Model	No. of User Responses	No. of Keying Stations Represented	Overall Performance					Ease of Operation					Hardware Reliability					Maintenance Service: Promptness					Maintenance Service: Quality				
			WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P
KEY/DISK SYSTEMS:																											
CMC 3	3	22	3.3	1	2	0	0	4.0	3	0	0	0	3.3	2	1	0	0	4.0	3	0	0	0	4.0	3	0	0	0
CMC 5	22	340	3.6	14	8	0	0	3.5	11	9	1	0	3.3	9	10	2	0	3.3	8	11	2	0	3.2	8	10	3	0
CMC 12	8	138	3.8	6	2	0	0	3.8	6	2	0	0	3.6	5	3	0	0	3.0	2	5	0	1	3.0	2	5	0	1
CMC, unspecified	5	128	3.6	3	2	0	0	4.0	5	0	0	0	3.8	4	1	0	0	3.2	2	2	1	0	3.2	1	4	0	0
Data 100	3	28	3.3	1	2	0	0	3.3	1	2	0	0	3.3	1	2	0	0	3.0	1	1	1	0	3.0	0	3	0	0
Entrex 480	11	303	3.6	7	4	0	0	3.7	8	3	0	0	3.2	4	5	2	0	3.2	4	5	2	0	3.1	4	4	3	0
Four-Phase IV/70	20	293	3.2	6	12	2	0	3.5	10	9	1	0	3.1	4	14	2	0	2.9	6	8	4	2	3.1	7	9	3	1
GCS 2100	7	188	3.7	5	2	0	0	3.7	5	2	0	0	3.4	3	4	0	0	3.3	2	5	0	0	3.3	2	5	0	0
GTE/IS, all models	5	56	3.2	1	4	0	0	3.4	2	3	0	0	3.4	2	3	0	0	3.2	3	1	0	1	3.0	1	3	1	0
Honeywell Keyplex	4	132	3.3	1	3	0	0	2.8	0	3	1	0	3.3	1	3	0	0	2.3	0	2	1	1	2.5	0	3	0	1
Inforex 1301	8	83	3.5	5	2	1	0	3.6	5	3	0	0	3.1	1	7	0	0	2.8	1	4	3	0	2.8	0	6	2	0
Inforex 1302	22	318	3.5	14	6	2	0	3.5	12	10	0	0	3.3	8	12	2	0	3.3	9	11	1	1	3.2	7	12	1	1
Inforex 1303	11	191	3.3	5	4	2	0	3.6	8	2	1	0	3.3	4	6	1	0	3.2	4	5	2	0	3.1	3	6	2	0
Inforex, unspecified	5	55	3.8	4	1	0	0	3.8	4	1	0	0	3.5	2	2	0	0	3.0	1	3	1	0	3.4	2	3	0	0
Mohawk 1200	6	46	3.2	2	3	1	0	3.3	2	4	0	0	2.5	1	2	2	1	2.7	0	4	2	0	2.3	1	2	1	2
Mohawk 2400	11	150	3.5	5	6	0	0	3.5	5	6	0	0	3.2	3	7	1	0	3.1	4	4	3	0	3.0	2	8	0	1
Scan-Data 2250	3	54	3.7	2	1	0	0	4.0	3	0	0	0	3.3	1	2	0	0	3.7	2	1	0	0	3.7	2	1	0	0
Univac CADE	5	48	3.4	2	3	0	0	3.8	4	1	0	0	3.2	2	2	1	0	3.4	3	1	1	0	3.3	2	1	1	0
Others	7	105	3.2	2	4	1	0	3.0	1	5	1	0	2.6	1	5	0	1	2.8	2	2	3	0	3.0	2	3	2	0
Totals	166	2,678	3.5	86	71	9	0	3.5	95	65	5	0	3.3	58	91	13	2	3.1	59	75	27	6	3.1	49	88	19	7
KEY/DISKETTE UNITS:																											
IBM 3741	22	190	3.8	18	4	0	0	3.5	14	6	2	0	3.5	11	11	0	0	3.3	11	7	4	0	3.5	13	8	1	0
IBM 3742	34	261	3.8	26	8	0	0	3.7	24	9	1	0	3.7	25	8	1	0	3.6	23	7	4	0	3.5	19	12	3	0
IBM 3740, unspec.	7	147	3.6	4	3	0	0	3.4	3	4	0	0	3.1	1	6	0	0	2.9	0	6	1	0	3.0	0	6	0	0
Totals	63	598	3.8	48	15	0	0	3.6	41	19	3	0	3.6	37	25	1	0	3.4	34	20	9	0	3.5	32	26	4	0
KEY/CASSETTE UNITS:																											
Sycor 340	6	116	3.3	2	4	0	0	3.3	4	1	0	1	3.7	4	2	0	0	3.0	1	4	1	0	3.0	1	4	1	0
Others	6	34	2.7	0	4	2	0	2.3	0	3	2	1	2.5	0	4	1	1	2.8	1	3	2	0	2.3	0	3	2	1
Totals	12	150	3.0	2	8	2	0	2.8	4	4	2	2	3.1	4	6	1	1	2.9	2	7	3	0	2.7	1	7	3	1
ON-LINE:																											
All vendors	6	262	3.0	1	4	1	0	2.7	1	2	3	0	2.8	1	3	2	0	3.5	3	3	0	0	3.5	3	3	0	0

LEGEND: WA—Weighted Average, E—Excellent, G—Good, F—Fair, P—Poor. The Weighted Average for each category is based on assigning weights of 4, 3, 2, and 1 for Excellent, Good, Fair, and Poor, respectively.

While we're comparing the response levels of keypunch and key/disk system users, a little comparative information between last year's and this year's survey is in order. Last year there were 453 responses representing 2,747 keypunches; this year there were 500 responses on 2,559 keypunches. While the number of responses increased by 10 percent, the number of keypunches represented went down by 7 percent. This caused the average number of keypunches per response represented in the surveys to decrease from 6.1 in 1974 to 5.1 in 1975.

Meanwhile, the number of responses for key/disk systems jumped from 92 to 166, an 80 percent increase. Paralleling this was only a 36 percent increase in the number of keystations reported on (from 1,977 to 2,678), but a jump of 46 percent in the number of systems reported on (from 177 to 258). Averaged out, these numbers represent a decrease in the number of keystations per system (down to 10.4 from 11.2) and keystations per response (down to 16.1 from 21.5). These statistics tend to support (but not conclusively prove) the attitude that key/disk systems are being increasingly accepted by smaller EDP installations.

Last year, we noted with surprise the high ratings given to the small sampling of on-line data entry systems uncovered during the survey. This year, the sampling was even smaller, and the degree of acceptance lower. Again, several users commented on the high cost of on-line data entry.

Overall, the users' additional comments were very similar to last year's results. Several extolled the key/disk concept, and many gave more detail to explain and augment their equipment ratings. One comment was just too good to pass up, however: "The Sycor 340 intelligent terminal has provided instant happiness because of its extensive capability to catch ordinary keyboarding errors. It has reduced computer error lists by over 99%." This

User Ratings of Key Entry Equipment

TABLE 1. USER RATINGS OF KEY ENTRY DEVICES AND SYSTEMS (Continued)

Key Entry Device Type, Supplier, and Model	No. of User Responses	No. of Keying Stations Represented	Overall Performance					Ease of Operation					Hardware Reliability					Maintenance Service: Promptness					Maintenance Service: Quality				
			WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P
80-COLUMN KEYPUNCHES AND VERIFIERS:																											
Burroughs	11	22	3.3	5	4	2	0	3.4	5	5	1	0	2.6	3	3	3	2	2.5	3	2	3	3	2.5	2	5	1	3
IBM 24	8	74	2.9	1	5	2	0	2.9	1	5	2	0	2.4	1	3	2	2	3.1	2	5	1	0	3.1	2	5	1	0
IBM 26	20	69	2.9	4	10	6	0	3.0	6	8	6	0	3.0	3	14	3	0	3.3	6	13	1	0	3.2	6	11	3	0
IBM 29	167	873	3.2	45	109	12	1	3.2	50	98	16	1	3.2	54	91	17	3	3.3	69	78	16	2	3.2	54	90	16	1
IBM 56	6	15	3.0	2	2	2	0	3.0	2	2	2	0	3.2	3	1	2	0	3.5	3	3	0	0	3.3	3	2	1	0
IBM 59	25	106	3.0	3	20	2	0	3.1	4	18	2	0	2.9	3	17	3	1	3.3	9	13	2	0	3.0	5	15	4	0
IBM 129	168	991	3.4	78	85	5	0	3.3	65	92	8	0	3.3	66	87	11	1	3.3	73	70	19	3	3.2	58	80	19	0
IBM, unspecified	4	8	2.0	0	1	2	1	1.8	0	0	3	1	2.0	0	2	0	2	3.0	2	1	0	1	2.5	1	1	1	1
Tab Products	8	17	2.9	1	5	2	0	3.5	4	4	0	0	2.3	0	3	4	1	2.8	1	4	3	0	2.6	1	3	4	0
Univac 1700	5	42	2.8	1	2	2	0	3.0	1	3	1	0	2.2	0	1	4	0	2.3	0	2	1	1	2.5	1	1	1	1
Univac 1701	16	104	3.3	6	8	2	0	3.3	6	8	2	0	3.1	5	8	3	0	3.1	5	9	1	1	3.1	4	9	2	0
Univac 1710	47	205	3.2	16	25	3	2	3.4	19	27	1	0	2.9	14	17	13	2	3.2	19	21	4	3	2.9	13	21	10	3
Univac 1800	12	25	3.7	8	4	0	0	3.2	3	8	1	0	3.3	4	8	0	0	3.3	3	9	1	0	3.3	4	6	1	0
Univac, unspecified	3	8	3.0	0	3	0	0	3.3	1	2	0	0	2.3	0	1	2	0	3.0	0	3	0	0	2.7	0	2	1	0
Totals	500	2,559	3.2	170	283	42	4	3.2	167	280	45	2	3.2	156	256	67	14	3.2	196	233	52	14	3.1	154	251	65	9
96-COLUMN KEYPUNCHES:																											
Burroughs	4	9	3.8	3	1	0	0	3.8	3	1	0	0	3.0	2	0	0	1	3.2	2	1	1	0	3.0	2	1	0	1
Decision Data	12	37	3.3	6	4	2	0	3.6	8	3	1	0	3.0	3	6	3	0	3.0	5	3	3	1	2.9	4	4	3	1
IBM	9	25	3.4	4	5	0	0	3.7	6	3	0	0	3.4	5	3	1	0	3.7	7	1	1	0	3.7	6	3	0	0
Totals	25	71	3.4	13	10	2	0	3.6	17	7	1	0	3.2	10	9	4	1	3.3	14	5	5	1	3.2	12	8	3	2
KEY/TAPE UNITS:																											
Burroughs Series N	3	6	3.7	2	1	0	0	3.7	2	1	0	0	4.0	3	0	0	0	3.7	2	1	0	0	3.3	1	2	0	0
Honeywell 700 Series	4	49	2.8	0	3	1	0	3.0	0	4	0	0	2.5	0	2	2	0	2.8	1	2	0	1	2.8	0	3	1	0
Honeywell, unspecified	4	23	3.0	0	4	0	0	3.3	1	3	0	0	2.8	0	3	1	0	2.5	0	3	0	1	2.8	0	3	1	0
Mohawk 1100 Series	4	30	3.3	1	3	0	0	3.3	2	1	1	0	3.8	3	1	0	0	3.0	1	2	1	0	3.5	2	2	0	0
Mohawk 6400 Series	10	122	2.9	1	7	2	0	2.5	0	5	5	0	2.6	1	7	0	1	2.9	3	2	4	0	2.9	2	3	4	0
NCR 735	4	16	3.0	1	2	1	0	2.8	1	2	0	1	3.0	1	2	1	0	2.8	1	2	0	1	2.8	1	1	2	0
NCR 736	8	74	3.3	4	2	2	0	2.6	2	3	1	2	2.9	2	3	3	0	2.9	2	4	1	1	3.3	3	4	1	0
Singer 4000 Series	9	36	2.7	2	3	3	1	2.7	1	4	4	0	2.7	2	4	1	2	2.4	0	5	3	1	2.6	1	4	3	1
Others	5	10	3.0	1	3	1	0	2.8	1	3	0	1	3.6	3	2	0	0	2.6	1	2	1	1	2.8	1	3	0	1
Totals	51	366	3.0	12	28	10	1	2.6	10	26	11	4	3.0	15	24	8	3	2.8	11	23	10	6	2.9	11	25	12	2
GRAND TOTALS	**823**	**6,684**	**3.3**	**332**	**419**	**66**	**5**	**3.3**	**335**	**403**	**70**	**8**	**3.2**	**281**	**414**	**96**	**21**	**3.2**	**319**	**366**	**106**	**27**	**3.1**	**259**	**408**	**109**	**21**

LEGEND: See preceding page.

same comment could apply to other intelligent terminals, key/disk systems, intelligent keypunches, etc. It reflects the great improvement in data preparation efficiency that results from having data validation capabilities present in the key entry equipment itself.

The Software Bugaboo

A supplement to the ratings information appears in Table 2, which is a tabulation of the users' ratings of the software and technical support provided by the vendors of key/disk systems. We expanded last year's single rating question to two for the current survey to permit distinguishing between the standard product facilities (software) and the degree of assistance the vendors give in support of their customers' installations (technical support). The raw numbers in the chart provide their own eloquence and need little editorial commentary. However, a general comment is in order.

A key/disk system can be regarded as a data processing computer site in miniature. All of the elements of traditional data processing are present: job-to-job control, file specification, processing specification, management of input and output data streams, etc. Integrating these systems into an overall data processing plan is complex. Many decisions are required to completely specify which of the data handling functions are handled where. For example, one user complained that he was unable to sort data records on his key/disk system. There is a large difference in the processing power of the central units in a key/disk system and in the host computer system. Convenience and efficiency of entering and correcting data while the source documents are still handy must be weighed against the increased processing efficiency normally available with the large host processor.

The key tying all these decisions together for the user is the scope and quality of the software supporting the

User Ratings of Key Entry Equipment

TABLE 2. USER RATINGS OF KEY/DISK SOFTWARE AND TECHNICAL SUPPORT

Key/Disk Manufacturer and Model	Number of User Responses	Number of Keystations Represented	Number of Systems Represented	Average Number of Keystations per System	User Ratings									
					Software					Technical Support				
					WA	E	G	F	P	WA	E	G	F	P
CMC 3	3	22	4	5.5	3.3	1	2	0	0	3.7	2	1	0	0
CMC 5	22	340	35	9.7	3.2	4	17	0	0	3.1	4	13	2	0
CMC 12	8	138	8	17.3	3.6	4	3	0	0	3.0	3	3	1	1
CMC, unspecified	5	128	8	16.0	3.5	2	2	0	0	3.8	3	1	0	0
Data 100	3	28	4	7.0	3.3	1	2	0	0	2.3	0	2	0	1
Entrex 480	11	303	19	15.9	3.5	7	2	2	0	3.2	5	2	3	0
Four-Phase IV/70	20	293	38	7.7	2.9	5	8	7	0	2.7	4	8	5	3
GCS 2100	7	188	12	15.7	3.0	1	5	1	0	2.6	0	5	1	1
GTE/IS, all models	5	56	7	8.0	1.8	0	0	4	1	2.7	0	2	1	0
Honeywell Keyplex	4	132	6	22.0	2.3	0	1	2	0	2.8	0	3	1	0
Inforex 1301	8	83	11	7.5	2.9	1	5	2	0	2.9	2	3	3	0
Inforex 1302	22	318	31	10.3	3.0	4	9	4	0	2.9	5	9	6	1
Inforex 1303	11	191	29	6.6	2.5	0	6	3	1	3.0	1	8	1	0
Inforex, unspecified	5	55	8	6.9	3.2	2	2	1	0	3.2	2	2	1	0
Mohawk 1200	6	46	7	6.6	2.7	2	1	2	1	2.5	1	2	2	1
Mohawk 2400	11	150	13	11.5	3.0	3	2	3	0	2.8	4	1	4	1
Scan-Data 2250	3	54	3	18.0	3.0	0	2	0	0	3.0	0	2	0	0
Univac CADE	5	48	5	9.6	3.5	2	2	0	0	3.0	2	1	0	1
Others	7	105	10	10.5	3.4	3	4	0	0	2.4	0	3	4	0
Totals	166	2,678	258	10.4	3.0	42	75	31	3	2.9	38	71	35	10

LEGEND: WA—Weighted Average, E—Excellent, G—Good, F—Fair, P—Poor.

key/disk systems, and the willingness and capability of each manufacturer to assist the user in formulating his plans. The prospective user would be well advised to work out his approach prior to installing a key/disk system, even though this entails extra work due to the differences in software support available. Making specific support functions part of the proposal goes a long way toward reducing misunderstandings between vendor and user.

But What Is Data Entry, Anyway?

In the questionnaire, we asked several questions to try to characterize the data entry function. These questions pertained to throughput (records per day), record size, format usage, and automatic field generation (average keystrokes per record). The results are tabulated in Table 3 as percentages to permit comparisons among different types of devices to be made more easily. The IBM 29 and 129 keypunches are shown individually to highlight the differences between buffered (129) and unbuffered (29) keypunches.

The output of a keypunch is traditionally regarded as about 1,000 cards per day per keypunch, for single-shift operation. However, many of the respondents reported a much lower level of usage than this. Of course, many of these users had only a few keypunches used in supporting roles for punching up JCL cards, source program decks, etc.; but several installations that fell in this category were sizeable ones that had more than six keypunches. No firm conclusions can be drawn without a detailed study, but it seems likely that such installations have decided to decentralize their data entry functions by spreading the keypunches out among the various departments originating the information.

Users of key/disk systems backed up the manufacturers' claims of increased throughput; 61% reported daily keying rates of over 1,000 records, and 33% of these users reported rates of over 1,500 records per day. However, 48% of the IBM 129 users also reported daily rates of over 1,000 records, with 33% reporting a daily rate of over 1,500 records. Generally, the keypunch users were operating with shorter records and without the benefits of data editing and validation procedures, but it is still quite apparent that the modern buffered keypunch represents a significant improvement over unbuffered ones.

Last year we noted that for all device types taken together, over half (52%) were being used with record lengths of 60 or fewer characters, and that about half (51%) of the key/disk users remained with the old keypunch limitation of 80 characters. This year, more than half of all the responding users (60%) employed record lengths of *over* 60 characters, but the proportion of key/disk users going keyond the 80-character boundary decreased to 35% from 49% last year. No doubt the influx of smaller users into key/disk systems had some influence on this result. (Note that these record lengths correspond to the amount of data keyed, and do not take into account reformatting with key/disk systems.)

The figures summarizing the average number of format levels per job are essentially self-explanatory. They need

User Ratings of Key Entry Equipment

TABLE 3. CHARACTERISTICS OF KEY ENTRY OPERATIONS

Type of Device	Records per Day per Keying Station, %						Average Characters per Record, %						Average Format Levels per Job, %						Average % of Record Keyed*				
	No.of Resp.	Under 500	500-750	751-1000	1001-1500	Over 1500	No.of Resp.	Under 40	40-60	61-80	81-150	Over 150	No.of Resp.	0-1	2	3-5	6-10	Over 10	No.of Resp.	0-25 %	26-50 %	51-75 %	76-100 %
Keypunches–																							
IBM 29	123	44	18	13	10	15	154	16	40	44	0	0	147	42	27	13	6	12	124	10	18	45	27
IBM 129	128	12	18	22	15	33	160	8	38	54	0	0	158	30	30	25	7	8	141	4	26	44	26
All Others	149	26	22	15	16	21	174	14	38	48	0	0	165	32	37	21	5	5	156	6	27	47	20
Total	400	27	19	17	14	23	488	13	39	48	0	0	470	34	32	20	6	8	421	7	24	45	24
Key/Tape	40	37	15	5	23	20	51	4	14	60	16	6	50	40	20	18	12	10	47	9	23	40	28
Key/Diskette	47	19	13	6	23	39	63	3	21	43	33	0	62	32	14	34	18	2	58	2	24	48	26
Key/Cassette	9	22	22	34	0	22	12	8	17	33	42	0	12	25	0	67	8	0	10	0	10	70	20
Key/Disk	148	12	11	16	28	33	165	4	16	45	31	4	161	9	20	52	11	8	153	2	27	43	28
TOTALS	644	23	17	15	18	27	779	10	30	48	11	1	755	29	27	28	8	8	689	5	25	45	25

Resp.–Responses.
*Average keystrokes per record as a percentage of total characters per record.

little comment beyond noting that the increased number of format levels provided with most key/disk systems does not seem as important to most users as does the capability to store a library of formats to provide convenient retrieval of format sets for many different jobs.

A new question was added to the Reader Survey Form this year to try to resolve the discrepancy between characters keyed per record and characters recorded per record. The difference occurs because of the facilities for automatic duplication in all types of key entry equipment and for automatic field generation in key/disk and other processor-based (intelligent) devices. Surprisingly, there were hardly any meaningful differences among the various types of devices. The conclusion is obvious: automatic field generation for key/disk systems, also called table look-up, is relatively untapped as yet. A typical example is the use of a table of customer names and addresses, which are automatically fetched and inserted into the record when the operator keys just the customer number.

What About Tomorrow?

Having determined the degree of user satisfaction and usage patterns, we turn to some market considerations. Table 4 presents the plans our subscribers reported for migrating from one type of key entry device to another. There are no surprises in this chart. Because we did not correlate last year's or this year's distribution of returns in terms of installed base sizes, we cannot make a direct evaluation of the accuracy of last year's migration plans as reflected in this year's device-type distribution. However, the pattern of users' plans remains similar. An increasing number of keypunch users want to change. The key/diskette approach has picked up some additional support, and key/disk users are even more satisfied than last year.

For Other Information

This report has discussed the key entry function itself and presented users' ratings of specific products. It by no means exhausts what DATAPRO 70 has to say about key entry and key entry products. Nearly all of the devices shown in Table 1 (except for the older IBM keypunches and key verifiers) are covered in individual product reports that follow this report in Binder 2; the reports are arranged alphabetically by manufacturer. The Index can be used profitably to find all of the Datapro reports on a particular type of equipment by looking under a generic head, such as "keypunches, 80-column." In addition, a guide to selecting and buying data entry devices is contained in Report 70D-010-70, which immediately precedes this report. □

TABLE 4. ANTICIPATED MIGRATION IN TYPES OF KEY ENTRY DEVICES

Users of the following types of devices	Number of Responses	Plan to change to the following device types, %*					
		Key/Tape	Key/Disk	Key/Diskette	On-Line	Other	No Change Planned
Keypunches	423	4	26	12	17	2	46
Key/Tape	44	–	18	16	30	2	36
Key/Diskette	52	0	4	–	11	4	81
Key/Cassette	12	0	8	42	0	8	42
Key/Disk	141	0	–	1	13	4	82

*Percentages may total more than 100% for some device types because some users indicated plans to change to more than one type.

All About Optical Readers

MANAGEMENT SUMMARY

The purpose of optical reading is the same as that of any other type of computer input technique: to translate data from the form in which it is created to a form that can be processed by a computer. A data processing cycle generally begins with data created by humans, and the form most suitable for use by humans is the printed or written word. But the form of data most suitable for computer processing is some type of digital encoding. How to cross this gap? By machine, of course. And the optical reader, in all its many forms, is the most promising type of machine yet devised to bridge this gap.

This report explores the world of optical readers – a world that is just as puzzling as it is promising. You'll find explanations and analyses of the different types of optical readers, their applications, their current status, and their prospects for the future. What's more, you'll find comprehensive equipment comparison charts, results of a survey of users' experience, and down-to-earth guidelines to help you decide whether optical input techniques have progressed to the point where you can profitably employ them.

This comprehensive report presents the characteristics of 104 current optical character, mark, and bar code readers from 46 manufacturers. You'll also find an analysis of the experience of 116 optical reader users, plus straightforward advice to aid you in assessing the pros and cons of optical input techniques, planning your installation, and selecting a suitable reader.

Replacing the Punched Card

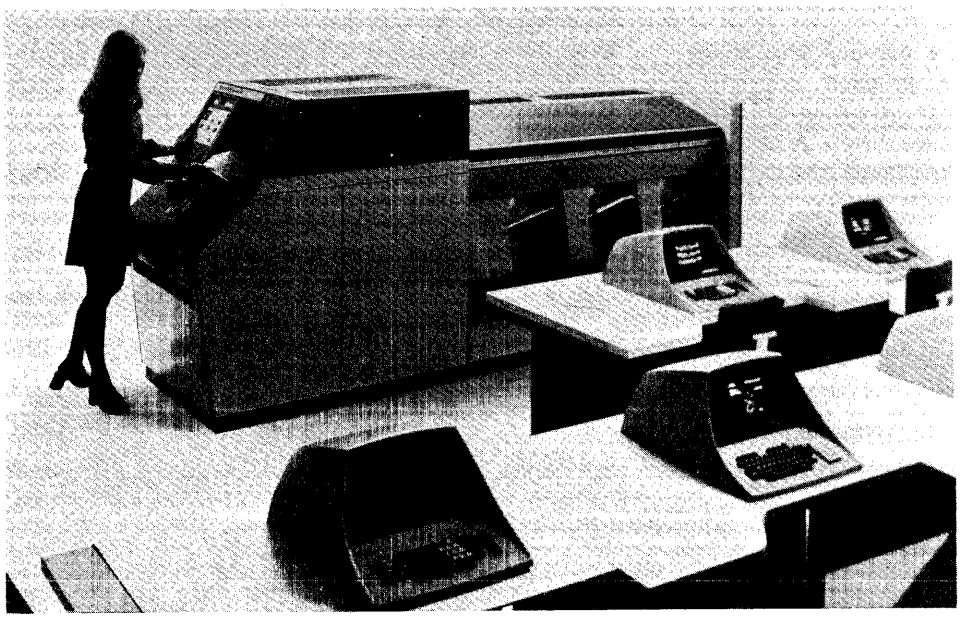
Although the punched card is still the most widely used medium for computer data entry, its use imposes serious limitations on many installations. There are three principal complaints against the punched card:

- Data preparation time is high.
- Input time is high, even with the fastest card readers.
- Cards are expensive because they are not reusable, and storage space is also a major expense.

Several techniques have been advanced to overcome these deficiencies. Those in use today and touted for the future include:

- Key-to-tape recorders, both single-station models and multi-station key/disk models.
- On-line data entry.
- Source data automation.
- Optical readers.

Key-to-tape recorders are direct replacements for key punches. Instead of punching cards, they record data directly on magnetic tape, which is inherently a much faster input medium for computers than punched cards ⊳



The Recognition Equipment Total Data Entry System combines an REI Input 80 optical reader with a modified Entrex 480 key/disk data entry system to produce what has come to be called a mixed-media system. The CRT data entry stations can be used independently to key batches of data or can be used in the "unreadable character" correction cycle for the scanner. REI joins Scan-Data and Cummins-Allison in marketing mixed-media systems, and other companies are planning to bring similar products to the market in 1974.

because of the greatly increased storage density. Moreover, modern shared-processor key-to-disk/tape systems offer data editing and validation capabilities far beyond those of keypunches. (Report 70D-010-70 contains a detailed discussion of these devices and systems).

On-line data entry makes use of remote or local terminals for direct entry of data into a computer system. Typical terminals include teletypewriters and CRT units.

Source data automation (SDA) is a broad term referring to capturing data in machine-readable form when it happens, rather than recording it and later transcribing it to machine-readable form. For example, a cash register can be equipped to produce a punched tape of transactions to be read directly into sales and inventory application programs. Alternatively, the cash register tape could be printed and then read by an optical character reader. Many specialized devices have been developed to expedite the development of this concept, but a lot more work needs to be done in business procedures and systems design before the era of source data automation overtakes us.

This brings us to the subject of this report—optical readers. Very simply, an optical reader is a device that employs an optical technique in the process of translating marks or characters on a document into the electrical signals that a computer requires. The use of optics is not new; punched cards and punched tape have been read by means of photoelectric cells for many years. The types of optical readers range from the simplest mark readers to complex multi-font character readers, with several way points in between.

The Optical Reader Industry

The optical reader industry is a puzzling one. It has made court jesters out of several prophets. For several years, it has been "on the verge of taking off," but performance has consistently fallen below predictions. Even so, there have been few departures from the ranks of companies building optical readers, and a number of new ones have entered the arena. Also, there has been little change in the pecking order of the established companies. In each of the three distinct classes of optical readers (mark readers, bar-code readers, and character readers), the leaders remain unchanged. IBM continues to lead the way in optical character readers, with Control Data a close second. In the field of bar-code readers, Addressograph-Multigraph still holds sway. And Optical Scanning continues to read more marks than anyone except IBM.

The true size of the market for optical readers is virtually impossible to derive. The estimates that have appeared in the trade press and research studies deal primarily with optical character readers and generally place the value of such equipment presently installed at about $400 to $500 million—a tiny portion of total EDP expenditures. Scanning the literature places the number of character readers currently installed at about 1500 to 2500, with current production amounting to about 400 readers a year. The other types of optical readers number substantially more, but have a lower installed value because of the great difference in average price per unit between character readers and mark or bar-code readers.

The depressed economic climate has unquestionably hurt the optical reader industry, tending to cause EDP installations to try to get by with the equipment on hand rather than make additional procurements. Higher operating costs sometimes must be tolerated if the alternative is making large capital expenditures. This situation is clouded, however, by the recognized tendency of EDP installations to rent or lease rather than buy, a policy nurtured by IBM.

In addition to the trauma associated with equipment coversion, use of optical readers often means substantial changes in procedures, which can lead to high implementation and training costs. Whether or not these are the only relevant factors can be argued; however, the fact remains that progress in the use of optical readers has not kept pace with equipment development or with the pace of other facets of EDP such as minicomputers and key/disk/tape recorders.

Hindrances to Acceptance

Unfortunately, the acceptance of optical scanning has been hindered by many obstacles. Against the many problems, only one major benefit can be cited in favor of the optical readers, and it is so obvious as to sound trite. This advantage, of course, is that these remarkable devices are *automatic:* they convert human-readable and human-prepared data into computer-readable codes automatically.

Before one can fully understand why the many disadvantages of present-day scanning have only slowed the progress of optical scanning but have not defeated it altogether, an elementary principle of economics must be grasped as the basic touchstone by which to gauge the worth of a prospective installation. That test is: how many people does the device replace, and how much money does it save by doing so? Obviously, if the device costs more to install, operate, and service than the equipment and personnel it supplants, it is a poor bargain. If it produces a net gain in its intended environment, then it is a good value at any price. In other words, the paradox of a million dollar machine (and there is at least one) being cheap and a fifty thousand dollar machine being dear would occur if the criterion were satisfied in the first case and unsatisfied in the second.

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The IBM 3886, announced in October 1972, employs light emitting diodes (LED) as the light source for scanning. It can accommodate the alphanumeric OCR A and European OCR B fonts as well as preprinted block printing and hand-printed numerics. It is considerably slower than the older IBM 1287 but is also significantly less expensive. The 3886 continues IBM's recent trend toward using "intelligent" controllers to relieve the main processor of some of the housekeeping work involved with managing the transfer of data between the processor and peripherals.

What does it take to demonstrate the proposition? That is a far more complex matter, because the number of factors to be weighed in arriving at a determination are manifold. But if you convince someone that your million dollar machine will save him money, you will generally make a sale. An actual example is the Information International Grafix I, which will be used by the U.S. Navy at a cost of $4 million to convert over 3 million pages of technical manuals into an updated microfilm data base. The Grafix I is also being tested by the Department of Health and Social Services of the United Kingdom. In contrast, if a fifty thousand dollar scanner is too slow to replace at least five keystation operators, it is unlikely that it can be cost-justified.

Even today, there is a much stronger trend toward the use of key-to-tape/disk devices and systems than optical readers. Indeed, so many of the new data entry installations are highly refined shared-processor key-to-disk systems that several optical reader manufacturers have seen fit to marry their technology to that of their doughty competitor. (If you can't beat them, join them.) The resulting "mixed-media" data entry systems will be discussed later in this report. For the moment, let it be noted that computer users are encountering steadily rising costs for both remote data input (the province of optical mark and bar code readers) and large-volume data input at central sites (the province of optical character readers). As a result, optical readers are slowly but steadily gaining acceptance as a feasible means of reducing such costs.

As noted before, the makeup of the companies forming the optical reader industry has been surprisingly stable in view of the lack of impressive results. Several new companies have surfaced, as can be seen in the comparison charts, but there have been no major upheavals within the industry for several years now.

With this understanding, the following hindrances to the acceptance of optical scanning should be considered.

High cost. Sometimes direct equipment charges are more than an interested potential user can afford, and he is eliminated as a customer. More often, he would manage to unearth the needed financial support if only the scanner installation would lower his operating costs sufficiently. But the aggregate costs of a proposed scanner system may be too high to overcome. Bear in mind that there are indirect or hidden costs, too, such as comprehensive redesign of forms, adjustment of input preparation procedures, personnel retraining, and sometimes revamping of the data processing system itself. The cost of system downtime is almost impossible to estimate with any assurance, but the consideration is important nonetheless.

Technical inadequacy. Perhaps the most serious shortcoming of optical scanning today remains its difficulties with handprinting, despite the substantial progress of the last two years. Handprinting is being read now (at least numerals and some special symbols), but with an appreciable rejection rate and some subtitutions (errors). Rejections require human intervention, and a high rejection rate can essentially neutralize the automation benefits of the scanner. Concerning substitution errors, unless various check routines are introduced, they may not be discovered until late in the data processing cycle, and correction then is usually costly. In brief, the industry still needs new technology to lower the rejection rates and obviate the correction procedures that interrupt scanning to the detriment of throughput. As throughput is reduced, the payoff in using automatic scanning diminishes. This squeeze against payoff has been reining the growth of optical scanning all along, and it is doing so today. The various directions that the industry is taking at present to counteract this situation will be discussed shortly.

Alternative data entry methods. The marvel of reading characters rapidly with a machine has no weight in a profit and loss statement. Key-to-disk systems, especially, are currently more cost-effective in most data entry

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environments than optical scanning and have therefore begun to dominate the scene. This ascendancy is hardly surprising in view of the facilities offered by the shared processors and supporting software of such systems. The attractiveness of this combination has not been lost upon optical scanner manufacturers, as shall be discussed. But what about the oft-maligned, primitive keypunch? Could this ridiculously simple contrivance be a serious competitor of optical scanning? Yes, it is. Should it be? This is a much more difficult question. For applications involving substantial data volumes, the keypunch deserves far less consideration than many EDP managers give it. The contest there should be between optical scanning and key-to-disk or on-line data entry systems. Nevertheless, there are many medium- and low-volume applications for which upgraded electronic keypunches are still quite appropriate, and optical scanner manufacturers cannot seriously compete in these areas.

In fact, any data entry device is a competitor of optical scanning. At some far-off future day, it is likely that optical scanning technology will be triumphant over all alternatives requiring human assistance. Today, however, it is still at an early stage of market penetration.

User fears. How does one convince a fearful manager that his data entry function would benefit from optical scanning? When sweeping changes in procedures are demanded and the associated problems are numerous and unpredictable, persuasion does not come easily. News of occasional fiascos, even though far less frequent than in earlier times, strain the manager's courage further. His fears, which have been a major deterrent from the start, are far from groundless. But the number of successful installations is climbing steadily, too. Now the manager should be just as fearful of missing out on something good.

High cost of marketing and field support. The cost of sales calls, demonstrations, customer personnel training, forms design support, and field engineering support have been a great burden to the independents, though less of a problem to giants such as IBM and Control Data. Now the independents are better capitablized and better organized, and this anchor on progress is waning.

Overspecialized equipment. Until recently, many of the manufacturers themselves lacked the experience and insight necessary to the understanding of their own market. Optical readers in the past were often designed for special applications that lacked any broad market base. With the passage of years, machines that cut across the price spectrum with a wide composite of capabilities have gradually evolved. Thus, the industry appears to be outgrowing this problem, too.

Neglect of the forms design problem. Until recently, most manufacturers fobbed off the critical task of forms design as the user's problem rather than their own. Some manufacturers still give little more than perfunctory attention to it. Many more, fortunately, now recognize that must of the throughput gained by their machines can be lost elsewhere by humans because of ineptly stuctured forms. Enough perfectly good machines have been expelled from users' premises as a result of forms design shortcomings to make them see the light.

Current Marketing and Design Trends

Efforts to expand the acceptance of optical scanning have taken some interesting and surprising turns during the past year. Probably the outstanding development is the movement toward a mixed-media system approach in which one or more optical scanning devices are combined or integrated with a multiple-station key-to-disk data entry system. The concept was introduced in 1972, and actual deliveries of three important systems began in 1973. In the order of first deliveries, these products are the Cummins-Allison 4400 KeyScan System (Report 70D-274-01), the Recognition Equipment Total Data Entry System (Report 70D-718-01), and the Scan-Data 2250 Mixed Media Systems (Report 70D-738-01).

Concerning scanning devices, there is a discernible trend toward photodiode arrays and matrices, and away from electron-beam techniques. Laser beam scanning appears here and there. Which technique is best? Only one thing is really clear. Although proponents of matrix analysis through diode cross-sectioning of a character field claim superiority, users of other methods concede nothing. And their products suffer from no obvious disadvantage attributable to the scanning techniques they employ.

We offer the following observation. The inherent objective of optical scanning is resolution. What happens to the information that the scanning yields? It must be processed by recognition logic, in hardware and/or software. As more resolution detail is furnished to this logic, more hardware elements must be added or more memory must be provided. Furthermore, there is the restriction of allowable processing time, which limits the degree of complexity that is practical. In relation to present technology, especially with regard to memory cycle time, recognition techniques have probably attained a near-optimum state. Certainly there has been no giant step in this regard during the past year – not even a move to capitalize on the emerging semiconductor memory technology as a basis for refining recognition software. Instead, there is a move to marry scanning to key entry systems, which is really a tacit admission that scanning cannot altogether displace human operators at keyboards for some time. For the present, it appears that even if more resolution and more memory were both available, they could not be effectively exploited.

The impact of LSI semiconductor memory, however, is being felt elsewhere. "Intelligence" is being added to mark

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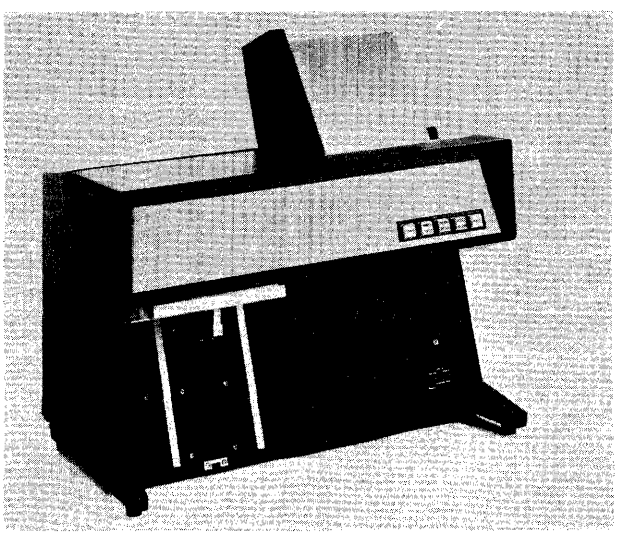
and bar-code readers to give these devices an automatic sorting ability. An even greater effect will probably be achieved in the medium-price class of optical character readers. The handicaps of these instruments compared to high-priced equipment are that they are inherently slower in operation, they employ slower peripheral devices, their font recognition capability is narrower, and their supportive validation software is comparatively limited. Thus, relative to state-of-the-art technology, today's medium-price readers have considerable latitude for improvement. The availability of low-cost semiconductor memory will enable the designers of these readers to significantly enhance their capabilities without prohibitively increasing their prices.

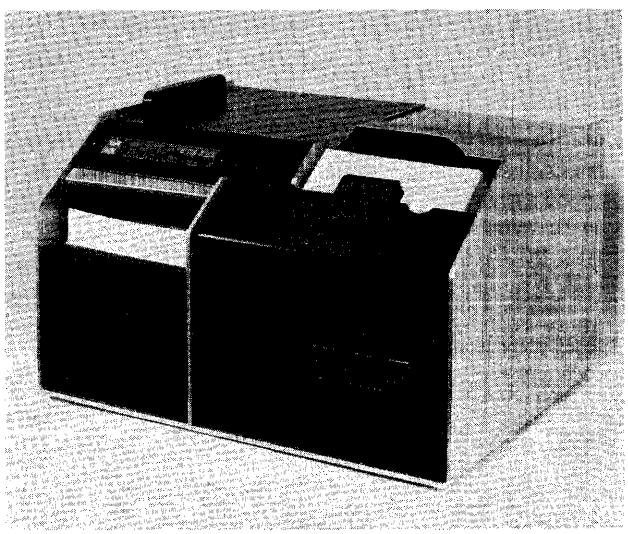
During the past year, several manufacturers have concentrated on optimizing their existing software within the bounds of current memory capacities. Once faster system operation is attained, it is feasible to upgrade peripheral components such as tape transports and printers. Cognitronics, for example, says that it has increased the throughput of its readers through such measures and will soon introduce faster output devices. The company also expects to increase the average memory size of its installations to 12K bytes over a period of time. As indicated by the previous discussion, this memory expansion will be expanded on refinements to device-control routines and to existing check digit verification, accumulation, cross-footing, and balancing routines. CompuScan, ECRM, and others have acknowledged similar plans, with perhaps slightly more stress on expanding their font recognition capabilities. But the Great Sphinx, IBM, remains silent. Despite its vigor in other spheres, a suspicion grows that IBM is doing very little in optical scanning.

The manufacturers of large, multifont scanners are refining their software, too, but their major emphasis is elsewhere. Scan-Data, for example, has already improved its throughput theough such innovative software as SWAMI (SoftWare Aided Multifont Input), which enables the system to acquire new font recognition capabilities as a comcomitant of actual operation, and Scan-Plex, which allows an operator to supply rejected characters in an operation that is completely independent of scanning. Both Cummins-Allison and Recognition Equipment have introduced similar capabilities during the past year.

Now Scan-Data, which rates its equipment as medium-speed readers, is finding that human interaction with the system is a primary cause of slowdown. Recognition Equipment, whose equipment is the fastest in the industry, finds the human component in its installations extremely critical. Accordingly, both companies are accentuating forms design to their customers. The starting point for all companies must be, of course, conforming design to the scanning characteristics of the reader; otherwise, there will be no throughput at all. But suppose a human in the data entry chain has trouble in using the form because he does not understand it. Suppose typists in the chain are uncertain about what information goes where. Suppose the design hampers insertion of rejected data. Clearly, the throughput gains achieved by fast scanning can be nullified by delays in data preparation and error handling.

Another pitfall should be mentioned in this context. Sometimes lettering produced by line printers can be displaced or irregular, and these flaws can severly handicap a scanner that is unprepared to cope with them. A





This pair of optical mark readers illustrates a current feeling among the independent card reader manufacturers that mark reading capabilities are a necessary part of a complete product line. The Peripheral Dynamics 6011MT on the left reads cards at 600 per minute; the Documation OM200 on the right reads 285 cards per minute. Both can read intermixed punches and marks. Documation produces other models that can read up to 1200 cards per minute.

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user who employs both an IBM 3211 Printer and an IBM 1287 Optical Reader reports that the reader must be "tuned" at least once a week to maintain operational continuity. Other users of the 3211 confirm similar difficulties. The obvious lesson to OCR users is that computer output printers should be kept in good adjustment.

Recognition Equipment probably serves as a good example of vendor policy at present. Initially, the company concentrates on getting the new installation to operate properly, with equal attention given to both hardware and software. Even before delivery, forms designers work with the customer toward a balanced forms structure, and they continue to make design adjustments during the shakeout phase. A critical part of the system design is the transfer of character insertion to the keyed data entry section if a mixed-media Total Data Entry System is involved. A definite effort is also made to expose errors through check digit verification, editing, and totaling and balancing procedures as soon as possible after scanning has been completed.

These last points imply the value of the mixed-media systems. Key-to-disk data entry systems are distinguished today by comprehensive error detection software. To capitalize on this software, a scanner needs only to transfer its output to the disk of the keyed data entry subsystem, which then manipulates this scanner output like any other data stored on the disk. Meanwhile, the scanner subsystem confines itself to scanning and recognition with a minimum of software interaction.

Another potentially valuable aspect of the mixed-media systems should not be overlooked. Suppose on a given form some 20 or 30 percent of the data can be read optically but the remainder must be keyed. Ordinarily, a data processing manager would not incur the additional expense of a scanner under these circumstances, expecially since he would then have the problem of mating the scanned data with the corresponding keyed data. In a mixed-media system scanned data can be stored on the disk in any convenient way, and keyed data, which can be entered at any time, is similarly stored. Software can be written to reformat these two kinds of data automatically, with proper identifiers, in accord with the desired sequence. Alternative procedures to accomplish the same objective are available as well. As a result of these provisions, a manager is likely to let a scanner process the material for which it is suited and to allot the remainder to keystation data entry. Thus, an extension of scanner utilization, compared to what scanners have been allowed to process in the past, can be expected from the new mixed-media configurations. The Scan-Data Mixed Media System has especially attractive characteristics along these lines, while the Cummins-Allison system is particularly striking for the variety of optical inputs that it accepts.

Optical Readers

An optical reader consists of several mechanisms: document feed, document transport, scanning, recognition, and document stacking. The purpose of the document feed, transport, and stacking mechanisms are self-evident.

The scanning mechanism consists of a light source and some sort of photosensitive device for converting reflected light into an electrical signal. Depending on the nature of the printed matter being scanned (mark, bar code, or character) additional complexity may be introduced to dissect the image so that its component parts can be identified.

The recognition logic identifies the image on the basis of its component parts. Marks are the simplest to handle, since only their presence or absence need be identified. Bar codes are designed to allow several different characters, typically numeric, to be represented in a manner that permits easy identification with the simplest of recognition logic. True character recognition is far more complex, particularly if conventional typewriter and printing type styles are to be read. To simplify the problem somewhat, special type faces (also called fonts) have been designed to create more distinction among the various numerals and letters of the alphabet.

The typical commerical data processing installation is faced with three types of input:

- Data input to an application program.
- Programming input.
- Correction input.

Input to the application programs is usually characterized by high volume and simple format.

Programming input, consisting of programs to be assembled or compiled, is characterized by relatively low volume and complex format.

Correction input—re-entry of invalid applications input or patches for programs—is characterized by low to medium volume and highly variable format.

The reason for segregating the computer input in an installation in this manner is to point out where optical readers can be used effectively. Keeping these types of input in mind, let's examine the range of optical readers more closely.

The most logical way to categorize optical readers is by what they read. Three principal divisions stand out:

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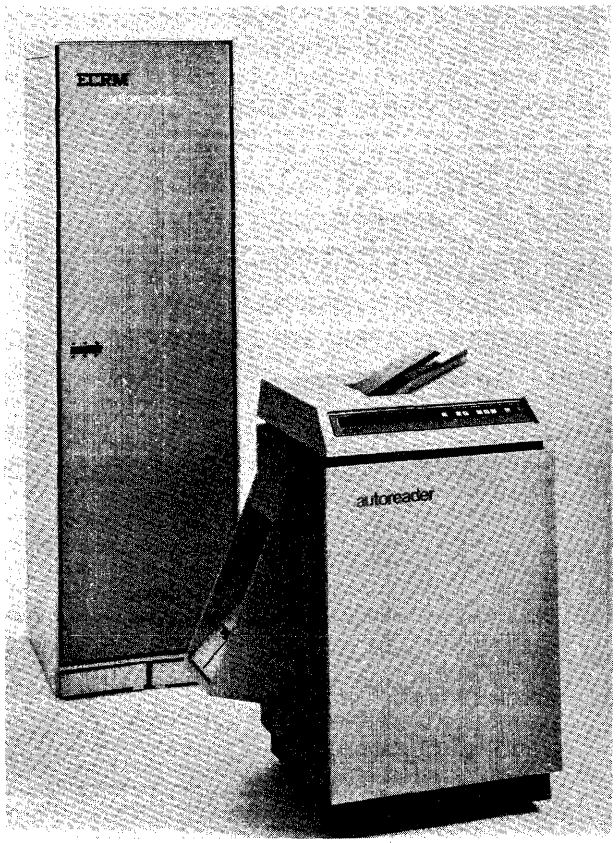

$HD By GENE JONES

$PD The ECRM AUTOREADER recognizes and accommodates certain /accommodates/ editing instructions upon a page of typed text. In particular, the AUTOREADER accommodates line editing, the deletion, correction, or insertion of groups of characters on a line.

All of the editing can be accomplished by means of handwritten strikeouts on a line and instructions /handwritten/ above the line, after which a typist converts the handwritten instructions to machine-readable form by typing the same instruction nearby, or just below the line to be edited.

The ECRM Autoreader is aimed at the text processing market, especially newspaper typesetting applications. The editing features, vital to this type of application, are pretty well summed up in the example shown above. Another company also aiming at text processing is Compu-Scan with its 170 system. In addition to typed corrections, the 170 includes a video display facility for making on-line corrections at the last minute. An alphanumeric CRT displays what the 170 reads while the video display shows what the document looks like; the reader is designed to note hand deletion marks which provide the indications of where to stop for editing input.

- Mark readers.
- Bar-code readers.
- Character readers.

Mark Readers

Mark readers are the simplest of the three types. Frequently, mark readers handle conventional 80-column cards. Others handle full-size sheets of paper. Mark readers typically read data in one of two ways. One is to interpret rows of marks in exactly the same way as punches in the card would be interpreted. Thus, one column of marks can be used to represent one character. This technique is usually limited to the coding of numeric information, since manual encoding of alphabetics would require at least two marks in a column and would require people to memorize the Hollerith code. Some mark readers mitigate this limitation by including the capability for recognizing conventional punched holes. The other technique used by mark readers is similar, but transmits a binary image of the marks to the computer. Appropriate programming then interprets the marks.

The principal disadvantage of mark readers is low information density. Typically, only 40 columns of hand-marked information can be put on an 80-column card. The binary imaging reader requires a place for marking each possible response; e.g., for each alphabetic character, a set of 26 boxes must be provided, one for each letter of the alphabet. Some readers compensate for low data density by allowing marks on both sides of the document.

Mark-sensing has been traditionally used for such applications as test scoring, questionnaire responses, and exception reporting (as when the amount paid differs from the amount billed).

Bar-Code Readers

Bar-code readers sense marks that are used in combinatorial form to indicate data. The type of marks used varies, but in most cases the marks cannot be formed by hand and are not easily readable by humans (although the GE COC-5 bar code is a significant exception).

Usually, special devices are required to produce the bar code imprinting—though at least one device, the Cummins Scanak 216, reads a bar code formed by printing the numeral "1" on a computer printer. Bar codes also suffer from taking up a lot of space.

For many years, Recognition Equipment, Inc. has been producing fluorescent bar codes with ink-jet printers attached to the company's OCR systems for the credit

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card industry. The bar codes use groups of four bars to represent hexadecimal characters for recording information for sorting documents off-line.

Character Readers (OCR)

Character readers are the elite among optical readers. They translate human-readable characters into machine-readable form. Many specialized fonts have been developed to simplify the character recognition logic and hence lower the price. Specific phraseology has arisen to differentiate among the many types of character readers.

The following brief discussion of vocabulary will assist you in reading the various manufacturers' sales literature. *OCR* means optical character recognition. A *document reader* reads documents of less than standard letter size (8.5 x 11 inches). A *page reader* reads at least letter-size documents and usually larger ones. Another way of distinguishing between document and page readers is that document readers generally read one or two lines per document, while page readers can read many lines from each document. *Single font* means that the reader can be equipped to read one type face only. *Multiple font* means that the reader can be equipped to read several type faces but only one at a time; switching between type faces can be a manual or programmed feature. *Multi-font* means that the reader can read multiple type faces intermixed; that is the most sophisticated and expensive type of optical reader. *Journal tape* is the rolls of tape used by adding machines and cash registers.

A more detailed discussion of the characteristics of the various types of optical readers is contained in the discussion of the comparison chart entries, later in this report.

Now that we have defined the types of devices we're talking about, let's discuss their application.

Of the three types of input mentioned earlier (application data, programming data, and correction data), application data is the one of most concern, since it represents by far the largest volume in any commercial shop.

Data for one application typically breaks down into a large number of records of a few different types. An inventory control application, for example, involves several types of transaction records: receipts, disbursements, deletions, additions, changes, etc. Accumulation of this data is usually a manual procedure. Clerical personnel record on appropriate forms the actions that have happened. In a typical keypunch installation, data is transcribed from the source documents to specially formatted documents for forwarding to the keypunch center. Frequently, the source document is one that has been prepared outside the environment of the company's own data processing installation—an invoice, for example. Another type of input is the turnaround document (i.e., a document sent outside the organization that is used for input when returned). Utility billing is the most familiar application of turnaround documents.

Who Uses Optical Readers?

Mark readers are used principally for data collection and for entry of limited amounts of data on previously punched cards.

Bar-code readers and character readers have many applications. The principal ones at present are the reading of slips imprinted with a credit card, processing of turnaround documents, and sorting of the U.S. Mail. Many case histories have been published in the trade press concerning these and numerous other applications.

Can You Use an Optical Reader?

Various manufacturers estimate that any installation having anywhere from 5 to 12 or more keypunches can profitably make use of a character reader. Where do the savings come from to pay for this expensive beast?

One place is the lessened cost of labor. Since manual input for the character readers is typically prepared on a typewriter, the hourly wage rate is generally lower than for keypunch operators, while the output is higher and the rate of errors is lower. The ease with which errors can be corrected when preparing typewritten documents contributes to the speed in comparison with keypunching. One user estimates that about 10 percent of the documents processed at his installation contain errors detected and corrected by the operator. Some readers contain special facilities for recognizing a character skip symbol or strike-throughs to further ease correction of errors detected by the typist.

Another area of cost savings is the cards themselves, which can amount to a sizable expenditure for large-volume installations.

Planning an Installation?

Before rushing out to order an optical reader, a thorough analysis of your requirements is in order. The following discussion is oriented toward character readers, but many of the same considerations apply to the other two types of optical readers.

The first consideration is volume of transactions. This will effectively identify the speed of the reader required. Don't overlook the possibility of two lower-speed readers in place of one high-speed reader. Economies of scale apply here as well as other places, but the sophisticated reader may contain much more in the way of font selection and document flexibility than you need for your application, and you would be paying for this as well as

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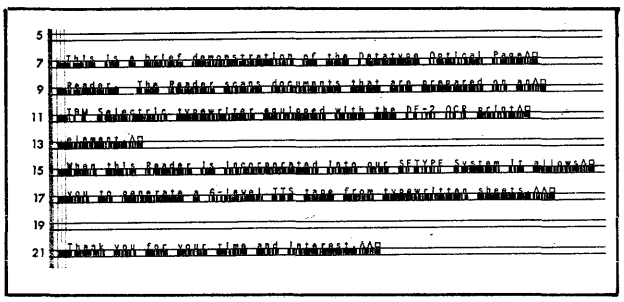

Still another company involved in text processing is Datatype Corporation. Datatype's story can be summarized by paraphrasing an old advertising slogan for a correspondence music school: "They smiled when I sat down to type." A special typing element for the IBM Selectric typewriter is used to generate copy that looks like the illustration above. The bar codes beneath the letters are engraved right on the element. The advantages of this approach are the simplicity (read lower cost) and the reduced rejection rate of bar code readers. The SETYPE system pictured is one of several standard configurations; this one is directed toward typesetting applications.

for increased performance. Identification of volume usually implies selecting certain applications. After you get your reader up and running, there's a good chance that additional applications will present themselves, so reserve capacity may be desirable. Long-range planning of this type is difficult, and it is not always wise to go to a large machine in the expectation of finding additional work for it. Perhaps this is the best justification for leasing rather than purchasing the machine, at least until the workload is well defined.

Be careful of the "white-wall tire" syndrome; don't order more machine than you actually need just because some of the features are neat. Unless you really need a reader that can read a newspaper, there's no point in paying for one.

The application for which the reader will be used determines how much machine you need. The essential decisions involve:

- Amount of data per record.
- Type of data to be read.
- Number of different formats required.

The amount of data per record distinguishes between the need for a "document" reader (one or two lines) and a "page" reader (many lines). If you have been getting along fine with one or two punched cards per record, then a document reader will probably suffice.

Three general types of data can be identified: numeric, alphabetic, and hand-printed (also normally numeric). The additional logic to recognize more different characters drives the cost of the unit up. Hand printing has proven itself reliable for numerics and a few letters (used as control symbols for the IBM 1287, to mention one), but again it costs you more. Hand printing can be used very successfully if the amount of printing per document is kept small and if the manufacturer's rules for forming the characters are carefully followed.

The number of formats is essentially the number of different documents you intend to input. Significant variations require fancier document transports and scanning logic. Again the factor of cost rears its head. A major decision point in document design is whether to hold as closely as possible to previously used forms or to completely redesign them. Complete redesign usually leads to a cleaner installation, but it does require more effort to implement.

Availability of imprinting devices will affect your plans. Additional discussion about this point can be found under the discussion of comparison chart entries. In general, imprinting is performed by typewriters, computer line printers, cash registers, adding machines, credit card embossers, or by hand. Not all fonts are usable with all of these imprinting methods, though, so be careful not to get locked into a font that is not available on an imprinting device you may want to use later.

Incidentally, the IBM Selectric Typewriter may contribute as much as anything else to spreading the use of OCR. Fonts particularly good for optical character recognition are sometimes objectionable when used for correspondence. With the swift changing of an $18 type sphere, the Selectric can change its type face.

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Where the document is prepared and how it will be handled are major considerations. Extensive and rigid specifications govern the appearance of the type to be read as well as the condition of the document. To minimize rejects and jams, the documents should be looked at before entering them into the reader. Frequent checks of imprinting devices should be made to ensure that the quality of printing is adequate. Some readers require that an imprinting device be "run in" for several minutes after changing the ribbon to prevent blurred characters that would not read well.

Preprinted forms used for optical readers are an often-overlooked source of difficulty. Overlooked, that is, until several thousand dollars worth must be thrown away because they are unsuitable for one reason or another. There are three aspects to proper forms design: paper, ink, and registration.

The document feed mechanisms are sensitive not only to physical size (length, width, and thickness) of the forms, but also to the more basic characteristics of the paper itself. Sensing of marks or characters is based on a difference in reflectance between the marks and the paper background. Because there is often a need to preprint information on the form that can be read by the reader (invoice number or control marks) or *cannot* be read by the reader (instructions or area highlighting), the user must be concerned about the characteristics of individual readers. Different readers react differently to different inks; what will be ignored by some will be picked up by others. And the human eye often cannot tell the difference.

Registration, the accuracy of locating printing on a page, can play an extremely important role in ease of reading. This seems to be more critical for character readers than mark readers. Not only must you be concerned about the relationship between various printed elements (controlled by the master drawing of the form), but the location with respect to the edges of the documents (controlled by printing and trimming) is important as well. For continuous forms, there is also form-to-form registration to be concerned about.

This sounds like a formidable problem, and it is. Typically, the optical reader manufacturer provides forms approval as a service, but a series of rejections can cause added expense and delay implementation. This means that care must be taken in finding a printer that is familiar with optical readers. Usually, the manufacturers publish detailed specifications on paper, ink, and registration. But these tend to change from time to time, so be sure you have the correct specifications for the device you are using.

In-house printing using offset presses has proved successful for some users, provided the masters were sufficiently accurate. In general, conventional drafting practices are not good enough. One way to improve accuracy is to make the master drawings oversize and reduce them for printing. However, it is difficult to reduce drawings to the exact size required.

The Big Three in computer forms are also the Big Three in the preparation of forms for optical readers. These are Moore Business Forms, Standard Register, and Uarco. Other up-and-coming forms companies, such as GAF, are making special efforts in the area of optical reader forms. These companies can handle the whole forms job from start to finish. Alternatively, you can have your masters prepared by a specialist for printing by you or a local printer. One such specialist is Williston Graphic Services, Inc. in Milwaukee.

In any forms design project for optical readers, the elements of user (information layout), draftsman (accuracy of drawing), printer (ink and accuracy of printing), and reader manufacturer (specifications and forms approval) must be carefully coordinated and controlled to ensure successful completion of the job. In procuring forms for optical readers, it is all too easy to be penny wise and pound foolish.

In the planning of an application, sufficient time should be allowed for the proper systems design, programming, and physical installation and checkout to be performed. Six months would not be an inordinate time to allow for the first application.

On-line Versus Off-line

This question has been argued almost since the first days of the computer. We see it cropping up in off-line print stations, satellite computers for printing or communications processing, and even in the time-sharing/batch-processing controversy. It's a question that you'll have to work out for yourself because each installation is so different. As a basic guideline, keep in mind that on-line operation of an optical reader usually gets you on the air at a lower cost, but off-line operation uses less of your main processor's time.

User Experience

Datapro Research Corporation recently conducted a comprehensive user survey to assess user experience and attitudes with respect to current optical scanning equipment. An Optical Reader questionnaire was included in the November 1973 supplement to DATAPRO 70, and by February 1, 1974, usable responses had been received from 116 users representing about 125 pieces of equipment.

Users were asked to rate the overall performance of their optical readers and their ease of operation, freedom from

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recognition errors, freedom from document jams, equipment reliability, and the quality of maintenance service. The evaluations were expressed in terms of an Excellent, Good, Fair, or Poor rating for each category. The ratings for specific readers and for the products of specific manufacturers, as submitted by the responding users, appear in the table on the next page.

The ratings submitted by all of the users can be consolidated to form the following overall picture of user attitudes toward the optical readers now on the market:

	Excellent	Good	Fair	Poor
Overall performance	26%	55%	16%	3%
Ease of operation	31%	52%	15%	2%
Freedom from recognition errors	19%	57%	21%	3%
Freedom from document jams	28%	33%	34%	5%
Equipment reliability	22%	48%	24%	6%
Maintenance service	23%	45%	28%	4%

These results may well explain the improvement over the past year in the financial posture of a number of companies in the industry. Scan-Data, Recognition Equipment, and Cognitronics, for example, all reported profits, while Optical Scanning reported a sizable reduction in its losses. There is no question that 1973 was a year of progress for the industry.

Another significant result of Datapro's user survey is the table of Optical Reader Utilization Patterns, which presents a profile of user application practices at the present time. As expected, most readers are called upon to read forms prepared by line printers, but a surprisingly large proportion of forms are at least partially handprinted. OCR A appears to be the most popular font by a wide margin. Off-line manual re-entry is still the most prevalent method of character insertion. It is also noteworthy that on-line operation to a computer mainframe and off-line operation to a magnetic tape drive are about equally popular.

From the results of the survey and the emergence of new manufacturers in the industry, especially in the mark reader class, it is apparent that the acceptance of optical reading is gradually increasing at a steady though far from spectacular rate.

Comparison Charts

The comparison charts included in this report represent comprehensive coverage of essentially all the important optical readers currently on the market. The entries are largely self-explanatory, but the following discussion will assist you in properly interpreting each entry and relating it to your application. Much additional information can be gleaned from the charts by fully understanding the implications of each entry.

OPTICAL READER UTILIZATION PATTERNS

	Number of User Mentions	Percent of Total Respondents
Rejection rate:		
0 to 2%	52	45%
2 to 5%	35	30%
5 to 10%	15	13%
Over 10%	11	9%
Source material characteristics:		
Documents (1 or 2 lines)	45	39%
Pages (many lines)	36	31%
Numeric handprinting	33	28%
Alphanumeric handprinting	3	3%
Intermixed fonts on a single form	23	20%
OCR A	46	40%
OCR B	7	6%
IBM 1428	10	9%
NCR NOF	4	3%
E-13B	7	6%
7B	5	5%
12F	1	1%
12L	0	0%
Mark readers:		
80-column card format	10	9%
Page format	31	27%
Marks and characters intermixed on same documents	14	12%
Bar-code readers:		
Addressograph-Multigraph code	7	6%
GE COC-5 code	0	0%
Cummins 1's code	2	2%
Method by which scanned forms are prepared:		
Line printer	69	60%
Typewriter	32	28%
Embosser	12	10%
Handprinted	58	50%
Preprinted	40	35%
Procedure for correcting scanning errors:		
On-line manual keying	35	30%
Off-line manual re-entry	73	63%
Character (error code) substitution	18	16%
Some operational characteristics:		
On-line to computer	46	40%
Off-line to magnetic tape (or other medium)	45	39%
Terminal	7	6%
Text	5	4%
Numeric only	56	48%
Alphanumeric	35	30%
Turnaround documents	47	41%

The key functional characteristics of 104 commercially available optical readers from 46 manufacturers are presented in the accompanying comparison charts. The information in the charts was supplied and/or verified by the manufacturers between November 1973 and February 1974; their close cooperation with the Datapro Research

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USERS' RATINGS OF OPTICAL READERS

Manufacturer and Model	No. of User Replies	No. of Units	User Ratings*																							
			Overall Performance				Ease of Operation				Freedom from Recognition Errors				Freedom from Document Jams				Equipment Reliability				Maintenance Service			
			E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P
Addressograph-Multigraph 9500	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0
Addressograph-Multigraph 9600 Series	4	4	0	3	0	1	1	2	1	0	0	1	2	1	2	2	0	0	1	2	0	1	1	1	2	0
Addressograph-Multigraph Totals	5	5	0	3	1	1	1	3	1	0	0	1	3	1	2	2	1	0	1	2	1	1	1	2	2	0
Automata 3600	1	7	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0
Computer Entry 7100	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Control Data 915	3	3	2	1	0	0	1	2	0	0	1	2	0	0	1	1	1	0	1	1	1	0	1	1	0	0
Control Data 921	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0
Control Data 935	1	1	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
Control Data 936	2	2	0	2	0	0	0	2	0	0	1	1	0	0	0	0	2	0	0	0	2	0	0	1	0	1
Control Data 955	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
Control Data Totals	8	8	3	5	0	0	1	7	0	0	3	5	0	0	2	3	3	0	2	3	3	0	2	3	1	1
Cummins Scanak 216	2	2	0	2	0	0	1	1	0	0	0	1	0	0	2	0	0	0	1	1	0	0	1	0	1	0
ECRM Autoreader 1200	1	4	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Honeywell DRD 200	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0
IBM 1231	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0
IBM 1232	6	6	0	4	2	0	0	5	0	1	0	0	6	0	0	0	4	2	0	3	2	1	1	1	3	1
IBM 1282	1	1	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
IBM 1287	24	25	4	18	2	0	4	14	5	1	3	15	6	0	4	12	8	0	3	15	5	1	7	9	7	1
IBM 1288	8	9	4	2	1	1	3	3	2	0	3	3	1	0	1	3	4	0	1	5	1	0	2	5	1	0
IBM 3881	1	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
IBM 3886	1	1	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0
IBM Totals	42	44	12	24	5	1	11	22	7	2	8	20	13	0	8	16	16	2	5	26	8	2	12	16	12	2
Lundy-Farrington 3030	1	1	1	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0
NCR 420	3	14	1	2	0	0	2	1	0	0	1	2	0	0	3	0	0	0	2	1	0	0	1	2	0	0
National Computer Systems Sentry/70	4	4	2	2	0	0	2	2	0	0	1	2	1	0	2	1	1	0	1	3	0	0	1	1	2	0
OCR Systems 1000	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0
Optical Recognition OCR-71	4	5	1	3	0	0	3	1	0	0	0	3	1	0	0	2	2	0	2	1	1	0	1	1	2	0
Optical Scanning 17	6	20	2	4	0	0	4	2	0	0	2	4	0	0	2	3	1	0	3	3	0	0	2	3	1	0
Optical Scanning 70	1	1	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0
Optical Scanning 100	6	6	0	4	1	1	2	3	1	0	1	2	1	2	1	2	1	2	0	2	2	2	1	2	2	1
Optical Scanning Totals	13	27	2	9	1	1	6	6	1	0	3	7	1	2	4	5	2	2	4	5	2	2	3	5	4	1
Recognition Equipment Input 80	3	7	1	1	1	0	0	2	1	0	0	2	1	0	1	0	2	0	1	0	2	0	0	3	0	0
Recognition Equipment Retina	3	4	1	1	1	0	1	1	1	0	1	2	0	0	1	1	1	0	1	1	1	0	0	2	1	0
Recognition Equipment Totals	6	11	2	2	2	0	1	3	2	0	1	4	1	0	2	1	3	0	2	1	3	0	0	5	1	0
Scan-Data 250	3	4	1	2	0	0	1	2	0	0	1	1	1	0	1	0	1	0	0	0	2	0	0	1	1	0
Scan-Optics 20/20	7	9	2	4	1	0	3	3	1	0	2	5	0	0	2	3	2	0	2	4	0	1	2	5	0	0

* Ratings are expressed in terms of number of user responses. The legend is E for Excellent, G for Good, F for Fair, and P for Poor.

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staff in the preparation of these charts is greatly appreciated.

Application

The most distinguishing features of optical readers are the types of media they accept and the form of data they read.

There are two principal media—documents and journal tape. Documents are any type of discrete paper form. Special types include several card forms, such as 80-column punch cards and tickets. Journal tape is the rolls of paper used by adding machines and cash registers.

A new medium just coming into use is microfilm. In particular, the growing use of computer output microfilm (COM) units may dictate increasing use of readers of film.

The three principal data forms are marks, bar code, and characters.

Marks are typically made by hand with a conventional pencil or pen. Almost all mark readers can also read preprinted marks if the proper ink is used. Usually, conventional punched holes, made by a keypunch, can also be read.

Bar codes are imprinted by a special device and in most cases are not easily read by humans.

Characters refer to the human-readable form. Recognition of hand-printed block numerals and a few letters is becoming common.

Optical readers can be used on-line or off-line. The on-line readers input data to your computer in much the same manner as any other peripheral device. The off-line readers output a machine-readable copy of the material being read. A terminal for remote data entry is a specialized type of on-line device that can be connected to a distant computer by means of a data communications link.

Document Handling

The movement of documents from the input hopper to the output stacker is of critical importance. Development of adequate mechanisms has been a real bugaboo for equipment designers since the earliest days of computers. Reliable, high-speed transporting of card forms is definitely solved, and inexpensive mechanisms are now available.

But card forms have a stiffness that is lacking in ordinary paper. This problem was solved in computer line printers through the use of forms with holes at the edges and driven by means of sprockets. This is not a practical solution for transporting individual documents, so other means have been worked out.

For low-speed readers, drive rollers (also called pinch rollers) are adequate, if only one size form is to be read. (Typically, only the width of the form is important, and length can vary without causing any major difficulties.) As the need for increased speed or the capability to handle different form sizes arises, more sophisticated techniques are required. Conveyor belts are typically used in higher-speed devices, often with a vacuum assist to hold the documents in position on the belt.

The document transport mechanism must solve a two-phase problem: (1) pick up one document from the input stack and start it moving, and (2) move the document through the read station to the stacker. Depending on the type of scanning technique, the document may need to be stopped under the read station for scanning.

Two common types of feeding are used: friction and vacuum. Friction feeding uses rollers that revolve against the documents to start them on their way. Vacuum feeding causes the document to be lifted slightly by the pick-up mechanism to free it from the remaining stack.

Two problems are outstanding in the area of document handling: double pick-up and jams. If two documents are picked up together they will usually pass through the reader as one unless special facilities are included to detect this problem. Jams will occur, even with the best and most carefully designed transports. The problem is intensified if the documents to be read have been handled considerably. However, the incidence of jams definitely seems to be on the decline. The ease with which the document path can be accessed for removal of jams is an often-overlooked factor in selecting equipment.

The range of sizes and weights of documents that can be accommodated by a reader govern your choice of source documents. The limits for maximum and minimum size are fairly obvious criteria—except that not all sizes in between the maximum and minimum are necessarily acceptable. One thing to be particularly watchful for is the *aspect ratio*; i.e., the ratio of the length to the width.

The weight of the paper tends to be a very confusing specification. The weight is determined by the actual weight, in pounds, of a ream (500 sheets) of the paper. The problem arises in that different types of paper are measured using different size sheets. Three types of paper are in common use: bond (office correspondence), offset (printing and copying), and card stock (tab cards). Typical bond and offset stock in use are actually about the same weight but carry different weight designations because of the different sheet size used in measuring. Another type of paper product in common use is tissue or onionskin, which is used to make copies when typing.

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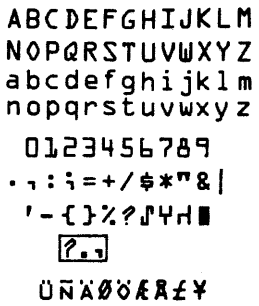
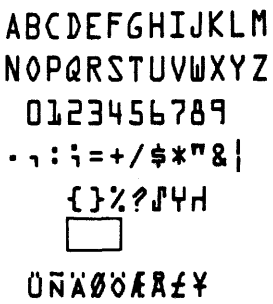
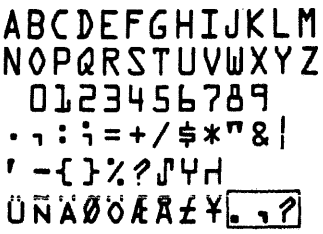


Size I



Size III



Size IV

The complete character set for ANSI OCR A is shown here in all three sizes. Size I is widely used in computer printers and typewriters, Size III is used mainly in cash registers and adding machines, and Size IV is used in credit card imprinters. The symbols enclosed in boxes are alternate shapes.

Paper weights in the 12# to 16# range are typically onionskin and measure 2 to 3 thousandths of an inch in thickness. Paper weights around 20# to 30# are usually bond papers measuring 3 to 6 thousands of an inch in thickness. Papers in the 50# to 70# class are usually offset papers and are equivalent to 20# to 30# bond paper. Paper weights around 100# usually represent card stock and measure about 5 to 7 thousandths of an inch thick.

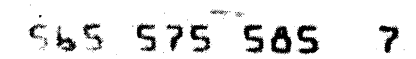
Input

The amount of data that can be read in one pass is an important consideration. Some devices can read several different lines, but the scanning mechanism must be manually adjusted; this feature is primarily directed toward accommodating forms with different formats rather than extending the reading capability for one document. The amount of data that can be read varies with the size of documents in many but not all cases. The one- or two-line readers are prime examples; increasing the length of the document doesn't increase the amount of data that can be read, though it does increase the flexibility of forms design.

A great deal of additional flexibility and usefulness are obtained if some measure of control can be exercised over what is read from the document and whether any editing and formatting can be performed. The range of capabilities span the gamut from none to just about anything you want to do. As an example of the power that such format control facilities can give the user, consider a bill that is prepared on a computer and is to be returned with payment. If the bill contains a field for hand-written entries, the clerk processing the returns can enter a partial payment in this field; she leaves it blank if the remittance is the same as the billed amount. If the reader can be so instructed, any mark in the low-order position of the hand-written field could cause that field to be read, skipping the billed amount; if that position is blank, then the billed amount can be read as the amount remitted. The idea here is to minimize the number of manual entries.

Careful distinction needs to be made between the capabilities of on-line and off-line devices. An on-line reader can depend on the computer for data manipulation. However, some on-line readers, such as the IBM 1287, can be selectively instructed to read or skip certain fields.

The comparison chart entries refer specifically to the capabilities of the reader itself.

Acceptable	
Unacceptable-Too Heavy	
Unacceptable-Too Light	
Unacceptable-Double Impression	

This guide, taken from an IBM manual, shows imprinting that is acceptable and unacceptable to an IBM 1287 Optical Reader.

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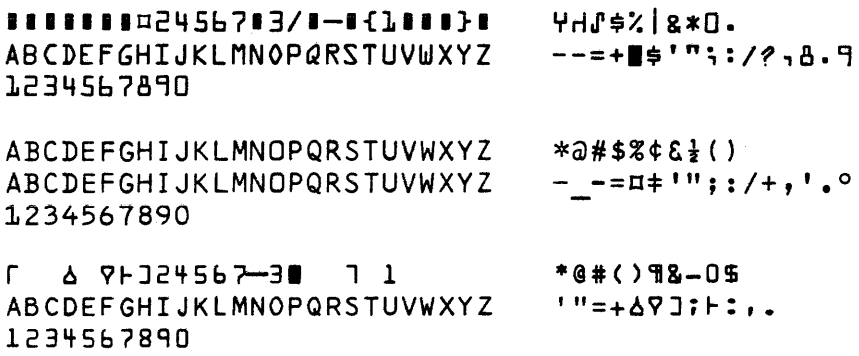

This figure shows the OCR A (Size I), IBM 1428, and Farrington 12F/12L OCR fonts, from top to bottom. These illustrations were taken from an IBM Selectric style manual. The type spheres are arranged so that the numerics fall in a right-hand grouping, as on a keypunch.

"External program" refers to those units that are connected on-line and can be instructed to perform field selection or editing and formatting. "Internal program" refers to those units that include processing logic (often a minicomputer) within the system defined. A less flexible method is to use plugboards to control functions.

Recognition

There is not too much to say about recognition of marks by a mark reader. Typically, they are diagonal slashes made in a preprinted box or outline. Care must be taken when erasing because if the paper is roughened too much, it will have a low reflectance and make the reader conclude that the roughened area is a mark.

Bar codes are well illustrated by one of the accompanying figures (page 70D-010-78i).

There are many specialized fonts that are used today in addition to traditional printing type styles. A few of the more sophisticated readers recognize printing type styles in addition to or in place of the OCR fonts.

The more commonly used OCR fonts include:

- OCR A–A group of three fonts having similar shapes but different sizes and proportions. Developed by the American National Standards Institute, these are now the most widely used OCR fonts. For perspective, the sizes are roughly equivalent to 10-point type (Size I), which is the size of the printing you are now reading, 14-point type (Size III), and 16-point type (Size IV; also called OCR C).

  Size I has a pitch of about 10 characters per inch and is typically used on typewriters and computer printers. Size III also has a pitch of about 10 characters per inch and is typically used on cash registers and accounting machines. Size IV has a pitch of about 7 characters per inch and is typically used on embossed plastic cards (credit cards) and metal plates.

  The newest revision of the ANSI standard (proposed) includes the definition of a lower case alphabetic group for Size I, alternate shapes for some punctuation marks, and expanded specifications for spectral bands, paper and print characteristics, and positioning.

- OCR B–Popular in Europe, this font is now under consideration for standardization in the United States. It differs considerably from the ANS standard and is characterized by being closer to conventional type faces than the ANS fonts. Exponents of the OCR B font are concerned about readability by people, even though it is more difficult to build the machine recognition logic to handle it. This font is also called ISO B, and occasionally ECMA-11. There are also three sizes defined for OCR B: I, III, and IV. These are essentially equivalent in size to OCR A, except that OCR B Size IV characters are a little shorter and broader than OCR A Size IV. OCR B Sizes I and IV include numerics, upper and lower case alphabetics, punctuation marks, special symbols, and several foreign language symbols. Size III includes numerics, 7 upper case alphabetics, and 3 special symbols.

- Farrington 7B, 12F, and 12L–Another popular group of OCR fonts, due to Farrington's early appearance on the OCR scene. The three codes have somewhat similar shapes but differ in size and character set. The 7B and 12F are numeric fonts, while the 12L is alphabetic only. The 7B is much larger than the 12 F/L. Imprinting is normally done by a special typewriter or a credit card embosser.

- IBM 1428–This is an alphanumeric font associated with the IBM 1428 Optical Reader and imprinted by an IBM 1403 Line Printer or IBM Selectric Typewriter.

- IBM 407–A font produced by the widely used IBM 407 Accounting machine.

- NCR NOF (Numeric Optical Font)–This is a numeric font, usually imprinted by an adding machine or cash register. It is widely used in retail applications.

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- E-13B–This is not properly an OCR font. It was developed by and for banks prior to the development of OCR. It is a highly stylized numeric font intended for printing in magnetic ink to facilitate the sorting and processing of bank checks. It has not caught on anywhere else, but most banks use it. Some optical readers can read this font, which enhances their suitability for banks converting to OCR.

- Handprint – If the ANSI standard that has been in the proposed stage for over a year finally jells, there will be an official handprint font. It may include numeric and alphabetic symbols, punctuation marks, deletion provisions, symbols oriented toward programming, and special provisions for international usage.

All fonts, both numeric and alphanumeric, usually include a few special symbols for control purposes. The OCR A and B fonts include a full array of punctuation symbols as well. Some of these fonts are illustrated in the accompanying figures.

The scanning technique is the method for optically converting the printed images to electrical signals. Some sort of photosensitive device, photocell or phototransistor, is used to sense the light reflected from the document. For bar-code and character readers, additional components are required to scan portions of the code or character in proper order so that the features, and thus the character, can be identified. The scanning components can be an array of photo devices, a mechanical disc, or a flying spot (CRT). The photo-device array is used by most bar-code readers. Size normally interferes with using it for scanning characters, but note that REI does quite nicely with it. The mechanical disc technique employs a rotating disc with a slit in it to project a beam of light over the character in a predetermined order. The flying spot scanner uses an electron beam that is moved within a CRT to generate a spot of light, thus providing, potentially anyway, a much faster scan rate. The flying spot scanner is very adaptable to reading multiple lines, while the mechanical disc scanning technique requires either an incremental document transport or an elaborate system of mirrors to scan multiple lines.

Once the printed image has been translated into electrical signals, the recognition logic interprets these signals as a particular character.

Three principal recognition techniques are used for character interpretation: matrix matching, stroke analysis, and curve tracing. Matrix matching involves comparing the matrix of signals caused by the reflecting (paper) and non-reflecting (printed character) portions of the character with a set of signals for each character until a match is found. Typically, the closest match within prescribed limits is identified, because a perfect set of signals is most unusual due to variations in print and paper quality. The stroke analysis method is somewhat similar on a much simpler basis; readers employing this technique usually are reading a highly stylized font specifically designed for the technique. Curve tracing logic actually traces out the outline of the character to derive a set of signals for analysis. The curve tracing technique is adaptable to variations in character size and orientation, making it a good choice for interpreting hand-printed characters. However, breaks in the printed character tend to affect this method more than the matrix matching method.

Output

The purpose of the optical reader is to generate data in a computer-readable form. Magnetic tape, punched cards, and punched tape are conventional computer-readable forms. De facto standards, now official, have been established by IBM for magnetic tape and punched cards. Teletype has done essentially the same for punched tape. Exceptions that are relatively new on the market are magnetic tape cassettes and 96-column cards–but neither of these has had much impact on the optical reader market, though they unquestionably will in the future.

Communications lines enable the transmission of data from remote locations to a central site for processing. Optical reading terminals are principally mark and bar-code readers, but a few character readers are available for use as remote terminals.

On-line optical readers are usually produced by a computer manufacturer for a particular line of computers, but a few independents also sell to this market. Frequently, the independents will design an interface for your computer, but it may cost you extra.

Performance

Readers that handle one size of documents are easy to rate for performance because it is predictable. In a similar manner, a journal tape reader typically transports the tape at a fixed rate, with predictable performance. Readers that handle different sizes of documents and variable-size data fields are not as conducive to having their performance stated in simple terms.

Three ways of measuring the performance of optical readers are documents per minute, lines per minute, and characters per second. The documents-per-minute rating is usually most applicable to mark and bar-code readers, as well as to character readers that read only one or two lines. The lines-per-minute rating is usually most meaningful for journal tape readers. The instantaneous character scanning rate in characters per second is probably the most meaningful single measure for character readers that read whole pages of text.

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Careful evaluation of timing information, which often becomes quite complex, is necessary to accurately predict the performance of the more sophisticated character readers. The size of the document, the amount and location of data on the document, and processing of the data read can all affect the rate at which documents proceed through the reader. On-line units can be affected by other activities of the computer, if running in a multiprogramming environment, or by poor programming of input/output functions.

Error Control

Discussion of errors and controls always leads to dissention no matter what area of data processing is being discussed. Advertised (and verified) reject rates of 0.25 to 0.5 percent cause some users to become startled and disillusioned when they see 30 or 50 percent of the documents going into the reject pocket.

There are three principal types of errors of concern to users of optical character readers: ambiguous characters, invalid data, and documents in poor condition.

Ambiguous characters are those for which the reader cannot make a decision about what character each should be. There can be many reasons. Typical ones include broken or poorly formed characters and dirt or other marks that are picked up by the reader. Handling of this situation varies with the reader and with programming. Many readers automatically rescan an ambiguous character. Some substitute a standard character for all unreadable characters and continue. Others display the character on a CRT screen for operator determination; sometimes adjacent data is also displayed to give the operator more context for making the decision. Printing quality and paper quality can drastically affect the incidence of this type of error.

OCR users quickly learned that the inclusion of checks in the data was extremely useful for insuring the maintenance of an adequate throughput level by reducing the number of rejected documents. This technique most frequently takes the form of repeated data fields, particularly for numeric entries. The technique is applicable only if the data can be processed and the actions of the reader controlled on the basis of the result.

Another commonly employed check is the check digit. The digits of a numeric field are manipulated, and there are several standard formulas, to generate a check digit. This digit is included in the input. The reader or associated processor generates another check digit while reading and compares it to the one read in. Failure of this check normally causes the document to be rejected.

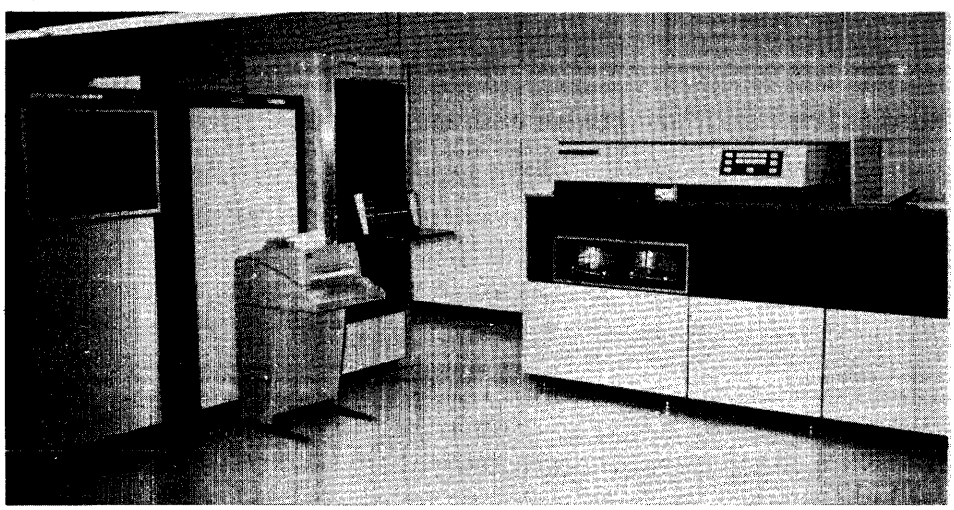
Documents that have extraneous items on them (such as stamps) or that have been badly mutilated can cause misfeeding and/or jams. The typical character reader is far less susceptible to this kind of jam than the average card reader, but people have been conditioned not to fold, spindle, or mutilate punched cards.

Pricing, First Delivery, and Number Installed

The prices in the comparison charts were furnished by the manufacturers in November and December 1973. Where a range is shown, the variations indicate the cost of optional features. Where only one price is shown, it is generally a base price for a working but not deluxe system. If a price is not shown, NA means the manufacturer declined to publish the price for that type of acquistion (typically, rentals that are negotiated).

First delivery indicates the date of the first successful installation of that model, or the anticipated date of first installation.

The number installed to date shows the number in use as of November or December 1973. When a manufacturer declined to provide this information, NA is inserted.



The Control Data 955 Page and Document Reading System, the top of the Control Data line, is one of the commercially successful optical character readers. Accompanying the reader at left are a magnetic tape transport, a magnetic tape controller, a teletypewriter, and the SC 1700 computer system controller.

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Manufacturers

Listed below, for your convenience in obtaining additional information, are the full names, addresses, and telephone number of 46 manufacturers whose products are summarized in the comparison charts.

Acme Visible Records, Inc., Crozet, Virginia 22932. Telephone (804) 823-4351.

Addressograph Multigraph Company, Data Systems Division, 29100 Aurora Road, Solon, Ohio 44139. Telephone (216) 248-7830.

Bell and Howell Company, Business Equipment Group, 6800 McCormick Road, Chicago, Illinois 60045. Telephone (213) 724-5778.

Bourns Management Systems, a division of Bourns, Incorporated, 6600 Jurupa Avenue, Riverside, California 92504. Telephone (714) 687-7220.

Bridge Data Products, Incorporated, 738 South 42nd Street, Philadelphia, Pennsylvania 19104. Telephone (215) 382-8700.

Burroughs Corporation, Business Machines Group, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000.

Chatsworth Data Corporation, 9732 Cozycroft Avenue, Chatsworth, California 91311. Telephone (213) 341-9200.

Cincinnati Time Recorder Company, 1733 Central Avenue, Cincinnati, Ohio 45214. Telephone (513) 241-5500.

Cognitronics Corporation, 41 East 28th Street, New York, New York 10016. Telephone (212) 889-3650.

CompuScan, Incorporated, 900 Huyler Street, Teterboro, New Jersey 07608. Telephone (201) 288-6000.

Computer Entry Systems Corporation, 2141 Industrial Parkway, Silver Spring, Maryland 20904. Telephone (301) 622-3500.

Computer Identics Corporation, 31 Dartmouth Street, Westwood, Massachusetts 02090. Telephone (617) 326-8960.

Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-8100.

Cummins Allison Corporation, 800 Waukegan Road, Glenview, Illinois 60025. Telephone (312) 724-8000.

Data Recognition Corporation, 908 Industrial Avenue, Palo Alto, California 94303. Telephone (415) 326-4810.

Datatype Corporation, 1050 N.W. 163rd Drive, Miami, Florida 33169. Telephone (305) 625-8451.

Datum, Incorporated, 170 E. Liberty Street, Anaheim, California 92801. Telephone (714) 879-3070.

Decicom Systems Incorporated, 857 Essex Street, Brooklyn, New York 11208. Telephone (212) 649-8110.

Decision, Incorporated, 5601 College Avenue, Oakland, California 94618. Telephone (415) 654-8626.

Dest Data Corporation, 1285 Forgewood Avenue, Sunnyvale, California 94086. Telephone (408) 734-1234.

Documation, Incorporated, P.O. Box 1240, Melbourne, Florida 32901. Telephone (305) 724-1111.

Electronic Associates Incorporated (EAI), 185 Monmouth Park Highway West, Long Branch, New Jersey 07764. Telephone (201) 229-1100.

ECRM, Incorporated, 17 Tudor Street, Cambridge, Massachusetts 02139. Telephone (617) 661-8600.

Hewlett-Packard Company, 640 Page Mill Road, Palo Alto, California 94304. Telephone (415) 493-1501.

Honeywell Information Systems, Inc., 60 Walnut Street, Wellesley Hills, Massachusetts 02181. Telephone (617) 237-4100.

IBM Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

Indenticon Corporation, 300 Second Avenue, Waltham, Massachusetts 02154. Telephone (617) 890-6600.

Information International, Incorporated, 12435 West Olympic Boulevard, Los Angeles, California 90064. Telephone (213) 478-2571.

Input Business Machines, Incorporated, 11900 Parklawn Drive, Rockville, Maryland 20852. Telephone (301) 881-0661.

Laser Computer Corporation, 218 West Ball Road, Anaheim, California 92805. Telephone (714) 778-5890.

Lundy Electronics & Systems, Incorporated, Computer Peripheral Division, 5535 Wilkinson Boulevard, Charlotte, North Carolina 28208. Telephone (704) 394-1161.

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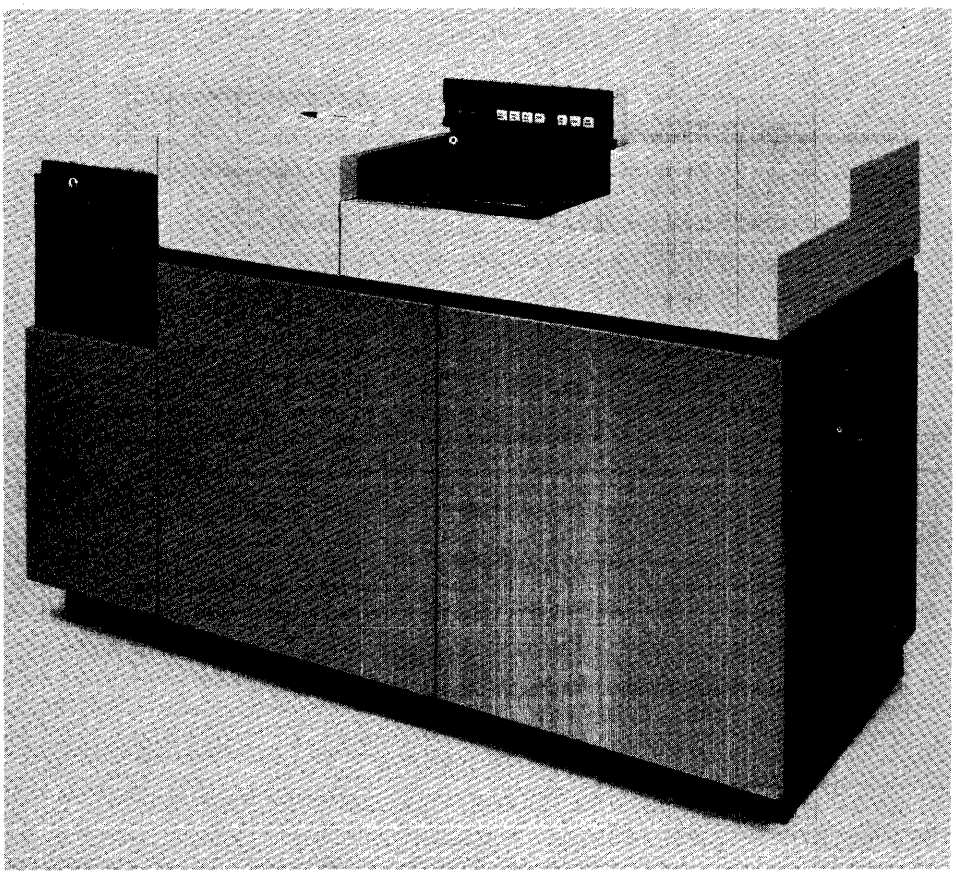

The Decision, Inc. OCR 7600 costs about $45,000 OEM. For this price, a prospective end-user marketing organization gets a minicomputer-based, OCR A/handprint system that can scan 8 fully typed pages per minute for a throughput of about 300 characters per second, with a hardware-augmented software recognition system. End-user prices would be about twice the OEM price. Cummins-Allison has picked this unit for its KeyScan mixed-media systems.

National Computer Systems, Incorporated, 4401 West 76th Street, Minneapolis, Minnesota 55435. Telephone (612) 920-3670.

National Cash Register Company, EDP Products, Main and K Streets, Dayton, Ohio 45409. Telephone (513) 449-2000.

OCR Systems, Inc., 2745 Philmont Avenue, Huntingdon Valley, Pennsylvania 19006. Telephone (215) 947-5700.

Optical Business Machines, Incorporated, 900 East New Haven Avenue, Melbourne, Florida 32901. Telephone (305) 727-1774.

Optical Recognition Systems, Incorporated, 1928 Isaac Newtown Square West, Reston, Virginia 22070. Telephone (703) 471-5060.

Optical Scanning Corporation, P.O. Box 40, Route 332 East, Newtown, Pennsylvania 18940. Telephone (215) 968-4611.

Peripheral Dynamics, Incorporated, 1030 West Germantown Pike, Norristown, Pennsylvania 19401. Telephone (215) 539-5500.

Recognition Equipment, Incorporated, Post Office Box 22307, Dallas, Texas 75222. Telephone (214) 259-8611.

Scan-Data Corporation, 800 East Main Street, Norristown, Pennsylvania 19401. Telephone (215) 277-0500.

Scan-Optics, Incorporated, 22 Prestige Park Road, East Hartford, Connecticut 06108. Telephone (203) 289-6001.

Terminal Communications, Incorporated, Box 27228, Raleigh, North Carolina 27611. Telephone (919) 834-5251.

True Data Corporation, 17905 Skypark Boulevard, Suite G, Irvine, California 92707. Telephone (714) 979-4842.

UNIVAC Division, Sperry Rand Corporation, Peripheral Sub-Systems, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 646-9000.

Westinghouse Learning Corporation, Data Processing Systems, P.O. Box 30, Iowa City, Iowa 52240. Telephone (319) 356-3011.

Wyle Computer Products, Incorporated, 128 Maryland Street, El Segundo, California 90245. Telephone (213) 322-1763. □

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MANUFACTURER & MODEL	ACME Visible Records 711	ACME Visible Records 711/ES	Addressograph-Multigraph Corp. 9630/31	Addressograph-Multigraph Corp. 9633	Addressograph-Multigraph Corp. 9637
APPLICATION					
Media	80-column cards	80-column cards	80-column cards	80-column cards	80-column cards
Data form	Marks/holes	Marks/holes	Bar code, marks	Bar code, marks	Bar code, marks
Use	On- or off-line, terminal	On- or off-line, terminal	Off-line	Off-line	Off-line
DOCUMENT HANDLING					
Minimum size, inches	3.25 x 4.875	3.25 x 4.875	3.25 x 7.375	3.25 x 7.375	3.25 x 7.375
Maximum size, inches	3.25 x 11	3.25 x 11	3.25 x 7.375	3.25 x 7.375	3.25 x 7.375
Weight	Card stock	Card stock	Card stock	Card stock	Card stock
Feed technique	Friction	Friction	Drive rollers	Drive rollers	Drive rollers
Transport method	Drive rollers	Drive rollers	Drive rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	Up to 132	Up to 132	60 bar codes and 40 marks	60 bar codes and 40 marks	60 bar codes and 40 marks
Lines per inch	–	–	–	–	–
Lines per pass	–	–	1	2	2
Field selection	Timing marks	Internal program	External	External	External
Editing and formatting	None	Internal program	None	Internal	Internal
RECOGNITION					
Font or code styles read	Marks, holes; Hollerith or binary	Marks, holes; Hollerith or binary	AM Bar Code; hand-made marks	AM Bar Code; hand-made marks	AM Bar Code; hand-made marks
Character set	Full ASCII, EBCDIC, BCD, binary image	Full ASCII, EBCDIC, BCD, binary image	0-9	0-9	0-9
Scanning technique	Phototransistors	Phototransistors	Photocells	Photocells	Photocells
Character recognition technique	None	None	None	None	None
OUTPUT					
Magnetic tape	7- and 9-track; 200-1600 bpi	7- and 9-track; 200-1600 bpi	–	–	–
Punched cards	80- or 96-column	80- or 96-column	–	96-column	80-column
Punched tape	7- or 8-level	7- or 8-level	8-level	–	–
Communications lines	110 to 1200 bps	110 to 1200 bps	10 char/sec	–	–
Computer	IBM System/3, 360, 370, and others	IBM System/3, 360, 370, and others	–	–	–
PERFORMANCE					
Documents per minute	300	300	100	100	100
Lines per minute	–	–	–	–	–
Characters per second	1000	1000	–	–	–
ERROR CONTROL					
Automatic rescan	No	No	No	No	No
Reject pocket	No	Yes	Yes	Yes	Yes
On-line manual correction	No	No	Yes	Yes	Yes
TYPICAL PURCHASE PRICE, $	3,000 to 6,000	9,000 to 12,000	19,600	19,600	19,600
TYPICAL MONTHLY RENTAL, $	100 to 300	180 to 360	665	621	621
FIRST DELIVERY	NA	NA	Jan. 1971	Oct. 1972	March 1972
NUMBER INSTALLED TO DATE	80	NA	25	10	8
COMMENTS	Interfaces Teletype 33 & 35 or keypunch; reads both sides; sorts to up to 7 pockets	Interfaces Teletype 33 & 35 or keypunch; reads both sides; sorts to up to 7 pockets	Interfaces Teletype Model 33 ASR	Interfaces IBM 5496 Card Punch	Interfaces UNIVAC 1701 or 1710 Card Punch

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MANUFACTURER & MODEL	Addressograph-Multigraph Corp. 9639	Bell and Howell MDR	Bourns Management Systems Standard Reader	Bourns Management Systems Reader/Sorter	Bridge Data 8022
APPLICATION					
Media	80-column cards	Documents, cards	Cards	Cards	Cards
Data form	Bar code, marks	Marks, punches	Marks, punches	Marks, punches	Marks, holes
Use	Off-line	On-or off-line, terminal	On- or off-line	On- or off-line	On- or off-line
DOCUMENT HANDLING					
Minimum size, inches	3.25 x 7.375	3.25 x 4.852	3.25 x 4.625	3.25 x 7.375	7.375 x 3.25
Maximum size, inches	3.25 x 7.375	3.25 x unlimited	3.25 x 14.0	3.25 x 7.375	7.375 x 3.25
Weight	Card stock	Card stock	Card stock	Card stock	Card stock
Feed technique	Drive rollers	Friction	Friction	Friction	Friction
Transport method	Drive rollers	Drive rollers	Drive rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	60 bar codes and 40 marks	60 marks or 80 punches	Up to 160 marks or 80 punches	Up to 160 marks or 80 punches	Up to 80
Lines per inch	–	–	–	–	4
Lines per pass	2	1	–	–	12
Field selection	External	None	–	Internal program	Timing marks
Editing and formatting	Internal	None	None	Internal program	–
RECOGNITION					
Font or code styles read	AM Bar Code; hand-made marks	Hollerith or binary	Marks, punches, line printer marks; Hollerith or binary	Marks, punches, line printer marks; Hollerith or binary	Marks, holes
Character set	0-9	Alphanumeric	Alphanumeric & special char.	Alphanumeric & special char.	Alphanumeric
Scanning technique	Photocells	Photodiodes	Photo array	Photo array	Photocells
Character recognition technique	None	None	None	None	None
OUTPUT					
Magnetic tape	–	7- or 9-track; 200, 556, or 800 bpi	7- or 9-track; 200, 556, 800, or 1600 bpi	7- or 9-track; 200, 556, 800, or 1600 bpi	–
Punched cards	80-column	80-column	80-column	80-column	–
Punched tape	–	8-level	5- to 8-level	5- to 8-level	–
Communication lines	–	110 to 1200 bps	110 to 2400 bps	110 to 2400 bps	2400 bps
Computer	–	–	Custom—synch or bisynch	Custom—synch or bisynch	–
PERFORMANCE					
Documents per minute	100	8 to 200	Up to 300	Up to 300	200
Lines per minute	–	–	Up to 300	Up to 300	–
Characters per second	–	10 to 180	Up to 240	Up to 240	Up to 575
ERROR CONTROL					
Automatic rescan	No	No	Yes	Yes	No
Reject pocket	Yes	No	No	Yes	No
On-line manual correction	Yes	No	Yes	Yes	No
TYPICAL PURCHASE PRICE, $	19,600	4,000 to 5,700	From 2,000	From 7,000	3,500
TYPICAL MONTHLY RENTAL, $	621	136 to 194	From 70	From 250	–
FIRST DELIVERY	Jan. 1971	1967	Jan. 1972	March 1973	Sept. 1973
NUMBER INSTALLED TO DATE	68	NA	170	50	NA
COMMENTS	Interfaces IBM 29 Card Punch	Many models; see Report 70D-092-01 for details	Double-side read error detection; switch-selectable transmission rates; optional output language.	Same features as Standard Reader; unit is programmable; software is tailored to user's applications	Reads both marks and holes in a single pass; standard interface is RS-232D

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MANUFACTURER & MODEL	Bridge Data 8025	Bridge Data 8035	Bridge Data 8045	Bridge Data 8065	Burroughs Corp. B 9134–1
APPLICATION					
Media	Cards	Cards	Cards	Cards	Documents
Data form	Marks, holes	Marks, holes	Marks, holes	Marks, holes	Characters
Use	On- or off-line	On- or off-line	On- or off-line	On- or off-line	On-line
DOCUMENT HANDLING					
Minimum size, inches	7.375 x 3.25	2.125 x 3.25	2.125 x 3.25	2.125 x 3.25	5.94 x 2.69
Maximum size, inches	7.375 x 3.25	7.375 x 3.25	7.375 x 3.25	7.375 x 3.25	9.06 x 4.06
Weight	Card stock	Card stock	Card stock	Card stock	–
Feed technique	Friction	Friction	Friction	Friction	Friction
Transport method	Drive rollers	Drive rollers	Drive rollers	Drive rollers	Conveyor belt and rollers
INPUT					
Characters per line	Up to 80	Up to 80	Up to 80	Up to 80	1 to 85
Lines per inch	4	4	4	4	2
Lines per pass	12	12	12	12	1 or 2
Field selection	Timing marks	Timing marks	Timing marks	Timing marks	Combination
Editing and formatting	–	–	–	–	Combination
RECOGNITION					
Font or code styles read	Marks, holes	Marks, holes	Marks, holes	Marks, holes	OCR A (also MICR Font E-13B)
Character set	Alphanumeric	Alphanumeric	Alphanumeric	Alphanumeric	0-9 plus 4 or 5 symbols
Scanning	Photo cells	Photo cells	Photo cells	Photo cells	Self-Scan
Character recognition technique	None	None	None	None	Feature identification
OUTPUT					
Magnetic tape	–	–	–	–	–
Punched cards	–	–	–	–	–
Punched tape	–	–	–	–	–
Communications lines	–	4800 bps	7200 bps	9600 bps	–
Computer	Parallel output	Parallel output	Parallel output	Parallel output	B 1700/2500/ 2700/3500/ 3700/4700
PERFORMANCE					
Documents per minute	200	Up to 300	Up to 450	Up to 600	1625 max.
Lines per minute	–	–	–	–	–
Characters per second	Up to 575	Up to 575	Up to 1010	Up to 1550	3000
ERROR CONTROL					
Automatic rescan	No	No	No	No	No
Reject pocket	No	No	No	No	Yes
On-line manual correction	No	No	No	No	No
TYPICAL PURCHASE PRICE, $	2,800	2,950	3,180	3,400	103,000 to 220,000
TYPICAL MONTHLY RENTAL, $	–	–	–	–	2,300 to 4,000
FIRST DELIVERY	Sept. 1973	Aug. 1972	Aug. 1972	Aug. 1972	1973
NUMBER INSTALLED TO DATE	NA	NA	NA	NA	NA
COMMENTS	Reads both marks and holes in a single pass	Reads both marks and holes in a single pass; card rates are stated for demand operation; continuous operation results in higher card rates	Same as Model 8035	Same as Model 8035	OCR and MICR documents can be intermixed; can be used off-line for sorting; 4 to 32 sorter pockets

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MANUFACTURER & MODEL	Chatsworth Data Corp. 1500	Chatsworth Data Corp. 3000 Series	Cincinnati Time Recorder 90 Series Tape Scanner	Cognitronics Corp. System/70	CompuScan Inc. Model 170
APPLICATION					
Media	Cards	Documents	Paper tape	Documents, pages, journal tape	Documents
Data form	Marks	Marks, punches	Bar code	Characters	Characters, marks
Use	On-line	On-line terminal	Off-line	Off-line	On- or off-line
DOCUMENT HANDLING					
Minimum size, inches	7.375 x 3.25	3.25 x 7.375	1" paper tape	4 x 3.25	5 x 7
Maximum size, inches	7.375 x 3.25	3.25 x 14.75	–	8.5 to unlimited	11 x 14
Weight	Card stock	Card stock	–	20# to card stock	20 # to card stock
Feed technique	Friction	Friction	Friction	Friction	Vacuum
Transport method	Drive rollers	Drive rollers	Drive rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	80-column	1	–	Up to 38 (hand print) or 76	0 to 100
Lines per inch	–	12	–	6 max.	1,2,2.5,3,4,5,6
Lines per pass	–	80 to 160	–	Unlimited	All
Field selection	Internal	None	–	Internal program	Internal program
Editing and formatting	Internal	None	External program	Internal program	Internal program.
RECOGNITION					
Font or code styles read	Marks	Marks	Bar code	OCR A & B, Courier 12, 1403, 1428, 7B, 12F, handprint	OCR A, OCR B, Printing and Publishing #199 (Perry), IBM Courier 12
Character set	Reads binary	Alphanumeric	0-9 plus EOM mark	Alphanumeric upper and lower case (OCR A & B and Courier 12); numeric and special symbols	Upper and lower case alpha-numeric and symbols
Scanning technique	Phototransistors	Phototransistors	Photocell	Laser	Phototransistors
Character recognition technique	None	None	Decoding matrix	Topological and matrix matching	Matrix matching
OUTPUT					
Magnetic tape	–	7- or 9-track; 200 to 1600 bpi	7- or 9-track, 800 bpi	7- or 9-track; 556, 800, or 1600 bpi	7- or 9-track
Punched cards	80-column	80-column	80- & 96-column	–	80-column
Punched tape	–	5- to 8-level	No	5-level	5- to 8-level
Communications lines	–	Up to 1200 bps	No	Dial network	Optional
Computer	IBM 360, 370, Honeywell 2000	Custom	No	–	Optional
PERFORMANCE					
Documents per minute	1500	Up to 600	–	Up to 100	–
Lines per minute	–	–	–	Up to 300	60
Characters per second	–	–	10-30	125 max. hand-print; 250 max. OCR A	120
ERROR CONTROL					
Automatic rescan	No	No	No	Yes	Yes
Reject pocket	Yes	Optional	No	No	Yes
On-line manual correction	No	No	Yes	Yes	Yes
TYPICAL PURCHASE PRICE, $	75,000	745 to 5,800	4,000 to 5,000	33,600 to 55,000	62,200
TYPICAL MONTHLY RENTAL, $	2,500	100 to 300	–	1,270 to 1,975	–
FIRST DELIVERY	1968	1967	Jan. 1972	Aug. 1970	1971
NUMBER INSTALLED TO DATE	20	Over 500	8	NA	220
COMMENTS	Reads 30-row cards on both sides; formerly produced by Datatrend Corp.	Models include OEM, manual feed, and automatic feed versions; formerly produced by Automata Corp.	Parity and length of message checks are standard	ROCR service available using same equipment; transmission between two System/70's is possible	Designed for text processing

All About Optical Readers

MANUFACTURER & MODEL	CompuScan Inc. ALPHA	Computer Entry Systems Corp. 7100	Computer Identics Corp. IDENTIC Scanner	Computer Identics Corp. IDENTIC Lightpen	Control Data Corp. 915
APPLICATION					
Media	Documents, pages	Documents	Goods in process	Goods in process	Documents, pages
Data form	Characters, marks	Characters	Bar code	Bar code	Characters
Use	On- or off-line	Off-line	On-line	On- or off-line	Off-line
DOCUMENT HANDLING					
Minimum size, inches	3 x 5	3 x 2	Preprinted labels on packages	Labels/tickets on goods	2.75 x 4.25
Maximum size, inches	14 x 50	9 x 6			12 x 4
Weight	20# to card stock	20# to 36#	–	–	18# to 38#
Feed Technique	Vacuum	–	–	–	Vacuum
Transport method	Drive rollers	Drive rollers	–	–	Conveyor belt
INPUT					
Characters per line	0 to 120	1 to 85	4 digits/inch of bar code	8 digits/inch of bar code	110 max.
Lines per inch	5	3	–	–	6 max.
Lines per pass	All	1	–	–	78 max.
Field selection	Internal	External	–	–	Internal program
Editing and formatting	Internal	External	–	–	Internal program
RECOGNITION					
Font or code styles read	Printing & publishing 199, IBM Courier 12	OCR A, 1428	Binary, BCD, 2-or-5 bar codes	2-or-5 bar codes	OCR A, hand printing
Character set	Upper- & lower-case alpha-numerics & specials	0-9, 6 letters plus 4 special symbols	0-9	0-9	Alphanumeric
Scanning technique	Photocells	–	Flying spot	Photodiodes	Photocells
Character recognition technique	Matrix matching	Matrix	Scan comparison & matching	None	Matrix matching
OUTPUT					
Magnetic tape	7- or 9-track	Reader only	Thru interface	–	7- or 9-track; 200, 556, or 800 bpi
Punched cards	80-column	–	Thru interface	Thru interface	Optional
Punched tape	5- to 8-level	–	Thru interface	Thru interface	Optional
Communications lines	Optional	–	Thru interface	Thru interface	–
Computer	–	–	Parallel or serial to any computer	Parallel or serial to any computer	CDC 3000, 1700/ SC1700, 8090, 8092
PERFORMANCE					
Documents per minute	Up to 100	Hand–30; auto–60	Conveyor line speed of 600 fpm+	60-70 labels	8 (8.5 x 11)
Lines per minute	120 (30 char/line)	30/60	–		–
Characters per second	60	100	–		370
ERROR CONTROL					
Automatic rescan	Yes	No	Yes	No	Yes
Reject pocket	No	Yes	Available	–	Yes
On-line manual correction	Yes	Thru external device	NA	Keyboard	No
TYPICAL PURCHASE PRICE, $	30,000	5,500 in quantity of 100	10,000 to 12,000	3,000 to 4,000	50,425
TYPICAL MONTHLY RENTAL, $	–	NA	NA	NA	1,365
FIRST DELIVERY	1973	Sept. 1972	NA	NA	1965
NUMBER INSTALLED TO DATE	4	70	200	NA	200
COMMENTS	Designed for text processing	Marketed as OEM product; manual switching between 2 fonts	Used as remote data collection device in real-time systems	Reads product identification codes on labels or tickets attached to goods in process or shelves	Can handle continuous forms; standard line marker

All About Optical Readers

MANUFACTURER & MODEL	Control Data Corp. 921	Control Data Corp. 955	Cummins-Allison Scanak 216	Cummins-Allison Scanak 229	Cummins-Allison 4400 KeyScan
APPLICATION					
Media	Documents	Documents, pages journal tape	Documents	Documents	Documents
Data form	Characters, marks	Characters	Bar code, marks perforations	Marks, perforations	Chars, marks, bars, perforations
Use	Off-line	Off-line	Off-line	Off-line	Off-line
DOCUMENT HANDLING					
Minimum size, inches	2.6 x 4.5	3.25 x 4.75	2.8 x 1.3	1.45 x 1.33	2.8 x 1.3
Maximum size, inches	4.5 x 8.5	11 x 12.5	8.75 x 4.0	3.22 x 1.33	8.75 x 4.25
Weight	20# to 38#	18# to 38#	20# to card stock	Card stock	20# to card stock
Feed technique	Vacuum	Vacuum	Friction	Sprocket	Friction
Transport method	Vacuum drum	Conveyor belt	Drive rollers	Conveyor	Drive rollers
INPUT					
Characters per line	80 max.	100 max.	1 to 81	1 to 28	1 to 81
Lines per inch	–	6	–	–	–
Lines per pass	1	60 max.	1	1	1
Field selection	Internal program	Internal program	Plugboard	Rotary switches	Internal program
Editing and formatting	Internal program	Internal program	None	None	Internal program
RECOGNITION					
Font or code styles read	OCR A, OCR C, ISO B, 7B, 12F, E-13B, 407-1, 1428	OCR A, OCR C, 1428, 1403, 7B, 12 F, E-13B, ISO B, hand printing	AM Bar Code; perforated numbers; special "1's" code; Hollerith	Dennison perforations; special "1's" code	OCR A, 1403, 7B, E13B, AM Bar Code, Hollerith, perforated code
Character set	Alphanumeric	Alphanumeric; lower case OCR A optional	Alphanumeric (Hollerith); numeric (all others)	Numeric	Alphanumeric (Hollerith); 0-9 plus 5 special chars. (all others)
Scanning technique	Laser/mirror	Photocells	Photocells	Photocells	Self-scanning array
Character recognition technique	Matrix matching	Matrix matching	None	None	Matrix matching
OUTPUT					
Magnetic tape	7- or 9-track; 200, 556 or 800 bpi	7- or 9-track; 200, 556, or 800 bpi	7- or 9-track; 200 or 800 bpi	7- or 9-track; 200 or 800 bpi	7-track, 200, 556, 800 bpi; 9-track, 800, 1600 bpi
Punched cards	–	Optional	Optional	80-column	RPQ
Punched tape	–	Optional	Optional	–	RPQ
Communications lines	–	–	Optional	Optional	Up to 9600 bps
Computer	CDC 8092	CDC SC1700/ 1700	–	–	–
PERFORMANCE					
Documents per minute	1200	15 (8.5 x 11) to 300	550 max.	100 to 500	–
Lines per minute	–	–	–	–	585
Characters per second	1547 or 2210	750	–	–	–
ERROR CONTROL					
Automatic rescan	Yes	Yes	No	No	No
Reject pocket	Yes	Yes	Yes	Yes	Yes
On-line manual correction	No	Optional	Yes	Yes	Yes
TYPICAL PURCHASE PRICE, $	28,500	115,350	40,000 to 65,000	20,750 to 45,500	85,000 to 185,000
TYPICAL MONTHLY RENTAL, $	920	2,510	1,200 to 2,000	300 to 1,100	2,000 to 4,500
FIRST DELIVERY	1971	1970	1967	1962	Jan. 1973
NUMBER INSTALLED TO DATE	40	40	130	75	NA
COMMENTS		Optional line marker and serial numbering device	"1's" code is effectively a bar code adapted for printing by computer printer; many models have various combinations of features		System includes CRT key entry stations for independent manual data entry

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MANUFACTURER & MODEL	Data Recognition ADES-1	Data Recognition Model 700	Datatype Corp. DF12-300	Datatype Corp. Entry 1, 2	Datatype Corp. SETYPE II
APPLICATION					
Media	Documents	Documents	Pages	Pages	Pages
Data form	OCR	Characters	Binary bar code	Binary bar code	Binary bar code
Use	Off-line	Off-line	On- or off-line terminal	On- or off-line	On- or off-line
DOCUMENT HANDLING					
Minimum size, inches	4.75 x 2.75	3 x 4.5	8.5 x 11	8.5 x 11	8.5 x 11
Maximum size, inches	8.75 x 4.25	3.67 x 8.5	8.5 x 11	8.5 x 11	8.5 x 11
Weight	20 # to 120 #	24# to 100#	Special forms	Special forms	Special forms
Feed technique	Friction	Vacuum	Friction	Friction	Friction
Transport method	Belt and rollers	Drive belt	Drive rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	1 to 82	Up to 43	0 to 70	0 to 70	0 to 70
Lines per inch	3	–	Up to 6	Up to 6	Up to 6
Lines per pass	6	2	All	All	All
Field selection	Minicomputer program	Prewired	None	Internal program	None
Editing and formatting	Minicomputer program	Internal	External program	Internal program	Internal program
RECOGNITION					
Font or code styles read	7B, OCR A, 1428A, OCR A/ 1428A, 1403, E-13B (optical or magnetic)	7B, 1428B	Font consists of binary bar code under each character; typed with DF-3 OCR Selectric typing element		
Character set	Varies with font	0-9	Alphanumeric, upper and lower case.		
Scanning technique	Self-scanning diode arrays	Solid state	Phototransistors	Phototransistors	Phototransistors
Character recognition technique	Stroke analysis & curve tracing	Stroke analysis	None	None	None
OUTPUT					
Magnetic tape	9-track; see comments	–	–	7- or 9-track; 556 or 800 bpi	–
Punched cards	–	–	–	–	–
Punched tape	–	–	–	5- to 8-level	6-level TTS
Communications lines	–	–	1200 bps	–	–
Computer	–	–	–	Data General Nova	MCS4
PERFORMANCE					
Documents per minute	85 to 167	67	1.3 (full)	1.3 (full)	1.3 (full)
Lines per minute	NA	–	34	34	34
Characters per second	40 handprinted or 250 computer-printed	–	60	60	60
ERROR CONTROL					
Automatic rescan	Yes	Yes	No	Yes	Yes
Reject pocket	Yes	Yes	Yes	Yes	Yes
On-line manual correction	Yes	No	–	Optional	Optional
TYPICAL PURCHASE PRICE, $	72,500+	80,000	15,500	20,120 to 42,200	22,500
TYPICAL MONTHLY RENTAL, $	1,486+	1,700 to 2,200	Lease/purchase	Lease/purchase	Lease/purchase
FIRST DELIVERY	May 1973	Oct. 1970	Sept. 1970	Feb. 1971	May 1973
NUMBER INSTALLED TO DATE	6	17	50	30	22
COMMENTS	Also outputs to IBM 3740-compatible diskette; performs field editing for additional error control	Output is MICR-encoded data at bottom of document read		Entry 2 system includes Data General Nova minicomputer; editing and formatting provided by FORMATEX program	System includes DEC PDP-16 minicomputer for code conversion and typewriter keyboard extension in typesetting application

All About Optical Readers

MANUFACTURER & MODEL	Datum, Inc. 5098 OMR	Decicom DCS-1000	Decicom DCS-5000	Decicom DCS-8000	Decision, Inc. OMR 6500
APPLICATION					
Media	Documents	22-column badges	80-column cards or 22-col badges	80-column cards or 22-col badges	Documents, pages
Data form	Marks	Hollerith	Hollerith	Hollerith	Marks, block print
Use	Terminal	On- or off-line, terminal	On- or off-line, terminal	Off-line, terminal	On- or off-line
DOCUMENT HANDLING					
Minimum size, inches	2 x 2	3.250 x 2.343	3.250 x 2.343	3.250 x 2.340	3 x 3
Maximum size, inches	8.5 x 11	—	3.250 x 7.375	3.250 x 7.375	9.5 x 14
Weight	60#	Card stock or plastic	Card stock or plastic	Card stock or plastic	20# to card stock
Feed technique	Friction	Manual	Manual	Manual	Friction
Transport method	Drive rollers	—	—	—	Friction
INPUT					
Characters per line	1 to 13	Up to 22	Up to 80	Up to 80	1 to 96 marks
Lines per inch	1 to 6	—	—	—	1 to 6
Lines per pass	1 to 64	—	—	—	1 to 64
Field selection	Internal	Internal program	Internal program	Internal program	External program
Editing and formatting	Internal	Internal program	Internal program and keyboard	Internal program	External program
RECOGNITION					
Font or code styles read	Marks	Hollerith	Hollerith	Hollerith	Marks, block print
Character set	ASC II	0-9	0-9	0-9	0-9 (block print); binary image (marks)
Scanning technique	Photocells	Photocells	Photocells	Photocells	Photodiodes
Character recognition technique	None	None	None	None	None
OUTPUT					
Magnetic tape	—	7-track, 200 bpi; 9-track, 800 bpi	7-track, 200 bpi; 9-track, 800 bpi	See Comments	9-track, 800 bpi
Punched cards	—				—
Punched tape	—	8-level	8-level	—	—
Communications lines	110 to 9600 bps	300 bps	300 bps	—	110 to 4800 bps
Computer	—	—	—	—	—
PERFORMANCE					
Documents per minute	60	—	—	—	5 to 15
Lines per minute	3840	—	—	—	30 to 250
Characters per second	800	60	60	60	—
ERROR CONTROL					
Automatic rescan	Auto retransm.	Yes	Yes	Yes	Yes
Reject pocket	—				Yes
On-line manual correction	—	No	Yes	No	Yes
TYPICAL PURCHASE PRICE, $	1,995	800 to 1,200	2,800 to 3,500	2,900 to 3,700	4,600
TYPICAL MONTHLY RENTAL, $	—	—	—	—	—
FIRST DELIVERY	April 1973	1970	1970	1970	February 1972
NUMBER INSTALLED TO DATE	20	—	—	—	NA
COMMENTS	Unit will retransmit on request without need to rescan document	Fail-safe sensor and light source monitoring	Fail-safe sensor and light source monitoring	Includes self-contained cassette tape recorder; fail-safe monitoring	Reads 4 formats; In on-line environments, scanner is under computer control

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MANUFACTURER & MODEL	Decision, Inc. OCR 7600	Dest Data Corp. OCR/COMP	Dest Data Corp. OCR/FAX	Dest Data Corp. OCR/EDP	Documation Inc. OD Series
APPLICATION					
Media	Pages, documents	Pages	Pages	Documents, pages	80-column cards
Data form	Characters, marks	Characters, marks	Characters, any	Characters, any	Marks, holes
Use	On- or off-line	On- or off-line	On- or off-line	On- or off line	On-line terminal
DOCUMENT HANDLING					
Minimum size, inches	3 x 5	8.5 x 11	Any	3 x 5	3.25 x 7.375
Maximum size, inches	9 x 14	8.5 x 11	8.5 x 14	8.5 x 14	3.25 x 7.375
Weight	20# to card stock	18# to 24#	Any (books or bound documents)	12# to card stock	Card stock
Feed technique	Friction	–	–	–	Friction
Transport method	Conveyor belt	Optional	Optional	Optional	Drive rollers
INPUT					
Characters per line	Up to 80	Up to 80	Up to 80	Up to 80	Up to 80
Lines per inch	6 max.	Up to 6	Up to 6	Up to 6	–
Lines per pass	Up to full page	Up to 64	All	Optional	–
Field selection	Internal program	Internal program	Full page	Internal program	–
Editing and formatting	Internal program	Optional (text editing terminal)	Optional (display and keyboard)	Optional (display and keyboard)	
RECOGNITION					
Font or code styles read	OCR A, OCR B, 3/16" Gothic, handprinting; also custom fonts	Courier 12, OCR A, OCR B, Perry; others optional	Courier 12, OCR A, OCR B, Perry; others optional	Courier 12, OCR A, OCR B, Perry; others optional	Marks, holes
Character set	Alphanumeric A & B; 0-9 and X for handprint; others custom	Full alphanumeric with symbols (up to 3 fonts resident)	Full alphanumeric with symbols (up to 3 fonts resident)	Full alphanumeric with symbols (up to 3 fonts resident)	Full ASCII, EBCDIC, compressed Hollerith
Scanning technique	Self-scanned linear array	–	–	–	Fiber optics
Character recognition technique	Feature analysis	Proprietary	Proprietary	Proprietary	Phototransistors
OUTPUT					
Magnetic tape	9-track; 800 or 1600 bpi	Optional	Optional	Optional	–
Punched cards	–	–	–	Optional	–
Punched tape	5, 7- or 8-level	Optional	Optional	Optional	–
Communications lines	110 to 9600 bps	Optional	2400 to 40,800 bps	Optional	110 to 9600 bps
Computer	Any with RS-232C port; others custom	Interface for text editing terminal	OCR/FAX communications receive printer	Optional	–
PERFORMANCE					
Documents per minute	9 to 85	–	–	–	150
Lines per minute	300	750	750	750	–
Characters per second	600	1000	1000	1000	–
ERROR CONTROL					
Automatic rescan	Yes	Optional	Optional	Optional	Retransmit
Reject pocket	Yes	No	No	No	No
On-line manual correction	Yes	Yes	Yes	Yes	No
TYPICAL PURCHASE PRICE, $	30,000 to 80,000	29,900 (OEM prices on request)	32,700 to 47,500	45,100 (OEM prices on request)	1,900 OEM
TYPICAL MONTHLY RENTAL, $	–	–	–	–	–
FIRST DELIVERY	Jan. 1974	April 1974	April 1974	April 1974	1972
NUMBER INSTALLED TO DATE	NA	0	0	0	60
COMMENTS	Multifont capability available; custom fonts and operating characteristics available to OEM buyers	Designed for use in text editing systems; manual switching among up to 3 fonts	Combined OCR and facsimile communications system; manual switching among up to 3 fonts	Combined OCR and mark sensing reader for EDP systems	Handles damaged cards effectively

All About Optical Readers

MANUFACTURER & MODEL	Documation Inc. OM Series	Documation Inc. TM Series	EAI MR 300	ECRM, Inc. Autoreader 700	ECRM, Inc. Autoreader 1200
APPLICATION					
Media	80-column cards	80-column cards	Cards	Pages	Pages
Data form	Marks, holes	Marks, holes	Marks	Characters	Characters
Use	On-line terminal	On-line terminal	Off-line	Off-line or on-line terminal	Off-line or on-line terminal
DOCUMENT HANDLING					
Minimum size, inches	3.25 x 7.375	3.25 x 7.375	3.25 x 7.375	85 x 6	8.5 x 6
Maximum size, inches	3.25 x 7.375	3.25 x 7.375	3.25 x 7.375	8.5 x 48	8.5 x 48
Weight	Card stock	Card stock	Card stock	16# to 24#	16# to 24#
Feed technique	Vacuum	Vacuum	Vacuum	Friction	Friction
Transport method	Drive roller	Drive roller	Drive rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	Up to 80	Up to 80	40 columns	0 to 75	0 to 75
Lines per inch	–	–	–	Up to 6	Up to 6
Lines per pass	–	–	–	All	All
Field selection	Internal program	Internal program	None	Internal program, control sheet	Internal program, control sheet
Editing and formatting	–	–	None	Context controlled via internal program	Internal program, context controlled
RECOGNITION					
Font or code styles read	Marks, holes	Marks, holes	Marks	Courier 12, OCR A	Courier 12, OCR A
Character set	Full ASCII, EBCDIC, compressed Hollerith	Full ASCII, EBCDIC, compressed Hollerith	Alphanumeric	Full upper/lower alphanumerics, special symbols	Full upper/lower alphanumerics, special symbols
Scanning technique	Fiber optics	Fiber optics	Phototransistor	Fixed vidicons	Fixed vidicons
Character recognition technique	Phototransistors	Phototransistors	None	Feature analysis	Feature analysis
OUTPUT					
Magnetic tape	–	–	–	7- or 9-track; 800/1600 bpi	9-track, 800/1600 bpi
Punched cards	–	–	80-column	–	–
Puched tape	–	–	–	5- to 8-level	5- to 8-level
Communications lines	110 to 9600 bps	110 to 9600 bps	–	Optional	Optional
Computer	–	–	Custom	Internal DEC PDP-8; output optional	Internal DEC PDP-8; output optional
PERFORMANCE					
Documents per minute	285 to 1200	300 to 1200	300	–	–
Lines per minute	–	–	–	–	–
Characters per second	–	–	715	75 (750 words per minute)	133 (1330 words per minute)
ERROR CONTROL					
Automatic rescan	Retransmit	Retransmit	No	No	No
Reject pocket	No	No	No	No	No
On-line manual correction	No	No	No	No	No
TYPICAL PURCHASE PRICE, $	2,800 up OEM	3,545 up OEM	2,800	59,000	65,000
TYPICAL MONTHLY RENTAL, $	–	–	–	–	–
FIRST DELIVERY	1970	1973	1969	Sept. 1970	Sept. 1972
NUMBER INSTALLED TO DATE	225	12	NA	100	60
COMMENTS	Handles damaged cards effectively	Handles damaged cards effectively	Formerly marketed by United Business Communications, Inc.	Reads unformatted copy with hand deletions and typed insertions; extensive copy editing capabilities	Reads unformatted copy with hand deletions and typed insertions; extensive copy editing capabilities

All About Optical Readers

MANUFACTURER & MODEL	ECRM, Inc. Autoreader 1800	Hewlett-Packard 7260A	Hewlett-Packard 7261A	Hewlett-Packard 9869A	Honeywell DRD 200
APPLICATION					
Media	Pages	Cards, forms	Cards, forms	Cards, forms	Documents
Data form	Characters	Marks, punches	Marks, punches	Marks, punches	Bar-coded characters
Use	Off-line or on-line terminal	On-line, terminal, off-line	On-line	Input to HP calculator	On-line
DOCUMENT HANDLING					
Minimum size, inches	8.5 x 6	7.375 x 3.25	7.395 x 3.25	3.25 x 7.375	2.75 x 4
Maximum size, inches	8.5 x 48	11.125 x 3.25	11.125 x 3.25	11.125 x 3.75	3.85 x 8
Weight	16# to 24#	Card stock	Card stock	Card stock	20# to card stock
Feed technique	Friction	Friction	Friction	Friction	Friction plus vacuum
Transport method	Drive rollers	Drive rollers	Drive rollers	Drive rollers	Belt
INPUT					
Characters per line	0 to 75	Up to 96	Up to 96	Up to 96	50 max.
Lines per inch	up to 6	–	–	–	6 max.
Lines per pass	All	–	–	–	1
Field selection	Internal program, control sheet	–	–	–	External program
Editing and formatting	Internal program, context controlled	None	None	None	External program
RECOGNITION					
Font or code styles read	Courier 12, OCR A	Marks, punches	Marks, punches	Marks, punches	COC-5 (composed of bar-coded characters which are directly readable by humans)
Character set	Full upper/lower alphanumerics, normal punctuation & special symbols	128 ASCII characters, binary	Binary	ASCII	0-9 plus 1 symbol
Scanning technique	Fixed vidicons	Photocells	Photocells	Phototransistors	Photocells
Character recognition technique	Feature analysis	None	None	None	Bar width analysis
OUTPUT					
Magnetic tape	7- or 9-track; 800/1600 bpi	–	–	–	–
Punched cards	–	–	–	–	–
Punched tapes	5- to 8-level	–	–	–	–
Communications lines	Optional	110 to 2400 bps			
Computer	Internal DEC PDP-8; output optional	IBM 360/370, UNIVAC Series 70, others	–	HP calculator	Honeywell 400, 6000 Series
PERFORMANCE					
Documents per minute	–	300	300	300	1,200
Lines per minute	–	–	–	–	–
Characters per second	180 (1800 words per minute)	–	–	–	2400
ERROR CONTROL					
Automatic rescan	No	Yes	No	Yes	No
Reject pocket	No	Yes	Yes	Yes	No
On-line manual correction	No	No	No	No	No
TYPICAL PURCHASE PRICE, $	65,000	2,975	2,575	2,775	51,900
TYPICAL MONTHLY RENTAL, $	–	200	–	–	1,273 to 1,419
FIRST DELIVERY	Jan. 1974	1973	1973	1973	1967
NUMBER INSTALLED TO DATE	NA	NA	NA	NA	NA
COMMENTS	Reads unformatted copy with hand deletions and typed insertions; extensive copy editing capabilities				2 output stackers

All About Optical Readers

MANUFACTURER & MODEL	Honeywell 243	IBM 1231	IBM 1232	IBM 1282	IBM 1287
APPLICATION					
Media	Documents	Pages	Pages	Tab cards	Documents
Data form	Chars., marks	Marks	Marks	Chars., marks	Characters
Use	On-line	On-line	Off-line	Off-line	On-line
DOCUMENT HANDLING					
Minimum size, inches	3.0 x 3.5	8.5 x 11	8.5 x 11	51-col. cards	2.25 x 3
Maximum size, inches	4.0 x 8.0	8.5 x 11	8.5 x 11	80-col. cards	5.91 x 9
Weight	20# to 100#	20#	20#	Tab card	20# to card stock
Feed technique	Friction	Friction	Friction	Friction	Vacuum
Transport method	Vacuum drum	Drive rollers	Drive rollers	Drive rollers	Conveyor belt
INPUT					
Characters per line	1 to 70	20 marks	20 marks	Up to 51 or 80	85 max.
Lines per inch	–	50/side	50/side	–	6
Lines per pass	1	50	50	1	No limit
Field selection	External program	None	None	Control card	External program
Editing and formatting	External program	None	None	Plugboard	External program
RECOGNITION					
Font or code styles read	OCA A, marks	Marks	Marks	1428, 1428E, 1428ER, 7B	1428, 7B, OCR A, 1428E, NOF, hand printing
Character set	0-9 plus 4 symbols	Reads binary image	Reads binary image	0-9 plus 3 symbols	0-9 and 5 letters (handprinting); full font (others)
Scanning technique	Photocells	Photocells	Photocells	Mechanical disc	Flying spot
Character recognition technique	Stroke analysis	None	None	Matrix matching	Curve tracing
OUTPUT					
Magnetic tape	–	–	–	–	–
Punched cards	–	–	80-column	Same card	–
Punched tape	–	–	–	–	–
Communications lines	–	–	–	–	–
Computer	Honeywell Series 200, 2000	IBM 1130, 1400, or 360	–	–	IBM 360, 370
PERFORMANCE					
Documents per minute	600 to 1100	33 max.	12 to 33	200	–
Lines per minute	–	–	–	–	3200 max.
Characters per second	1000	–	–	–	2000
ERROR CONTROL					
Automatic rescan	No	No	No	Yes	Yes
Reject pocket	Yes	Yes	Yes	Yes	Yes
On-line manual correction	No	No	No	No	Yes
TYPICAL PURCHASE PRICE, $	29,000	22,800 to 30,640	16,000 to 23,400	71,200 to 11,118	124,000 to 271,530
TYPICAL MONTHLY RENTAL, $	1,534 to 2,101	423 to 587	321 to 407	1,530 to 2,378	2,760 to 6,050
FIRST DELIVERY	Nov. 1970	NA	NA	1965	1968
NUMBER INSTALLED TO DATE	NA	NA	NA	NA	NA
COMMENTS					3 output stackers; can read journal tape with option; mark reading optional

All About Optical Readers

MANUFACTURER & MODEL	IBM 1288	IBM 3881	IBM 3886	Identicon 100	Identicon 300
APPLICATION					
Media	Documents, pages	Documents, pages	Documents, pages	Moving objects	Stationary or moving objects
Data form	Characters	Marks	Characters	Bar code	Bar code
Use	On-line	On- or off-line	On- or off-line	Industrial; on- or off-line	Industrial; on- or off-line
DOCUMENT HANDLING				Unrestricted	Unrestricted
Minimum size, inches	3 x 6.5	3 x 3	3 x 3	–	–
Maximum size, inches	9 x 14	9 x 12	9 x 12	–	–
Weight	16# to card stock	20#	20#	–	–
Feed technique	Friction	Friction	Friction	–	–
Transport method	Belt and rollers	Drive rollers	Drive rollers	–	–
INPUT					
Characters per line	Up to 10 char/inch	Up to 40 marks	NA	12 digits	12 digits
Lines per inch	6	Up to 6	NA	–	–
Lines per pass	All	Up to 62	NA	1	1
Field selection	External program	Internal via control sheet	Internal program	External program	External program
Editing and formatting	External program	Internal via control sheet	Internal program	Internal program	Internal program
RECOGNITION					
Font or code styles read	OCR A, hand printing	Marks	OCR A, OCR B, 3/16-inch Gothic, hand pring	2-out-of-5 bar code	2-out-of-5 bar code
Character set	0-9 and 5 letters (handprinting); full font (others)	Reads binary image	Alphanumeric (OCR A,B); numeric (others)	Numeric	Numeric
Scanning technique	Flying spot	Photocells	LED	Moving beam (incandescent)	Wand
Character recognition technique	Curve tracing	None	NA	None	None
OUTPUT					
Magnetic tape	–	9-track, 800 or 1600 bpi	9-track, 800 or 1600 bpi	7- or 9-track	7- or 9-track
Punched cards	–	–	–	–	–
Punched tape	–	–	–	–	–
Communications lines	–	–	–	1200 bps	1200 bps
Computer	IBM 360	IBM 370/135, 145	IBM 370	IBM System/7, DEC PDP-11, and others	IBM System/7, DEC PDP-11, and others
PERFORMANCE					
Documents per minute	444 max.	Up to 100	5 to 97	60	60
Lines per minute	–	–	–	–	–
Characters per second	1000	–	–	–	–
ERROR CONTROL					
Automatic rescan	Yes	No	Yes	Yes	No
Reject pocket	Yes	Yes	Yes	No read signal	–
On-line manual correction	Yes	No	Yes	Optional	Yes
TYPICAL PURCHASE PRICE, $	227,000 to 301,450	52,000 to 70,768	92,000 to 135,471	6,000 to 7,000	2,500 to 3,500
TYPICAL MONTHLY RENTAL, $	4,850 to 6,301	1,248 to 1,691	2,357 to 3,434	Contact vendor	Contact vendor
FIRST DELIVERY	1970	NA	1973	1970	1971
NUMBER INSTALLED TO DATE	NA	NA	NA	100	50
COMMENTS	Can optionally be equipped to read marks	Serial number imprinter optional; up to 6 formats can be stored	Serial number imprinter & error line marking are optional	Finds and reads bar-coded labels on moving objects in production, receiving, and distribution operations	Portable, hand-held pen reader for physical inventory and similar functions

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MANUFACTURER & MODEL	Identicon 400	Identicon Porta Pen	Information International, Inc. GRAFIX I	Input Business Machines RIT 200
APPLICATION				
Media	Moving objects	Stationary and moving objects	Microfilm	Documents
Data form	Bar code	Bar code	Any	Characters, marks
Use	Industrial; on- or off-line	Off-line	Off-line	On- or off-line
DOCUMENT HANDLING	Unrestricted	Unrestricted	See comments	
Minimum size, inches	—	—	—	2.0 x 0.5
Maximum size, inches	—	—	—	8.5 x 11
Weight	—	—	—	Tissue to card
Feed technique	—	—	Film transport	Friction
Transport method	—	—	Film transport	Drive rollers; hand feed
INPUT				
Characters per line	12 digits	15 digits	—	1 to 110
Lines per inch	—	—	—	3
Lines per pass	—	—	—	1
Field selection	External program	—	Internal program	None
Editing and formatting	Internal program	Internal program	Internal program	Reject correction
RECOGNITION				
Font or code styles read	2-out-of-5 bar code	2-out-of-5 bar code	Any font, including full alphanumeric hand print	OCR A, OCR B, 407, E-13B, 12F, mark sense
Character set	Numeric	0-9 plus 3 symbols	Any character set	0-9 plus 5 symbols
Scanning technique	Moving beam (laser)	Wand	CRT	Self-scan diode array
Character recognition technique	None	None	Mix of several	Sequential feature analysis
OUTPUT				
Magnetic tape	7- or 9-track	Magnetic tape cartridge	7 or 9-track, 800 or 1600 bpi	8-bit output
Punched cards	—	—	Yes	—
Punched tape	—	—	Yes	—
Communications lines	1200 bps	600/1200 bps	Yes	—
Computer	IBM System/7, DEC PDP-11, and others	—	DEC PDP-10	—
PERFORMANCE				
Documents per minute	60	60	—	30
Lines per minute	—	—	—	30
Characters per second	—	—	Up to 1000	100
ERROR CONTROL				
Automatic rescan	Yes	No	Yes	No
Reject pocket	No read signals	—	No	No
On-line manual correction	Optional	Yes	Yes	Yes
TYPICAL PURCHASE PRICE, $	7,000 to 8,000	2,600 to 3,200	1.3 to 1.8 million	5,000 to 10,000
TYPICAL MONTHLY RENTAL, $	Contact vendor	Contact vendor	40-50K	—
FIRST DELIVERY	1973	1974	4th quarter 1973	Nov. 1971
NUMBER INSTALLED TO DATE	50	NA	—	25
COMMENTS	Finds and reads bar codes imprinted on moving kraft cartons	Hand-held wand with numeric keyboard	Reads from microfilm; original document size and format restricted by photographic process only	

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MANUFACTURER & MODEL	Input Business Machines OEM Electronics	Laser Computer Corp. System 6000	Laser Computer Corp. System 7000	Lundy-Farrington 7100	Lundy-Farrington 8000
APPLICATION					
Media	Any	Documents, pages	Documents, pages, microfilm	Documents	Pages
Data form	Characters, marks	Characters	Any	Characters, marks	Characters
Use	Any	On- or off-line	On- or off-line	Multipocket sorter; on- or off-line	On- or off-line
DOCUMENT HANDLING					
Minimum size, inches	–	1.25 x 1.25	1.25 x 1.25	5.5 x 2.5	8 x 10
Maximum size, inches	–	11 x 12.5	14 x 17	8.9 x 4.25	9 x 11.75
Weight	–	12# to card stock	12# to card stock	20# to card stock	20# to 24#
Feed technique	–	Vacuum	Vacuum, film	Friction	Adhesive
Transport method	Wand option	Vacuum	Vacuum, film	Belts & rollers	Rollers
INPUT					
Characters per line	Variable	Variable	Variable	Up to 80	Up to 75
Lines per inch	3	Variable	Variable	–	0 to 6
Lines per pass		All	All	1	Up to 62
Field selection	External control	Internal program	Internal/external program	CPU program	Manual switches or CPU program
Editing and formatting		Internal program	Internal/external program	CPU program	Manual switches or CPU program
RECOGNITION					
Font or code styles read	OCR A, OCR B, 407, E-13B, 12F, 7B, handprint, mark sense	Any, including OCR A & B, handprint, signatures	Any, including image storage	OCR A, OCR B, mark sense	OCR A, OCR B, numeric hand printing
Character set	0-9 plus 5 symbols per font	Any	Any	0-9 plus 6 alpha or special symbols	Alphanumeric plus special symbols
Scanning technique	Self-scan diode array	Laser/photocells	Laser/hologram	Self-scan array	Self-scan array
Character recognition technique	Sequential feature analysis	Topographical, holographical	Topographical, holographical	Template matching	Template matching, feature analysis
OUTPUT					
Magnetic tape	8-bit output	7- or 9-track; 200 to 1600 bpi	7- or 9-track	7- or 9-track; 556, 800, 1600 bpi	7- or 9-track; 556, 800, 1600 bpi
Punched cards	–	Yes	Yes	–	–
Punched tape	–	Optional	Optional	–	–
Communications lines	–	–	–	–	–
Computer	–	Any	Laser Computer Corp. LC-100	DEC PDP-11/05	DEC PDP-11/05
PERFORMANCE					
Documents per minute	–	–	3200	600	3 to 10
Lines per minute	–	3500	12,000	–	120
Characters per second	Up to 4000	2000	–	1500	240
ERROR CONTROL					
Automatic rescan	–	Yes	Yes	No	Yes
Reject pocket	–	Yes	No	Multipocket sorter	Yes
On-line manual correction	–	Yes	No	No	Yes
TYPICAL PURCHASE PRICE, $	2,000 to 6,000	48,000 to 98,000	750,000	60,000 to 90,000	45,000 to 60,000
TYPICAL MONTHLY RENTAL, $	–	–	–	1,500 to 2,500	1,000 to 1,500
FIRST DELIVERY	July 1972	NA	1974	2nd qtr. 1974	1972
NUMBER INSTALLED TO DATE	30	NA	NA	0	NA
COMMENTS	Electronics only, for OEM use	Holographic and microfiche image recognition optional		MICR version of this unit has 1000 installations to date	

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MANUFACTURER & MODEL	National Computer Systems Sentry/70 (7010)	National Computer Systems Sentry/70 (7015)	NCR 420-2	OCR Systems, Inc. System 1000 Document Reader	OCR Systems, Inc. System 1000 Page Reader
APPLICATION					
Media	Pages	Pages	Journal tape	Documents	Documents, pages
Data form	Marks	Marks	Characters	Characters, marks	Characters, marks
Use	Off-line	Off-line	Off-line	Off-line	Off-line
DOCUMENT HANDLING					
Minimum size, inches	3 x 7	3 x 7	1.31 x 1 ft.	2.6 x 2.75	4 x 5
Maximum size, inches	11 x 17	11 x 17	3.25 x 130 ft.	8.75 x 5.75	11 x 12
Weight	24#	24#	Std. tape	20# to card	18# to 26#
Feed technique	Friction	Vacuum	Spools	Friction	Friction
Transport method	Drive rollers	Belt	Drive rollers	Vacuum conveyor trap belt	Drive roller, vacuum drum
INPUT					
Characters per line	6 per inch	6 per inch	32 max.	80 max.	105 max.
Lines per inch	6	6	4 max.	3 max.	6 max.
Lines per pass	All	All	Continuous	3 max.	69 max.
Field selection	Internal program	Internal program	Plugboard	Internal program	Internal program
Editing and formatting	Internal program	Internal program	Plugboard	Internal program	Internal program
RECOGNITION					
Font or code styles read	Marks	Marks	NCR NOF	Wide range of OCR, computer, and typewriter styles plus alpha-numeric handprint	Wide range of OCR, computer, and typewriter styles plus alpha-numeric hanprint
Character set	Reads binary image	Reads binary image	0-9 plus 6 symbols	10 to 360 characters from intermixed styles	10 to 360 characters from intermixed styles
Scanning technique	Photocells	Photocells	Mechanical disc	Diode array	Diode array
Character recognition technique	None	None	Matrix matching	Hardware/ software (proprietary)	Hardware/ software (proprietary)
OUTPUT					
Magnetic tape	7- or 9-track; 800 or 1600 bpi	7- or 9-track; 800 or 1600 bpi	7- or 9-track; 200, 556, or 800 bpi	7- or 9-track; up to 1600 bpi	7- or 9-track; up to 1600 bpi
Punched cards	—	—	—	Optional	Optional
Punched tape	—	—	7-level	8-level	8-level
Communications lines	1200 bps	1200 bps	—	Optional	Optional
Computer	Any	Any	NCR Century, IBM 1400, UNIVAC 90 Series	Varian 620F/72	Varian 620F/72
PERFORMANCE					
Documents per minute	50 max.	100 max.	—	900	150 (pages)
Lines per minute	—	—	3120 max.	—	550
Characters per second	—	—	1664 max.	700 min.	700 min.
ERROR CONTROL					
Automatic rescan	No	No	Yes	Yes	Via program
Reject pocket	Yes	No	—	Yes	Yes
On-line manual correction	Yes	Yes	Yes	Via program	Via program
TYPICAL PURCHASE PRICE, $	55,000	85,000	66,000 to 110,000	105,000 to 125,000	105,000 to 125,000
TYPICAL MONTHLY RENTAL, $	1,300	2,150	1,400 to 2,800	2,400	2,400
FIRST DELIVERY	January 1973	January 1970	1966	May 1972	March 1974
NUMBER INSTALLED TO DATE	NA	NA	200	6	NA
COMMENTS	Flexible forms design through software; can read both sides of a document simultaneously	Flexible forms design through software; can read both sides of a document simultaneously		Software Font Learning package permits loading of Multifont Library Table at run time. In-line key-disk entry is available. Document handler and page handler are interchangeable.	

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MANUFACTURER & MODEL	OCR Systems, Inc. System 1000-S Reader/Sorter	Optical Business Machines Laser OCR-ONE	Optical Recognition OCR-71	Optical Scanning Corp. 12	Optical Scanning Corp. 17
APPLICATION					
Media	Documents	Pages, documents	Documents	Documents, pages	Documents, pages
Data form	Characters, marks	Characters, marks	Characters, marks, bar code	Marks	Marks, block print
Use	Off-line	Off-line	On- or off-line	Terminal	Terminal or off-line
DOCUMENT HANDLING					
Minimum size, inches	2.6 x 2.75	2.9 x 3.25	2.75 x 5	2 x 3.667	2 x 3.667
Maximum size, inches	8.75 x 5.75	8.5 x 14	4.875 x 9	8.5 x 11	8.5 x 11
Weight	20# to card	15# to card stock	0.003 to 0.012 in.	60#	60#
Feed technique	Friction	Vacuum	Vacuum, friction	Friction rollers	Friction rollers
Transport method	Vacuum conveyor trap belt	Drive rollers	Conveyor belt	Friction rollers	Friction rollers
INPUT					
Characters per line	80 max.	0 to 80	1 to 85	8	1 to 16
Lines per inch	3 max.	0 to 6	–	Up to 12	Up to 12
Lines per pass	3 max.	All	2	Up to 61	Up to 61
Field selection	Internal program	Internal program using Lead Sheet	Internal program	None	Program sheet
Editing and formatting	Internal program	Internal program	Internal program	None	Control sheet
RECOGNITION					
Font or code styles read	Wide range of OCR, computer, and typewriter styles plus alpha-numeric handprint	OCR A, 7B, handprint	E-13B, OCR A,	Marks	Marks, block print
Character set	10 to 360 characters from intermixed styles	Alphanumeric and symbols (OCR A); 0-9 (others)	Alphanumeric	0-9, alpha grid	0-9, alpha block print
Scanning technique	Diode array	Laser illuminated, photocell sensed	Self-scanning photocell array	Photocells	Photocells
Character recognition technique	Hardware/ software (proprietary)	Matrix matching, feature analysis	Feature analysis, topographical	None	None
OUTPUT					
Magnetic tape	7- or 9-track; up to 1600 bpi	7- or 9-track; all popular densities	7-track, 200, 556, 800 bpi; 9-track, 800, 1600 bpi	–	7- or 9-track
Punched cards	Optional	–	–	–	80-column
Punched tape	8-level	–	–	–	–
Communications lines	Optional	–	9600 bps	110, 300, or 1800 bps	110, 300, or 1800 bps
Computer	Varian 620F/72	–	IBM 360/370, Burroughs B 3500	–	–
PERFORMANCE					
Documents per minute	900	55	300 to 450	5	5
Lines per minute	–	300	600 to 900	305	305
Characters per second	700 min.	400	600	–	–
ERROR CONTROL					
Automatic rescan	Yes	Yes	No	No	No
Reject pocket	Yes	Yes	Yes	Yes	Yes
On-line manual correction	Via program	Yes	Yes	No	No
TYPICAL PURCHASE PRICE, $	105,000 to 125,000	49,500 to 64,500	90,000 to 190,000	4,600	8,000
TYPICAL MONTHLY RENTAL, $	2,400	--	2,000 to 5,000	160	320
FIRST DELIVERY	June 1974	1971	1971	Oct. 1971	Oct. 1971
NUMBER INSTALLED TO DATE	0	Over 20	55	5	600
COMMENTS	Can have up to 21 output pockets	Programmed with operator-prepared Lead Sheet; document numbering and error line marking are optional	Three models with 2, 7, and 14 pockets; all use Varian 620L minicomputer; microfilmer and endorser are optional		

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MANUFACTURER & MODEL	Optical Scanning Corp. 70	Optical Scanning Corp. 100	Optical Scanning Corp. OpScan 37	Peripheral Dynamics, Inc. Model 6011MT	Recognition Equipment Inc. Retina
APPLICATION					
Media	Pages	Pages	Pages, documents	Cards	Documents, pages
Data form	Marks	Marks	Characters, marks	Marks, holes	Characters
Use	Off-line	Off-line	Terminal or off-line	On-line	Off-line
DOCUMENT HANDLING					
Minimum size, inches	8.5 x 11	8.5 x 11	2 x 3.667	3.25 x 7.375	3.25 x 3.25
Maximum size, inches	8.5 x 11	8.5 x 11	8.5 x 11	3.25 x 7.375	4.75 x 8.75
Weight	60#	60#	20# to card stock	Card stock	12# to card stock
Feed technique	Friction rollers	Friction rollers	Friction rollers	Friction	Air-vacuum
Transport method	Friction rollers	Friction rollers	Friction rollers	Drive rollers	Vacuum and belts
INPUT					
Characters per line	1 to 8	1 to 16	1 to 72	Up to 80	4 to 12 char/inch
Lines per inch	Up to 12	Up to 12	3	–	6
Lines per pass	61	62	30	–	1 or 2
Field selection	Plugboard	Program sheets	Program sheets	–	Internal program
Editing and formatting	None	Plugboard	Program sheets	–	Internal program
RECOGNITION					
Font or code styles read	Machine or hand-made marks	Machine or hand-made marks	OCR A, handprint, marks	Marks, holes, or marks and holes intermixed	Modular circuit boards permit reading almost any type style including numeric handprinting
Character set	Alphanumeric plus 11 symbols	Alphanumeric plus 11 symbols	Full alphanumeric plus special symbols	–	Up to 360 char., intermixed, plus hand-printing (0-9, 5 letters, 2 symbols)
Scanning technique	Photocells	Photocells	Integrated photo array	–	Photo array
Character recognition technique	None	None	Feature analysis, matrix matching	–	Matrix matching
OUTPUT					
Magnetic tape	7- or 9-track; 200 to 800 bpi	7- or 9-track; 200 to 800 bpi	7- or 9-track; 556, 800, or 1600 bpi	–	7- or 9-track; 200, 556, or 800 bpi
Punched cards	–	80-column	No	–	–
Punched tape	–	–	5-, 7-, or 8-level	–	–
Communications lines	–	–	110 to 9600 bps	–	–
Computer	–	–	–	–	–
PERFORMANCE					
Documents per minute	40	40	4 to 400	600	1200
Lines per minute	–	–	120	–	–
Characters per second	–	–	200	–	2400
ERROR CONTROL					
Automatic rescan	No	No	Yes	–	Yes
Reject pocket	Yes	Yes	Yes	–	Yes
On-line manual correction	No	No	Yes	–	Yes
TYPICAL PURCHASE PRICE, $	34,750	41,770	39,000 to 51,000	2,915 (qty. 1); 2,150 (qty. 100)	875,000
TYPICAL MONTHLY RENTAL, $	818	1,044	1,200 to 1,900	–	18,000 to 20,000
FIRST DELIVERY	1966	1963	Dec. 1973	NA	1964
NUMBER INSTALLED TO DATE	150	400	NA	NA	Over 80
COMMENTS	Characters interpreted by position of mark within an identified type of grid (field); alphabetic, numeric, mixed, and special grids can be used	Oriented toward test scoring but can read data similar to 70		For OEM use; five other models available with speeds of 300, 500, or 600 cpm	Alternate or additional component reads 7 to 24 pages/min., up to 80 lines/page, 16# to 30# paper, from 3.25 x 4.75 to 14 x 14

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MANUFACTURER & MODEL	Recognition Equipment Inc. Input 80 Models A, B	Recognition Equipment Inc. Input 80 Model C	Recognition Equipment Inc. Model 2000	Recognition Equipment Inc. Trace System	Scan-Data Corp. 2250/1 OCR System
APPLICATION					
Media	Documents, pages	Documents, pages	Documents	Documents	Pages, documents, journal tape
Data form	Characters, marks	Characters, marks	Characters	Characters, bar codes	Characters
Use	Off-line	Off-line	On- or off-line	On- or off-line, in banking	Off-line
DOCUMENT HANDLING					
Minimum size, inches	4 x 5.75	4 x 5.75	3.25 x 3.25	2.75 x 4.25	5 x 3
Maximum size, inches	14 x 12	14 x 12	4.25 x 8.33	4.25 x 9.00	11 x 14
Weight	20# to card stock	20# to card stock	20# to card stock	24# to 100#	15# to 32# plus card stock
Feed technique	Air-vacuum	Air-vacuum	Air-vacuum	Air-vacuum	Friction
Transport method	Vacuum belts	Vacuum belts	Vacuum belts	Vacuum belts	Vacuum belts
INPUT					
Characters per line	1 to 137	1 to 137	4 to 10 char/inch	4 to 10 char/inch	100
Lines per inch	1 to 6	1 to 6	–	–	6 max.
Lines per pass	1 to 81	1 to 81	1	1 or 2	81 max.
Field selection	Internal program	Internal program	Internal program	Internal program	Internal program
Editing and formatting	Internal program	Internal program	Internal program	Internal program	Internal program
RECOGNITION					
Font or code styles read	Wide range of OCR, computer, and typewriter styles plus numeric hand print	Wide range of OCR, computer, and typewriter styles plus numeric hand print	OCR B, 1403, 1428, 12F	E-13B, OCR B, OCR A, 1403, bar codes	OCR A, OCR B, Pica 72, 1403, NOF, 7B, 12F, E-13B, 407, 1428, handprint, etc.
Character set	40 to 360 char. from intermixed styles; 0-9, 5 letters, 2 symbols (hand print)	40 to 360 char. from intermixed styles; 0-9, 5 letters, 2 symbols (hand print)	Numeric; up to 40 masks	Numeric; up to 40 masks	Full font, including upper and lower case where applicable
Scanning technique	Photo array	Photo array	Photo array	Photo array	Flying spot
Character recognition technique	Matrix matching feature analysis	Matrix matching feature analysis	Matrix matching	Matrix matching	Feature analysis
OUTPUT					
Magnetic tape	7- or 9-track, 200, 556, 800, or 1600 bpi	9-track, 800 or 1600 bpi	7- or 9-track, 200, 556, or 800 bpi	7- or 9-track; 800 or 1600 bpi	7- or 9-track; 556, 800, or 1600 bpi
Punched cards	–	–	–	–	–
Punched tape	–	–	–	–	8-level
Communications lines	–	–	–	–	Optional
Computer	–	–	IBM 360, 370	IBM 360, 370 Burroughs 3500, 4700, UNIVAC 1110	DEC PDP-8/E
PERFORMANCE					
Documents per minute	37 to 300	19 to 150	1800 to 2400	1800 to 2400	Up to 300
Lines per minute	–	–	–	–	–
Characters per second	3600	1800	1800 to 2400	–	800
ERROR CONTROL					
Automatic rescan	Yes	Yes	No	No	Via software
Reject pocket	Yes	Yes	Yes	Yes	Yes; 2
On-line manual correction	Yes	Yes	No	Yes	Yes
TYPICAL PURCHASE PRICE, $	358,000 to 1,000,000	259,250 to 600,000	600,000 to 700,000	369,000 to 856,000	210,000 to 525,000
TYPICAL MONTHLY RENTAL, $	10,700 to 28,000	8,265 to 18,000	14,000 to 16,000	7,885 to 17,910	4,200 to 12,000
FIRST DELIVERY	3rd quarter 1971	June 1973	January 1972	August 1972	Nov. 1967
NUMBER INSTALLED TO DATE	19	14	6	4	62
COMMENTS	Systems are based on Datacraft 6024 minicomputers; an optional Total Data Entry feature provides in-line key-disk re-entry, yielding a mixed-media system (Report 70D-718-01)		System based on Datacraft 6024 minicomputer; developed for European postal banks. Can be off-line for sorting into 12 stackers	12 to 24 sorting pockets; reads E-13B magnetically as well as optically; output includes bar codes on documents; system includes minicomputer	SWAMI software extends recognition capability; can be extended to mixed-media data entry system (Report 70D-738-01)

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MANUFACTURER & MODEL	Scan-Optics Inc. 20/20	Scan-Optics Inc. 20/10	Scan-Optics Inc. 410	Terminal Communications Inc. TC-20/22	True Data Corp. Model 800 P/M
APPLICATION					
Media	Documents, pages, journal-tape	Documents, pages, journal-tape	Documents, pages, journal-tape	Cards	Cards
Data form	Chars., marks	Marks	Marks	Marks	Marks, holes
Use	Off-line	Off-line	Off-line	Terminal	On- or off-line, terminal
DOCUMENT HANDLING					
Minimum size, inches	4.5 x 3	4.5 x 3	2.25 x 3	3.25 x 4.5	51-column card
Maximum size, inches	9 x 14	6 x 9	6 x 9	3.25 x 14	80-column card
Weight	16# to 100#	16# to 100#	16# to 100#	Card stock	Card stock
Feed technique	Friction	Friction	Friction	Friction	Friction
Transport method	Vacuum belts, rollers	Vacuum belts, rollers	Vacuum belts, rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	80 max.	80 max.	80 max.	24 to 74 col.	Up to 51 or 80
Lines per inch	6 max.	6 max.	6 max.	–	–
Lines per pass	76 max.	30 max.	30 max.	–	–
Field selection	Internal program	Internal program	Internal program	None	External program
Editing and formatting	Internal program	Internal program	Internal program	None	External program
RECOGNITION					
Font or code styles read	OCR A, OCR B, 12F, 7B, 1403, 407, 1428E, NOF, E13-B, handprint, marks	OCR A, OCR B, 12F, 7B, 1403, 407, 1428E, NOF, E13-B, handprint, marks	OCR A, OCR B, 12F, 7B, 1403, 407, 1428E, NOF, E13-B, handprint, marks	Marks	Marks and/or punches
Character set	Full font	Full font	Full font	0-9 plus 5 symbols	–
Scanning technique	Image dissector	Image dissector	Image dissector	Fiber optics, photocells	Photo transistors w/fiber optics
Character recognition technique	Feature matching	Feature matching	Feature matching	None	–
OUTPUT					
Magnetic tape	7- or 9-track; 556 to 1600 bpi	7- or 9-track; 556 to 1600 bpi	7- or 9-track; 556 to 1600 bpi	–	–
Punched cards	–	–	–	–	–
Punched tape	–	–	–	–	–
Communications lines	–	–	–	110 to 300 bps	–
Computer	–	–	–	–	Standard and custom interfaces
PERFORMANCE					
Documents per minute	500	500	500	15	600 to 800
Lines per minute	–	–	–	–	–
Characters per second	2000	2000	2000	10, 15, or 30	–
ERROR CONTROL					
Automatic rescan	Yes	Yes	Yes	No	Yes
Reject pocket	Yes	Yes	Yes	No	No
On-line manual correction	Yes	Yes	Yes	No	No
TYPICAL PURCHASE PRICE, $	154,815 to 197,815	122,794 to 168,212	130,830 to 173,228	1,235 to 1,275	2,895
TYPICAL MONTHLY RENTAL, $	4,600	3,800	4,000	NA	Contact vendor
FIRST DELIVERY	Sept. 1970	March 1973	Dec. 1973	Feb. 1970	July 1973
NUMBER INSTALLED TO DATE	NA	NA	NA	50	200
COMMENTS	Includes minicomputer with 8K 16-bit words, expandable to 32K	Includes minicomputer with 8K 16-bit words, expandable to 32K	Includes minicomputer with 8K 16-bit words, expandable to 32K	Two models, one with 8-level ASCII output and the other compatible with the IBM 2740	Punched and marked cards can be intermixed; 96-column card capability is planned; 200-400 cpm models are also available

All About Optical Readers

MANUFACTURER & MODEL	UNIVAC 2703	Westinghouse Learning W-2000	Westinghouse Learning W-2300	Wyle Model 710	Wyle Model 720
APPLICATION					
Media	Documents	80-column, 29-channel cards	Pages	Cards	Cards
Data form	Chars., marks, punches	Marks, punches	Marks	Marks	Marks
Use	On-line	Off-line	Off-line	On-line	On-line or terminal
DOCUMENT HANDLING					
Minimum size, inches	2.75 x 3	3.25 x 7	3.25 x 7	3.25 x 6	3.25 x 6
Maximum size, inches	4.25 x 8.75	3.25 x 7	8.75 x 11.25	3.25 x 11	3.25 x 11
Weight	20# to 110#	Card stock	60# offset	20# to 120#	20# to 120#
Feed technique	Friction	Friction	Friction	Friction	Friction
Transport method	Belt	Drive rollers	Drive rollers	Drive rollers	Drive rollers
INPUT					
Characters per line	Approx. 77 max.	80 columns	58 marks	No limit	80 per card
Lines per inch	–	–	12	12	12
Lines per pass	1	–	61	No limit	80
Field selection	External program	Internal program	Internal program	–	–
Editing and formatting	External program	Internal program	Internal program	–	–
RECOGNITION					
Font or code styles read	UNIVAC H-14, OCR A, OCR B	Marks, punches	Marks	Marks	Marks, Hollerith
Character set	0-9 plus 4 symbols	Binary image	Binary image	–	128 characters, Hollerith to ASCII
Scanning technique	Parallel photocells	Photocells	Photocells	Phototransistors	Phototransistors
Character recognition technique	Matrix matching	None	None	None	None
OUTPUT					
Magnetic tape	–	7- or 9-track; 800 or 1600 bpi	7- or 9-track; 800 or 1600 bpi	–	–
Punched cards	–	–	–	–	–
Punched tape	–	–	–	–	–
Communications lines	–	9600 bps	9600 bps	–	110, 300, 1200 bps
Computer	UNIVAC 9000 Series and 90 Series	–	–	Parallel at TTL levels	–
PERFORMANCE					
Documents per minute	Approx. 300 or 600	400	300	Hand fed	Hand fed
Lines per minute	–	–	–	–	–
Characters per second	1500	–	–	500	120
ERROR CONTROL					
Automatic rescan	No	No	No	No	No
Reject pocket	Yes	No	No	No	No
On-line manual correction	No	Yes	Yes	No	No
TYPICAL PURCHASE PRICE, $	42,000 to 64,560	52,450	–	995	1,575
TYPICAL MONTHLY RENTAL, $	1,150 to 1,600	1,574	2,925	–	–
FIRST DELIVERY	Aug. 1970	1969	1969	Jan. 1974	Jan. 1974
NUMBER INSTALLED TO DATE	NA	9	NA	NA	NA
COMMENTS		Includes minicomputer with up to 32K; reads both sides of documents in single pass: 58 data channels, 80 rows	Includes minicomputer with up to 32K; reads both sides of documents in single pass: 58 data channels, 61 rows	Punched and marked data can be intermixed	Punched and marked data can be intermixed

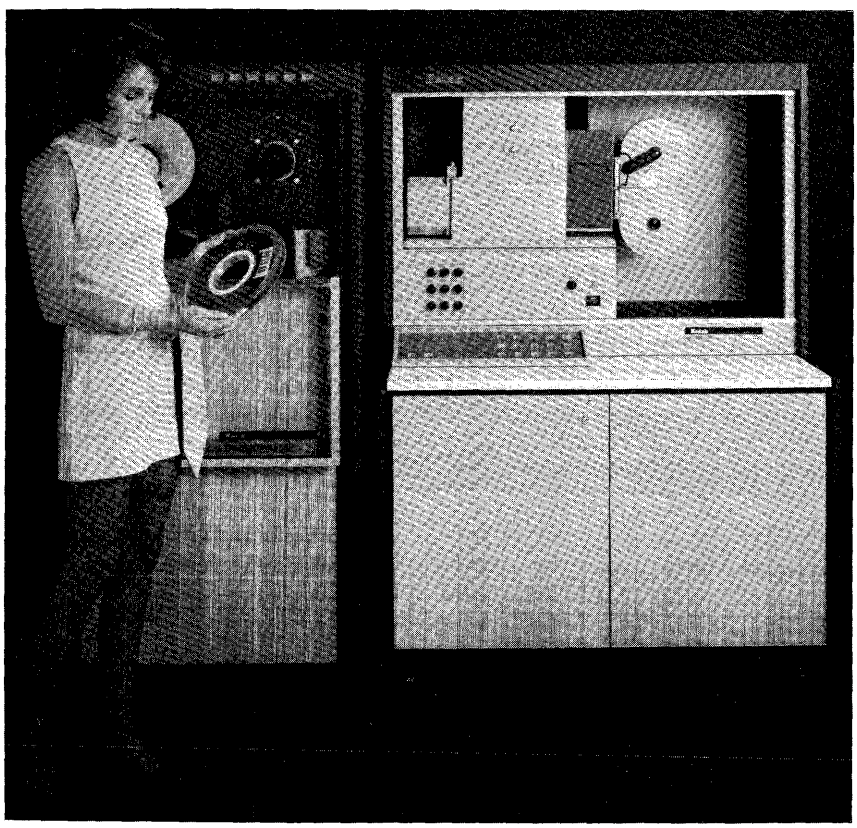
All About Computer Output Microfilm (COM)

Computer output microfilm (COM) is perhaps the most "foreign" technology since data communications to compete for your data processing dollars. This report describes the characteristics, applications, advantages, and disadvantages of COM, and presents concrete equipment selection guidelines and the results of a survey of COM user experience. Accompanying comparison charts summarize the capabilities of 37 commercially available COM recorders from 16 suppliers. Descriptions of microfilm formats and film types are included.

Probably the most misunderstood and misapplied computer-related device in the history of data processing is the computer output microfilmer, or COM. After its use in the early sixties to produce graphic plots on film at rates substantially greater than those of digital plotters, the potential of COM as a high-speed alphanumeric printer gained recognition by the late sixties.

It should be noted that this kind of printing is effected on film rather than on paper. Indeed, the failure to recognize the magnitude of this distinction has led to the widely held view of the COM recorder as a simple peripheral accessory and a direct replacement for the impact printer. Many EDP managers still innocently approach COM in this manner today. Although we shall see that in certain instances this concept has sufficed, its culmination is more often disappointment and grief. Much of the hardware, furthermore, was badly designed in the early days from the standpoint of both operational convenience and reliability. Hence, disillusionment spread, and as resistance to COM hardened, sales refused to obey the optimistic forecasts that abounded so freely in the literature.

This prolonged period of stagnation, however, appears to be over. Many COM industry observers believe that 1972 marked the long-awaited and long-predicted watershed in COM acceptance. Gone was the anticipation of electrifying growth rates and the coining of easy fortunes. What gradually emerged was a marketplace offering a smaller number of COM devices that are reliable in a hardware sense and reasonably well supported by software. This generation of relatively new machines, which enjoy the benefits of integrated semiconductor technology and vastly improved photo-optical technology, signalled a maturation with respect to the early forebears from which they had evolved. In short, the new devices generally operate well, while their outmoded ancestors generally failed to fulfill their extravagant promises.



Eastman Kodak's KOM-80 and KOM-90 microfilm recorders differ only in their ability to respond to programmed commands, with the KOM-90 the more versatile. Usage plans, which bill the user in proportion to the actual use of the recorder, are available. Kodak's software is among the most wide-ranging in the industry.

All About Computer Output Microfilm (COM)

It appears that 400 to 450 new COM devices were shipped in 1972. This record is significant because the new units nearly equalled the total of COM installations that existed prior to 1972. Shipments in 1973 have accelerated further. At the midpoint of 1973, industry sources put the total installations at almost 1100. This figure would be considerably higher if all shipments resulted in new installations, but many have been replacements.

It is true that better hardware, greatly improved software, and a livelier economic climate were vital to this first significant upsurge in COM volume. Yet, there is reason to believe that a psychological change in the industry has been equally important. More EDP personnel are at last perceiving COM as one of many components in a total micrographics system – or if you prefer, a microfilm system. It is also the bridge that links this system to computer technology. When grasped in this systems way, a modern COM has an excellent chance of producing the cost savings and operational improvements that its characteristics predicate. But the user must be prepared to divorce himself from paper and wed himself to film forever.

The Evolution of COM

To understand how to use COM, one must understand what it is and know something of the background that evolved it. A computer output microfilmer is a device that combines electronic, photo-optical, and electromechanical techniques for the purpose of converting digitized computer output into human-readable images of alphanumeric or graphic forms and automatically recording these images on microfilm or microfiche in a specified format. The acronym COM is often applied to such film – computer output microfilm – as well as to the recording device. The ability to produce graphic forms as well as alphanumerics is one of many attributes that distinguish COM recorders from impact printers.

The birth of COM was actually a succession of scattered events, rather than a specific occurrence, consisting of the many instances in which engineers hung Polaroid cameras over CRT screens to record waveform patterns. This technique represented an application of a rapid photo-recording method to high-speed image generation via the cathode-ray tube. Meanwhile, high-speed data generation via the digital computer was rampantly outpacing the primitive printing and plotting peripheral devices then available.

The coordination of the cathode-ray tube and the camera as a high-speed technique for recording computer output was pursued in the late 1950's by such companies as Stromberg DatagraphiX, California Computer Products, Computer Industries (now University Computing Company, which has regrettably gone out of the COM business), IBM, Eastman Kodak, and Data Display Incorporated of St. Paul (now a part of Control Data Corporation). These early COM devices, which were mainly CRT printer-plotters capable of executing up to 220,000 points per second, were intended for administrative, military, engineering, and scientific applications. The first COM was delivered to the Social Security Administration in 1958 by DatagraphiX (then known as Stromberg Carlson). Despite the sale of a few other COM devices to the government, their marketability was uncertain and further development stopped. During this period IBM left the field and has never returned; the company also sold its microfilm reader-printer line to Keuffel and Esser.

The COM industry has still not fully recovered from the nearly fatal blow it sustained when IBM abandoned it. Since innumerable people regard IBM as omniscient in the world of data processing, they considered COM a failure simply on the basis of IBM's retirement from the industry. We now know that it was not a failure, only a fledgling, and the day of its ability to produce profits was then still remote. In this respect IBM's judgment was valid.

Undoubtedly, the company that kept the COM faith was Stromberg-DatagraphiX. The contributions of CalComp were essential as well. DatagraphiX developed alphanumeric printing as well as graphic plotting, while CalComp emphasized the plotting function.

Today there are 16 companies offering COM devices. Of these, two are selling COMs produced by other companies that are also marketing the same equipment under their own names.

Attractions of COM

The manager who loves paper and vows never to leave it, no matter how much money it may cost him, has no need to contemplate COM. Even an open-minded manager presiding over a modest monthly volume of report production (say, not more than 500,000 pages) may not need to regard COM seriously yet. Nevertheless, volumes of this order might well be handled advantageously by a COM when there are special formatting considerations, lengthly distribution lists, limited storage space for filing of paper report copies, or special retrieval requirements. Once the output volume approaches a million report pages per month, there is little question that an information system based on paper is wasteful.

Placing the crossover of economic advantage from the printer to the COM at about 500,000 pages per month is a cautious estimate. As duplication needs and distribution costs of an application increase, this crossover point goes down. Indeed, some analysts have put the crossover point at 200,000 monthly report pages and

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project a cost reduction of 50 percent from COM at the 500,000-monthly page level. Since many variables in the environmental equation are changeable, it is prudent to take a cautious approach.

It should be noted that not one word so far has been said about printing speed. At one time printing rates of the order of 50,000 lines per minute stirred a sensation; such capabilities were considered equivalent to saving many dollars. When report volumes are immense, extraordinary printing speeds may well be productive. At the present time, the fastest COM recorder achieves speeds of up to about 30,000 lines per minute, which is more than adequate for the great majority of applications.

What is the proper way to look at printing speed? The answer here is the same as it always is: does it cost less to operate a faster machine or a slower machine?

To illustrate these considerations, let us assume a fairly brisk impact printing rate of 1500 lines/minute. Let us say that this machine leases for $1500/month. In addition to this charge, operator wages must be paid. The total of wages and lease charges for prime-shift operation only represents the minimum monthly cost of the machine. Taking setup time and maintenance into consideration, calculations show that the impact printer can produce about 175,000 pages/month. If more report pages must be printed, say up to about 350,000, labor expenses for a second operating shift are incurred. Even a COM recorder that prints at the rate of only 10,000 lines/minute can expose over a million frames per month in one operating shift. To the extent that no overtime charges are imposed, the COM has contributed a saving with respect to the increased volume. If multiple impact printer installations are necessary to handle extremely high-volume requirements, but a single COM can produce these pages within a single operating shift, then the higher COM operating speed has truly become relevant.

To summarize, COM becomes attractive when an information system utilizing film attains a clear-cut operating cost advantage over its paper counterpart. For report volumes at which such economies prevail, the fast printing rates of COM will hold some advantage in themselves.

Most people, unfortunately, flinch at the thought of replacing paper with film. And well they should. Conversion to a new medium is hardly a trivial matter. Yet, it is easy for those who have joined the film fraternity and have found happiness there to deride colleagues left behind in the ruck of paper. The road to film happiness, however, it perilous and marked by many failures. These debacles include installations that should never have been attempted and others that should have been successful but went sadly awry. Embracing film and leaving the comfort of paper is a most serious undertaking.

These hurdles notwithstanding, one should ponder the fact that even a film cassette occupies less than 1 percent of the space required for a paper stack of equivalent reports, and a fiche occupies less than 0.05 percent as much space as the equivalent paper. Similar proportions hold for weight. An exercise with postal rates would show that cost savings in distributing fiche, for example, can be enormous. Another exercise involving rental for storage space would show that significant savings can be realized through film in this respect as well. Film can be retrieved in approximately 1/9th the time required to access a paper document. All duplicates can be produced at about 1/10th of a cent per frame, or even less at high reduction ratios.

Unhappily, there is yet another matter to ponder. Paper mills today are operating at near-capacity, and can increase their output from the present levels only slightly. Paper consumption, meanwhile, leaps ahead year by year. No new plants are currently being built. A period of about five years is required from start of construction to the time when paper is first produced by a new plant. The disquieting possibility of shortages looms large and real at the present time. Many of us may have to convert to film much sooner than we realize.

Reliability

User interviews have established that the current COM recorders typically incur significantly less downtime than the mechanical printers they replace or augment. Since unreliability and lengthy job changeover have been troublesome sources of user disenchantment with COM up to as recently as three years ago, it appears that one of the early claims for COM – superiority in operational reliability – can now be realized. This issue is still moot and is challenged, of course, by manufacturers of impact printers. Nevertheless, it is safe to say that reasonable operational reliability of COMs has been achieved, and many users consider them superior to impact printers in this respect.

Special COM Properties

A COM is not simply a printer that imprints on film instead of paper. It has a number of useful properties that go beyond the impact printer, which uniformly prints computer output in a single font and in not more than 64 lines per page. Although the low-cost alphanumeric COM printers are similarly restricted, other COMs can print in many fonts, underline, subscript, print in several sizes, print in several intensities, rotate text automatically within a given frame, and draw graphic plots. A standard format consisting of lines and headings that are to appear on all printouts can be automatically superimposed on the frame area. A common procedure is to photoengrave the form on a glass slide and then project the image onto the film by

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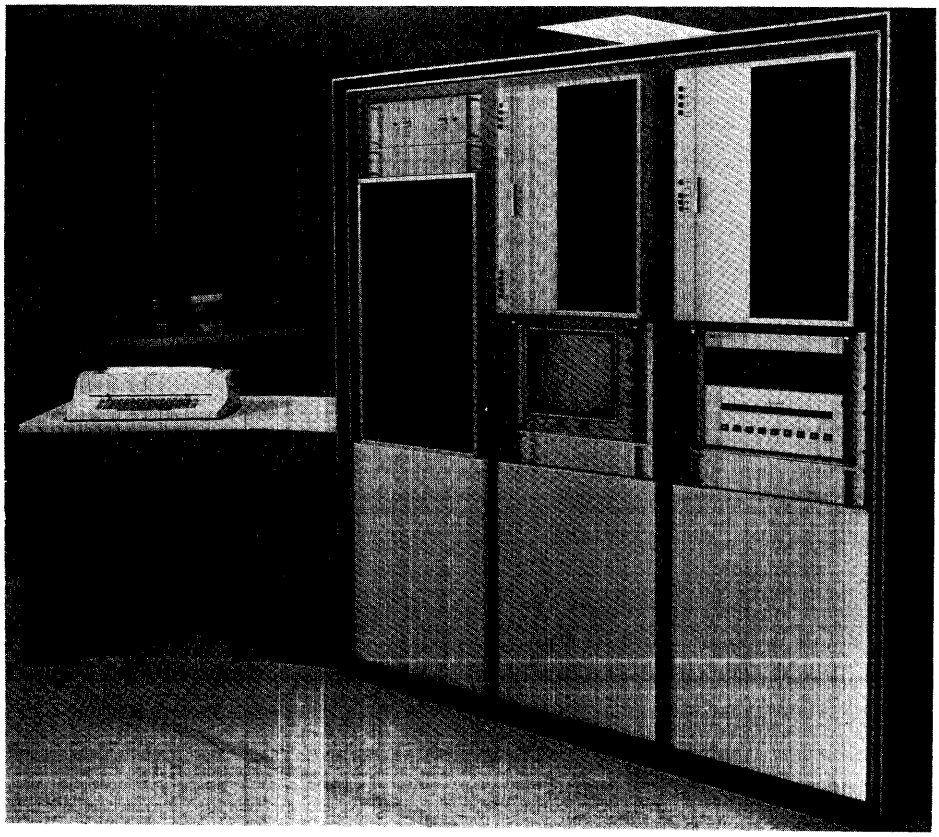

The Seaco Model 451 COM Recorder, which is also marketed by Sperry-Remington as the Rand Graphic COM 510, is a high-precision graphic arts device. This category of COM recorders, despite its remarkable capabilities, has been handicapped by its comparatively high pricing and so has had only limited market acceptance to date.

flashing a high-intensity light. Alternatively, these standard forms can be stored in the memory of an internal controller. A particular form is then plotted on the CRT screen along with the formation of alphanumeric data.

Another feature of alphanumeric COM recorders is the ability to add page retrieval coding to each page of microfilm. This feature becomes necessary because of the nature of microfilm and the difficulties of "flipping through it" to find the data being sought. The COM recorder can imbed retrieval coding data between the page frame images to enable operators of the microfilm readers and viewers to find the desired data within seconds. Bar codes, frame counts, and various binary patterns are the coding techniques most frequently used with today's popular microfilm viewers.

A feature called "abutment" ("butting" a frame directly against the one preceding) can join columns of data into long, continuous columns without the customary breaks that mark where one paper page joins the next and without the normal page headings. Other features permit on-line marking of unrecognizable characters with an error symbol and writing titles on various film segments that are large enough to be read directly by human eyes.

Disadvantages of COM

If the advantages of COM had no offsetting disadvantages, data processing managers would clamor for the latest model. But there are many valid reasons to hesitate.

1. *Psychological factors.* Many individuals simply rebel against the strangeness of microfilm. Paper is familiar and comfortable; microfilm is foreign. This resistance had some foundation, since early COM and non-COM microfilm systems often exhibited poor image quality and ineffective page retrieval systems. Today there is still the perennial problem of human beings resisting a new procedure simply because it is new.

2. *Personnel training.* During the transitional period, personnel must be trained to cope with the various parts of a total COM system. Operating a COM, developing film, and duplicating film are, after all, new skills that are unfamiliar to EDP personnel. Training in the proper use of readers is also advisable.

3. *High investment.* A COM recorder and its necessary accessories are an expensive investment. Often COM does not replace other equipment, such as a line printer, but is used in addition to other installed data processing equipment. A steady, high-volume workload must be present to justify COM installation.

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4. *Incompatibility with certain applications.* When the data base must undergo frequent and rapid changes, as in airline reservations and inventory applications, microfilm may be too static. Updating film entails reprinting an entire reel or an entire fiche, even for one revision. This cycle is too long for many situations. The need to reprint much unchanged data along with the changes adds an element of awkwardness.

5. *Limitations of microfilm.* The user cannot make notes on microfilm, and he cannot flip through it, marking pages, scanning back and forth, etc. In fact, he cannot use it at all without a microfilm reader. Furthermore, the COM recorder must be occasionally checked for image clarity and optical alignment. This requirement is less onerous now than formerly, but it is still a consideration. The readers sometimes require optical adjustments.

6. *Retrieval techniques.* Microfilm can have imbedded and external indexes of various kinds which are used by the microfilm readers to assist in rapid retrieval of data being searched out. Some COM/reader retrieval techniques leave much to be desired in the opinion of many users and prospective users. The indexing of subjects recorded on a fiche and labeling (titling) the fiche segment have successfully served many storage and retrieval functions where cartridges or cassettes have proved both clumsy and expensive. Expense has arisen from the need for costly automated readers for searching the retrieval code.

7. *Software.* Depending on the nature of his COM recorder, the user may be forced to create two versions of his print tapes: one especially formatted for the COM unit and another prepared for the line printer in case the COM unit becomes inoperative. Moreover, large program libraries may have to be modified to change printer output tapes to effective COM input tapes. Mainframe operating systems may have to be modified.

8. *File integrity.* Microfiche and aperture card systems provide poor file integrity, because it is easy to remove one fiche or card from the file and never have the removal detected. (By contrast, roll film provides excellent file integrity.)

9. *Temptation to make paper.* Almost everybody likes to take a source document (in other words, paper) to his desk and work on it. Looking up at data on a screen is strange and uncomfortable. Therefore, if a microfilm printer is included in the installation, there is a temptation to work it to death. But since each copy costs from 4 to 10 cents, the entire system can die, too, under the crush of unjustified expense.

10. *Political impact.* The introduction of COM and micrographics to a facility may affect its organizational structure. There is no doubt that an impact printer is part of the data processing department. But when film processors and duplicators are installed, they are usually located in a company's publications department. Where does an off-line COM go? Questions of this kind should be considered carefully during the planning stage.

11. *Reliability.* Not long ago the reliability of all micrographic components was dubious, especially that of the COM recorder. This situation has fortunately improved. Nevertheless, maintenance considerations should be borne in mind, especially since the servicing record of some COM suppliers is still questionable. Two of the better companies in this regard are 3M and DatagraphiX.

Classes of COM Devices

There are four primary types of COM devices, as determined by their basic applications:

- *The Alphanumeric Printer* – records alphanumeric characters and symbols in accordance with preselected formats, such as the standard computer printout format of 64 lines of 132 characters each. No graphics (except whatever might be projected from a forms overlay) are produced. Some COMs of this type are restricted to the standard format, while others can construct a different format, such as 86 lines per frame, or a continuous scrolled output form. In this form, for example, 105mm film would have the appearance of continuous columns side by side instead of columns broken into separate frames.

- *Alphanumeric/Business Graphics* – offers both an alphanumeric printing capability and low-precision graphic forms, such as bar and circular charts, graphs, and line drawings.

- *Graphic COMs* – offer a tolerably precise graphics capability in addition to alphanumeric printing. Where business graphics is restricted to commercial applications, graphic COMs can be used advantageously in engineering applications as well.

- *High Resolution/Graphic Arts* – produces precision scientific and engineering plots and line drawings to

a high degree of precision; this category of equipment also is usually capable of some photocomposition and exact layout functions. Alphanumeric printing rates are usually slow in comparison with those of alphanumeric printers. This category is invariably supported with elaborate software.

In the past, the CRT photocomposer has often been included as a category of COM equipment. Owing to the exorbitant prices of such devices, only those limited to pure photocomposing applications have achieved any noteworthy marketing success. An instrument like the Videocomp, originally produced by RCA and now offered by Information International, has made only a small market impression. For all practical purposes, therefore, the CRT photocomposer should no longer be regarded as a COM.

On the other hand, the day is probably not far off when every nearly COM will perform in some photocomposing role. This expectation arises from the evolution of new inexpensive plate-making processes that work directly from microfilm. Among the companies with such developments are Addressograph and Information International. Although COM is not yet a practical photocomposer, the prospect is encouraging.

Of the four categories listed above, only the alphanumeric printer does not include an internal controller. It must be operated from a properly formatted tape in order to function. An exception to this statement is the on-line type of recorder that is designed for plug-to-plug compatibility with the IBM 1403 impact printer. This report centers primarily on the alphanumeric COM as most relevant to EDP activities. As had been predicted, the alphanumeric COM accounted for the lion's share of shipments in 1972.

How Does a COM Unit Work?

COM recorders differ substantially one from another in the hardware techniques they use in handling the computer's data and recording output data on microfilm. Yet, to help understand exactly what a COM device is, it is reasonable to reduce their many different component parts to six basic functional components:

- *The input section.* This section receives digital data from a computer system in either on-line or off-line mode. If it is an on-line recorder, the COM device must have the proper interface to attach to the specific computer's I/O channel. If it is an off-line device, the COM's tape drive must be compatible in data recording format and code with the computer's tape drive which produced the tape.

- *The logic section.* Here the input data is acted upon. Data records are sent to the next section for conversion, and "action" records (i.e., COM control codes) are interpreted and appropriate actions are initiated (such as film manipulation, output formatting, etc.).

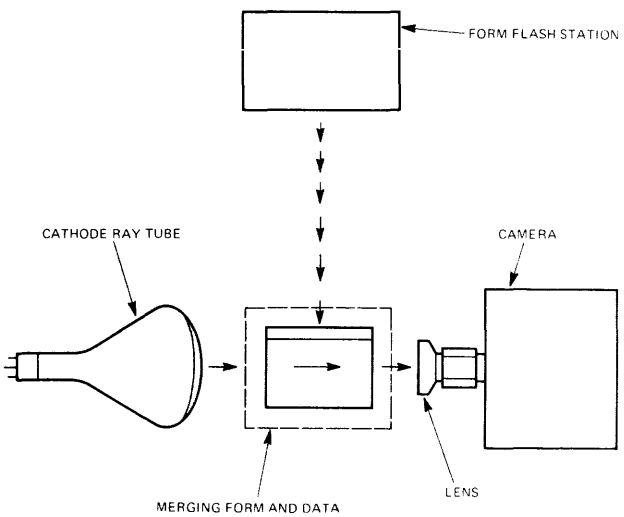
- *The conversion section.* Here the digital data records are converted to analog signals, which are then converted to human-recognizable characters, lines, and points. This section generally includes a character generator, a vector generator, a point plotting system, or some combination of the three.

- *The deflection controls section.* This section controls the placement of the converted data images on the face of a CRT display tube or, in some cases, directly on the film.

- *The display section.* This section controls the image quality as projected on the CRT or the film. It also handles overlaying fixed forms on the image area.

- *The film-handling section.* This section generally consists of a 16mm, 35mm, or 105mm camera and the exposure and film advance mechanisms. Here the images are photographed and permanently recorded on microfilm. In some systems the film is processed (i.e., developed) on-line, and in others it must be removed and processed in a chemical bath before it is ready for use.

The breakdown above is typical of those COM units that employ a CRT to expose the film. Some manufacturers have implemented other ways of exposing the film. The 3M Company, for example, uses an electron beam



This figure illustrates the basic internal components of a COM recorder: CRT screen for displaying the data, forms flash station for displaying a form overlay, and a 16mm, 35mm, 70mm, or 105mm camera for photographing the composite data and overlay image on microfilm.

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directly, while Memorex uses LED's (light-emitting diodes) as the light source. Additional details about specific techniques are contained later in this text under "Character Generation Technique".

Application Areas

Some fundamental applications of COM are the following:

- Business-oriented listings with a low or high frequency of reference, but with an infrequent need for updating (less than once per day). These listings can be used at single or multiple locations, and the more locations required, the more suitable is microfilm output. This application includes parts catalogs, customer and employee vendor lists, transportation schedules, accounts receivable and payable, finished inventory, bank and credit statements, etc.

  (If business-oriented listings require updating as changes occur, or perhaps once an hour, then the files should probably be retained on-line to the computer system, and definitely not on microfilm.)
- Management information reports requiring both alphanumeric and graphic output for proper display of the data.
- Computer-generated data bases, such as catalogs, abstracts, indexes, bibliographies, directories, financial data, etc.
- Engineering drawings, including plots, graphs, charts, maps, circuit designs, etc.
- Libraries
- Insurance; examples are agents' commission statements, agents' digest system, positions' records, vendors' records, etc.
- Financial and investment companies which typically produce a considerable volume of charts, graphs, tables, and general printing.
- Animated movies and scientific sequencing, which usually employ sprocketed film to assure precise registration of recorded frames.
- Education and training films for schools, industry, hospitals, government and military training.

Potential COM Users

Any company using computers and also using microfilm equipment to any extent should definitely investigate the use of COM operation. Companies producing the report volumes discussed earlier, and those with large distribution lists, should also feel under economic pressure to investigate COM. Engaging a COM service bureau is a sensible first step in this analysis. Not mentioned previously is the fact that for many medium-volume operations, delegation of the film making to a service bureau is the most economical approach. Even those environments with large enough report production volumes to qualify for advantageous in-house COM operation would probably do well to learn the subtleties of this new operating methodology from a service bureau. Planners often overlook the need for backup in case of equipment breakdown. A service bureau is a logical selection for this purpose as well.

It has been estimated that use of a COM service bureau is the most economical choice for computer output microfilming of up to 200,000 pages of output per month, and some experts even maintain that the crossover point is beyond 500,000. But in this vicinity a changeover to in-house operation is usually justified.

If desired, COM recorders can be tried as substitutes for line printers with little, if any, change to existing computer systems. For example, many installations already write their print files to magnetic tape for later printing, usually in multiprogrammed mode while another main program is being processed. These printer output tapes can, in many cases, be used directly as input to a COM recorder as part of a COM performance test. It is possible that the tape may have to be converted and reformatted via a computer program before entry to the COM system, but a COM service bureau or the interested COM supplier may be able to perform the necessary preparations. This kind of operation, however, is completely archaic today because of the resulting throughput degradation, and really should not be attempted unless such ineffectiveness is acceptable.

Information Systems

The potential COM user must not loose sight of his ultimate objective – to integrate the COM recorder and the microfilm it produces into an effective EDP/COM micrographic information system.

One of the most important elements of a micrographic system is the microfilm or microfiche reader that must display the COM-produced microfilm. In terms of systems design, the readers (and the reader-printers that produce hard-copy duplicates of selected microfilm frames) must be carefully investigated prior to selection. Factors that demand evaluation are cost (most have purchase prices that range from several hundred to several thousand dollars), ease of use, microfilm indexing schemes for selected frame retrieval, image clarity, scanning speeds, image control, etc.

Some readers are simple viewers; others are complex information retrieval systems, with built-in control logic.

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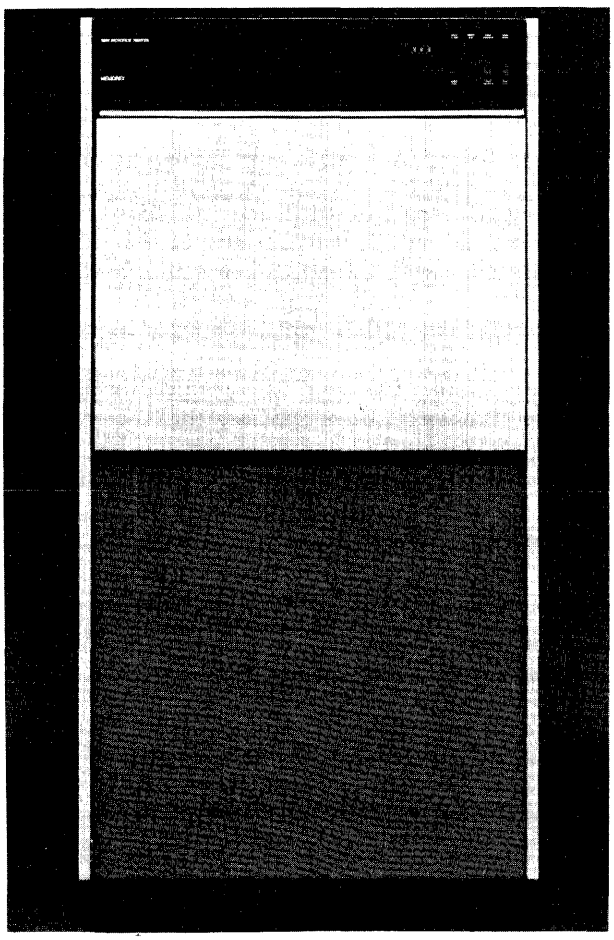
In any case, the microfilm reader is a critical element in every COM information system. It represents the end-user interface. If it is noticeably weak with regard to any of the factors mentioned above, it can cause the entire COM system to fail.

Other hardware components of a total COM information system include film processing (i.e., developing) units, film previewers (to view the film prior to duplication and end use), hard-copy printers, film duplicators, film cartridge loaders, microfiche cutters, etc. This equipment should be carefully evaluated as to price and compatibility with the film output of the COM recorder before any selections are made. It has been estimated that the purchase price of the total of the supporting microfilm equipment can equal the cost of the COM recorder. (In addition, supply costs, such as for film, chemicals, printer paper, etc., can run between 15 and 25 percent of the annual expenditure on the COM unit itself.)



The Memorex 1603 Microfilm Printer is a low-cost alphanumeric recorder that employs four matrices of light-emitting diodes (LEDs) to form characters. Associated fiber-optic strands conduct light from each diode to a viewing assembly, which passes the images through a shutter mechanism and lens system directly to 16mm film. The unit emulates the IBM 1403 Printer in on-line operation with an IBM System/360, Model 25 and up.

In designing an integrated COM information system, the designer should investigate and evaluate:

- Requirements of end use (content and format of information, need for hard copy, number of locations for readers, skill of available operators, frequency of use, etc.).
- File characteristics (updating frequency, percent of file updated each cycle, size of file, location and type of file index for microfilm retrieval, etc.)
- Dissemination requirements (number of film duplicates, form of duplicates, portion of file required for duplication, delivery form and method, etc.).
- Costs (data preparation, computer time, COM recorder, microfilm peripherals, supplies, labor, etc.).

Once all of these factors have been carefully evaluated, a COM-inspired microfilm information system can be designed. Evaluating the various cost elements mentioned above will permit a direct comparison with costs of roughly equivalent paper-based systems currently in operation.

In particular, the COM recorder itself must be priced carefully. Some units have a low base price which does not include many necessary or at least desirable components or features required for effective operation. Other units appear excessively high-priced until it becomes apparent that the devices are extremely flexible, with many impressive features built into the basic device.

The cost of making programming changes and additions to existing computer programs is another factor requiring careful evaluation. Even with those COM recorders with line printer simulators in the hardware, some programming changes can add to the effectiveness of the COM unit's operation. And if graphic capabilities, indexing, and titling are desired, entirely new program segments will have to be introduced. Most manufacturers today give extensive help free of charge in this area.

And finally, the most all-encompassing cost factor to be evaluated is the cost of redesigning total information systems to utilize COM efficiently and effectively. A new departmental organization may be required.

Selection of a COM Recorder

If a user's investigation and experiments indicate that installing a COM recorder is economically justifiable, then he is faced with the complex task of evaluating and selecting the most suitable hardware.

An effective starting point in such an equipment selection project is to carefully define the goals and objectives of the future hardware/software/microfilm system.

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Any unusual requirements should be noted, and the question of compatibility with existing EDP and microfilm equipment should be completely reviewed. Then, the user should prepare a detailed Request for Proposals (RFP) and send it to the principal COM suppliers whose products generally seem to meet his system goals. The suppliers who seriously want this business will probably respond with truly helpful proposals, complete with important guidance in system design and implementation. Consultants can be obtained to help evaluate these proposals.

The prospective COM user is advised, however, that even the frames per minute performance measure is an optimum kind of figure, since it includes no allowances for overhead functions such as preparing the COM camera, loading film, mounting the magnetic tape reel, instructing the COM unit by control card, plugboard or some other means concerning any special requirements, tape rewind time for tape errors, re-recording for errors, recording void marks, changing magnetic tape reels, changing the forms overlay, monitoring the recorded images, less-than-optimum tape blocking factors, operator errors, and machine downtime. These overhead functions can reduce the real COM output in a given recording day by as much as 50 percent.

Some Film Fundamentals

Silver halide films are acknowledged to have a higher resolution than any other kind. Types of such film employed in COM recording range from 100 to approximately 190 lines per millimeter or even higher in film intended for reductions of 48X. Despite imposing claims made for the resolution of other types of film, silver halide remains superior in present-day application environments. Accordingly, the COM industry has adopted this film type for making the master copy in the recorder. The only exception is the use of so-called dry silver film in the 3M EBR microfilmer. Micromation microfilm (MMF), which Stromberg DatagraphiX distributes for its machines, is rated at 155 lines per millimeter. Perhaps the most widely accepted film for COM recording is Kodak Dacomatic. One of the highest film grades utilized in COM work is Kodak AHU, but this fine-grain variety has a higher price tag.

An important property of silver halide film is its inherently wide tonal range. Furthermore, its contrast range satisfies most specifications. An extremely vital matter is the archival property of silver halide images. A film specimen known to be over 50 years old shows no sign of degradation, and there are many examples of film in storage for over 25 years with no deterioration.

The most annoying property of the silver halides is their requirement for wet chemical processing. These films must be passed through several chemical baths at moderate rates and then squeezed through rollers before emerging fully developed.

Another significant limitation is price. Although occasionally recruited to serve as duplicating film as well as master film, silver halides as a rule give way to cheaper films in most COM duplication work.

The most widely used duplicating film, according to industry reports, is called *diazo.* This film type is much less expensive than silver halide film, and processing it is far simpler. The process is started by introducing ammonia. A master film is placed in contact with the diazo film, and the master is then exposed to ultraviolet light. The image areas of the master absorb the high-energy photons, but clear areas pass photons through to the diazo molecules. These molecules are inhibited from any chemical reaction. In contrast, the diazo molecules protected from the ultraviolet light react with color-formers to create a dye. This dye reproduces the original image on the master film. Since a clear area on the master produces a clear area on the duplicate, and a dark produces a dark area, diazo chemistry is called a direct, or positive reproduction process. It is also called nonreversing.

It should be noted that the standard development process for silver halide film leads to a tone reversal. The introduction, however, of additional baths can effect a nonreversing reproduction process. This cycle, incidentally, is available in the in-line (internal) processors of the Quantor 100 and 105 COM recorders.

Diazo films today are coated in various shades of black and sepia. The selected pigmentation determines the background hue of the duplicated image.

The resolution of diazo images is considered highly satisfactory for duplicating work. Contrast of the microfilm print is also excellent.

Vesicular film is the third major type used widely in COM applications. This comparatively recent film development has been competing hard against diazo, to which it is similar in the utilization of diazonium compounds. Its processing chemistry, however, is quite different. It also requires exposure to ultraviolet light, but no ammonia whatever is needed and the process, unlike that of diazo, is reversing. In dispensing with ammonia, the vesicular film environment is free of any tinge of pungent aromas. A disadvantage pointed out by some critics is that the second exposure to ultraviolet light in the duplicating process must be sufficiently prolonged or the images will not be permanently fixed and will tend to darken over a period of time. Avoidance of carelessness is usually enough to overcome this pitfall.

Vesicular films manufactured by Kalvar and Xidex are the major brands on the market today.

Dry silver film, which is also heat-developed in the 3M Electron Beam Recorder, is not a vesicular type.

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COM Software

The early COMs executed numerous complex functions uncommon to an impact printer, such as variable character intensity, variable character size, multiple fonts, program image rotation, subscripting and superscripting, and graphics. The applied record format, therefore, had to contain appropriate instruction codes. From these considerations it should be evident that one of the original obstacles to COM was the obligation of the user to write subroutine modifications to his operating system, or to link appropriate subroutines supplied by the COM manufacturer whenever available. His task was a stern one. In non-IBM environments, especially, programming for COM was often infeasible from any practical standpoint.

Designers of on-line microfilm printers such as the Memorex 1603 have sidestepped this problem by orienting their equipment toward the operating environment of the IBM System/360, Model 25 and up. The 1603 operates directly from the normal data stream intended for the IBM 1403 Printer. In adhering to linear (simplex) recording and imprinting simple code line retrieval marks, the 1603 does, in fact, escape from the software plague. But the price is to lock the 1603 into a comparatively limited functional role.

With the introduction of simple alphanumeric printers that could emulate the IBM 1403 in a linear recording mode on 16mm film, there seemed to be another opportunity to sidestep programming entanglements. A relatively simple plugboard was adequate for duplicating the program format tape of the 1403 and otherwise attaining the plug-to-plug compatibility necessary for operation from a standard IBM print tape. The Rand 500 (Seaco 401) is an outstanding example of this approach. Other COMs such as the Pertec 3700, can operate from a standard tape without any special programming, but a reduction in throughput is suffered. Usually, special programming to produce a tape more compatible with COM characteristics is beneficial. The DatagraphiX 4200 can emulate the 1403, but it is seldom operated in this mode.

With the perfection of more sophisticated cameras and electro-mechanical support, the production of fiche became more practical. Accordingly a movement toward fiche and away from strip film began in early 1971. Besides improved data compression and film utilization, the division of a data bank into a succession of discrete fiche segments was conducive to more convenient indexing and retrieval. But to produce indexing in the form of a dedicated frame and to label the fiche with eyeball characters – usually at the top, but occasionally along the sides or along the bottom – a revolution in COM operation was inaugurated. Now operation from a standard IBM print tape was absolutely impossible. A particular tape with imbedded codes for instructing the COM to generate the eyeball titles and to print appropriate headings in the index frame, along with appropriate frame references, became mandatory.

There are two basic procedures for producing such tapes, the older and still more usual method is to leave the computer program unmolested and let it print the standard print tape in the normal manner. By means of a special conversion or translation program, the data stream from the print tape, when it is run through the computer in a second pass, is then restructured into the desired COM format. A more recent and more sophisticated approach is to break into the operating system of the host computer and delay all tape output instructions for the purpose of sending the data through newly introduced subroutines. The format of the data stream emerging from these subroutines is that required by the COM and contains all the instruction codes necessary to operate it. DatagraphiX, Eastman Kodak, Pertec, Quantor, 3M, and SynerGraphics offer packages of this type. These companies also offer programs of the tape translation type.

Still another technique circumvents both the second-pass tape translation process and the need to break into the mainframe operating system. This method interfaces the COM recorder to the standard print tape with a control processor as an intermediary. The necessary programming is entered into this external processor. Both Eastman Kodak and California Computer Products (CalComp) offer this technique. CalComp also provides software for generating the necessary object deck in an IBM System/360 or 370 mainframe.

The COM software available today has a wide range of capabilities. Perhaps the most elaborate is provided by Eastman Kodak. A wide variety of eyeball titles, for example, are possible. The titles can be one or two rows and one, two, or three heights, and the index frames can choose headings from a number of record fields. Quantor software offers the convenience of entering the program into the mainframe from an object deck. Other available software capabilities are far too numerous to list here.

In July 1973, Pertec announced a new software package called DATACOM. It is a high-level language similar in concept to RPG II but without some of the latter's restrictions. Pertec describes this software as a direct way, through the use of key words, to create titles and indexes directly from data bases. The straightforward commands permit use by programmers and nonprogrammers alike.

Another important advance came earlier: the introduction of internal processors within the COM system. The Gould BetaCOM 600 and the Information International FR-80 were among the first. When an internal processor is provided, it is customary for the manufacturer to supply extremely versatile software in addition to that

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supplied by the minicomputer manufacturer. This software is directed toward executing complex graphics, printing multiple fonts, and performing some photocomposing functions. Control of printing heights, brightness levels, image rotation, forms merging, and frame abutment are other examples of processes that require software management.

Ironically, users are evidentally still dissatisfied with the COM manufacturers' software support if the returns of our user survey are any criterion. In view of the strides made in the past two short years, it is reasonable to expect a further manufacturer response to the currently unsatisfied user needs.

User Experience

To determine the current status of user satisfaction with various COM recorders, Datapro Research Corporation conducted an extensive user survey. A Computer Output Microfilm Reader Survey Form was included in the April 1973 supplement to DATAPRO 70 and mailed to all subscribers. By July 1, usable responses had been received from 88 users with a total of 111 installed COM units. It is worth noting that this figure is approximately 10 percent of the estimated total number of COM installations. Actually, a number of these responses overlap a common COM installation, in that the replies show that some of our respondents are clients of the same service bureau.

In 16 of the reporting facilities, there were two COM installations. In one facility there were three installations, and in still another there were four. In addition, there were six returns from users who obtained film from COM service bureaus, but who did not know the identity of the recorders being used.

Users were asked to rate the print quality of the COM-produced film, ease of operation, stability of operating adjustments, equipment reliability, maintenance service, manufacturer's software, and throughput performance by assigning a rating of Excellent, Good, Fair, or Poor. The ratings for 16 recorders as reported by responding subscribers are presented in the accompanying table.

USER RATINGS OF COM RECORDERS

Manufacturer and Model	No. of User Replies	No. of Units	User Ratings*																									
			Print Quality				Ease of Operation				Stability of Operating Adjustments				Equipment Reliability				Maintenance Service				Manufacturer's Software				Throughput			
			E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P	E	G	F	P
CalComp 2130	2	2	2	0	0	0	2	0	0	0	0	2	0	0	0	1	1	0	0	1	1	0	–	–	–	–	2	0	0	0
CalComp 835	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0
CMS 7000**	4	3	3	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	–	–	–	–	–	–	–	–	2	0	0	1
Control Data Corp. 3398/250**	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0	0	0
Gould BetaCOM 600 L	3	3	1	2	0	0	0	1	0	0	0	1	0	0	0	2	0	1	0	1	0	0	0	2	0	0	0	1	1	0
III FR-80	2	2	2	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0
Kodak KOM-80	9	11	7	4	0	0	3	5	0	0	2	6	0	0	3	5	0	0	2	5	1	0	4	2	1	1	5	4	0	0
Kodak KOM-90	9	8	4	5	0	0	1	4	0	0	1	4	0	0	0	5	0	0	3	1	0	0	0	4	1	0	3	5	1	0
Memorex 1603	13	13	5	6	1	1	8	4	1	0	4	5	2	1	5	5	3	0	4	5	2	2	–	–	–	–	5	6	2	0
Quantor 105	2	3	0	3	0	0	1	2	0	0	0	2	1	0	0	1	2	0	0	1	1	0	1	1	0	0	0	3	0	0
Pertec 3700	9	9	4	4	1	0	1	4	0	0	0	0	4	0	3	4	0	1	0	1	2	1	0	2	3	0	1	4	1	1
Rand COM 500-Seaco 401	5	5	2	2	0	0	1	1	1	0	1	2	0	0	1	2	0	0	0	3	0	0	0	3	0	0	0	3	0	0
Stromberg-DatagraphiX 4200	1	1	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0
Stromberg-DatagraphiX 4360	18	21	9	12	0	0	7	9	2	0	2	13	2	0	10	5	2	0	11	5	1	0	2	9	7	1	4	12	1	0
Stromberg-DatagraphiX 4400	6	6	5	1	0	0	1	2	0	0	1	2	0	0	1	2	1	0	0	2	0	1	0	1	2	0	3	1	0	0
3M EBR	7	9	7	2	0	0	4	4	1	0	1	6	2	0	1	6	2	0	4	4	0	0	2	3	0	1	3	4	1	0

* Ratings are expressed in terms of number of user responses. The legend is E for Excellent, G for Good, F for Fair, and P for Poor.
** Discontinued.

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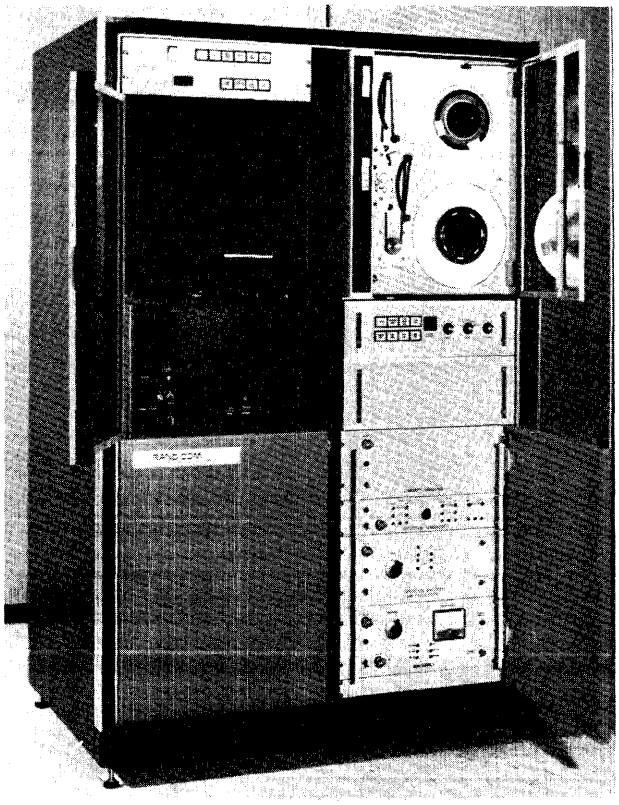

The RandCOM 500 is another representative of the new low-cost alphanumeric recorders that have appeared within the last few years. Made by Seaco and identical to its Model 401, this recorder features stroke character generation and is well regarded for good print clarity. The 500 has won sales acceptance in Europe as well as in the United States.

Since Sperry Rand and Seaco market the same units, which Seaco manufactures, and since Computer Micro-Image, which manufactured the CMS-7000, is now defunct, 11 actual manufacturers or distributors are represented. The information on the Control Data 3398/250 recorder is quite interesting, since this unit was one of the early devices on the market and for that reason holds some historical significance.

Readers should be cautioned about certain ambiguities of the table; namely, multiple users of the same service bureau have reported on the same equipment, and some users with a multiple installations have reported on more than one unit. This situation occasions some seeming contradictions in the figures in the "No. of User Replies" column and the "No. of Units" column.

A dash indicates inappropriateness of some kind. For example, an on-line COM like the Memorex 1603 has no function but emulation of the IBM 1403 printer and thus requires no software support. With their manufacturer no longer in business, the CMS-7000 recorders in the field have no manufacturer software support or maintenance.

It was interesting to discover that the most widely used COM reported in the survey was the Stromberg-DatagraphiX 4360 rather than the Memorex 1403, despite the remarkable market penetration that the latter is said to have made. The inference that one might cautiously make here is that DatagraphiX still holds a sizeable lead in total number of equipment installations despite the rash of competition it has encountered in the last few years.

It is unfortunate that some of the better-known recent COMs, such as the Quantor 105 and the Remington RandCOM 500, are so sparsely represented in the table. The Quantor device in particular is enjoying a surge this year, perhaps helped in part by its new marketing arrangement with NCR, and a more substantial sampling would have been timely.

The ratings can be combined to form the following overall picture of user attitudes toward the current COM recorders:

	Excellent	Good	Fair	Poor
Print quality	51%	43%	4%	1%
Ease of operation	40%	51%	9%	0
Stability of operating adjustments	17%	69%	13%	1%
Equipment reliability	32%	49%	18%	3%
Maintenance service	36%	44%	13%	7%
Manufacturer's software	13%	54%	27%	5%
Throughput	34%	54%	10%	2%

The situation, we think, is definitely encouraging to the cause of COM partisans, in that only a few years ago considerable disenchantment with COM hardware was rife – and software support was practically negligible. The responses on software, perhaps the key at present to whether COM can gain new adherants, tell a revealing story: software has happily come a long way in the last two or three years, but a lot remains to be done.

The final compilation, in the "COM Utilization Patterns" table, presents a profile of user application patterns at the present time. Note the popularity of fiche and its associated titling and indexing method of retrieval. Note also the frequency of 42X reduction at the expense of 24X. The NMA fiche formats are seen to dominate, while Mini-Cats and 48X reduction, despite pressure from the government, have hardly made a ripple so far, according to the survey.

One outcome is perhaps surprising. The survey indicates a decisive preference for vesicular film duplication, even though industry reports put diazo film in the lead. Yet, conversation with users tends to support our finding. It is likely that vesicular film is rapidly becoming the preferred duplicating film type.

Concerning the nagging problems blocking the way to greater COM acceptance, the table seems able to speak

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COM UTILIZATION PATTERNS

	Number Reporting
Total respondents	97
In-house operation	49
Film supplied by service bureau	45
Service bureaus reporting	3
	Number of User Mentions
Film use:	
16mm	58
35mm	9
70mm	0
105mm	65
Reduction ratios:	
24X	39
28X	4
42X	58
48X	6
Cassette or cartridge use	30
Fiche formats:	
NMA	18
COSATI	5
DoD	3
Mini-Cats	1
Retrieval codes	13
Void marks	10
Titling	65
Index frames	63
Tape recording density:	
800 bpi	32
1600 bpi	53
Master film:	
Silver halide	54
Dry silver	6
Duplicating film:	
Silver halide	7
Diazo	27
Vesicular	43
On-line operation	17
Method of obtaining COM tape:	
From first computer run	51
Tape-to-tape conversion	30
Reformat print tape with internal or external processor	37
Major problems in conversion to microfilm:	
Eye fatigue	17
Film processing and duplication	19
Personnel resistance	41
Personnel training	18
Overall system cost	8
Report updating	15
Storage & retrieval	7
Problems mentioned by respondents:	
Training programmers	1
Programming priorities	2
Inability to write on film	2
Lengthy machine break-in time	1
Poor reliability	1
Lengthy turnaround time	1
Vendor incompetence and indifference	1

for itself. It appears safe to believe, however, that despite these problems the COM industry has progressed significantly and is now in a period of steady growth. It is equally clear that the millennium of spectacular growth, predicted so freely just a few years ago, is not only still remote, but might do more good for the industry by never occurring.

Characteristics of COM Recorders

Prospective COM users can become familiar with the basic specifications of the currently popular COM recorders by studying the comparison charts at the end of this report. The charts present the principal characteristics of 37 commercially available COM recorders from 16 different manufacturers and distributors. All information was supplied and/or verified by the manufacturers during the months of June and July 1973. Their cooperation is acknowledged and greatly appreciated.

The chart entries and their significance to a prospective COM user are explained in the following paragraphs. Guidelines are also presented to assist in evaluating and selecting the most suitable COM device for specific information system needs.

On-line usage. Some COM units can attach directly to an input-output channel of a digital computer system. Output data is transferred directly to the COM unit for printing. Data can be made available to the COM unit at the extremely high speeds of the electronic computer. Very high-speed COM printing is thus made possible, contributing especially to the performance of those devices which provide graphic output. If the COM device is incapable of high-speed operation, then the on-line arrangement usually will only serve to slow down the internal performance of the computer system.

Data transfer rate between computer and COM recorder is expressed in characters per second. The next entry specifies which computer systems the COM unit can directly interface with. Some COM manufacturers offer a great deal of flexibility in this area by guaranteeing to interface their recorder with any of today's third-generation computer systems.

The prospective user should ask to see demonstrations of the proposed COM recorder functioning on-line with his specific computer make and model.

Off-line usage. Other COM recorders function in the off-line mode, accepting data from the digital computer system through the intermediate medium of a reel of magnetic tape. (And some COM devices can function in either on-line or off-line mode, depending on the requirements of the user.)

In off-line mode, the COM device uses a conventional magnetic tape drive to read the input tape. Such usage can maximize the performance of the installation's computer system by permitting output data to be generated at the high speeds of magnetic tape. Then, when the COM unit needs supplies or other operator attention, its lack of operation does not affect the computer system in any way.

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The tape drive that is used in conjunction with the COM recorder can read the data on the magnetic tape reel at a certain maximum speed. The greater this speed, the faster (potentially) the COM device can print the output data on microfilm. This tape input speed is expressed in terms of maximum of characters transferred per second.

The next entry specifies the names of the data codes that can be interpreted by the COM's magnetic tape drive. Different computer systems generate data in different data codes, such as EBCDIC and ASCII, and not every COM recorder can handle every kind of data code. Therefore, it must be verified that the tape drives on the proposed COM systems can accommodate the data codes produced by the installation's in-house computer system.

If the data codes are incompatible, it is possible in some cases to convert the computer's output tape at a service bureau to a data code acceptable to the COM recorder's tape drive.

Some COM manufacturers will supply a tape drive capable of reading any popular third-generation data code.

Magnetic tape unit. In the off-line mode, the COM's tape drive must match the computer's tape drive in the number of data tracks recorded across the tape (7 or 9 tracks are most common) and the recording density (i.e., the number of characters recorded per inch on the tape). The greater the recording density, the more data can be stored on a given reel of tape, and the easier to produce high-speed tape reading and writing.

Some COM tape drives can read 7- and 9-track tape, recorded at any of the popular recording densities (200, 556, 800, and 1600 bpi). These devices are obviously more likely to match the recording specifications of the computer's tape drives than those with more limited capabilities.

Some COM manufacturers include the price of their required magnetic tape drive in the price of their total COM package, but others price the two separately. It is most important in comparing prices of COM recorders to know whether or not the price of the tape drive is included. It is a necessary component in off-line usage and one which, if not included, must be added to the COM recorder price in reviewing the total price of every COM system. The chart entry represents a purchase price for this tape unit. If it is already included with the price of the COM hardware, the entry indicates that the tape unit is "Standard."

Internal computer controller. Some of the more expensive COM recorders have built-in minicomputers to control their operations. The primary function of this internal computer is generally to reformat the input data prior to recording on microfilm. This function is most often utilized in graphic applications requiring "drawing" of maps, charts, graphs, etc. If the internal computer performs a major portion of this data formatting, it will relieve the external computer's application programs from laborious, repetitive coding in generating the raw graphic data.

The charts also list the name of the manufacturer of the internal computer. It is frequently supplied by a minicomputer manufacturer with proven experience in that area. The main memory capacity of the minicomputers is stated in number of data words. Generally, the larger the capacity, the greater the flexibility in control and logic functions that can be internally programmed.

Character generation technique. Most COM recorders use a hardware character generator of some sort to form or draw digital character data. The digital input is converted to analog signals to direct the electronic beam positioning in a CRT display tube. The beam draws character images on the face of the CRT tube, where a shutterless camera photographs them character by character (or stroke by stroke). As the character is displayed, it is photographed. The image then fades without need for continual image refreshment.

Most COM recorders permit an entire page or frame of data to be exposed before advancing the film. The page size is usually 132 to 160 characters per line and 64 lines per page, although greater page packing densities can be achieved with several available recorders.

The Burroughs BCOM Computer-Output-to-Microfilm unit, like many of the others, draws its characters by using a series of up to 20 strokes per character, controlled by X and Y position signals. Many others create their characters by illuminating certain dots within a matrix frame; for example, Memorex employs a 5 by 7 matrix, Pertec, 7 by 9, and Quantor, 7 by 10. Character sharpness naturally improves as the number of matrix elements increases.

Stromberg-DatagraphiX uses a patented Charactron CRT tube, consisting of, among other elements, a thin foil disc (or character matrix) through which all alphanumeric and special characters have been etched. The tube's electron stream passes through this character stencil and is extruded as a bundle of shaped electron beams. Selection plates deflect the beams so that only the specific character required by the input is positioned and displayed on the face of the tube. Harris Communications Systems' Monoscope character generation technique is quite similar; it utilizes an electron beam to scan a character stencil. The selected character pattern is then paralleled on the face of the tube at the proper location.

Both the 3M Company and Memorex eliminate the CRT in the design of their COM recorders. The 3M Electron Σ

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Beam Recorder uses an electron gun to emit electron beams in the form of characters and directly exposes the film with these beams. Memorex, with its 1603 Microfilm Printer, directs its digital signals to a bank of light-emitting diodes (LED's) through a character translation matrix. Light from these diodes is transmitted through fiber optic strands to form a character image. An entire line of characters is thus formed, displayed, and photographed via the fiber optics assembly. The film is then advanced a line at a time.

It should be recognized that the LED technique is not without serious limitations. This imaging method can produce basic graphics, but only with difficulty in controlling movement of the film. Another serious handicap is the formable problems that stand in the way of microfiche production. Again, the necessary control over film movement is at present an insurmountable barrier. Because the diodes emit red light, red-sensitive film must be employed in LED recorders. It happens that silver haloid film is naturally sensitive in the blue regions of the spectrum, and special filtering processes must be introduced to recover film sensitive only to red. This special film is appreciably less sensitive than blue-sensitive film, and somewhat inferior to it in resolution. Since photodiodes produce about a thousand times more energy than CRTs, the disadvantage of poorer film sensitivity is somewhat lessened.

Still other COM recorders either totally lack hardware character generators or offer them only as optional features. When characters are generated by software, printing speeds are slow.

Monitor. Most COM devices provide some form of monitor to enable the operator to check on the unit's operation, and specifically, to check on the quality of the filmed image. Some devices permit the CRT display tube to be viewed directly through lenses and mirrors, either through a viewing port or via a projected image. Others use a Polaroid camera to photograph and develop a page image after the recorder has printed it on microfilm. Still other units use an additional CRT tube specifically for purposes of monitoring and displaying the entire page of data for checking purposes.

A monitor is a useful tool and is always present in a high-resolution/graphic arts recorder.

Film. COM recorders use microfilm in one or more of the standard sizes: 16mm, 35mm, 70mm, or 105mm. Some COM cameras can use only one film size, others can accommodate more than one size through optional features, and still others have "universal" cameras capable of recording on many film sizes, notably 105mm, and in many formats.

All film is distributed in roll form. The most common 16mm and 35mm roll film is then packaged for use as standard rolls, or in cartridges or cassettes. The 16mm film size can also be cut into six-inch strips and inserted into jackets, packed closely side by side, to create microfiche-style cards.

Particularly in engineering applications, both 35mm and 70mm film is often cut into frames and inserted into windows of unit-record-style punched cards. These forms are called *aperture cards.*

The most prevalent microform today is called *microfiche,* which is a rectangular sheet of film containing microimages arranged in a matrix of rows and columns. These tiny images are presently recorded at reduction ratios ranging from 24X to 48X, with 24X and 42X predominating at this time. The most common fiche size is approximately 4 by 6 inches (108 by 148.75mm). A once popular size, but now uncommon, is 3-1/4 by 7-3/8 inches–the standard tab card dimensions; 6-by-8-inch fiche finds occasional use today as well.

Column pagination is the standard procedure today for generating a fiche. In this technique, images are photographed across the width of the film, or, in other words, along a column of the fiche segment in its normal orientation. Sometimes the film is transported in this process, and in other systems camera motion is employed. It is entirely possible, however, for the rows to be photographed instead (row pagination). Usually, movement along either the column or rows holds to a single direction, but sometimes adjacent columns are traversed in opposite directions. This procedure is called zig-zagging.

The outstanding format at 24X reduction today is that of the National Microfilm Association (NMA); it consists of a total of 98 images arranged into 7 rows and 14 columns. Once predominant, the COSATI structure of 5 rows and 12 columns, or 60 images, is declining because of its relatively inefficient utilization of space. AT 42X reduction, the NMA standard of 14 rows by 16 columns, or 224 images, is an overwhelming favorite. The ratio of 42X, incidentally, has been gradually supplanting 24X ever since the attainment of good resolution at this reduction.

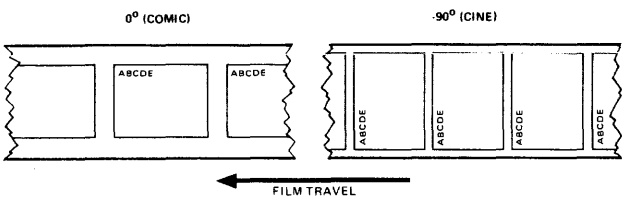
The Department of the Navy has been pressing hard to standardize 48X reduction in a 270-image format called Mini-Cats, which comprises 15 rows and 18 columns. Not all COM recorders have overcome the resolution problems inherent to this higher reduction. Among those that have are the FR-80 by Information International, the DatagraphiX recorders, the Kodak KOM-90 and KOM-80, the Pertec 3700, and the Quantor 105. The last mentioned is employed in several Navy installations, and the KOM-80 is used by the Air Force.

All About Computer Output Microfilm (COM)

Efficient retrieval of documents on microfiche requires the presence of titling and indexing. Titling is the technique of imprinting so-called eyeball (eye-readable) characters somewhere on the fiche, usually in the space otherwise occupied by the first one or two rows of microimages. As the name implies, the purpose of titles is to label and thus make possible direct identification of the fiche. Title characters can be of various sizes, styles, and densities (number to the inch). They can be abstracted from data records in various ways.

An index frame is a vital tool in the process of locating a desired document frame for viewing on a reader. Once a fiche has been selected by means of its title, the operator inserts it into a microfiche reader and displays the index frame, which is usually in the extreme lower-right corner, on the screen. Some kind of label is listed for each frame on the fiche, such as first and last account numbers of first and last names. This description is followed by the frame grid location. As in the case of titles, software can be written to obtain information from data records in various ways.

The COM camera generally film the page frames in either cine or comic strip orientation. The *cine* orientation means that each frame is positioned one beneath the other, much as motion pictures are arranged. The *comic* orientation means that each frame is arranged side by side, along the length of film, much as comic strips are laid out. Both formats are examples of simplex recording. Some COM cameras can record in either mode, and others have even more flexibility and permit any degree of image angle in relation to the edge of the film.



This figure shows the difference between orienting the microfilm images in the comic or cine mode. The cine mode packs the frames more densely, averaging about 22 frames per foot of microfilm rather than the comic mode's 20 frames per foot.

For the most part, the significance of the frame orientation relates to the operating characteristics of the microfilm readers that will be used with the COM output. Some can operate in only one mode, so this mode must correspond to the recording mode in the COM recorder. Also, some information is thought to be more easily scanned when the images move up and down on the viewing screen, while other material seems more suited for viewing from side to side, such as in scanning through a book. The cine mode permits more frames to be recorded per foot of microfilm.

The photo-optical systems that create microfiche can also record two lateral images across 16mm film at a reduction of 42X or better, or from two to four images across 35, 70, or 82.5mm film. This procedure is called "two-up" and "four-up" recording, respectively. When there are four or more images across a film width, it would assume the appearance of microfiche if the film were segmented instead of left in roll form. In typical two-up recording, the image pair consists of the front and rear sides of a single sheet, and a precise side-by-side juxtaposition is maintained along the entire length of film. This alignment is called "duplex" recording. Another procedure is that of recording single images down one half of the film and another series up the remaining half. The second series may or may not be precisely registered alongside the first set of images. This recording technique has been called "duo."

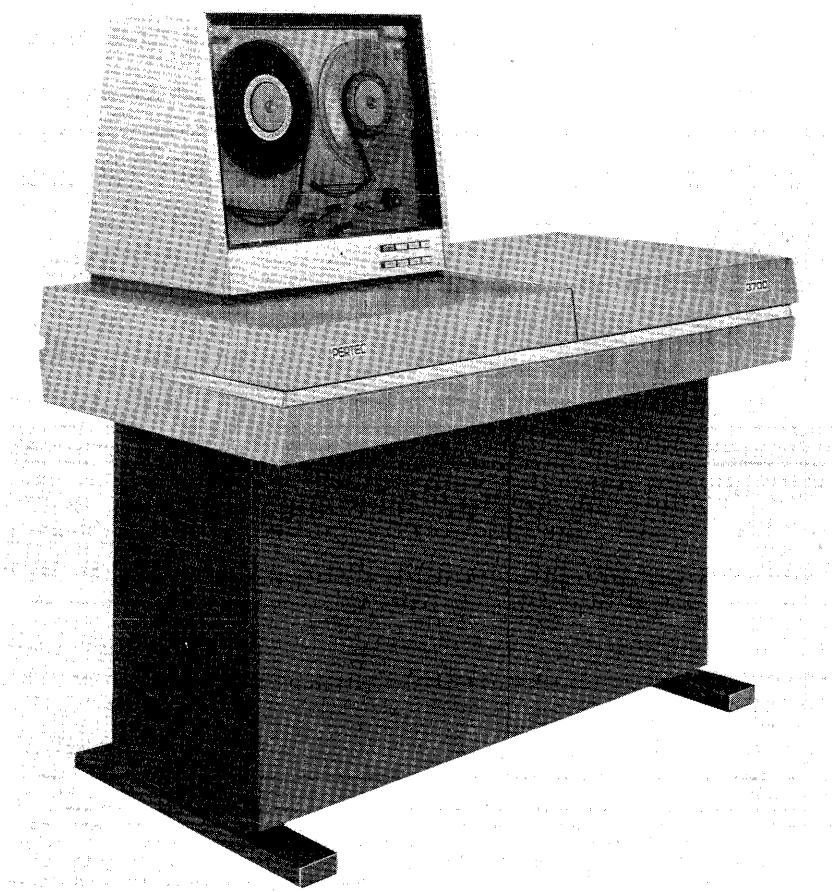
Most COM recorders produce positive images, i.e., black characters and lines on a white background. Yet most users agree that negative images are easier to use, since dust particles and film scratches seem to interfere less with the legibility of negative images than positive. Some users find that positive images are tiring to read for extended periods due to the high light intensities necessary to overcome ambient light levels; if such intensities are not used, the image is dim and just as tiring. Negative images are usually generated when film copies are made from the positive master film.

Alphanumeric capability. Most COM units offer a single type-font or style. Others offer more than one (such as IBM 1403-style, bold, and italics), sometimes as optional features. The microfilm output can be more impressive and legible if more than one type font is used. Likewise, some COM devices permit the characters to be printed in several program- or plugboard-selectable sizes and intensities (brightness factors). These features contribute greatly to the attractiveness of the formatted output.

Graphic capability. For those COM recorders with graphic capabilities, several figures of merit have been devised to measure the image quality of the drawings they produce. One is the number of addressable spot positions. This figure refers to the maximum number of locations on the CRT where a spot can be placed. The other quality measure is the number of resolvable elements. This figure refers to the number of points which can be placed on the microfilm completely separated from one another. In both cases, the larger the numbers, the more likely the image will be of high quality. Of course, the required quality of the image is dictated solely by the end use of the filmed images.

An important performance criterion of graphic COM recorders is the number of discrete points which can be plotted per second. The faster this point plotting capability, the higher the device's throughput.

All About Computer Output Microfilm (COM)



The compact Pertec 3700 has a throughput rating of 150 to 500 pages per minute. In addition to providing tape formatting software, Pertec offers a considerable repertoire of application software oriented especially toward the banking industry.

The charts also list the number of point sizes and line widths available. The larger these numbers, the more drawing facilities are available, and hence, the easier the programming of these devices.

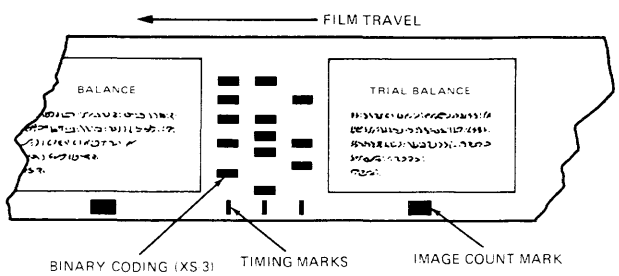
Forms overlay technique. Most COM recorders permit a fixed form to be overlayed on the alphanumeric or graphic data, creating the effect of printing or drawing on highly specialized forms. Extremely attractive and legible page formats can be achieved using this feature. Both forms flashing and programmed forms have been described previously.

Retrieval codes. Many different retrieval coding techniques can be used by COM devices. They all serve the same purpose, namely, permitting the filmed images to be retrieved on a microfilm reader as quickly as possible.

Most techniques involve recording some kind of codes on each microfilm frame as the data is printed. Depending on the coding technique and the characteristics of the microfilm reader, some retrieval systems can operate automatically, such as by pushing a numbered button to retrieve the corresponding microfilm frame number. (This technique is referred to as image count.) The index of frame numbers can be prepared externally, or it can form part of the roll of microfilm.

Other retrieval systems operate manually, such as the code line technique, in which the operator of the reader scans rapidly through the film while watching the easily legible code lines pass by a graduated scale on the side of the reader. The operator can then stop the scanning when the code line matches the desired point on the scale.

Bar coding systems are also common for automatic frame retrieval, as is Kodak's patented Miracode system. Miracode uses binary patterns recorded between page frames, which are automatically read by appropriate microfilm readers.



This figure illustrates two of the more popular microfilm retrieval coding techniques: binary and image count. Kodak's Miracode is probably the most common form of binary coding in use. Both types of coding can be read automatically by appropriately equipped microfilm readers.

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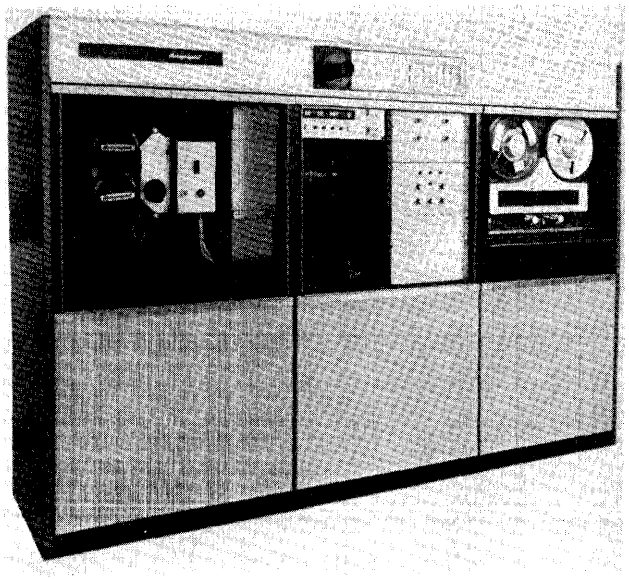


The DatagraphiX 4360, on the COM market since 1967, is still the first choice of many veterans in the field and of many about to make their first commitment. Benefitted by the patented Charactron method of character formation and upgraded in 1970 with the DatagraphiX F230 Universal Camera, one of the most rugged and reliable available, the 4360 performs competitively both in its operating characteristics and in price against the newer devices. This recorder enjoys the greatest number of installations among subscribers who responded to the Datapro COM survey.

It is important for a prospective COM user to try out the various indexing and retrieval systems to determine which ones suit his needs. He must then verify that the COM devices can accommodate his desired system and that corresponding readers are available and affordable.

Usually, the COM user does not need complex, automated microfilm storage and retrieval systems. He merely needs one that works and is easy to implement. The user generally works with files that are already in straightforward alphabetic or numeric sequence, and hence are easy to scan for the retrieval of desired data.

Error marking. Most COM devices have some capability for marking the film to indicate error conditions. Most often the problem will arise when either a given character cannot be read from the input tape, or else the character is read but not recognized as valid. Some units will print a special, highly recognizable character in place of the error character, and others will simply include some kind of "void" mark across the entire frame. Some kind of error marking is highly desirable.

Optional features. The prospective COM user will be confronted with a great variety of special and optional features offered with most COM recorders. The desirability of these features can only be evaluated in relation to each user's intended applications and project budget. The charts list some of the major optional features. In all cases the names of these features are self-explanatory.

Support. The prospective COM user will definitely want to know whether or not he can directly use his print tapes on the proposed COM recorder. Some suppliers permit this direct usage, using what is usually called a hardware line printer simulator. Other suppliers require usage of a software simulator, run on a computer, to reformat the print tapes to include the COM unit's required action or control records. The charts indicate whether the software is a standard, no-charge component of the total COM system or whether it is priced as an option.

Most of the suppliers of the graphic COM recorders also supply software application packages to ease the burden on the user programs in creating their highly technical drawings. The charts indicate whether the user can expect to pay for this software or whether it is supplied as a no-charge item.

In every case it is highly desirable for the COM manufacturers to supply pre- and post-installation systems and general technical assistance. In these days of separate pricing of products and services, the user should determine the price, if any, of this manufacturer-supplied systems support.

Performance data. In measuring the performance of competitive alphanumeric COM recorders, several factors must be considered. First of all, it is important to note the time required to mechanically advance the film after a page or frame has been recorded. The charts present this time in terms of milliseconds. Ultimately, high-speed electronic printing can be greatly degraded if the frame advance rate is excessively slow.

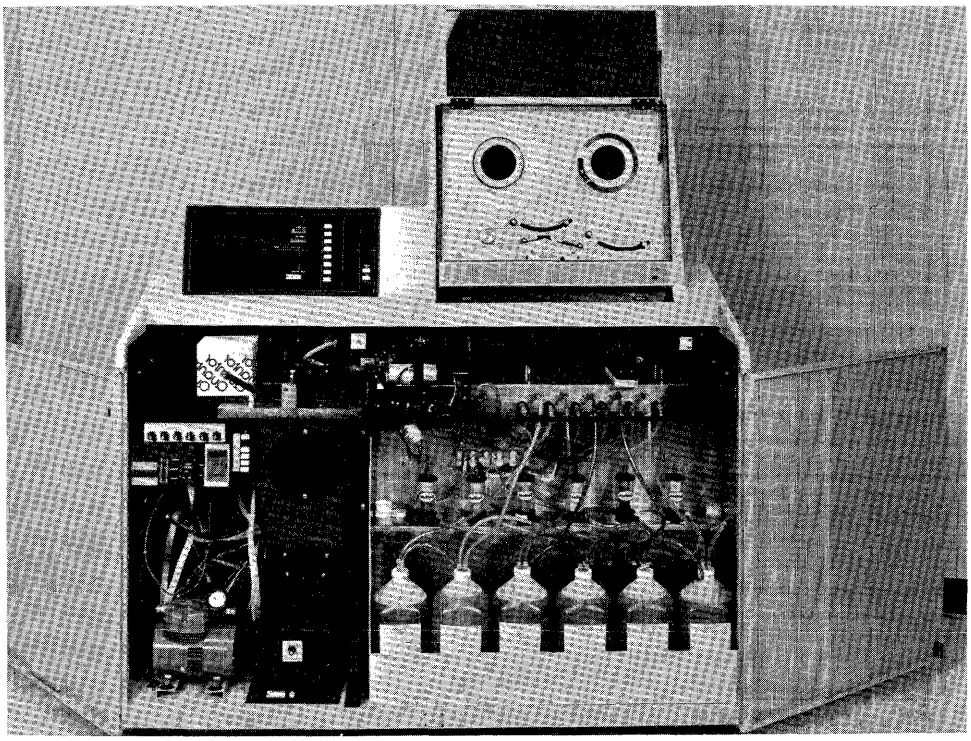
The performance measures most frequently quoted by the suppliers of COM recorders are characters printed per second and number of 132-character lines printed per minute. Both are important figures, yet both also represent optimum operating circumstances, such as optimum tape blocking factors, no frame advancing, no printing of graphics, etc.

A better performance criterion is the one referred to on the charts as frames per minute. This represents an attempt to measure throughput, since it includes not only the device's basic printing speed, but also the time required to advance a frame of film after an entire 64-line page has been exposed.

Conclusion

In summary, most business-oriented, medium-to-large-scale computer users should seriously investigate COM technology to determine whether or not real cost savings

All About Computer Output Microfilm (COM)



The Quantor 105 Microfiche Recorder has been gaining a significant market foothold over the past two years, owing in part to its in-line film processor, which is shown to the left below the tape drive. The six jugs that are installed in this unit, rather than the basic four, indicate that the film undergoes a tone reversal and the dry fiche segments coming from the 105 are negative in polarity. Since negative film is usually preferred, diazo duplication, which is non-reversing, can be used. A chemical charge lasts for about 50 hours of operation and hence can process about 50,000 pages.

and improved operations can be achieved in their particular installations. The potential for savings is evident.

COM Manufacturers

Listed below for your convenience in obtaining additional information are the full names and addresses of the manufacturers and distributors whose products are summarized in the following comparison charts.

Burroughs Corporation, Second Avenue at Burroughs, Detroit, Michigan 48232. Telephone (313) 972-9115.

California Computer Products, Inc., 2411 West LaPalma, Anaheim, California 92801. Telephone (714) 821-2260.

Eastman Kodak Company, 343 State Street, Rochester, New York 14650. Telephone (716) 325-2000.

Ferranti-Packard Limited, 121 Industry Street, Toronto 15, Ontario, Canada. Telephone (416) 762-3661. Ferranti is represented by

Hughes-Owens Company, Ltd., 124 Bermondsey Road, Toronto M4A1X, Ontario, Canada. Telephone (416) 757-8751.

Gould Data Systems, a Division of Gould, Inc., 20 Ossipee Road, Newton Upper Falls, Massachusetts 02164. Telephone (617) 969-6510.

Harris Communications Systems, Inc., a subsidiary of Harris-Intertype Corporation, 11262 Indian Trail, Dallas, Texas 75234. Telephone (214) 241-0551.

Information International, 12435 West Olympia Boulevard, Los Angeles, California 90064. Telephone (213) 478-2571.

Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-1000.

Pertec Corporation, 17112 Armstrong Avenue, Santa Ana, California 92705. Telephone (714) 540-8340.

Quantor Corporation, 520 Logue Avenue, Mountain View, California 95014. Telephone (415) 965-3700.

SEACO Computer-Display Incorporated, 2800 West Kingsley Road, Garland, Texas 7504. Telephone (214) 271-2431.

Singer Micrographic Systems, Singer Link Division, a Division of Singer-General Precision, Inc., 1077 East Arques Avenue, Sunnyvale, California 94086. Telephone (408) 732-3800.

Sperry Remington, P.O. Box 1000, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

Stromberg-DatagraphiX Inc., a General Dynamics subsidiary, P.O. Box 2449, San Diego, California 92112. Telephone (714) 291-9960.

SynerGraphics, Inc., Transamerica Pyramid, P.O. Box 7958, San Francisco, California 94120. Telephone (415) 983-5200.

3M Company, Computer Graphics Section, 3M Center, St. Paul, Minnesota 55101. Telephone (612) 733-1110. □

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Burroughs BCOM B 9262	CalComp 835	CalComp 1670/1675	CalComp 2100 Series	Eastman Kodak KOM-80
ON-LINE USAGE	Yes	Yes	Yes	Yes	No
Input data transfer rate, chars/sec.	96KC	100KC	500KC	500KC	–
Computer system interfaces	B3500, B4700, B6700, B7700	Any	IBM 360/370	IBM 360/30 up and IBM 370	–
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes	Yes	Yes
Input data transfer rate, chars/sec.	72KC, 96KC	16.5KC-30KC	30KC-60KC	30KC-60KC	60KC-120KC
Acceptable data codes	BCD/BCL, EBCDIC, ASCII	BCD, binary	BCD, ASCII, EBCDIC, binary	BCD, EBCDIC, ASCII, binary	EBCDIC
MAGNETIC TAPE UNIT	Yes	Yes	Yes	Yes	Yes
Number of tracks	7 and 9	7 or 9	7 or 9	7 and/or 9	9
Recording densities, bpi	200, 556, 800, 1600	200, 556, 800, 1600	200, 556, 800, 1600	200, 556, 800, 1600	800
Purchase price of tape unit	$27,000 and up	$17.5K-$30.5K	Standard	Standard	Avail. from mfr.
INTERNAL COMPUTER CONT'LL'R	No	Yes	Yes	Yes (see Com'nts)	No
Manufacturer	–	CalComp	CalComp	CalComp	–
Memory size, words	–	4K-32K	4K-32K	8K-32K	–
CHARACTER GENERATION TECHNIQUE	Stroke	Incremental plotting	Stroke	Stroke	Stroke
MONITOR	Polaroid	CRT	CRT (optional)	Viewing port	
FILM					
Width, mm	16, 35, 100	16, 35	16, 35, 105	16, 35	16, 35, 82.5, 105
Form	Roll, fiche	Roll	Roll, fiche	Roll, fiche	Roll, cartr.,fiche
Frame orientation	Cine or comic	Cine or comic	Cine or comic	Cine or comic	Cine or comic
ALPHANUMERIC CAPABILITY					
Characters per font	128	Unlimited	64	64; 128 (opt)	82
Standard and max. fonts	1; 1	Unlimited	1; infinite	1	2; 2
Character sizes	3	Unlimited	1; infinite	1	2
Intensity levels	1	32	1; infinite	1	10
GRAPHICS CAPABILITY	Yes	Yes	Yes	No	No
Addressable spot positions	1×10^6	16×10^6	256×10^6	–	–
Resolvable elements	1×10^6	1200 x 1200	16×10^6	–	–
Points per second	16KC	100KC	400KC	–	–
Point sizes	1	32	Infinite	–	–
Line widths	1	32	32	–	–
Intensity levels	1	32	32	–	–
FORMS OVERLAY TECHNIQUE	Forms flash	Programmed forms	Programmed forms	Forms flash	Forms flash
RETRIEVAL CODES	Image count, titles, index frames	Miracode, image count, bar code	Miracode, bar code, image count, code line	Image count	Image count
ERROR MARKING	Special character	None	Special characters	Special character	Special character
OPTIONAL FEATURES	81 lines/page	Disc storage and retrieval	Katakana character set, 105mm full-frame,disc,etc.	Katakana characters, various fiche software	Miracode, code line retrieval coding; interfaced operation with HP 2022A
SUPPORT					
Software	Standard	Basic-standard; applic't'n-opt.	Basic-standard; applic't'n-opt.	Basic-standard; applic't'n-opt.	Standard
Systems Assistance	Standard	Standard	Standard		Standard
PERFORMANCE DATA					
Frame advance rate, msec.	40	200	50-400	40-80	50-100
Characters printed/second	96KC	2.6KC	30KC	–	60KC-120KC
132-character lines/minute	31,000	1200	10,000	10,000-15,000	20,000
Frames/minute	365	17	100-250	230 max.	312
PRICING AND AVAILABILITY					
Purchase price	$65,000	$25K-$50K	Request price quotation	Request price quotation	$80K-$110K (see Comments)
Monthly rental, including maintenance (1-year lease)	$2,100	Request price quotation	Request price quotation	Request price quotation	$1,600 (see Comments)
Date of first delivery	10/69	1966	1970	1972	1971
Number installed to date	Not avail.	Over 50	Over 20	Not avail.	Not avail.
COMMENTS	Limited usage rate available.	Obtainable as used equipment on an as available basis. "Unlimited" above implies software execution.	"Infinite" above implies software execution. Model 1670 lacks the internal controller.	Controller is actually external and consists of a CalComp 900 Series Controller. Models 2130 and 2131 do not have a controller.	Lease price covers 10 hr/mo. Usage plan for additional operation is available. All prices are Datapro estimates.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Eastman Kodak KOM-90	Ferranti EP140 & EP 240	Gould Beta COM 600L	Gould Beta COM 700L	Gould Beta COM 800L
ON-LINE USAGE	No	Yes	No	No	No
Input data transfer rate, chars/sec.	–	33KC	–	–	–
Computer system interfaces	–	PDP-8, ICL 1900, IBM/360, Eliot 905	–	–	–
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes	Yes	Yes
Input data transfer rate, chars/sec.	7.5KC-120KC	5KC-30KC	36KC	36KC	36KC
Accepatable data codes	BCD, ASCII, EBCDIC	ASCII	Any	Any	Any
MAGNETIC TAPE UNIT	Yes	Yes	Yes	Yes	Yes
Number of tracks	7 or 9	7 or 9	7 and/or 9	7 or 9	7 and/or 9
Recording densities, bpi	200, 556, 800	200, 556, 800, 1600	556, 800, 1600	556, 800, 1600	556, 800, 1600
Purchase price of tape unit	Avail. from mfr.	Standard	Standard	Standard	
INTERNAL COMPUTER CONTR'LL'R	No	Internal option	Yes	Yes	Yes
Manufacturer	–	DEC	DEC	DEC	DEC
Memory size, words	–	4K-8K	4K-16K	4K-16K	4K-32K
CHARACTER GENERATION TECHNIQUE	Stroke	Linear circular interpolation	Dot matrix	Dot matrix	Dot matrix
MONITOR	Image	CRT	No	No	Optional CRT
FILM					
Width, mm	16, 35, 82.5, 105	16, 35	16, 35	16, 35, 70, 105	16, 35, 105
Form	Rolls, cartridge	Roll	Roll	Roll, fiche	Roll
Frame orientation	Cine, comic	Cine or comic	Cine or comic	Cine or comic	Cine or comic
ALPHANUMERIC CAPABILITY					
Characters per font	121	94-100	128	128	128
Standard and max. fonts	2; 2	1; 1	1; infinite	1; infinite	1; infinite
Character sizes	2	2	3	3	3
Intensity levels	10	1	4	4	
GRAPHICS CAPABILITY	No	Yes	Yes	Yes	Yes
Addressable spot positions	–	4×10^9	16×10^6	16×10^6	256×10^6
Resolvable elements	–	256×10^6	1×10^6	1×10^6	9×10^6
Points per second	–	500KC	100KC	100KC	200KC
Point sizes	–	2	1	1	1
Lines widths	–	2	1	1	8
Intensity levels	–	1	4	4	8
FORMS OVERLAY TECHNIQUE	Forms flash	Forms flash	Programmed form	Programmed form	Programmed form
RETRIEVAL CODES	Miracode, image count, code line	Image count, code line	Miracode, image count	Miracode, image count	Miracode, image count
ERROR MARKING	Special characters	Optional	Void or programmed mark	Void or programmed mark	Void or programmed mark
OPTIONAL FEATURES	Interfaced operation with HP 2022A	Programmed forms; character generator; CRT monitor	Axis vector generator, card reader, paper tape reader/punch, disc file external memory		
SUPPORT					
Software	Standard	Standard	Standard	Standard	Standard
Systems assistance	Standard	Standard	Standard	Standard	Standard
PERFORMANCE DATA					
Frame advance rate, msec.	50-100	100	100	100	100
Characters printed/second	60KC-120KC	10KC	40KC	40KC	20KC
132-character lines/minute	20,000	5,000	18,000	18,000	9,100
Frames/minute	312	75	178	178	115
PRICING AND AVAILABILITY					
Purchase price	$95K-$130K (see Comments)	Not avail.	$64,500	$73,500	$150,000
Monthly rental, including maintenance (1-year lease)	$2,850 (see Comments)	Not avail.	$2,345 (2-year lease)	$2,595 (2-year lease)	$4,900 (2-year lease)
Date of first delivery	1969	12/71	10/69	10/70	10/73
Number installed to date	Not avail.	Not avail.	Not avail.	Not avail.	–
COMMENTS	Lease price covers 20.1 hrs/mo. Usage plan for additional operation is provided. All prices are Datapro estimates.	EP 140 specializes in aperture cards. For further information, refer to Hughes-Owens, Ltd. of Canada.	Infinite number of fonts means that the user can order any style or change at any time.		This high-resolution graphic arts COM will be delivered in October 1973.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Harris Communications Model 300-2	Harris Communications Model 300-3	Information International FR-80	Information International COMp 80	Memorex 1603
ON-LINE USAGE	No	No	Yes	No	Yes
Input data transfer rate, chars/sec.	–	–	100KC	–	500KC
Computer system interfaces	–	–	Any	–	IBM 360/370
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes	Yes	No
Input data transfer rate, chars/sec.	36KC	36KC	30KC/60KC	30KC/60KC	–
	BCD, ASCII, EBCDIC	BCD, ASCII, EBCDIC	BCD, ASCII, EBCDIC	BCD, ASCII, EBCDIC	–
MAGNETIC TAPE UNIT	Yes	Yes	Yes	Yes	No
Number of tracks	7 and/or 9	7 and/or 9	7 or 9	7 or 9	–
Recording densities, bpi	556, 800, 1600	556, 800, 1600	200, 556, 800, 1600	556, 800, 1600	–
Purchase price of tape unit	Standard	Standard	Standard	Standard	–
INTERNAL COMPUTER CONTR'LL'R	No	No	Yes	Yes	No
Manufacturer	–	–	I. I. I.	I. I. I.	–
Memory size, words	–	–	4K-32K	8K-32K	–
CHARACTER GENERATION TECHNIQUE	Dot matrix	Dot matrix	Stroke	Stroke	5 x 7 dot matrix
MONITOR	Image	Image	CRT	CRT	No
FILM					
Width, mm	16, 35, 70, 105	16, 35, 70, 105	16, 35, 105	16, 35, 82.5, 105	16
Form	Roll, fiche, aperture	Roll, fiche, aperture	Roll, fiche	Roll, fiche	Roll
Frame orientation	Cine or comic	Cine or comic	Any	Any	Cine
ALPHANUMERIC CAPABILITY					
Characters per font	62	62	128	128	64
Standard and max. fonts	1; 1	1; 1	3; inf.	3; inf.	1; 1
Character sizes	1	1	64	64	1
Intensity levels	1	1	8; 64 optional	8; 64 optional	1
GRAPHICS CAPABILITY	No	Yes	Yes	Yes	No
Addressable spot positons	–	–	256 x 106	256 x 106	–
Resolvable elements	–	–	16 x 106	16 x 106	–
Points per second	–	16.8KC	90KC	50KC	–
Point sizes	–	1	8	8	–
Line widths	–	1	8	8	–
Intensity levels	–	1	8	8; 64 optional	–
FORMS OVERLAY TECHNIQUE	Forms flash	Forms flash	Programmed form	Programmed form	Forms flash
RETRIEVAL CODES	Image count, code line Miracode	Image count, Miracode	Image count, bar code, code line, Miracode	Image count, bar code, code line, Miracode	code line
ERROR MARKING	Error symbol and label void	Error symbol and label void	Any (as programmed)	Any (as programmed)	Any (as programmed)
OPTIONAL FEATURES	Hard copy, 128 characters (124 are printable)	Hard copy, 128 characters (124 are printable)	Color film; disc storage	Optical merge; disc storage	None
SUPPORT					
Software	Standard	Standard	Standard	Standard	Not required
Systems assistance	Standard	Standard	Standard	Standard	Standard
PERFORMANCE DATA					
Frame advance rate, msec.	100	100	74	74	42
Characters printed/second	36KC	36KC	8KC/40KC	250/40KC	22KC
132-character lines/minute	16,500	16,500	3,600/18,000	110-18,000	10,000
Frames/minute	180	180	52/194	52/194	141
PRICING AND AVAILABILITY					
Purchase price	$115,000	$139,000	$225,000	$245,000	$44,250
Monthly rental, including maintenance (1-year lease)	$3,175	$4,560	$7,500	$8,500	$895
Date of first delivery	1/70	10/70	7/69	6/71	4/70
Number installed to date	Not avail.	Not avail	26	3	200-250
COMMENTS	Harris Intertype has secured marketing rights to University Computing COM products.		The FR-80 is well respected for precise imaging and accurate registration. Different font generators can be substituted.	The COMp 80 adds to the FR-80 further photo-composition power. Different font generators can be substituted.	Although exact installation figures are not known, industry sources place the number of 1603 units in operation at 200-250.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Pertec 3700	Quantor Series 100	Quantor Series 105	Remington Rand Graphic COM 510	Remington Rand Rand COM 500
ON-LINE USAGE	No	No	No	Yes	No
Input data transfer rate, chars/sec.	—	—	—	36KC	—
Computer system interfaces	—	—	—	IBM/360	—
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes	Yes	Yes
Input data transfer rate, chars/sec.	60KC	30KC	30KC	36KC	36KC
Acceptable data codes	BCD, EBCDIC, ASCII	Any	Any	Any	Any
MAGNETIC TAPE UNIT	Yes	Yes	Yes	Yes	Yes
Number of tracks	7 and 9	7 and/or 9	7 and/or 9	7 and 9	7 and 9
Recording densities, bpi	556, 800, 1600	200, 556, 800, 1600	200, 556, 800, 1600	556, 800, 1600	556, 800, 1600
Purchase price of tape unit	Standard	Standard	Standard	Standard	Standard
INTERNAL COMPUTER CONTR'LL'R	No	No	No	Yes	No
Manufacturer	—	—	—	H-P	—
Memory size, words	—	—	—	8K-32K	—
CHARACTER GENERATION TECHNIQUE	7 x 9 dot matrix	7 x 10 dot matrix	7 x 10 dot matrix	Dot matrix	Stroke
MONITOR	No	Image	Processed fiche output	CRT	None
FILM					
Width, mm	16, 35, 70, 105, 82.5	16	105	16, 105	16, 35, 70, 82, 105
Form	Roll, fiche, aper.	Roll	Roll	Roll, fiche	Roll, fiche
Frame orientation	Cine or comic	Cine or comic	Comic	Cine and comic	Cine or comic
ALPHANUMERIC CAPABILITY					
Characters per font	64-128	64, 128	64, 128 (opt.)	Infinite	73
Standard and max. fonts	1; 1	1; 1	1; 1	Infinite	1
Character sizes	2	5	5	64	1
Intensity levels	1	2	2	256	1
GRAPHICS CAPABILITY	No	No	No	Yes	No
Addressable spot positions	—	—	—	8192 x 8192	—
Resolvable elements	—	—	—	4096 x 4096	—
Points per second	—	—	—	10K-100K	—
Point sizes	—	—	—	4	—
Line widths	—	—	—	4	—
Intensity levels	—	—	—	256	—
FORMS OVERLAY TECHNIQUE	Forms flash	Forms flash	Forms flash	Programmed, forms flash	Forms flash
RETRIEVAL CODES	Image count, titles, index frame	Bar code, image count, code line	Titles, index frames	Bar code, image count	Image count
ERROR MARKING	Void mark, parity symbol	Special character	Special character	Special character	Special character
OPTIONAL FEATURES	—	On-line film processing	—	None	1600-bip tape, extended page, tabbing
SUPPORT					
Software	Standard	Standard	Standard	Standard	Standard
Systems assistance	Standard	Standard	Standard	Standard	Standard
PERFORMANCE DATA					
Frame advance rate, msec.	100	80	Not applicable	70	90
Characters printed/second	60KC	30KC	30KC	36KC	26KC
132-character lines/minute	27,000	—	13,000	16,400	11,800
Frames/minute	245	180	200	228	145
PRICING AND AVAILABILITY					
Purchase price	$80,000	$50K-$65K	$65,000	$220,000	$45,000
Monthly rental, including maintenance (1-year lease)	$2,720	$1,750	$1,950	$8,980	$1,830
Date of first delivery	12/71	1/71	11/71	Not avail.	3/71
Number installed to date	130	Not avail.	109	Not avail.	65
COMMENTS	Extensive reformatting software is provided.	Reductions of 48 x, 42 x, 27 x, and 24 x are possible.	On-line film processing is standard. Comprehensive software support is provided. Reductions of 48 x, 42 x, 27 x, and 24 x are possible.	A flexible lease plan is available The Model 510 is the same as the Seaco Model 451.	A flexible lease plan is available. The Model 500 is the same as the Seaco Model 401.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Remington Rand Rand COM 505	Remington Rand Artwork Generator 1500	Seaco Model 401	Seaco Model 421	Seaco Model 451
ON-LINE USAGE	Yes	No	No	No	Yes
Input data transfer rate, chars/sec.	42KC	–	–	–	100KC
Computer system interface	IBM/360	–	–	–	Any
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes	Yes	Yes
Input data transfer rate, chars/sec.	36KC	36KC	36KC	36KC	30KC
Acceptable data codes	Any	Any	Any	All	Any
MAGNETIC TAPE UNIT	Yes	Yes	Yes	Yes	Yes
Number of tracks	7 and 9	7 and 9	7 or 9	7 and 9	7 and 9
Recording densities, bpi	556, 800, 1600	556, 800, 1600	556, 800, 1600	556, 800, 1600	556, 800, 1600
Purchase price of tape unit	Standard	Standard	Standard	Not avail.	Standard
INTERNAL COMPUTER CONTR'LL'R	No	Yes	No	No	Yes
Manufacturer	–	H-P	–	–	H-P
Memory size, words	–	8K-32K	–	–	8K-32K
CHARACTER GENERATION TECHNIQUE	Stroke	Stroke	Stroke	Stroke	Stroke
MONITOR	None	None	None	No	CRT
FILM					
Width, mm	16, 35, 70, 82 105	Plate, sheet	16, 35, 70, 105	16, 35, 70, 105	16, 35, 70, 105
Form	Roll, fiche	–	Roll, fiche	Roll, fiche	Roll
Frame orientation	Cine or comic	–	Cine or comic	Cine, comic	Cine or comic
ALPHANUMERIC CAPABILITY					
Characters per font	133	Infinite	73	132	128
Standard and max. fonts	1	–	1; 1	1; 1	1; infinite
Character sizes	1	–	1	1	64
Intensity levels	1	16	1	1	256
GRAPHICS CAPABILITY	No	Yes	No	No	Yes
Addressable spot positions	–	16K x 16K	–	–	8192 x 8192
Resolvable elements	–	16K x 16K	–	–	4046 x 4046
Points per second	–	20KC	–	–	100KC
Point sizes	–	2	–	–	4
Line widths	–	3	–	–	4
Intensity levels	–	16	–	–	4
FORMS OVERLAY TECHNIQUE	Forms flash	Programmed	Forms flash	Forms flash	Forms flash; programmed forms
RETRIEVAL CODES	Optional	Programmed	Code line, bar code	Code line, bar code	Miracode, image count, bar code, code line
ERROR MARKING	Special character	No	Special character	Special character	Special character
OPTIONAL FEATURES	1600-bpi tape, Fiche camera	16 to 105 mm camera and lens	1600 bpi tape; microfiche camera; 9 track tape; etc.	Tape drives, universal camera	Additional tape unit
SUPPORT					
Software	Not required	Standard	Standard	Standard	Standard
Systems assistance	Standard	Standard	Standard	Standard	Standard
PERFORMANCE DATA					
Frame advance rate, msec.	70	–	90	90	90
Characters printed/second	36KC	–	26KC	26KC	22KC
132-character lines/minute	16,400	–	11,800	11,800	10,500
Frames/minute	228	–	145	145	130
PRICING AND AVAILABILITY					
Purchase price	120K and up	Over $250K	$45,000	$115K and up	$175K-$200K
Monthly rental, including maintenance (1-year lease)	$5,000 and up	Not avail.	$1,830	Not avail.	$7,450
Date of first delivery	7/71	12/69	7/70	Not avail.	8/71
Number installed to date	Not avail.	Not avail.	Not avail.	Not avail.	Not avail.
COMMENTS	A flexible lease plan is available. The Model 505 is the same as the Seaco Model 421.	For printed circuits and integrated circuit masks.	Same as Rand COM 500.	This model is essentially Model 401 enhanced with various ROMs for special character fonts and code translations; intended for foreign markets.	Model 451 is a high-quality graphic arts recorder.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Singer MS-5000	Singer MS-6000	Stromberg DatagraphiX 4020	Stromberg DatagraphiX 4060
ON-LINE USAGE	Yes	Yes	Yes	Yes
Input data transfer rate, chars/sec.	Up to 600KC	Up to 600KC	90KC	250KC
Computer system interfaces	Any	Any	IBM/360	IBM/360
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes	Yes
Input data transfer rate, chars/sec.	14KC-240KC	14KC-240KC	90KC	120KC, 90KC
Acceptable data codes	Any	Any	BCD, binary	BCD, ASCII, EBCDIC
MAGNETIC TAPE UNIT	Yes	Yes	Yes	Yes
Number of tracks	7 and 9	7 and 9	7 or 9	7 or 9
Recording densities, bpi	556, 800, 1600	556, 800, 1600	200, 556, 800	200, 556, 800, 1600
Purchase price of tape unit	$15K-$32K	$15K-$32K	$22,000	$31K-$34K
INTERNAL COMPUTER CONTR'LL'R	No	Yes	No	Yes
Manufacturer	—	Datacraft	—	Honeywell
Memory size, words	—	4K-64K	—	8K
CHARACTER GENERATION TECHNIQUE	Stroke	Stroke	Charactron vector	Charactron vector
MONITOR	CRT	CRT	No	Image
FILM				
Width, mm	16, 35, 105	16, 35, 105	16, 35	16, 35
Form	Roll, fiche	Roll, fiche	Roll	Roll
Frame orientation	Cine or comic	Cine or comic	Cine or comic	Cine or comic
ALPHANUMERIC CAPABILITY				
Characters per font	128	128	64	119
Standard and max. fonts	1; 1	1; 1	1; infinite	1; infinite
Character sizes	1	1	1	4
Intensity levels	1	1	16	1
GRAPHICS CAPABILITY	Yes	Yes	Yes	Yes
Addressable spot positions	256×10^6	256×10^6	1×10^6	12×10^6
Resolvable elements	16×10^6	16×10^6	2×10^6	3×10^6
Points per second	200KC	200KC	12.5KC	60KC
Point sizes	8	8	1	12
Line widths	8	8	1	4
Intensity levels	8	8	1	2
FORMS OVERLAY TECHNIQUE	Forms flash (manual and carrousel); programmed forms	Forms flash (manual and carrousel); programmed forms	Slide	Slide or programmed form
RETRIEVAL CODES	Miracode, titles, index frames	Miracode, titles, index frames	Sequential retrieval mark (SRM)	Miracode, code line, image count, SRM
ERROR MARKING	No	No	Special character	Special character and void mark
OPTIONAL FEATURES	Character generator; forms flash	Character generator; forms flash	Hard copy	None
SUPPORT				
Software	Standard	Standard	Standard	Standard
Systems assistance	Standard	Standard	Standard	Standard
PERFORMANCE DATA				
Frame advance rate, msec.	100	100	100	100
Characters printed/second	20KC	20KC	17KC	25KC
132-character lines/minute	9,100	9,100	7,000	7,000
Frames/minute	115	115	101	90
PRICING AND AVAILABILITY				
Purchase price	$135K-$185K	$200K-$300K	Not avail.	Not avail.
Monthly rental, including maintenance (1-year lease)	$4,400-$6,000	$6,600-$10,000	Not avail.	Not Avail.
Date of first delivery	11/70	3/71	5/60	6/66
Number installed to date	Not avail.	Not avail.	Not avail.	Not avail.
COMMENTS	Character data assumes the inclusion of the optional hardware character generator. Other retrieval codes are optional. Font style can be selected. Software for MS-6000 is extensive and free of charge. Both units exhibit unusual stability and precision.		No longer manufactured, but reconditioned units are available in limited quantities.	Used unit pricing available.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Stromberg DatagraphiX 4360	Stromberg DatagraphiX 4200	Stromberg DatagraphiX 4400	Stromberg DatagraphiX 4440
ON-LINE USAGE	Yes	Yes	No	Yes
Input data transfer rate, chars/sec.	–	60KC	–	120KC
Computer system interfaces	–	IBM/360	–	IBM/360
OFF-LINE USAGE (with magnetic tape)	Yes	No	Yes	Yes
Input data transfer rate, chars/sec.	60KC	–	62.5KC	120KC
Acceptable data codes	BCD, EBCDIC	–	BCD, EBCDIC	BCD, EBCDIC, ASCII
MAGNETIC TAPE UNIT	Yes	No	Yes	Yes
Number of tracks	7 or 9	–	7 or 9	7 or 9
Recording densities, bpi	556, 800, 1600	–	200, 556, 800	556, 800, 1600
Purchase price of tape unit	$15.8K-$19.7K	–	$22,000	$19.7K-$28K
INTERNAL COMPUTER CONT'LL'R	No	No	No	No
Manufacturer	–	–	–	–
Memory size, words	–	–	–	–
CHARACTER GENERATION TECHNIQUE	Charactron	Charactron	Charactron	Charactron
MONITOR	Viewing port	Viewing port	Viewing port	Polaroid viewing port
FILM				
Width, mm	16, 35, 105	16, 35, 105	16	16, 35, 105
Form	Roll, fiche	Roll, fiche	Roll	Roll, fiche
Frame orientation	Cine and comic	Cine or comic	Cine and comic	Cine and comic
ALPHANUMERIC CAPABILITY				
Characters per font	64	64	64	128
Standard and max. fonts	1; 1	1; 1	1; 1	1; 2
Character sizes	1	1	1	1
Intensity levels	1	1	1	1
GRAPHICS CAPABILITY	No	No	No	No
Addressable spot positions	–	–	–	–
Resolvable elements	–	–	–	–
Points per second	–	–	–	–
Point sizes	–	–	–	–
Line width	–	–	–	–
Intensity levels	–	–	–	–
FORMS OVERLAY TECHNIQUE	Slide	Slide	Slide	Slide
RETRIEVAL CODES	SRM, titles, index frames	SRM, titles, index frames	image count, Codeline, SRM, titles, index frames	SRM, titles, index frames
ERROR MARKING	Special character and void mark	Special character and void mark	Special character and void mark	Special character and void mark
OPTIONAL FEATURES	Line printer simulator, fiche camera	None	Line printer simulator	Line printer simulator, fiche camera
SUPPORT				
Software	Standard	Standard	Standard	Standard
Systems Assistance	Standard	Standard	Standard	Standard
PERFORMANCE DATA				
Frame advance rate, msec.	116	116	100	96
Characters printed/second	60KC	60KC	62.5KC	120KC
132-character lines/minute	14,000	14,000	13,800	21,000
Frames/minute	218	200	224	330
PRICING AND AVAILABILITY				
Purchase price	$69,000	$49,000	$72,000	$108,000
Monthly rental, including maintenance (1-year lease)	$2,200	$2,200	$2,300	$3,650
Date of first delivery	11/67	2/71	1/66	4/68
Number installed to date	Not avail.	Not avail.	Not avail.	Not avail.
COMMENTS	24X, 42X, and 48X reduction ratios; $1,250/mo. under Frame Usage Lease Plan.	24X, 42X, and 48X reduction ratios; $950/mo. under Frame Usage Lease Plan.	No longer manufactured; used units available at special prices	24X, 42X, and 48X reduction ratios; $2,900/mo. under Frame Usage Lease Plan.

All About Computer Output Microfilm (COM)

MANUFACTURER AND MODEL	Stromberg DatagraphiX 4460	SynerGraphics Northstar 3700	3M Company Series "F" EBR
ON-LINE USAGE	Yes	No	Yes
Input data transfer rate, chars/sec.	250KC	—	60KC
Computer system interfaces	IBM/360	—	IBM/360
OFF-LINE USAGE (with magnetic tape)	Yes	Yes	Yes
Input data transfer rate, chars/sec.	120KC	60KC	41.7KC/60KC
Acceptable data codes	BCD, EBCDIC, ASCII	BCD, EBCDIC, ASCII	BCD, EBCDIC
MAGNETIC TAPE UNIT	Yes	Yes	Yes
Number of tracks	7 or 9	7 and 9	7 or 9
Recording densities, bpi	200, 556, 800, 1600	550, 800, 1600	200, 556, 800, 1600
Purchase price of tape unit	$31K-$34K	Standard	$11K-$19K
INTERNAL COMPUTER CONTR'LL'R	Yes	No	Yes
Manufacturer	Honeywell	—	3M/CDC/Lockheed
Memory size, words	8K	—	4K-32K
CHARACTER GENERATION TECHNIQUE	Charactron vector	7 x 9 dot matrix	Stroke
MONITOR	Image	No	Image
FILM			
Width, mm	16, 35, 105	16, 35, 70, 82.5, 105	16, 105
Form	Roll, fiche	Roll, fiche, aper. cards	Roll
Frame orientation	Cine and comic		Cine or comic
ALPHANUMERIC CAPABILITY			
Characters per font	119	128	64-128
Standard and max. fonts	2; infinite	1; 1	Infinite
Character sizes	4	2	2
Intensity levels	1	1	1
GRAPHICS CAPABILITY	Yes	No	Yes
Addressable spot positions	12×10^6	—	4×10^6
Resolvable elements	2×10^6	—	4×10^6
Points per second	60KC	—	40KC
Point sizes	12	—	2
Line widths	4	—	2
Intensity levels	2	—	Operator adjustable
FORMS OVERLAY TECHNIQUE	Slide, programmed form	Forms flash	Slide; programmed form
RETRIEVAL CODES	Codeline, image count, SRM, titles, index frames	Image count, titles, index frames	Image count
ERROR MARKING	Special character and void mark	Void mark, parity symbol	Error symbol
OPTIONAL FEATURES	4 interchangeable cameras, card reader, paper tape reader		On-line film processing; 105mm camera
SUPPORT			
Software	Standard	Standard	Standard
Systems assistance	Standard	Standard	Standard
PERFORMANCE DATA			
Frame advance rate, msec.	100	100	25-60
Characters printed/second	50KC	60KC	60KC
132-character lines/minute	12,000	27,000	20,000
Frames/minute	180	245	362
PRICING AND AVAILABILITY			
Purchase price	$150,000	$80,000	$86,600
Monthly rental, including maintenance (1-year lease)	Not avail.	$2,720	$2,140-$3,085
Date of first delivery	6/71	Not avail.	10/68
Number installed to date	Not avail.	Not avail.	75
COMMENTS	24 x, 42 x, and 48 x reduction ratios.	This unit is the same as the Pertec 3700. SynerGraphics software enables COM tapes to be recorded in a single mainframe run.	A fiche maker accessory supplied by 3m can convert roll film to any fiche structure.

All About Data Collection Equipment

Data collection is the catch-all phrase for data input devices normally used in environments other than computer data preparation areas. The equipment ranges from central recording systems for reporting attendance and work-in-progress information to hand-held tape recorders for inventory-taking. And there are some exotic devices in between. This report surveys the specialized equipment available from 31 vendors and summarizes users' experience with the most popular data collection systems.

In the course of responding to our subscribers' expressed interest in data collection systems and devices, Datapro had to draw some boundaries around the category. Otherwise, every device that records or transcribes data in any fashion would be a candidate for inclusion in the report. After all, there is little difference between a conventional card reader and a badge reader, except in the environmental and human engineering aspects. The desirability of being able to accommodate a thicker document (plastic card), the desirability of low cost, and the lack of need for high reading speed or stacker capabilities have produced badge readers that differ markedly from conventional card readers in practice, but the basic principles are the same. A card reader could be used as a badge reader, but it would definitely not be a practical choice.

The subject material of this report is circumscribed by two criteria:

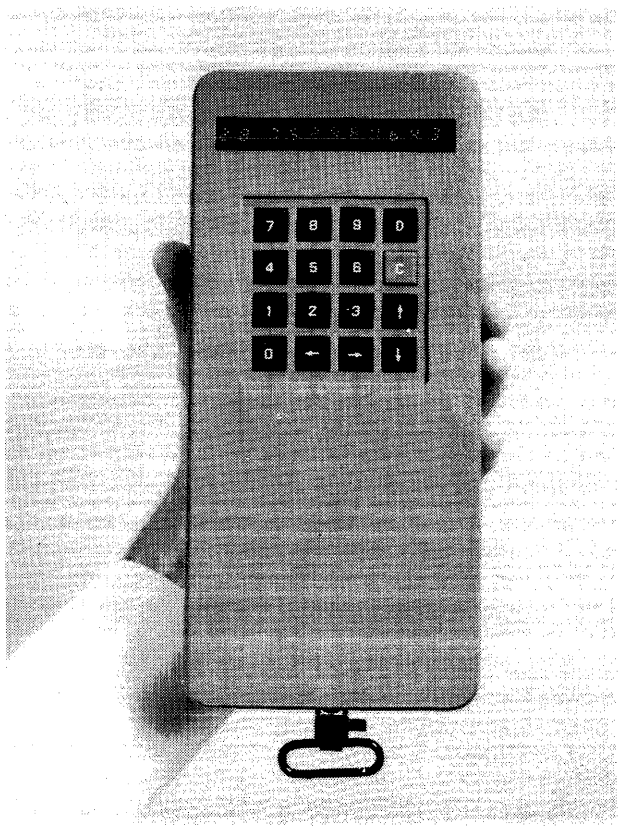
- The equipment must be capable of accepting variable information manually entered by an operator.
- The equipment must not appear elsewhere in DATAPRO 70 as a type of device already reported on.

These rules largely exclude the wares of component manufacturers, computer peripheral equipment vendors (disk drives, tape units, card readers, OCR/OMR readers, etc.), key entry vendors (keypunches, key/disk systems, etc.), office equipment vendors (typewriters recording on cassette tape, word processing systems, etc.), and many computer terminal vendors (intelligent terminals, typewriter terminals, CRT's, etc.). Of these types of equipment, only mini-peripherals and office equipment are not covered in other places within the pages of DATAPRO 70. (Later on in this report we will get more specific about just where they *are* covered and whether they are viable alternatives to the equipment described in this report.) Mini-peripherals and office equipment are covered adequately in other Datapro reference services (*Datapro Reports on Minicomputers* and *Datapro Reports on Office Systems,* to be specific).

Defining Our Terms

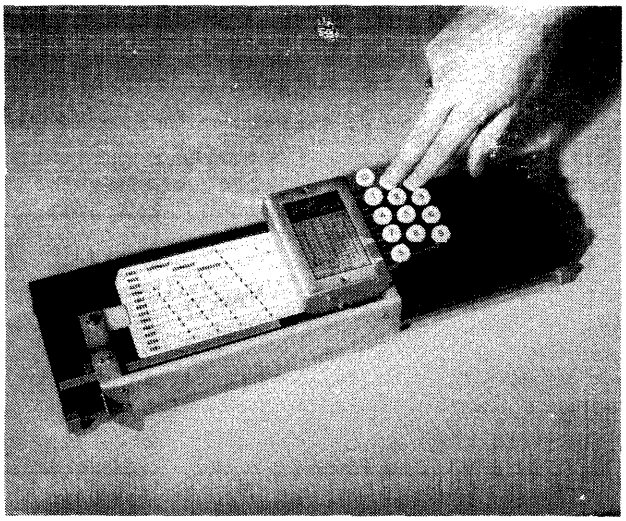
To examine the need that provided the impetus for the development of data collection equipment, we need to distinguish among three terms, all relating to converting data into a form that can be manipulated by a computer. Those three terms are *key entry, source data automation,* and *factory data collection.* In the younger, simpler days of data processing, when we were talking about bringing the power of the computer to bear on the problems of information management but before the majority of us had gotten around to actually doing it, these terms comprised the whole of the vocabulary concerning data preparation for the computer. Employing the precision available with hindsight, these terms meant:

- *Key entry*—That which was done in the keypunch room, although even then many users desired alternatives.
- *Source data automation*—Capturing data as the byproduct of a conventional business transaction. Optical character readers and/or recording typewriters that read or recorded documents as they were generated were seen to be the answer for eliminating the need for double keying of business information. This equipment was always thought of in terms of a clean office or store environment.



For those of you who remember when the Digitronics Port-A-Verter was the only portable terminal, this self-contained Infopac I from AzurData may seem more like a watch fob. It stores data in a semiconductor memory and transmits it to a central pooling station via an acoustic coupler unit.

All About Data Collection Equipment



It looks simple, and it is. The Wright Line Punch can produce any card code by simply depressing as many keys as required. It may not be fast, but it doesn't require anything but a tab card and an operator to produce computer input.

- *Factory data collection*–Recording data as it happened on the shop floor. This was the "dirty" or industrial-environment equivalent to source data automation.

As is typical with maturing technologies, simple, generalized solutions were usually found to be impractical for addressing specific problems. Source data automation was replaced with point of sale (POS) and transaction processing (which creeps over into other areas as well). And POS was in turn fragmented into department/retail stores, supermarkets, fast food outlets, hotels, hospitals, etc., each with slightly different information entry and handling needs. This was the natural result of equipment makers, faced with the economic necessity of generating revenues, finding out that general solutions are great for learned papers and philosophical discussion but are inadequate for specific solutions. Specialization was inevitable.

Key entry, on the other hand, was already specialized. The changes in that area involved the development of new kinds of equipment to do the job cheaper and faster. In fact, there is reverse specialization occurring, with key entry equipment taking on some of the tasks traditionally assigned to the host computer.

Factory data collection shares with source data automation (POS) the need for highly human-engineered input stations, and it shares with key entry and POS the advantages of distributed processing (intelligent input stations). But in two ways it is unique. One has already been mentioned–the need to function reliably in adverse environments. The other is the lack of clerically oriented personnel to operate the input stations. The problem of getting a master machinist to enter data at an input station is radically different from getting a counter clerk to use a different kind of cash register. These two considerations–adverse environment and personnel–are just as important in the development of a data collection system as is the information to be collected and the manner in which it is processed.

The term "factory data collection" unfortunately implies that it involves only shop floor data reporting. Just as the term "source data automation" could not for long completely summarize data collecting activities in stores or other business transaction locations, the term "factory data collection" inadequately summarizes the range of data collecting activities that can be grouped under its head. In general, this group includes all data collection occurring in an uncontrolled environment, whether it be a manufacturing area, a warehouse, or outdoors.

It is not possible to be entirely rigorous about categorization of product and application types. There is too much crossover in the application of technology and techniques. However, undaunted by the impossible, we will set up some categories to make the equipment covered in this report understandable. *Key entry* encompasses all of the conventional data preparation and entry tasks directly associated with the computer and the people who tend it. It includes keypunch and key/disk operations as well as terminal operations. Normally, the data entry process and people are not directly involved with a business transaction at the time of entry. *POS* includes those operations involving a business transaction where control of the transaction is an important function and the collection of data is a byproduct; frequently, such operations involve a money transfer, cash or credit. *Data collection,* then, includes those operations performed in an uncontrolled environment by the people responsible for doing the work being reported on, and the transactions do not normally involve money transfers. POS usually involves a transaction between a company and the public; data collection usually involves an internal company operation.

Narrowing the field in this manner leaves three general classes of equipment: 1) portable units to be carried to the point of information occurrence; 2) stand-alone devices that record data in a manner that enables it to be transferred to a computer at a later time, but are not portable; and 3) systems composed of multiple stand-alone devices feeding a central data recorder or computer directly.

Why Collect Data?

The *reason* for collecting data is essentially the same regardless of the application or the equipment used. Information is required to enable management 1) to know what is going on, and 2) to make intelligent decisions about what to do next. Those decisions include making changes as well as letting things continue just as they are with the comforting assurance that things are proceeding according to plan.

If you can stand in one place and see everything that is going on and keep straight in your head how much raw material remains, who is working today, how much time each employee has spent on each job (and how that

All About Data Collection Equipment

compares with previous jobs), the status of each job in house, the status of inventory of finished goods, how much has been shipped, how much remains to be shipped on each contract, etc., then you do not need any fancy collection equipment to record the elements of such data or information. If however, your manual reporting system consistently fails to let Purchasing know about the need for a raw material or component before the floor runs out, or if you find yourself with a warehouse full of widgets and a pile or orders for whatchamacallits, then you need to take a look at improving your information collection procedures.

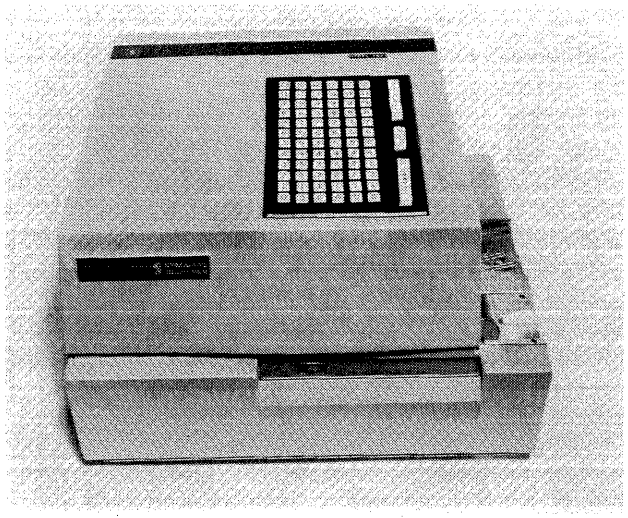
Advantages of Automated Data Collection

The advantages of using automated recorders to gather data are threefold: 1) it is faster; 2) it is more accurate; and 3) it permits data processing equipment to be used in the analysis and reporting of information.

Speed is relative, and not necessarily a good thing in its own right. Each level of system enhancement implemented to increase the speed of data flow must be justified in terms of cost-effectiveness. In general, the faster information becomes available to managers, the more closely events can be controlled. Closer control can translate into reduced inventories and other efficiencies that mean direct savings in purchases and storage. But closer control can also translate into interference that upsets the smooth functioning of an operation. Which result you'll achieve depends on the quality of management you have and its adaptability to the new tools represented by improved information gathering. But managers have been coping with changes in techniques for a long time, and the previous statement should not be considered to represent an alarmist attitude. It merely reiterates the important point that improved equipment and tools provide the opportunity for enhanced performance but cannot guarantee it.

The accuracy of automated recorders stems from the reduction in the number of times data is transcribed manually. Magnetic tape recorders, semiconductor memories, optical wands, badge readers, keyboards, and all the other types of electronic/mechanical devices can and do introduce errors in a host of different ways. But just as the computer cannot (at present) exercise intuitive data perception and linking, the human cannot equal the transcription accuracy of these devices. Of course, the data is normally entered by the human as the first step, and cards can be inserted upside down or a wrong key depressed; but the subsequent transfers and manipulations of data are relatively free of transcription errors from that point on. As with speed, each implementation of a higher level of freedom from error carries with it costs which must be evaluated in terms of the cost of the error and the cost of alternatives.

The third advantage, permitting the use of data processing equipment, is really self-evident. You would not collect the data if you were not going to analyze it, and you would not put it in machine-readable form if you were not going to use machines to read it. (This statement excludes the whole area of reading environmental variables directly for process control, for security access control, and other automated control systems, as that area is outside the scope of this report.)



The Standard Register Source Record Punch is, in essence, a considerably more sophisticated version of the portable Wright Line Punch in the preceding photograph. In addition to punching keyed data, it can also be attached to digital output devices such as scales to produce a permanent, readable record of events and values.

Getting Down to Specifics

The general nature of the preceding discussion serves to set the stage for discussion of the specifics. (You can get a general article in the supplement to a Sunday newspaper for a quarter; Datapro intends to provide more than that.) The general discussion was necessary to prevent multitudinous exceptions and comments about the scope of the report.

There are two basic types of situations that occasion the recording of data. In one, a person in a fixed location observes occurrences that need recording as they pass his station. An example of this is reporting on work in progress. As each job order passes a particular point in manufacture, that information is recorded. The task location remains fixed and the information comes to it, so to speak. The second situation is where the job requires the person observing the information (and recording it) to move over a fairly wide area. Inventory taking is an example of this situation. It would be inconvenient, time-consuming, and costly to move all the inventory items past a fixed recording station each time you wished to take a count of what is in inventory. In this situation, the information remains fixed and the observer goes to it.

All data collection systems can be resolved into combinations of these two types of situations—but that resolution is not always simple. Part of the complication has to do with who performs the data recording. Take, for example, the work-in-progress reporting task mentioned above. If

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the person doing the reporting is the operator of the fork-lift who physically moves the components under construction from point to point, is the operator or the information moving? If the production operation is geared to bringing different specialized teams to the component under construction, is the reporting performed at a fixed location by different personnel as they move into the area, or are portable recorders taken along with the moving teams, or is some combination of both used? Do you count parts as shipped, or do you count each day's beginning and ending totals and assume that the difference is the number shipped?

It should be clear by now that the overriding characteristic of data collection is not the particular equipment employed, but the information to be collected and the uses to which it is to be put. But that is an oversimplification. There is an interrelationship between the equipment available and the things that can be done. Without portable data recording devices, it would be pointless to discuss applications requiring them. Without centralized data recording systems, it would be pointless to discuss minute-to-minute information updating and analysis.

Three Key Questions

This brings us to the point of being able to summarize the problem of data collection system design in terms of the answer to three interrelated questions:

- What do you want to do?
- What equipment is available to accomplish this?
- What compromises are required because of cost or equipment availability?

We approach a discussion of the first question with some trepidation, because it is very easy to tread on someone's toes. Every conceivable combination of committee, task force, specialist, vendor, consultant, relative, etc., has been used to ferret out the design parameters for an information system. Each approach has met with success—and each with failures. The first question is actually a shorthand way of summarizing a number of questions, such as: What information is needed? How is it going to be generated and who will enter it? Who will use it and what does he need to see? What is the time frame between the entry and use of information?

Regardless of the actual procedure you use for tying down the information reporting needs, sooner or later you have to get specific. Asking whether you should look at available equipment first or determine functional requirements first is like asking whether the chicken or the egg came first—there is no set answer. You must do both at the same time. Preliminary information and cost needs will to some degree place restrictions on the equipment that can fill those needs, and available equipment will suggest possible solutions to your problem.

One often-overlooked aspect of system design is system assurance. Whether the system is designed by in-house personnel, a consultant, or a vendor under a development contract, someone needs to have the responsibility for checking the final plans to make sure that all needs are met in a reasonable way. This takes extra time and personnel but should be a key part of any information system development project. System assurance personnel frequently need to display tact to avoid offending someone because his pet idea is not feasible. The usual manner of system implementation is to get input from all affected personnel before the system is finished. The tacit assumption is that since everyone has had an opportunity to comment, the final version will meet everyone's needs. While the process looks rather trite when set down on paper, in actual practice, it is anything but trite.

Another source of possible difficulty, closely related to system assurance, is the question of who is responsible for putting the system together. If the final system includes components from multiple vendors, then someone has to interface with those vendors to make sure that the various components are delivered on time and are indeed the ones ordered. This can be performed internally or by an external agent, such as a prime contractor, or even by the major vendor of components if he also assumes the responsibility for the system. In any case, make sure that someone does have the responsibility—and that he knows he has it.

Equipment Considerations

The principal portion of this report is devoted to the available equipment. The comparison charts at the end of this report provide an overview of the various vendors and the products they market. The explanation of the comparison chart entries immediately preceding the charts contains a great deal of information about the various types of equipment. Here, let us only be concerned with some general comments on equipment style.

Perhaps the most basic question concerning equipment is whether the recording devices need to be portable or whether they can remain in a fixed location. Portable devices are normally tied into a system through communications links. Typically, a central recorder can poll a number of remote locations, using the telephone network. The only catch is that, if the portable device has not been returned to its cradle or the cassettes have not been loaded into the remote transmitter, the central receiver draws a blank. Fixed devices, barring malfunction, are always ready.

If your information needs are not time-critical, you can consider equipment that is not tied directly into a central system. The recorders, portable or fixed-location, record on some type of medium (punched cards, magnetic tape, etc.) that is hand-carried to the central processing facility. Advantages of recording accuracy are gained at the expense of timeliness.

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A second consideration having a significant effect on possible system design, assuming that direct connection is desirable, is whether one-way or two-way transmission is needed. One-way transmission permits the gathering of data at a central point. Two-way transmission permits instructions, inquiry responses, or other information to be returned to the input stations. If two-way transmission is decided upon, the type of display must be determined. Displays can be "soft" (such as a CRT or LED array) or "hard" (such as a printer), depending on whether or not you want a permanent copy.

Each of these advances in flexibility costs more, not only in terms of equipment, but also in terms of system development and programming. It is your problem to determine whether the flexibility that enables supervisors to make system inquiries about the status of particular jobs at many remote locations around a plant is a luxury or a necessity.

The environment in which the equipment will be called on to function is also an important factor that needs to be clearly spelled out to prospective suppliers. If you neglect to mention that your input station has to operate in the middle of a car wash, for example, then you will get a lot of proposals from vendors that are inadequate and will only waste both your time and theirs. Excluding toxic areas, machines are generally more sensitive to adverse environments than humans, so knowledge that people will be working in an area is no sure indication that special requirements for machines do not exist. One point of confusion involves the special environmental requirements for large computers, whereas small computers can function in a "typical office" environment. The fact is that large computers could function perfectly well in the same typical office environment, but they dissipate so much heat that without special air conditioning they would soon convert that office environment to something approaching the Sahara Desert.

What About Conventional Terminals?

Early in this report we set down the rules which we used for selecting the equipment to be included in this report. At that time, we mentioned the conventional data processing devices discussed in other places within DATAPRO 70. Virtually any device that can record or read data can be worked into a data collection system somehow, whether at the central recording site or at a remote input station. Therefore, nearly all of the equipment reports in DATAPRO 70 may be applicable, to one degree or another. There are two guides to the contents of DATAPRO 70. Near the front of Binder 1, there is a comprehensive, functional Index that lists all the reports by product type, vendor name, and product name. In addition, there is a detailed Table of Contents at the beginning of each binder, which lists all the reports in that binder. Other pertinent reports in DATAPRO 70 include the survey reports, such as this one, on particular classes of products (the "All About" report series).

Most of the equipment included in this report can be considered specialized, if for no other reason than the fact that you do not find these devices in the typical business data processing shop. In considering the implementation of data collection systems of the type discussed in this report, you may well wonder whether more conventional devices, and communications terminals in particular, could be used effectively to reduce the number of vendors involved and thus simplify the procurement task. The answer is yes, they can, except where environmental conditions prohibit their use. However, the nature of such devices generally indicates that they would be a poor choice because of the second unique characteristic of data collection systems mentioned early in this report—personnel considerations.

The Termiflex photographer has produced a clever bit of staging. Enclosed in the attache case is everything the modern businessman needs—a calculator, a personal dictating unit, an appointment book, and a computer terminal. Although not truly portable, the Termiflex HT/2 hand-held display unit has sufficiently powerful features to generate a great deal of interest at trade shows. A fully portable unit resembling the Termiflex, but with less sophisticated display features, is marketed by Telxon.

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USER RATINGS OF DATA COLLECTION EQUIPMENT

Equipment	No.of User Responses	No.of Input Stations	Environment*				User Ratings**																						Problems*				
			Office	Warehouse	Shop, clean	Shop, dirty	Overall Satisfaction					Ease of Input					Ease of Training					Hardware Reliability					Maintenance					Training	Reliability	Usability of info.	Environment	Ease of input
							WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P	WA	E	G	F	P					
Data Pathing	8	495	5	5	6	5	3.6	4	3	0	0	3.4	3	4	0	0	3.6	4	3	0	0	3.4	3	4	0	0	3.7	5	2	0	0	0	0	0	0	0
IBM 357	5	58	0	1	2	4	2.8	1	3	0	1	3.4	2	3	0	0	3.4	2	3	0	0	2.6	2	0	2	1	3.0	2	1	2	0	0	3	0	1	0
IBM 1030	10	279	1	2	7	4	2.9	1	8	0	1	3.2	4	4	2	0	3.2	2	8	0	0	2.8	2	5	2	1	2.9	2	5	3	0	1	3	0	0	3
IBM S/7-2790	8	103	0	1	4	4	3.3	3	4	1	0	3.5	5	2	1	0	3.4	3	5	0	0	3.5	4	4	0	0	3.3	3	4	1	0	1	3	1	1	1
IBM 3270***	4	193	4	2	3	3	3.3	1	3	0	0	3.8	3	1	0	0	3.8	3	1	0	0	3.3	1	3	0	0	3.3	1	3	0	0	0	0	0	0	0
Totals	35	1125	10	11	22	20	3.1	10	21	1	2	3.4	17	14	3	0	3.4	14	20	0	0	3.1	12	16	4	2	3.2	13	15	6	0	2	9	1	2	4

* Response counts.

** Response counts. Legend is E—Excellent; G—Good; F—Fair; P—Poor; WA—Weighted Average based on assigning equal weight to each user response and weights of 4 for Excellent, 3 for Good, 2 for Fair, and 1 for Poor.

***The IBM 3270 CRT display is not normally thought of as a data collection device in the same sense as the other equipment mentioned, but the use environments and the applications which the users listed clearly indicated that they were using the 3270 in place of equipment like the other types listed here.

General-purpose data communications terminals seldom have the necessary provisions for operator guidance unless extensive programming is done at the central site to generate prompting messages. Simple data entry in fixed formats without extensive prompting is feasible; but a complete typewriter keyboard may not convey the essential concept of simplicity to the personnel having to use it. Conventional data processing devices are normally keyed to high-volume production. Hunt-and-peck typing constitutes a misuse of such equipment. But it is possible to use conventional data terminals if your personnel will go along with the idea. There are many plant locations that provide an adequately clean environment for the operation of a CRT or typewriter terminal. Perhaps the greatest contrast between specialized and conventional devices occurs when using the input stations to record time and attendance information. Clearly, having each employee type in his name and/or employee number via a teleprinter keyboard cannot approach the efficiency or employee acceptance of simply inserting a badge and walking on.

User Experience

With high hopes, Datapro designed a detailed questionnaire on data collection equipment and included it in the March 1975 supplement to DATAPRO 70. By the editorial cutoff date of May 12, we had received a total of 99 returned forms containing information. Upon examining the returns, it became clear that many of our subscribers had confused the *collection* of data with the *processing* of collected data. Perhaps we did not make the questionnaire clear enough as to equipment types covered; perhaps our subscribers just wanted to respond anyway. (The support we have received from our subscribers in the filling out and returning of our survey questionnaires has helped us immensely in making our reports better; for this we are indeed grateful. It has helped us, and it has helped you in turn.)

In any case, through careful sorting of the questionnaires, reading between the lines in doubtful cases, and plain guessing in a few others, we segregated the questionnaires into two stacks. In one stack we had a group of 56 Reader Survey Forms that appeared to deal with data collection equipment. In the second stack, we had the remaining 43 forms that appeared to deal with equipment that processed data after it had been collected by unspecified means (e.g., keypunch). Regretfully, we set aside the second stack as not applying to this report. Eagerly, we picked up the first stack of 56 forms and began sorting and tabulating the results. Regretfully, only five separate products received sufficient responses to merit individual mention. This information is presented in the accompanying table.

The questionnaires in this group, on the whole, were more completely and consistently filled out than any other group Datapro can remember seeing. We heartily thank those subscribers who took the time to fill them out and return them. However, the survey generated neither the response volume not the diversity of responses to warrant tabulation beyond the information presented in the accompanying table—for which we are not apologizing by any means.

Included in the questionnaires was a smattering of responses on companies such as Control Data Corporation (Transactor) and Mohawk Data Sciences (Colorado Instruments C-Dek), which were early pioneers in data collec-

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tion systems but are no longer marketing that equipment. We received just two responses on the Singer System Ten, which has been marketed vigorously in the data collection field. And there were no responses on equipment from Sierra Research, North Electric, or Panasonic, all well-known names in the data collection field. Standard Register received just a couple of responses, and Addressograph-Multigraph none; both companies have long been active in the data collection market. The conclusion is obvious. We did not reach many of the users of this type of equipment. But the ones we did reach responded well.

Equipment Characteristics

The accompanying comparison charts summarize the products of 31 vendors. The two sets of charts cover:

- Portable or stand-alone data capture devices; and
- Centralized data recording systems.

Beginning in March 1975, Datapro requested information by mail and telephone from more than 70 vendors known or believed to supply equipment for data collection applications. Some vendors responded that they produce components only and do not sell directly to end users. Some said they market only "conventional" data processing devices. Some we could not find. Some, despite repeated requests, failed to convey the necessary information to us in time to be included in this report. The net result is the comparison charts at the end of this report. They are as comprehensive as our best efforts could make them. The cooperation of the various manufacturers in the preparation of these charts is greatly appreciated.

The chart entries and their significance are explained in the following paragraphs.

Portable and Stand-Alone Devices

The basic *type* or style of device is entered first. Three terms are generally used: hand-held, portable, or stand-alone. Hand-held indicates that the recording device is held in one hand while entering data. Normally, the other hand is occupied with depressing keys or handling an optical wand. Most of these devices, but not all, include recording provisions and an internal battery to permit portable operation free from an I/O or power cable. Some of the devices that use semiconductor memory as the data storage medium are able to contain the entire works in a single hand-held package; others that use a cassette recorder incorporate the batteries and recorder in a separate package hung from the belt or slung from the shoulder. A stand-alone unit is one that records data in machine-readable fashion but is not portable.

Output media identifies the basic means used for recording data or transferring it to the point where it is used. Some devices use semiconductor memory or a cassette recorder to record data locally, but use a communications line to transfer data. Usually, a separate device is employed that includes the communications interface and control logic required for the data transmission operation; typically, the separate device is AC-powered although the associated input device is battery-powered. Again, typically, the input device includes a battery recharging circuit.

Environmental orientation identifies specific conditions under which the manufacturer indicates that each device can perform reliably. We specifically asked for recommendations as to suitability for the following environments: office, warehouse; high humidity; high temperature; corrosive atmosphere; dirty atmosphere; vibration; and electrical machinery. The latter environment—electrical machinery—frequently involves radio frequency interference (RFI) and magnetic fields of intensity sufficient to disturb some devices if brought too close. Manufacturers were less than candid in their replies to our environmental questions, probably because of the difficulty of determining what constitutes "high" temperature and humidity, etc. In any case, we reported the replies as presented by the manufacturers. If your environment is other than an office or clean warehouse, you had better question the vendor specifically to make sure there is no misunderstanding.

Data input describes how data can be entered into each device for recording. A wide range of device types is included in the charts, ranging from prosaic portable keypunches to exotic digitizers. The input methods are described in place wherever methods other than conventional numeric keyboards and such are employed. One method that is growing in use needs a little more explanation—the optical wand. Generally, these units resemble large ball-point pens and include circuitry for scanning a bar code to pick up fixed information such as product number. There are several different bar codes in use, including the Universal Product Code (UPC) as found on food items in grocery stores and codes devised by the manufacturers of the devices themselves. If you plan to use bar coding for data pickup, be sure to let any vendor know if you are already committed to a specific code. Changeovers can be tiresome, but are sometimes worthwhile.

The remaining Data Input entries—quantity, character set, and data display—are self-explanatory within the chart.

The *physical properties* of the device are listed next, including size, weight, type of power supply, and approximate battery life if battery power is used. Most battery-operated units use rechargeable batteries. NiCad is a specific type of rechargeable battery.

Under *recording device*, the type and capacity of the recording device are listed. The "conversion" entry discusses the procedure for getting the data from the temporary semiconductor memory or cassette recorder into a form convenient for data processing. Typically, this is through a data communications link to a centrally located receiving station, which outputs the data onto

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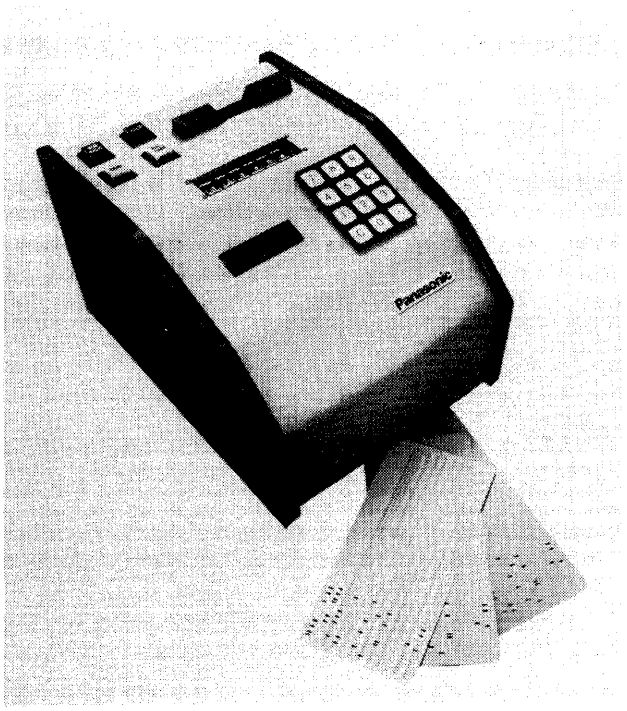

This Panasonic unit is in the classic mold of data collection equipment. It accommodates 80-column punched cards, permits key entry of variable numeric data, and provides a group of lever switches for semi-fixed numeric data.

half-inch magnetic tape, punched cards, or punched tape. Sometimes, the receiving station can be linked directly to a computer channel, or indirectly to the computer through a higher-speed communications link. Devices that record the collected data on punched cards or half-inch magnetic tape do not require conversion.

Because of the number of devices likely to be required, the *pricing* information is particularly sensitive. Where the manufacturer offers a lease arrangement, the information is stated; the manufacturers were asked to state the monthly rental rate for a two-year lease arrangement including maintenance. The cost for the converter, when separately priced, is also given. The converter price includes the local station only, and not a remote receiving station. The same comments apply to purchase price. Where a range is not given, the pricing information should be considered as representing a basic model without options.

Data Collection Systems

This set of charts describes equipment that is typified by, but not restricted to, a group of input stations connected by cable to a central control component. The central control may include the capability for outputting data on computer-compatible media or it may be connected directly to the computer. In many cases, the central unit can do both. Other systems included in this group provide communications links with data recording devices, but provide substantially more logical capability than simple receiving stations.

The entries under *system arrangement* describe the configurational aspects of the system. The principal configuration characteristic is whether the system is self-contained (i.e., off-line) or connected to a host computer (i.e., on-line). Frequently, where the entry indicates both, the on-line mode is an additional capability of the system. The interconnection among the input stations and the central controller is described in basic terms. The type of connection (e.g., twisted-pair cable, 4-wire line/cable, communications link, etc.) is identified, along with the number of trunks or independent data paths where known.

A detailed description of the interconnection techniques is beyond the scope of this report, but they can be quite important. For example, the size of wire used will affect the maximum distance that an input station can be from the central controller because of the different electrical characteristics exhibited. The maximum distance allowed between an IBM 2791 Area Station and the central controller using #22 AWG outside-type telephone cable is 1000 feet; if #19 AWG cable is used, the maximum distance is 1750 feet. (Both of these distances are without extra-cost options for extending the distance.) If the connections are made using modems and communications links, distance becomes immaterial but operational speed becomes an important factor. In addition, the manner in which the connections are made may have an affect on promulgating equipment failures; i.e., if one input station goes down, others may be affected.

When evaluating configurational capabilities, do not forget to consider future growth. The growth can be accommodated by expanding one system or by installing multiple systems. Which you choose can have a decided effect on the equipment cost of your data collection system. Usually, but not always, expansion of a system is less expensive than installing multiple systems. Usually, there is no intercommunication between two input stations, nor any need for such. If there were such a need, it also could affect your expansion plans. The maximum number of stations per system and the maximum distance between controller and input stations is stated. Usually, the distance also applies between successive input stations, but that is also a function of the interconnection technique. The simplest way to handle that variable is to plan the locations where all your input stations should be and ask the vendors whether they can handle it.

The *environmental orientation* of the controller and the input stations is briefly described. It is not unusual for the central controller to be more sensitive to environment and require more gentle surroundings than the input stations. If you have unusual or adverse environmental considerations for the location of your input stations, be sure the vendors know about them in detail in advance. (Some consider anything beyond an office or warehouse to be adverse.)

The vendors may want to come out and see for themselves and even make some measurements. That's good. Some

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vendors have become somewhat skeptical after finding out that what was described as a "warm room" turned out to be next to a blast furnace. Be honest with the vendors when you request equipment and system proposals; it may raise the cost, but the chances are it will lead to getting the equipment you really need.

The converse of this applies as well. Some vendors may over-specify equipment to be on the safe side or for other reasons. If the vendor cannot explain to your satisfaction why each component has been selected, then the chances are he will not be able to install the system to your satisfaction. Don't hesitate to question the makeup of a system, and stay with it until you get a satisfactory answer.

The range of capabilities offered by the *input stations* is described in a series of entries summarizing the capabilities of all the available types of input stations. Usually, a modular range of capabilities is available either through a series of models or through options.

The entries are largely self-explanatory and consist of the sizes of fields or messages that can be entered in one set-up of the device. Some input stations use more rigid message formatting than others, with specific portions of the transferred messages reserved for special meanings. Others are more flexible and depend on programs stored in the central controller or host computer to set the message format.

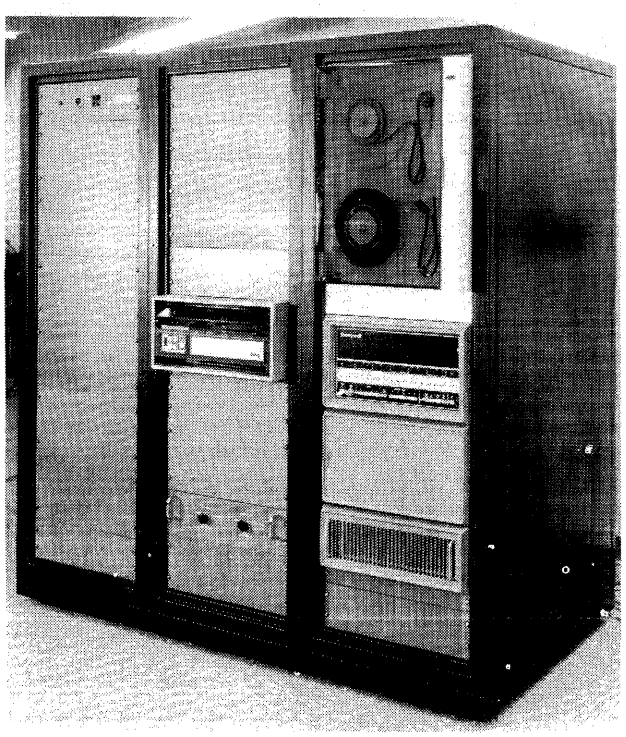
The entries under *central controller* identify the type of device used. Frequently, this is a minicomputer with extensive programming capabilities. The type and amount of storage available govern the size of the system that can be controlled and the degree of independence from the host computer, as well as the amount of processing you can do with the system by itself. The availability of disk and tape peripherals provides a back-up capability for accumulating data while the host computer cannot accept it because of system malfunction, special jobs running, or some other reason. These peripherals are also required to do any extensive amount of data processing with the system itself.

Space considerations make it impossible to identify specific software support or other peripheral devices available for the central controller. If the system is based on a minicomputer, then an assembler at the least and typically one or more higher-level language processors are likely to be available. In any case, the minimum support you can expect is I/O control routines that permit the generation of orderly files of data for presentation to the host computer. If the system operates in a free-standing mode, you will want to be sure that sufficient capabilities are present, in terms of language support and configuration possibilities, to meet your needs for analyzing the data and generating the kinds of action reports that prompted you to collect the data in the first place.

If the central controller is not a minicomputer, but a hard-wired device instead, then an answer of "limited" sometimes appears to the question of user programmability. If the controller presents options for message lengths and formats, style of time notation, and sequencing of guidance instructions, then it provides some of the same capabilities for which the stored program would be used in a minicomputer-based system, thereby justifying the "limited" entry.

Pricing is a nebulous term. Presented here are monthly rental costs (on a two-year lease arrangement, including maintenance) and purchase costs for the basic controller and input station equipment only. The final cost of a system will include development, programming, installation, employee training, project monitoring, and system monitoring and maintenance.

Many of the vendors specializing in data collection systems will undertake the whole task from system design through equipment selection, installation, and checkout, including any programming and employee training required. This is called a turnkey arrangement. At first glance, the costs for a turnkey contract may seem startlingly high. But when you begin evaluating the services offered and comparing their costs with the costs of providing the equivalent services within your own organization, you may change your mind. One advantage of a turnkey arrangement is that it gives you a single point of responsibility for the progress of the complete system implementation task.



The central controller for Sierra Research Corporation's SDA-770 Factory Data Collection System resembles an ordinary minicomputer system except for the casework, perhaps. And indeed it is a minicomputer system. The differences are in the programming and in the types of peripherals it is intended to work with.

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Manufacturers

Listed below, for your convenience in obtaining additional information, are the full names and addresses of the 31 vendors whose products are summarized in the accompanying comparison charts.

Addressograph Multigraph Corporation, Data Systems Division, 29100 Aurora Road, Solon, Ohio 44139. Telephone (216) 248-7930.

AzurData Corporation, 1305 Mansfield Avenue, Richland, Washington 99352. Telephone (509) 946-5161.

Bourns Management Systems, 6600 Jurupa Avenue, Riverside, California 92504. Telephone (714) 687-7220.

Computer Identics Corporation, 31 Dartmouth Street, Westwood, Massachusetts 02090. Telephone (617) 326-8960.

Data Devices, International, Inc., 6301 DeSoto Avenue, Woodland Hills, California 91364. Telephone (213) 884-5500.

Data Pathing, Inc., 370 San Aleso Ave., Sunnyvale, California 94086. Telephone (408) 734-0100.

Data Systems Engineering, a division of General Automation, 1620 East Ball Road, Anaheim, California 92805. Telephone (714) 535-2894.

Datron Equipment, Inc., 100 Route 46, Mountain Lakes, New Jersey 07046. Telephone (201) 334-4521.

F. P. Developments, Inc., 27 Cherry Avenue, Maple Shade, New Jersey 08052. Telephone (609) 779-0400.

IBM Corporation, Route 52, Dayton, New Jersey 08810. Telephone (201) 329-1000.

Identicon Corporation, 1 Kenwood Circle, Franklin, Massachusetts 02038. Telephone (617) 528-6500.

Interactive Systems Inc., 3980 Varsity Drive, Ann Arbor, Michigan 48104. Telephone (313) 973-1500.

Iomec, Inc., 3300 Scott Boulevard, Santa Clara, California 95050. Telephone (408) 246-2950.

MSI Data Corporation, 1381 Fischer Avenue, Costa Mesa, California 92627. Telephone (714) 540-6600.

Nationwide Electronic Systems, Inc., 7N662 Route 53, Itasca, Illinois 60143. Telephone (312) 773-0370.

Norand Corporation, P.O. Box 666, Cedar Rapids, Iowa 52406. Telephone (319) 366-7611.

North Electric Co., Electronetics Division, P.O. Box 688, Galion, Ohio 44833. Telephone (419) 468-8100.

Panasonic, M.E.C.A., Industrial Apparatus Dept., Industrial Division, 2960 Hart Drive, Franklin Park, Illinois 60131. Telephone (312) 451-1340.

Science Accessories Corporation, 970 Kings Highway West, Southport, Connecticut 06490. Telephone (203) 255-1526.

Scope Electronics Inc., 1860 Michael Farraday Drive, Reston, Virginia 22080. Telephone (703) 471-5600.

Sierra Research Corporation, P.O. Box 222, Buffalo, New York 14225. Telephone (716) 632-8823.

Singer Business Machines, 2350 Washington Avenue, San Leandro, California 14225. Telephone (415) 357-6800.

Source Information Systems, Inc., 1532 Third Street, Santa Monica, California 90401. Telephone (213) 394-0225.

The Standard Register Co., Dayton, Ohio 45401. Telephone (513) 223-6181.

Summagraphics Corporation, 35 Brentwood Avenue, Fairfield, Connecticut 06430. Telephone (203) 384-1344.

Telxon Corporation, 3726 Dacoma Street, Houston, Texas 77018. Telephone (713) 686-8656.

Termiflex Corporation, 17 Airport Road, Nashua, New Hampshire 03060. Telephone (603) 889-3883.

Texas Instruments, Inc., Digital Systems Division, P.O. Box 1444, Houston, Texas 77001. Telephone (713) 777-1301.

Threshold Technology, Route 130 & Union Landing Road, Cinnaminson, New Jersey 08077. Telephone (609) 829-8900.

Wright Line, 160 Gold Star Boulevard, Worcester, Massachusetts 01606. Telephone (617) 852-4300.

Xebec Systems, Inc., 566 San Xavier Avenue, Sunnyvale, California 94086. Telephone (408) 732-9444. □

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CHARACTERISTICS OF PORTABLE AND STAND-ALONE DEVICES

MANUFACTURER AND MODEL	Addressograph Multigraph Corp. Data Recorders	AzurData Infopac I	AzurData Infopac II	Computer Identics PCP Portable Code Processor	Data Devices Micro Punch 461
TYPE	Stand-alone, portable	Hand-held, portable	Hand-held, portable	Hand-held, portable	Stand-alone, portable
OUTPUT MEDIA	Printed document; OCR or bar code	Communications line; RS-232C	Communications line; RS-232C	Magnetic tape cassette	80-col. cards
ENVIRONMENTAL ORIENTATION	Any	Normal office	Any; waterproof, dustproof, shock resistant	Office, warehouse,	Any
DATA INPUT					
Method	One or two embossed cards; up to 14 numeric slides; mark sense	Numeric keyboard; optical wand for universal identification codes	Keyboard; optical wand for universal identification codes; communications line	Optical wand for bar codes; numeric keyboard	8 slides for setting up field
Quantity	Up to 20 lines/14 digits	8 digits	15 or 30 digits	16-digit field	Up to 80; 8 per setting
Character set	Alphanumeric/ numeric	16	16 or 20	Numeric	Numeric
Data display	Visual setting of slides	11-digit LED, including 3-digit record no.	18- or 33-digit LED, incl. 3-digit record no.	16-digit LED	Visual setting of slides
PHYSICAL PROPERTIES					
Size of input unit (w, d, h, inches)	Table top	4 x 9 x 2.625	4 x 9 x 2.625	12 x 4 x 8	13 x 9.5 x 4
Weight of input unit, pounds	–	2.5	2.5	7	8
Power supply	Manually operated	AC and/or self-contained NiCad batteries	AC and/or self-contained NiCad batteries	Self-contained rechargeable batteries	Manually operated
Battery life, approx. operational hrs.	–	8	8	4	–
RECORDING DEVICE					
Type	Printer	Semiconductor memory	Semiconductor memory	Cassette	Card punch
Capacity	Varies	4K to 64K digits	3.8K to 64K digits	67K digits	80 col.
Conversion	A-M bar code/ mark readers; OCR scanner	Data transmission at up to 1200 bps via acoustic coupler	Data transmission at up to 1200 bps via modem or acoustic coupler	Data transmission at up to 1200 bps via modem	Not required
PRICING AND AVAILABILITY					
Monthly rental:					
Input unit	Contact vendor	–	–	–	–
Converter	Contact vendor	–	–	–	–
Purchase price:					
Input unit	Contact vendor	$1,280 basic	$2,450 basic	$2,500 to $4,000	$595
Converter	Contact vendor	–	$550 (comm. int.)	–	–
Date of first customer delivery	NA	1/75	9/73	1974	1967
Number in use	NA	NA	Over 300	NA	850
Serviced by	A-M	AzurData	AzurData	Computer Identics	Data Devices
COMMENTS	Wide variety of models available to input fixed data from plastic credit cards and/or variable numeric data	Unit designed for off-line data recording and on-line transmission to central receiver. Check digit and memory retention (aux. battery) optional	Unit permits 2-way data transmission; memory retention (aux. battery) optional	Other, non-portable models available for direct connection to to computer or cassette recording	Unit interprets (prints) data on cards as punched

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CHARACTERISTICS OF PORTABLE AND STAND-ALONE DEVICES

MANUFACTURER AND MODEL	Datron Equipment 401	F.P. Developments, Inc.	Identicon Portapen 2	IBM 1001
TYPE	Stand-alone	Stand-alone	Hand-held, portable	Terminal
OUTPUT MEDIA	80-col. cards	80-col. cards	Communications line	Communications line
ENVIRONMENTAL ORIENTATION	Office, warehouse	Office, warehouse	Office, warehouse	Office, warehouse
DATA INPUT				
Method	Punched as entered	Keyboard; 80-col. plastic/tab card	Optical wand for UPC and other bar codes; keyboard	Reads first 22 col. of 22, 51, or 80-col. card; numeric keyboard
Quantity	7 digits	80 char.	12 digits	80 char.
Character set	Numeric	Alphanumeric	Numeric	Numeric or alphanum.
Data display	7 digits	None	12-digit LED	None
PHYSICAL PROPERTIES				
Size of input unit (w, d, h, inches)	NA	33 x 16 x 12	13.5 x 9.75 x 3.75	18.5 x 8 x 5
Weight of input unit, pounds	45	NA	9	21
Power supply	110 VAC	110 VAC	Self-contained rechargeable batteries	Derived from telephone
Battery life, approx. operational hrs.	–	–	8	–
RECORDING DEVICE				
Type	Card punch	Card punch	Semiconductor memory	None
Capacity	7 digits	500-card hopper	12K/20K/28K char.	–
Conversion	Not required	Not required	Data transmission at 1200 bps via separate unit	–
PRICING AND AVAILABILITY				
Monthly rental:				
Input unit	–	–	–	$16
Converter	–	–	–	–
Purchase price:				
Input unit	$1,850	$4,500	$2,895	$535
Converter	–	–	NA	–
Date of first customer delivery	1970	1973	NA	NA
Number in use	100	20	NA	NA
Serviced by	Datron Equipment	Mfr. and customer	Identicon	IBM
COMMENTS		Three versions avail.: reader combining up to 2 cards for output; punch with remote inputs; keyboard punch	Company also produces Models 100 and 400 bar code scanners for fixed-station scanning of moving labels in factory or outdoors	

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CHARACTERISTICS OF PORTABLE AND STAND-ALONE DEVICES

MANUFACTURER AND MODEL	Iomec Portaverter Model 40	MSI SOURCE 1100	MSI SOURCE 2000 Series	MSI SOURCE 2100
TYPE	Portable with cart	Hand-held, portable	Hand-held, portable	Hand-held, portable
OUTPUT MEDIA	Proprietary mag. tape cartridge; printer	Communications line	Communications line	Communications line
ENVIRONMENTAL ORIENTATION	Office, warehouse	Office, warehouse	Office, warehouse	Office, warehouse
DATA INPUT				
Method	Numeric keyboard; optical wand	Numeric keyboard	Numeric or alpha-numeric keyboard	Numeric keyboard; optical wand for MSI bar code
Quantity	15 dig. plus 5 fixed	15 digits	No limit	15 digits
Character set	Numeric	Numeric; 4 specials	Numeric or alphanum.	Numeric; 6 specials
Data display	Journal tape	10-digit LED	10-digit LED; strip printer	12-digit LED
PHYSICAL PROPERTIES				
Size of input unit (w, d, h, inches)	14 x 18 x 7.25	4.5 x 3 x 7.5	7.25 x 3.5 x 10.25	7.5 x 8.5 x 10.25
Weight of input unit, pounds	30	43	6	6
Power supply	Self-contained rechargeable batteries and AC	Self-contained NiCad batteries	Self-contained NiCad batteries	Self-contained NiCad batteries
Battery life, approx. operational hrs.	6 to 8	6	6	6
RECORDING DEVICE				
Type	Magnetic tape	Semiconductor memory	Mag. tape cassette	Mag. tape cassette
Capacity	87K digits	8K digits	60K char.	250K char.
Conversion	Data transmission via separate unit	Data transmission at 40 char./sec. via separate acoustic coupler	Data transmission at 40 char./sec. or 1200 bps via separate device with acoustic coupler or modem	Data transmission at up to 1350 bps via separate device with acoustic coupler or modem
PRICING AND AVAILABILITY				
Monthly rental:				
Input unit	—	Contact vendor	Contact vendor	Contact vendor
Converter	—	—	—	—
Purchase price:				
Input unit	Approx. $2,000	$1,360	$1,135-$2,100	$1,270-$2,200
Converter	Contact vendor	—	—	—
Date of first customer delivery	1972	1974	1972	1973
Number in use	5,000	1,000	13,000	10,000
Serviced by	Iomec	MSI	MSI	MSI
COMMENTS	Company produces a line of compatible peripherals including tape and disk drives, printers, punched card units, and punched tape units	MSI is a pioneer and leader in hand-held data recorders. The company has delivered about 30,000 units including models no longer manufactured. MSI's product line includes several central receiving stations for on- or off-line use with computers. Models include 2710/2720 for direct interface to IBM S/3 or S/360 ($5,300 to $5,850); 215 for off-line receiving on 7- or 9-track mag. tape ($9,000); 280 for off-line receiving on 80- or 96-col. cards ($7,500); 211 for off-line receiving on 8-level punched tape ($8,160); and programmable 3040 (see Systems charts)		

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CHARACTERISTICS OF PORTABLE AND STAND-ALONE DEVICES

MANUFACTURER AND MODEL	Norand NT3/NT7 Series	Norand NT50 Series	North Electric PEC 7452	SAC Graf/pen GP3
TYPE	Stand-alone	Hand-held, portable	Stand-alone	Stand-alone
OUTPUT MEDIA	Communications line	Magnetic tape cassette	Philips cassette	Mag. tape; cassette; punched tape; others
ENVIRONMENTAL ORIENTATION	Office, warehouse, high humidity, dirty or corrosive atmosphere	Office, warehouse, high humidity, dirty or corrosive atmosphere	Adverse environment	Any
DATA INPUT				
Method	Keyboard	Keyboard; optical wand for bar codes	Badge; 80-col. cards; manual entry	Hand-held pen identifies point on paper; position is digitized to give a pair of 8-bit coordinates
Quantity	Up to 14 digits	Up to 14 digits	31 or 60	Unlimited
Character set	Numeric	Numeric	Numeric; 6 alpha.	As programmed in host computer
Data display	Up to 14 digits LED	Up to 14 digits LED	Matrix printer	Custom
PHYSICAL PROPERTIES				
Size of input unit (w, d, h, inches)	13 x 13 x 4	NA	12 x 12 x 14	Up to 72 x 72
Weight of input unit, pounds	25	5.4	50	NA
Power supply	120 VAC	Internal rechargeable batteries	117 VAC	Custom
Battery life, approx. operational hrs.	—	6	—	—
RECORDING DEVICE				
Type	Semiconductor	Mag. tape cassette	Mag. tape cassette	Custom
Capacity	4K or 8K digits	NA	76K char.	—
Conversion	Data transmission at 1200 bps via acoustic coupler or modem	Data transmission at 1200 bps via console and acoustic coupler or modem	Separate cassette to 0.5-in. tape or disk; data transmission	—
PRICING AND AVAILABILITY				
Monthly rental:				
Input unit	Contact vendor	Contact vendor	$94	Contact vendor
Converter	Contact vendor	Contact vendor	$42 (adapter)	Contact vendor
Purchase price:				
Input unit	Contact vendor	Contact vendor	$2,585	Contact vendor
Converter	Contact vendor	Contact vendor	$1,200 (adapter)	Contact vendor
Date of first customer delivery	NA	NA	12/70	NA
Number in use	NA	NA	NA	NA
Serviced by	Norand	Norand	Local	SAC
COMMENTS	Designed for order entry. Check digit feature is optional	Designed for order entry. Check digit feature is optional	Designed for time/ attendance and labor distribution reporting	Digitizer can be incorporated in custom units for data entry by "pointing at" data symbol; decoding of coordinate data to get alphanumeric data is required

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CHARACTERISTICS OF PORTABLE AND STAND-ALONE DEVICES

MANUFACTURER AND MODEL	Source Information Systems Selectapunch	Standard Register Source Record Punches	Summagraphics HW-1/HW-2	Telxon data-Kap 919
TYPE	Stand-alone, portable	Stand-alone	Portable, stand-alone	Hand-held, portable
OUTPUT MEDIA	80-col. cards	80-col. card; Zipcard tab-size form set	Mag. tape, cassette, cart.; punched cards, tape; comm. line	Philips cassette
ENVIRONMENTAL ORIENTATION	Office, warehouse, high humidity/temp.; mech. vibration	Office, warehouse, factory, hospital	Any	Office, warehouse, high humidity, vibration, elec. mach.
DATA INPUT				
Method	6-digit numeric field set up via slides; punches and prints data	Reads 80-col. cards; internal slides for fixed data; columnar keyboard; clock; badge reader; scales; other digital devices	Overlay on board has picture of data keyboard; position of stylus is digitized and converted to char. code	Numeric keyboard
Quantity	80 col.	80 char.	Variable	12 digits
Character set	Numeric	Numeric (alpha. read)	Variable	Numeric, 3 alpha.
Data display	Slides; printed data	Prints numeric data	NA	12-digit Panaplex
PHYSICAL PROPERTIES				
Size of input unit (w, d, h, inches)	Table top	19 x 17 x 12.5	11 x 11 to 36 x 48	NA
Weight of input unit, pounds	NA	80	NA	7.9
Power supply	Manually operated	115 VAC	NA	Self-contained NiCad batteries
Battery life, approx. operational hrs.	–	–	–	6 to 8
RECORDING DEVICE				
Type	Card punch	Card punch	Any	Mag. tape
Capacity	6 dig. per field	80 col.	–	70K char.
Conversion	Not required	Not required	–	Data transmission at up to 1200 bps via acoustic coupler or modem
PRICING AND AVAILABILITY				
Monthly rental:				
Input unit	–	$68 to $290	–	$70
Converter	–	–	–	–
Purchase price:				
Input unit	$495	$1,800 to $5,725	Contact vendor	$1,855
Converter	–	–	Contact vendor	–
Date of first customer delivery	NA	1966	4/73	3/74
Number in use	NA	Over 7,000	1,500	4,000
Serviced by	SIS	Standard Register	Summagraphics	Telxon
COMMENTS	Company also has product line for punching/printing fixed data from embossed plastic templates	12 different models in product line		911 Receiver ($600/mo.; $16,600 purch.) can poll multiple terminals automatically, pool data on 800/1600 bpi tape, and transmit to host computer

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CHARACTERISTICS OF PORTABLE AND STAND-ALONE DEVICES

MANUFACTURER AND MODEL	Termiflex HT/2	Wright Line 2600/2610/2620	Wright Line 2629-29	Wright Line 2611/2621	Xebec Systems Alphabec-75
TYPE	Hand-held	Stand-alone, portable	Stand-alone, portable	Stand-alone	Stand-alone
OUTPUT MEDIA	Cable or comm. line; RS-232C or current loop	20 to 80-col. tab and plastic cards; see Comments	80-col. cards and some sets; thin plastic	20-col. (2611) or 22- and 80-col. plastic cards	Philips cassette; floppy disk
ENVIRONMENTAL ORIENTATION	Office, industrial, RFI	Normal environment	Normal environment	Normal environment	Office, warehouse
DATA INPUT					
Method	Alphanumeric data keyboard using 4 cases; 1000-char. memory	12-key keyboard; 1 for each card row; multi-key depression permitted	Selector dial with char. set equivalent to IBM 29/129 keypunches	12-key keyboard, 1 for each card row; multi-key depression permitted	Proprietary ball-point pen device; hand-print motions are translated to data codes
Quantity	NA	20 to 80 char.	80 char.	20, 22, or 80 char.	No limit
Character set	Alphanumeric	Any	Alphanumeric	Any	Numeric, some alpha
Data display	20 char. LED	None	Prints on card	None	96 char.
PHYSICAL PROPERTIES					
Size of input unit (w, d, h, inches)	2 x 4.25 x 7	18 x 4 x 5	18.5 x 8 x 6.25	18 x 5 x 10.5	22 x 17 x 6.5
Weight of input unit, pounds	1.5	8.5 or 12	16	30	25
Power supply	AC	Manually operated	Manually operated	115 VAC or 220/240 VAC, 50/60 Hz	AC
Battery life, approx. operational hrs.	—	—	—	—	—
RECORDING DEVICE					
Type	Semiconductor memory	Card punch	Card punch	Card punch	Cassette, floppy disk
Capacity	1000 char.	80 col.	80 col.	80 col.	145K or 243K char.
Conversion	Data transmission at up to 1200 bps via acoustic coupler or modem	Not required	Not required	Not required	Self-contained communications unit
PRICING AND AVAILABILITY					
Monthly rental:					
Input unit	—	—	—	—	$240
Converter	—	—	—	—	—
Purchase price:					
Input unit	$1,570 to $2,300	$285 to $665	$550 to $595	$1,195 to $1,280	$4,300
Converter	—	—	—	—	—
Date of first customer delivery	6/74	1962	1967	1968	6/75
Number in use	200	About 14,000	Over 5,000	Over 1,000	—
Serviced by	Termiflex	Wright Line (by mail)	Wright Line (by mail)	Wright Line (by mail)	Xebec
COMMENTS	HT/1 is available with 10-character display and 500-character memory for $1190; minimum order is 50 units	Units handle 80, 51, and 22-col. cards/sets (2600); 20-col. plastic cards (2610); 22 and 80-col. plastic cards (2620)			Prices exclude cassette or floppy disk units; comm. is IBM BSC or asynchronous

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CHARACTERISTICS OF DATA COLLECTION SYSTEMS

MANUFACTURER AND SYSTEM NAME	Bourns Management Systems	Data Pathing, Inc. System 150	Data Systems Engineering Model 2801	IBM 2790 (stand-alone)	IBM 2790 (on-line)
SYSTEM ARRANGEMENT					
Connection to main computer	Off-line/stand-alone	On- or off-line	On-line	Stand-alone (S/7)	On-line to IBM 360/370
Off-line output	9-tk., 800/1600 bpi magnetic tape	7- or 9-track magnetic tape	—	—	—
Interconnection	1 to 4 communications lines	2-wire direct or communications line	4-wire direct or communications line	500 kbps 2-wire lines to area sta.; 40 cps 2-wire lines to input sta.	500 kbps 2-wire lines to area sta.; 40 cps 2-wire lines to input sta.
Maximum input stations per system	No fixed limit	225	63 per line	512	1024
Maximum distance between controller and input stations, feet	Communication via modem	12,000 feet or via modem	2000 feet direct or via modem	1000 or 6000 to area sta.; 1000 to input sta.	1000 or 6000 to area sta.; 1000 to input sta.
ENVIRONMENTAL ORIENTATION					
Controller	Office, warehouse, high humidity, factory	Office, warehouse, factory	Computer room	Office	Office
Input stations	Office, warehouse, factory	Office, warehouse, factory	Factory floor	Industrial, except dirty, corrosive, or electromag. environment	Industrial, except dirty, corrosive, or electromag. environment
INPUT STATIONS					
Prepared data input:					
80-column card	Punched or hand	22 or 80 col.	80 col.	80 char. (2791); 10 digits (2796/2797)	
Badge, 15/22-column punched	—	10 digits	10 or 22 digits	10 digits (2791/2796/2797)	
Optical wand, bar code	—	No	No	—	
Transaction codes	—	User request	User defined	1 digit (2791); 4 digits (2796); 2 (2797)	
Fixed data	—	User defined	—	—	
Variable data:					
Columnar numeric keyboard	—	—	—	—	
10/12-key numeric keypad	—	16 or 32 digits/field	—	6 digits per field (2791/2797)	
Alphanumeric keyboard	—	16 or 32 char./field	28-key	16 digits (2798)	
Lever switches	—	—	Up to 18 digits	4 digits (2796)	
Rotary switches	—	—	—	—	
Other types of data entry	—	—	19-key function keyboard; relay I/O	Pulse counters	
Operator guidance	—	Tutorial; backlighted mask	Through function keyboard	31 (2791) or 48 (2798) backlighted instruction displays	
Data display	—	16 or 32 char./field	16 alphanumeric LED	Lever switches (2796); 6 digits (2791/2796); 16 char. (2798)	
Automatic entry clear after transfer?	Yes	Yes	NA	Yes	
Max./min. message length, digits/chars.	1 to 160 char.	1920 char. max.	NA	As programmed	
Mixed message lengths permitted?	Yes	Yes	NA	Yes	
CENTRAL CONTROLLER					
Model number	Bourns	150-30/-60	GA SPC/16, etc.	IBM System/7	2715
Type	Minicomputer	Minicomputer	Minicomputer	Minicomputer	Processor
Programmable by user?	Yes	Yes	Yes	Yes	Limited
Storage	8K bytes core	256K bytes core; 120M bytes disk	Varies	Semiconductor memory; disk	16K or 32K char. control storage
Time/date	Standard	Standard	Optional	Optional	Optional
PRICING AND AVAILABILITY					
Monthly rental (two-year lease, including maintenance):					
Controller	$1,000-$1,300(3-yr.)	Contact vendor	2.54 to 3.6% of purchase price	—	$1,675-$2,300
Input Station	$250-300 (3-yr.)	Contact vendor		$130-360 (area sta.); $27-96 (2796/7/8)	
Purchase price:					
Controller	$30,000-$35,000	Contact vendor	Contact vendor	—	$79,100-$109,000
Input Station	$7,500-$8,000	Contact vendor	$2,800-$9,775	$6,180-$15,800 (area sta.); $1,160-$4,400 (2796/7/8)	
Date of first customer installation	4/74	1973	NA	NA	
Number installed to date	200	20-25 systems	NA	NA	
Serviced by	Bourns	Data Pathing	General Automation	IBM	
COMMENTS	Auto. poll of remote locations; auto. dial and transmit to central computer; remote terminals are OMR 160 optical mark readers	Company specializes in turnkey source data management systems. Company has installed 150 earlier-model systems	2801 terminals are highly modular & can be interfaced to any computer; DCAM software support for GPC/16 costs $3,000	Prices are for month-to-month lease. Configuration is complex. Controller connects to multiple area stations, to which input stations are attached; 2791 functions as both an area station and input station; 2793, as area station only. Remote connection between area stations and controller is possible	

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CHARACTERISTICS OF DATA COLLECTION SYSTEMS

MANUFACTURER AND SYSTEM NAME	IBM 1030	IBM 357	Identicon 600 Series	Interactive Systems VIDEODATA	MSI Data System IV Model 3040
SYSTEM ARRANGEMENT					
Connection to main computer	On- or off-line	Off-line	On-line	On- or off-line	On- or off-line
Off-line output	80-col. cards	80-col. cards	—	Magnetic tape	9-track 800 or 1600 bpi mag. tape
Interconnection	2-wire cable or communications link	Multiwire cables	2 twisted-pair cables per terminal and to computer	Sgl. broadbd. coax. cable loop connects all units thru TDM RF 2-way mpxr.	Up to 4 communications lines
Maximum input stations per system	24 per line	20	16	256 per ch.; 200 ch.	4 at a time
Maximum distance between controller and input stations, feet	Up to 30,000	NA	2000	60,000	40 (local terminals)
ENVIRONMENTAL ORIENTATION					
Controller	Office	Office	Office, warehouse	Office	Office, warehouse
Input stations	Industrial, except dirty or corrosive environments	Industrial, except dirty or corrosive environments	Office, warehouse	NEMA 12	Office, warehouse
INPUT STATIONS				See Comments	
Prepared data input:					
80-column card	80 char.	80 char.	—	—	—
Badge, 15/22-column punched	10 digits	10 digits	—	—	—
Optical wand, bar code	—	—	20 digits	—	15 digits
Transaction codes	—	—	—	—	As programmed
Fixed data	—	—	—	—	—
Variable data:					
Columnar numeric keyboard	—	—	—	—	—
10/12-key numeric keypad	—	—	12 digits	—	15 digits
Alphanumeric keyboard	—	—	—	—	15 chars.
Lever switches	12 digits	6, 9, or 12 digits	—	—	—
Rotary switches	—	—	—	—	—
Other types of data entry	Up to 12 digits via special Data Cartridge	Up to 12 digits via special Data Cartridge	—	—	—
Operator guidance	Thumbknob scroll for written instructions for set-up	None	Audible beep for valid read by wand	—	—
Data display	None	None	12-digit LED for keyboard data	—	—
Automatic entry clear after transfer?	Yes	Yes	Yes	—	—
Max./min. message length, digits/chars.	NA	NA	20	—	As programmed
Mixed message lengths permitted?	NA	NA	Yes	—	Yes
CENTRAL CONTROLLER					
Model number	1034 (off-line)	358	635	300	3040
Type	Hard-wired	Hard-wired	Microprocessor	Minicomputer	Minicomputer
Programmable by user?	Limited	Limited	No	Yes	Yes
Storage	None	None	None; multiplexor	4K char. up	8K to 24K words of memory; mag. tape
Time/date	Optional	Optional	No	—	Yes
PRICING AND AVAILABILITY					
Monthly rental (two-year lease, including maintenance):					
Controller	$389-$557	$83	—	$950	Contact vendor
Input Station	$27-$216	$30-$77	—	$75-$150	Contact vendor
Purchase price:					
Controller	$19,500-$27,151	$2,880	$2,865	$19,000	$18,190-$28,000
Input Station	$1,110-$10,647	$1,040-$2,980	$900	$750-$10,000	$1,360-$2,200
Date of first customer installation	NA	NA	5/75	2/72	1973
Number installed to date	NA	NA	—	14 systems	150 systems
Serviced by	IBM	IBM	Customer/ Identicon	Negotiable	MSI
COMMENTS	Off-line sys. can accommodate 1 line; on-line sys. can incl. printers at remote locations. Each input sta. above can accommodate 4 satellite badge readers	No longer being manufactured; controller does not include 24/26 keypunch	Interface to computer is RS-232C or local or remote 20-ma current loop	Wide range of conventional & specialized devices can be connected; prices above are for station interfaces; TV, data, & audio can be handled	Input stations are MSI hand-held recorders; see preceding Devices charts

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CHARACTERISTICS OF DATA COLLECTION SYSTEMS

MANUFACTURER AND SYSTEM NAME	NES Chronologger	North Electric System 700	Panasonic Model B/BT/C	Scope Inc. VDETS 1000
SYSTEM ARRANGEMENT				
Connection to main computer	On- or off-line	On- or off-line	On- or off-line	On- or off-line
Off-line output	Mag. tape cassette; punched tape	Tape or disk	Any RS-232C device	Mag. tape; cassette; punched tape
Interconnection	Single 2- or 4-wire bus	2- or 4-wire	2- or 4-wire, direct or via modems	1 to 4 lines; cable or FM link
Maximum input stations per system	100	Unlimited	No practical limit	1 per line
Maximum distance between controller and input stations, feet	5000 or more	15,000 or more	3000 at 1200 bps	500
ENVIRONMENTAL ORIENTATION				
Controller	Any	Office, warehouse	–	Industrial
Input stations	Any	Adverse environment	Adverse environment	Any
INPUT STATIONS				
Prepared data input:				
80-column card	–	10, 22, 52, 80	10 or 22	Opt.
Badge, 15/22-column punched	10 digits	10, 15, 22	10 or 22	Opt.
Optical wand, bar code	–	–	–	–
Transaction codes	18 digits	Per customer spec.	–	User specified
Fixed data	–	Per customer spec.	2-digit terminal ID	User specified
Variable data:				
Columnar numeric keyboard	–	Up to 20 col.	–	–
10/12-key numeric keypad	Up to 18 digits	–	12 digits (Model C)	–
Alphanumeric keyboard	–	–	–	Opt.
Lever switches	Up to 20 digits	Up to 20 digits	6 digits (Model C)	–
Rotary switches	–	–	–	–
Other types of data entry	–	Heat sensors, counters, switches, etc.	–	Voice
Operator guidance	None	–	–	Visual display or audio response prompting
Data display	LED	Matrix printer	4-digit time(Model BT); 12-digit LED (Model C)	2-digit hex LED; 16-char.
Automatic entry clear after transfer?	Yes	No	Yes	Yes
Max./min. message length, digits/chars.	70 char.	1 to 120 char.	17 to 49	User specified
Mixed message lengths permitted?		Yes; not recommended	No	Yes
CENTRAL CONTROLLER				
Model number	NES	C700	Not required	VDETS 1000
Type	Hard-wired	Minicomputer	–	Minicomputer
Programmable by user?	Limited	Yes	–	Yes
Storage	Magnetic tape cartridge, disk, punched tape	Disk, tape; per customer requirements	–	16K to 64K bytes core; disk; mag. tape; cassette
Time/date	Optional	Std. in input station	Standard	Standard
PRICING AND AVAILABILITY				
Monthly rental (two-year lease, including maintenance):				
Controller	–	$300-$900	Contact vendor	–
Input Station	–	$50-$150	Contact vendor	–
Purchase price:				
Controller	$4,000-$10,000	$7,000-$15,000	Contact vendor	$12,000
Input Station	$2,500-$5,000	$1,500-$3,500	Contact vendor	$3,200
Date of first customer installation	NA	NA	NA	7/75
Number installed to date	NA	NA	NA	12 (prev. model)
Serviced by	NES	North Electric	Panasonic	Computer Services Support Corp.
COMMENTS		Company provides custom-tailored systems; above is a typical arrangement	Units operate in contention mode on multipoint line	Translates spoken, discrete words to ASCII data codes by encoding the analog signal & comparing patterns with previously recorded patterns by the same speaker

All About Data Collection Equipment

CHARACTERISTICS OF DATA COLLECTION SYSTEMS

MANUFACTURER AND SYSTEM NAME	Sierra Research SDA-770	Singer System Ten	Standard Register LCT Series	Texas Instruments DSX Data Exchange System	Threshold Technology VIP 4000
SYSTEM ARRANGEMENT					
Connection to main computer	On- or off-line	Stand-alone	On- or off-line	On- or off-line	On- or off-line
Off-line output	Magnetic tape	—	80-col.card;Zipcard tab card sets	9-tk, 800/1600 bpi tape	Standard periph.
Interconnection	Local cables; remote via modems	Twisted pair lines	Twisted wire pair; modem	Twisted pairs or via modems	2-wire cable or radio link
Maximum input stations per system	256	190	1	64 to 256	Up to 100
Maximum distance between controller and input stations, feet	10,000 (local)	Up to 8 wire miles	2000 (twisted pair)	10,000 (twisted pair)	Variable
ENVIRONMENTAL ORIENTATION					
Controller	Computer room	Office	—	Office	Factory
Input stations	Factory	Any	Office, warehouse, factory, hospital	Warehouse, factory, office	Factory
INPUT STATIONS					
Prepared data input:					
80-column card	80 digits	80 dig. (Mdl. 100)	80 digits	—	Translates spoken, discrete words to character data codes by encoding analog signal from microphone and comparing with previously recorded patterns by same speaker
Badge, 15/22-column punched	10 digits	10 digits	10 digits	—	
Optical wand, bar code	—	—	—	—	
Transaction codes	No limit	—	—	—	
Fixed data	—	—	10 digits, internal slides	—	
Variable data:					
Columnar numeric keyboard	—	—	6, 10, or 16 digits	—	
10/12-key numeric keypad	16 digits	13 dig. (Mdl. 100)	—	As programmed	
Alphanumeric keyboard	—	—	—	As programmed	
Lever switches	—	—	—	—	—
Rotary switches	—	—	Special	—	—
Other types of data entry	Relay contacts	CRT/keyboard; MDTS POS terminals	Clocks, scales, other digital devices	Model 914A CRT/ keyboard	—
Operator guidance	Tutorial display via lighted indicators	Tutorial; 36 backlighted display messages	—	Via CRT	Via display
Data display	16 char.	13 dig. (Mdl. 100)	Columnar keys	1920 char. (CRT)	Yes
Automatic entry clear after transfer?	Yes	Yes	Yes	Yes	Yes
Max./min. message length, digits/chars.	No limit	160(100);384(105)	NA	1920	Variable
Mixed message lengths permitted?	Yes	Yes	NA	Yes	Yes
CENTRAL CONTROLLER					
Model number	SDA-770	Singer System Ten	—	960B	—
Type	Minicomputer	Minicomputer	—	Minicomputer	Minicomputer
Programmable by user?	Yes	Yes	—	Yes	Yes
Storage	32K core; 24M-byte disk	Wide range	—	Up to 128K bytes memory; up to 400M bytes disk	Application-dependent
Time/date	Standard	Optional	Optional in input station	As programmed	As programmed
PRICING AND AVAILABILITY					
Monthly rental (two-year lease, including maintenance);					
Controller	—	$950-$2,000	—	Contact vendor	Contact vendor
Input Station	—	$70-$160	$269-$290	Contact vendor	Contact vendor
Purchase price:					
Controller	$150,000-225,000 (system)	$25,924-$76,775	—	Contact vendor	—
Input Station		$1,845-$5,000	$5,725-$6,425	Contact vendor	$10,000-$12,000 per terminal
Date of first customer installation	1970	11/71	NA	1973	9/75
Number installed to date	17 systems	3200 input stations	NA	NA	—
Serviced by	Sierra	Singer	Standard Register	Texas Instruments	Threshold
COMMENTS	Custom and turnkey support available	Model 100 input station is programmable; Model 105 is badge reader	Units punch/print cards and transmit to central computer	System is supported for transaction processing as a stand-alone system in conjunction with central host	Company also markets single-terminal models, including special version for numerical control programming. Company began product deliveries in 1972

All About Graphic Digitizers

Graphic digitizers, like voice input and recognition of handwritten characters, represent a "natural mode" data input technique. They can save a lot of labor in converting graphic elements into digital forms that can be processed by computers. This report summarizes the characteristics of 43 digitizers from 21 vendors.

The circuits or mechanisms of computing machines (or data manipulation equipment, if you prefer to reserve "computing" for numeric operations and "machine" for mechanical devices) require the input signals (data) to be in specific forms. The signal forms used with computers are, for the most part, generated by key depressions. Frequently there are some intermediate steps, such as recording signals in the form of equivalent holes in cards, magnetic patterns on tape or disk, or even readable typewritten characters on paper. Natural-form data entry, such as handwritten numbers or letters, handmade marks, human voice, and process signals, is used to some degree, but the great majority of computing operations begin with the keying of input data.

Data keying is a nice, deterministic operation. The operator wants to input an "A," so he or she depresses the key marked "A." The circuitry takes care of generating the necessary signals so that the computing device will eventually receive a set of signals that will be irrevocably interpreted as an "A." Through programming, that "A" can either be used as the alphabetic letter "A" or as a code to indicate something else; but in any case, barring hardware failures or software glitches, it is indubitably an "A."

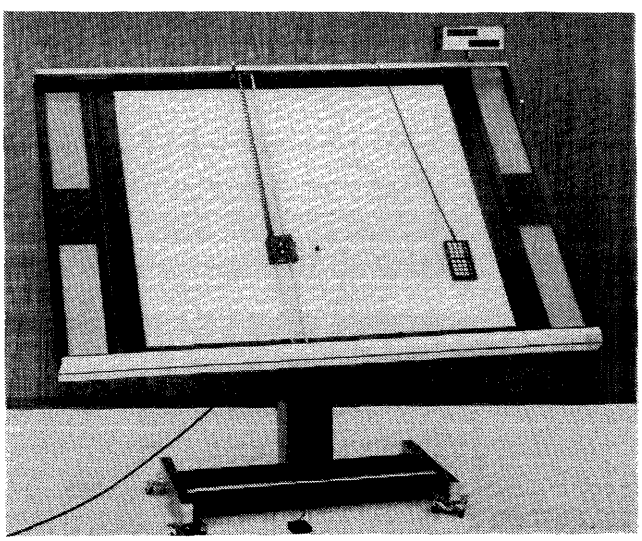
If you are inputting and manipulating a payroll or insurance application with names and addresses, numbers, and transaction type codes, this language-style data input is exactly what you want. But if you desire to use your computer to work with a drawing or other graphic element, language-style data input is quite difficult and error-prone. It is *possible* to completely and accurately describe a graphic element in words alone. How else can a figure be drawn on a plotter or display? If it can be drawn that way, then it can also be input that way. But the amount of labor is so great that it is hardly worth doing.

To accomplish the task of getting the graphic element into the computing system conveniently, something other than a keyboard is required. That something is called a *digitizer.* The input to a digitizer is a graphic element; the output is a series of digital signals just like those from a keyboard. It is the programs in the computer that interpret the digital representations that result. While the bit patterns in the computer are the same bit patterns that result from keyboarding data, the interpretation differs. The significant point is not the interpretation of the bit patterns, but the fact that a means is used to create those patterns without the laborious process of describing a graphic element in words and then keyboarding those words.

Digitizing of graphic elements can be performed actively or passively; i.e., as the element is drawn (active) or after the element is drawn (passive).

A familiar example of passive digitization is optical character reading. The image of each character is scanned and the elements are digitized. The recognition logic processes the digitized form of the graphic elements to interpret the character. The output to the computer is the conventional bit pattern normally generated when the corresponding key on the keyboard is depressed. (Not all scanners employ digital logic to generate the output.) A word description of the graphic form of the character is lengthy. For example, the most recently announced Scan-Data optical character reader encodes the graphic element digitization as the presence or absence of 8 characteristics in 9 areas, or a total of 72 bits or pieces of information. To input the equivalent information in *graphic* orientation, using only a keyboard, would require a minimum of 72 key depressions, one for each information element. (Depressing the single key corresponding to the character being scanned inputs the logical equivalent, not the graphic equivalent.)

An example of active digitization is the use of a light pen with a CRT. The circuitry "reads" the presence of the pen and generates a digital address which can be used to identify the choice selected or the location identified. (The use of a light pen becomes a graphic operation, because the location of the pen is involved.)



This Calma digitizer fits into the classic restrained cursor mold. Shown here with a 40-by-60-inch bed, the unit is also available with optional backlighting. The Calma digitizer is not marketed by itself, but only as part of one of the company's complete graphics processing systems.

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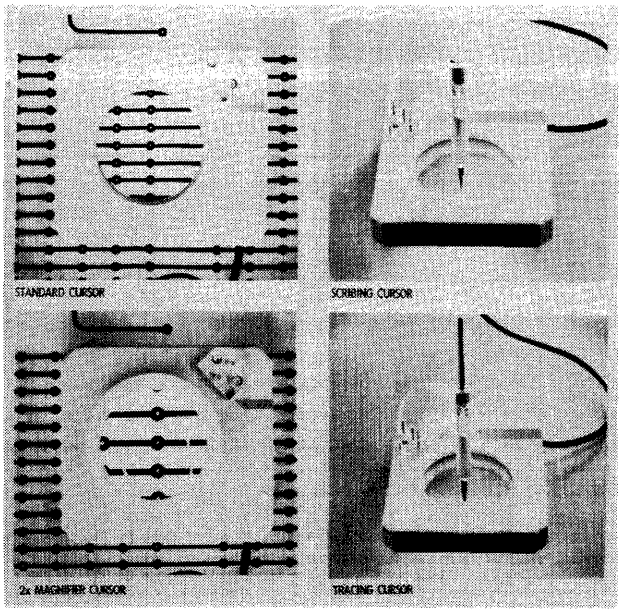

These four cursor options offered by Instronics, Ltd. are typical of those available with other digitizing equipment.

The previous examples are adequate to illustrate the theory of digitizing, but they barely begin to cover the uses that computer users find for digitizers.

Digitizer Applications

The concept of digitizing graphical information includes two basic approaches:

- Identifying a location on a graphical element.
- Identifying the density or grayness of a specific point.

Identifying locations includes the concept of inputting a digital representation of a graph by reading the values of a curve on two axes (which is a location on a piece of paper) and that of identifying the location of a feature of interest. Density recording is used to manipulate photographic or similar pictorial representations. In this report we will concentrate on the first approach, although representative devices for pictorial digitizing are included in the comparison charts.

A two-dimensional graph is a representation of the interrelationship between two parameters. The graph is a convenient means for viewing such relationships, and is also a convenient means for recording observed relationships. While geometric methods are known for manipulating graphs to derive additional information, they are difficult to apply and seldom used.

For example, a graph of distance traveled versus time of travel completely defines the motion of a body. Graphically, you can draw lines tangent to the curve at specific points and derive the velocity of the body at each point by measuring the angle the tangent makes with the axis. Practically, this is taught to engineering students to reinforce the concepts of differential calculus, but the students are never expected to utilize such techniques. The skills required for accurate graphical differentation are beyond the desire of the students to master and usually require more time than is practical to allow in a commercial situation.

The same problem can be handled algebraically if a function can be derived that expresses the relationship between the variables in the region of interest. Such analytic functions can be derived by inspection of the physical processes and creation of a mathematical model that expresses the physical happenings in terms of one or more equations. Algebraic procedures can then be used to manipulate the mathematical model to derive whatever additional information is desired.

Frequently, the physical processes are not well enough understood or are so complicated as to render the production of a theoretical mathematical model either inconvenient or downright misleading. However, in many of these cases, the physical processes can be observed and the parameters recorded. As mentioned, a convenient means for doing this is a chart recorder. The result is a graph of two parameters. To convert this graph into a form that can be handled algebraically, a table listing corresponding values of the parameters is required. Using a ruler to measure is time-consuming and highly imprecise. The resulting errors render the table virtually useless for practical purposes. (For the statistician, it is possible by repetitive measurements to reduce the error to any desired level, but the time consumed in doing this usually eliminates repetitive measurements as a practical means for reducing a graph to tabular form.)

Once a tabular set of values of the two parameters has been constructed, algebraic means can be used to derive analytic expressions equivalent to a mathematical model. (This whole procedure falls into the branch of applied mathematics referred to as numerical analysis, which occupied much of the time of early computer scientists.) The device for measuring the values of the parameters is called a digitizer. It is, essentially, a highly precise ruler. In general, a digitizer provides the capabilities for measuring distances. Once this capability is established, all of the techniques of manual drafting and numerical manipulation become available to the user.

The capability to measure distances, in addition to providing the means to digitize (or tabulate) the parameter relationships of a graph, provides the means for completely describing any drawn figure. After all, manual drafting is entirely the practice of measuring the locations of points and drawing lines to connect them. Much skill is involved in doing this accurately, and many conventions are adopted to make the drawings less ambiguous and more understandable–but measuring distances is the fundamental technique involved. Drawing without concern for accurate measurement is called sketching or art, but not drafting.

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With a little imagination, a digitizer can be applied to the task of drafting. Use of the digitizer to identify the location of a point or a group of points of interest can be expanded by the use of a console to input commands. For example, a center point for a circle can be identified by means of the digitizer, and the circle's diameter can be specified from the console. Or, two points can be located using the digitizer, and the command for a circle of specified diameter can be issued. (Additional specification would have to be made in this case, since the problem as described could result in either of two circles.) The computations required for determining the commands to the drawing device (plotter or display) require the presence of a processor in this type of interactive arrangement. This approach is essentially equivalent to the long-used practice of pairing an engineer with a highly skilled draftsman to create a design team. Many engineering problems involve physical location of parts, which is not readily amenable to computative efforts alone.

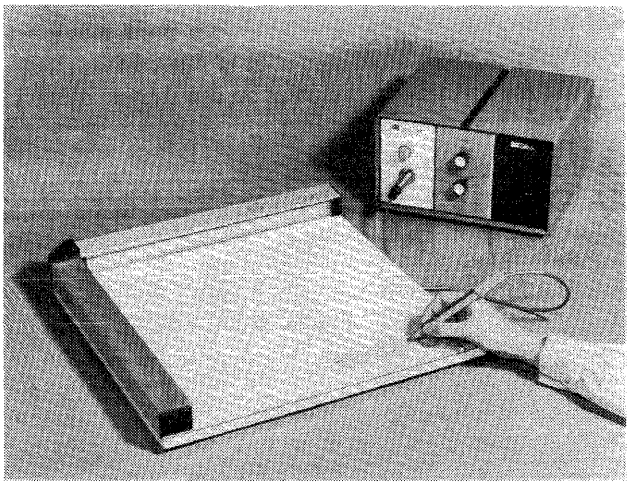
A second type of interactive drawing allows the operator to sketch while the coordinates of the lines are monitored. These coordinates are manipulated, and a figure is created with straight lines and smooth curves replacing the wiggly ones of the sketch. This technique is usually blended with command input to reduce the programming burden of trying to deduce the figure from the sketcher's input.

The console input can be used to input data as well as or instead of commands. For example, the coordinates of points can be established to define an area, and the console can be used to input the type of feature associated with that area. Using a map as the graphic element, resource areas and types could be identified. The arrangement of the system, including interactive capabilities with the mainframe and graphic output devices, will have a lot to do with the procedures that can be used to associate nongraphic data with the graphic points or areas identified.

A digitizer consists basically of three parts: a device that allows the operator to identify a point on the graphic element being digitized, a mechanism for translating the position of this device into numerical coordinates, and a unit for recording the results.

The point-identifying device may be a cross-hair reticule with or without a magnifier (commonly called a cursor), or it may be a pointer-like unit.

The translation mechanism can be electromechanical, driven by a linkage to the cursor, or electronic, interpreting signals generated by the cursor/pointer or signals caused by field disturbances created by the cursor/pointer. A wide variety of techniques is employed to produce signals which are uniquely related to the position of the cursor/pointer and which can be converted to digital values.



The Graf/Pen digitizer from SAC utilizes an unusual digitizing method. The channel-like units at the top and left of the board are sonic receptors for hypersonic wave pulses generated by the pointer. Shown at lower right is a drawing of a keyboard which could be used for alphanumeric input with proper interpretation in the processor.

The output from the digitizer, in digital form, can range from logic-level signals intended to go directly to a processor to recording media such as punched cards or magnetic tape. The paragraphs later in this report which discuss the comparison chart entries provide more details on the actual arrangements currently in use.

Digitizer Performance Parameters

By now you've learned that a digitizer is a device that can be used to generate digital values of coordinate pairs, and you've absorbed a general outline of its potential applications. Next, a discussion of just what you can and cannot do with a digitizer is in order.

There are three distinct elements that control the accuracy of the final table resulting from a digitizing run: the performance of the digitizer itself, the performance of the operator, and the quality of the input graphic.

The performance of the digitizer is largely defined by the resolution and accuracy of the unit. *Resolution* measures the number of points per inch that the digitizer can recognize. *Accuracy* measures the fidelity ot the actual distance being measured. *Linearity* is another parameter sometimes mentioned; basically, it tells how much variability of the other two parameters there is across the field of work.

Typical resolutions span the range of 25 to 1000 points per inch. Some units designed for image digitizing can have substantially higher resolutions. Accuracy generally does not keep up with resolution in the higher ranges. A unit that can resolve 100 points per inch generally has an accuracy of 0.01 inch. However, units that can resolve 1000 points per inch seldom exceed 0.005 inch in accuracy.

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The Tektronix 4954 Graphics Tablet (another name for a free-cursor digitizer) is shown here in use with the Tektronix 4014 Graphics Terminal. Shown at left is a cross-hair cursor that can be substituted for the stylus in use. Although the press release did not describe the application in detail, a little imagination can be used to create a scenario: the map is used to generate a precise picture of the layout of several buildings; the graphic display is then used to determine routing of a power line, or to plan street alterations, or to measure property areas, or to . . .

The performance of the operator is highly dependent upon the skill and dedication of the person. The limits imposed by human physiology are seldom approached. For example, the eye can resolve about 5000 lines per inch under bright illumination at about 10 inches. (A corresponding figure for very low-level illumination is about 100 lines per inch.) If suitable controls are provided, the positioning accuracy will be a function primarily of visual acuity. For nonmechanical positioning, operator accuracy will typically be about ±0.01 inch. A highly skilled draftsman can beat this, but the effort required is intense, and fatigue becomes a problem. If the device itself is included in the measurement of the operator's performance, a deterioration can be observed if the device does not permit a comfortable working position or a well-lighted viewing area.

The graph or drawing being digitized is subject to inaccuracies in the positions of the points or lines and to variations caused by the paper expanding or shrinking due to humidity in the air. (In most drafting shops, master drawings are made on Mylar or equivalent material to eliminate the effects of humidity.) In addition, the width of the lines often means that the operator will actually be positioning a cross-hair within an area rather than on a line. Line widths can vary from 0.005 inch for a fine pencil line to about 0.01 inch for a ball-point pen. Liquid-ink pens usually turn out lines about 0.01 to 0.02 inch wide. A bold stroke from a fiber-tip pen can generate a line 0.05 inch wide, but 0.02 inch is more typical.

The inaccuracies inherent in the positioning of points on drawings are similar to those for the positioning of cursors. However, becasue the draftsmen are normally skilled, accuracy should be better than 0.01 inch; but it's hard to tell by looking. A typical chart recorder might produce a chart with an accuracy within 1.0 percent of full scale (although more accurate ones are available). Over a 20-inch span, this can amount to a 0.2-inch inaccuracy. Paper expansion and contraction due to humidity can span a range of ±0.05 percent. This doesn't seem like very much, but over a distance of 20 inches, it can amount to 0.01 inch.

It is difficult to relate all of these potential sources of divergence from the "true" value. Some are interrelated; e.g., operator visual acuity, precision of cursor placement, accuracy of drawing, and effect of line width. None can be measured with reliability for input to a correction procedure. The net effect is that the table of values generated will include some variation from the "true" set. If the level of inaccuracy is lower than the precision required for whatever calculations are going to be performed, then there is no problem. If not, then there is a problem. Since the performance of the digitizer is only one of the factors, and usually one of the smaller ones, involved in determining the final level of accuracy, a "perfect" digitizer would not eliminate the problem.

One sure-fire approach to reducing error levels is redundant measurements. Depending on the nature of the graphic element being digitized, this may take the form of measuring at smaller intervals or repetitions of the digitizing run. (Interactive graphic manipulation doesn't usually lend itself well to this approach, but it could be implemented.) The redundant information is reduced to a single set with improved accuracy because the errors are assumed to be random. Over several measurings, they will tend to balance out. Obviously, an error in the drawing or graph is there in the same degree for each measuring and will not be balanced out, but much of the human error in positioning the cursor and much of the digitizer error can be. The theory behind the foregoing is beyond the scope of this report, but the subject is treated exhaustively in the literature on probability and statistics.

The above discussion ignored the question of how you know whether or not your data set is accurate enough for your needs. The frank answer is that you don't. But you can do some estimates of the probability that it is or isn't. This subject is also covered in the literature on probability and statistics, but a quick example will give you a feel for the subject. Assume that the combined accuracy for positioning the cursor due to human limitations and the line widths of the drawing is 0.015 inch; assume that the accuracy of the digitizer is 0.01 inch; and assume that the accuracy of the drawing itself is within 0.01 inch. Then, probably half of the measurements will have an accuracy of less than about 0.02 inch, and half more. (The 0.02

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inch figure was arrived at by taking the square root of the sum of the square of each of the possible variations.)

The moral is clear: highly precise work takes a lot of effort and/or money.

User Experience

In the September 1974 supplement to DATAPRO 70, a Reader Survey Form was included on graphic digitizers. By the editorial cut-off date of February 1, 1975, only nine usable responses had been received. Altogether, these users rated 13 separate units representing a total of 43 devices. Seven different manufacturers were represented in the responses. While the small response does not permit the generation of reliable user ratings for specific manufacturers or models, some insight into the use of digitizers can be gleaned.

Perhaps the most significant insight is the diversity of usage to which digitizers are put. We asked the users to identify the types of applications for which they were using digitizers. Functional categorization of their answers yielded the following results:

Curve fitting:	2 responses
Refinement of sketches:	2 responses
Interactive graphic changes:	6 responses
Graphic design:	3 responses

Specific applications mentioned included:

Computer-aided architecture
Environmental resource inventory and analysis
Page layout for magazines and yearbooks
Production of printed circuit boards
Putting land surface information in digital form
Digitizing of seismic data
Map generation

No two users mentioned the same application.

In reply to questions about configuration, the users said their digitizers were:

On-line to a computer–	
Specific minicomputer:	2 responses
Computer not specified:	2 responses
Off-line to–	
Punched cards:	2 responses
One-half-inch magnetic tape:	4 responses
Cassette tape:	2 responses
Part of a plotter system:	4 responses
Part of a graphic CRT system:	2 responses

We also asked the users to identify the types and sources of graphic input they were utilizing, with these results:

Types of graphic input–	
Areas (complete digitizing of graphic):	7 responses
Curves or graphs:	1 response
Line drawings:	3 responses
Hand-drawn sketches:	3 responses
Sources of graphic input–	
Hand-drawn:	9 responses
Projected microfilm images:	1 response
Chart or strip recorder:	2 responses

Also included in the questionnaire was a query about the degree of use each digitizer received. The responses from the eight users who replied can be summarized as follows:

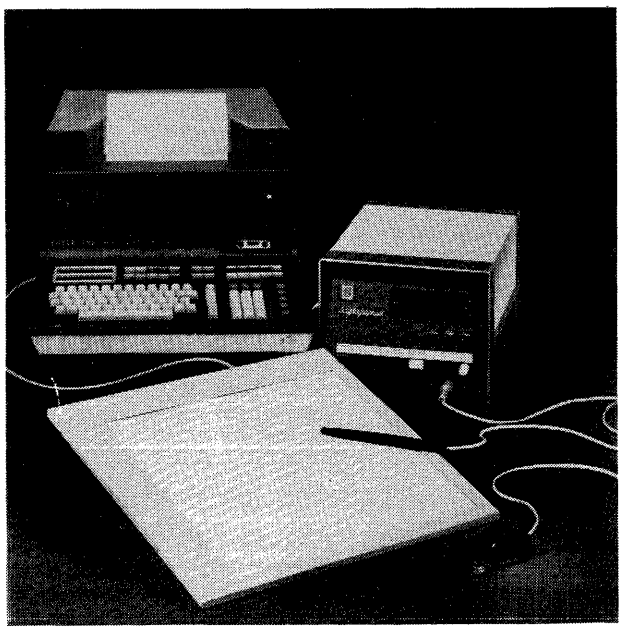
0 to 1 hour per day:	1 response
2 to 3 hours per day:	5 responses
Over 6 hours per day:	2 responses

The users' sources of software for processing the digitized output showed the following pattern:

Mainframe vendor:	2 responses
In-house programming:	7 responses
Digitizer vendor:	1 response
Consultant:	1 response

The digitizer vendor and one of the two mainframe vendors identified were vendors of complete graphic systems.

The seven vendors mentioned in the users' responses were Auto-trol, Bendix, Calma, Computervision, Numonics, SAC, and Summagraphics. Of the 43 individual digitizers reported on, 31 were from SAC, 4 were from Summagraphics, and there were 1 or 2 from each of the others. Datapro feels that the limited number and pattern of



The Summagraphics Data Tablet is shown interfaced to a Hewlett-Packard 9830A Programmable Calculator. The stylus pointer and cross-hair cursor options are both shown.

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responses would make it unfair to list the ratings given to individual units. However, we are presenting the following overall summary to give a perspective as to what these digitizer users had to say:

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	3	6	4	0	2.9
Convenience of use	3	6	4	0	2.9
Speed	3	10	0	0	3.2
Accuracy	4	6	2	1	3.0
Hardware reliability	4	4	1	3	2.8

*Weighted Average on a scale of 4.0 for Excellent.

Specific additional comments from the users centered around ease or convenience of use, flexibility of use, and reliability. These comments were positive or negative, as reflected by the high or low ratings in the table above, and indicate the factors these users considered most important.

Digitizer Characteristics

The accompanying comparison charts summarize the characteristics of 43 digitizers from 21 vendors. The information in the charts was largely supplied by the vendors between October and December of 1974. Their cooperation is greatly appreciated.

The chart entries and their significance are explained in the following paragraphs.

For your convenience, a list of the vendors, including addresses and telephone numbers, immediately precedes the charts.

Type

The principal distinguishing characteristic of digitizers is the manner in which the points to be digitized are identified. There are three general types: restrained cursor, free cursor, and image scan.

The *restrained cursor* employs a rigid mechanical linkage between the cross-hair reticule (cursor) and the coordinate translation arrangement. Movement of the cursor moves the linkage, and this movement is transformed into a digital value. The usual arrangement is a vertical beam moving across the table. The cursor rides up and down the beam. The linear motion of the beam and cursor can be encoded directly, or a rotary encoder can be driven by the respective motions. An optical arrangement is frequently used to translate the linear or rotary motion into digital values.

One vendor objected to the term "restrained cursor," substituting instead the term "constrained cursor." Actually, neither term is really appropriate. The cursor can be moved to any part of the table. Movement is neither restrained nor constrained. (The two terms carry negative and positive connotations for limiting motion, respectively.) However, the arrangement does provide a convenient means for locking one of the directions of motion and moving the cursor vertically or horizontally only; the other axis will then have a constant-value output.

The *free cursor* is so designated because there is no rigid mechanical linkage to the translation device. But there is a cable. One of the ways to achieve this freedom is to imbed a network of wires in the table. A signal generated at the cursor induces a signal in the network. Appropriate circuitry can determine just where the cursor is by the resulting signals generated in the network. Several other techniques are also employed, as described in the accompanying chart entries. In some cases, signals induced in the cursor are measured. In one case, the cursor generates a hypersonic signal that is picked up by receptors and translated.

A special type of free cursor is the pen or stylus used with so-called "data tablets." These can be used to "monitor" and digitize lines as they are being drawn or to point to positions to be digitized. While the accuracy of positioning is substantially less than with the cross-hair cursor, the speed and convenience of use are substantially higher. Data tablets are well suited to the interactive sketching environment.

There is much discussion as to the relative merits of restrained versus free cursors and the different methods of implementing each type. The discussion centers on two aspects—ease of use and accuracy. There are no easy answers. A steep board angle will favor the restrained cursor for ease of use by about as much as a flat board angle will favor a free cursor. The ease with which each can be positioned accurately will vary from operator to operator. The question of accuracy is also a tough one. Proponents of an all-electronic approach (free cursor) mention mechanical wear and tolerances and play in parts. Advocates of the restrained cursor talk about nonlinearity across the field, particularly at the edges. Back come the retorts about anti-backlash gearing—and what about shifts in the operating points of the circuitry due to environment changes?

If you got lost during the above discussion, don't let it worry you. We've simply attempted to illustrate the types of technical discussions that can arise in comparing different approaches. Fortunately, you, the users, are in a more comfortable position than the manufacturers. You do not have to justify a technical approach; you have only to decide which type is more convenient for you, whether a particular unit will provide the accuracy your application demands, and whether the price can be justified for your application. But making these decisions does require that you actually *use* the various types and models before a purchase is made. This is not an unusual requirement for a device that depends so much on manual operation for its successful use.

The last general type of digitizer is the *image scan* variety. This approach is used when the presence or absence of a

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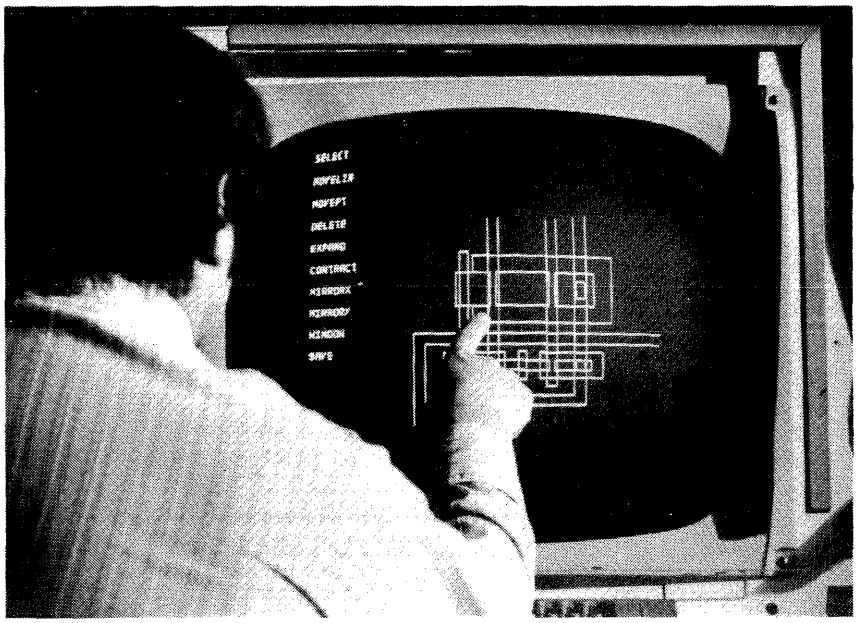

This digitizer from Instronics, Ltd. is perhaps the most unusual unit covered in this report, which includes a host of novel devices. Can you find the digitizer? The display is a conventional CRT unit. The digitizer is a transparent overlay that fits in front of the display screen. The operator's finger is used as the stylus; direct connection to the electronics is not *required. Admittedly, the resolution achievable is not high (10 to 50 points per inch is claimed by the manufacturer) unless you have very slender fingers, but it is a neat way to provide light pen capability for a CRT device.*

mark at a particular point is to be determined. Usually, a grid is implied, and a "yes/no" or intensity value is recorded for each point in the implied grid. Addressing information is not recorded explicitly; the sequence of values carries the implied address of each point within the grid. Using this technique, a photograph or other pictorial image can be completely recorded in digitized form. The usual application for this technique is image enhancement or manipulation.

Marketing Orientation

This entry simply identifies whether the manufacturer markets the device to end users or to vendors (OEM).

Interfaces

This group of entires specifies the choices available for the destination of the digitized output. It is closely allied with the entry *System Output.* The two entries were chosen to permit proper distinctions between equipment available as a digitizer only and equipment available as part of a system. Many of the current digitizers are available either way. Of particular significance are interfaces for minicomputers or larger computers and the RS-232 interface, which is directed toward data communications and the use of the digitizer as a terminal. Keep in mind, however, that many minicomputers also use the RS-232 interface for local low-speed peripherals.

Digitized Output

This entry attempts to state the form of the digitized output. Two general forms are possible. One is a pure binary form in which the entire output word (up to 16 bits or so) is to be interpreted as a binary number representing the value. The second is a series of digits (each in binary form) which represent the value. The pure binary form is more compact. A range of values up to 1024 can be represented by 10 bits in pure binary form. Conversely, a range of values up to 999 can be represented by 3 digits, which will require either 12 bits (4 bits/digit), 18 bits (6 bits/digit), or 24 bits (8 bits/digit), depending on the format. Either binary or BCD (binary coded decimal) forms can be used to process or record data. The form required depends on the associated equipment.

The size of the output is closely related to the resolution. Obviously, more bits are going to be required to represent each value if 1000 points per inch are being read than if 50 points per inch are being read. In addition, the size of the table affects the maximum magnitude of the coordinates. Some digitizers utilize a fixed origin at the lower left corner of the table and output only positive values. Others can set the origin at any point and output positive and negative values. Some digitizers can apply scaling factors to the values read to convert the magnitudes to a different value range. All of these factors affect the magnitude range of the final output and, consequently, the number of bits required to fully represent the values.

To the best of our ability, based on the information available, we have reported the output form of each digitizer. If you are going to be using the digitizer with another device via logic-level signals or compatible media, be sure to check out the exact format conventions for recording the results.

System Output

This entry summarizes the output choices available to the customer. Mention of a particular type of output device in this entry indicates that it is available from the digitizer vendor.

Size of Input Document

Generally, this entry presents the range of table sizes available. These dimensions control the size of document

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that can be used without letting some of it hang over the edges, a non-neat approach that can result in damage to the document. In practice, the area reachable by restrained cursor devices may be (but is not necessarily) somewhat smaller than the table sizes presented.

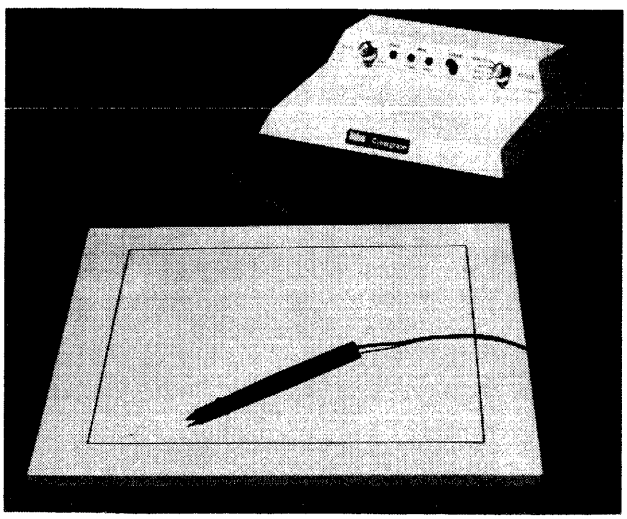
Speed

For a manual mode of operation, the speed of the digitizer is obviously dependent on the operator and the job. As explained below under the *Digitizing Modes* heading, semi-automatic operation is available for several units. In general, the speed characteristic represents the maximum rate at which the translation circuitry can track and convert values.

Digitizing Method

This entry summarizes the technique employed to convert the location of the cursor or pointer to a digital value. A great diversity of techniques is employed. There are lots of great phrases to impress your friends with—phrases like phase measurement of magnetically induced signals; elastic surface wave; air-conducted hypersonic wave front; closed-loop, negative-feedback electric field; and magnetostrictive strain wave. Even a cursory discussion of these techniques is beyond the scope of this report. (The manufacturers will be only too happy to go into detail with you about them.)

Virtually any physical or electrical property could be employed in the process of generating signals for input to an analog to digital converter. In general, all that is required is for the position of the cursor to either generate a signal or interfere with a field or signal in a nonambiguous way so that a unique pair of coordinates can be generated.



This data tablet from Talos uses still another technique for generating the signals to be digitized. The technique is proprietary and is described as frequency measurement of a closed-loop, negative feedback electric field. The pen picks up the field, and this signal is used to generate the field, thus the closed-loop nature. The electric field "rides" the top surface, so a pad up to one-half inch thick could be between the pen tip and the surface of the tablet. Talos also comments on the great strength of the tablet itself, which means it can withstand rough handling.

The manufacturers of digitizers appear to have been most ingenious in utilizing different properties. But no matter how clever the manufacturer has been, the accuracy of the output is the controlling factor in judging the worth of a particular technique and its implementation into a piece of hardware by that manufacturer. Testing the device to see exactly what it will do is entirely in order.

Resolution

Resolution is simply the measure of how fine a distinction can be made between adjacent points. This involves both the conversion and positioning aspects of the unit. A sufficiently wide resolution in the output data form is required to accommodate the resolution capabilities of the mechanical or electronic positioning and sensing portion. For resolutions up to 100 points per inch, any of the available techniques can be accommodated. As resolutions go beyond this, measurement becomes difficult. For example, to digitize 1000 points per inch, a rotary optical encoder must be able to resolve an angle one-tenth that required to digitize 100 points per inch. To use an acoustic wave, timing must be performed in tens of nanoseconds rather than hundreds. And the list can be continued for the other techniques.

The point is simple: Very high resolution is expensive. And the result may not be worth paying for, as discussed earlier in the text. Undoubtedly, there are applications that require such high resolution. But make sure you need it, because the cost is high.

Digitizing Modes

Most digitizers can operate in a manual mode. The operator positions the cursor/pointer and activates a button on the cursor or a foot switch. The coordinate pair is recorded. Additional data may be added from the console, or perhaps a few buttons on the cursor allow limited data to be added conveniently without moving away from the cursor.

In addition to the manual mode, many devices permit a semi-automatic mode of operation. Usually, the operator moves the cursor freely along the line being traced, and coordinate pairs are generated at every increment. The increment may be distance along one axis or a time increment. This mode of operation is sometimes referred to as "stream digitizing." Usually, the operator has some selectivity in the increment size chosen. "Remote operation" indicates that the reading can be triggered by an external signal.

System Support

If a digitizer is available as part of a full graphic processing system, a brief indication is made in this entry. For most such systems, additional information can be found in the DATAPRO 70 reports *All About Plotters* and *All About Graphic Display Devices*, which immediately precede this report.

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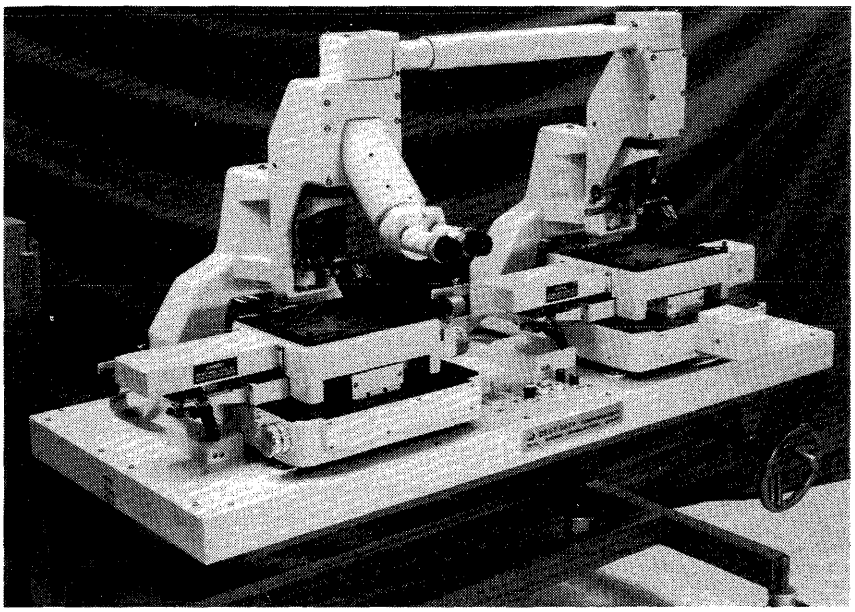

For high detail work, this Micron Mensuration Stage is available from Dest Data. It accommodates photographic films up to 4 by 4 inches. The model shown is a dual unit for use with a stereo microscope arrangement, as shown, for measuring in three dimensions. The resolution is 25,400 points per inch, which means it can measure points one micron apart. This unit demonstrates that if you provide sufficient magnification and adequate movement mechanisms, the resolution of a digitizer can be extended to almost any desired degree. But don't expect to digitize a five-foot strip chart in any big hurry with this.

Pricing and Availability

These entries are self-explanatory, with the addition that monthly rental costs are given for a two-year lease including maintenance.

Digitizer Vendors

Listed below, for your convenience in obtaining additional information about their products, are the names, addresses, and telephone numbers of the 21 vendors represented in the accompanying comparison charts.

Auto-trol Corp., 5650 North Pecos Street, Denver, Colorado 80221. Telephone (303) 485-5900.

Bendix Computer-Graphics, 23629 Industrial Park Drive, Farmington, Michigan 48024. Telephone (313) 477-3700.

Broomall Industries, Inc., 682 Parkway, Broomall, Pennsylvania 19008. Telephone (215) 353-4610.

Calma Company, 707 Kifer Road, Sunnyvale, California 94086. Telephone (408) 245-7522.

Compunetics, Inc., 1100 Eldo Road, Monroeville Industrial Park, Monroeville, Pennsylvania 15146. Telephone (412) 373-2520.

Computek, Inc., 143 Albany Street, Cambridge, Massachusetts 02139. Telephone (617) 864-5140.

Computer Equipment Company, 1055 First Street, Rockville, Maryland 20850. Telephone (301) 424-4790.

Dest Data Corporation, 1285 Forgewood Avenue, Sunnyvale, California 94086. Telephone (408) 734-1234.

Digital Equipment Corporation, 200 Forest Street, Marlboro, Massachusetts 01752. Telephone (617) 841-9511.

Faul-Coradi, Inc., 643 West Onondaga Street, Syracuse, New York 13204. Telephone (315) 475-2155.

The Gerber Scientific Instrument Company, P.O. Box 305, Hartford, Connecticut 06101. Telephone (203) 644-1551.

Graph-Data Digitizing, 6451 West 83rd Street, Los Angeles, California 90045. Telephone (213) 645-0331.

Instronics Ltd., Stittsville, Ontario, Canada. Telephone (613) 836-4411.

Numonics Corporation, Hancock Street and Route 202, North Wales, Pennsylvania 19545. Telephone (215) 643-7410.

Optronics International, Inc., 7 Stuart Road, Chelmsford, Massachusetts 01824. Telephone (617) 256-4511.

Ruscom Logics Ltd., Unit 7, 62 Alness Street, Downsview, Ontario, Canada M3J 2H1. Telephone (416) 661-9470.

SAC (Science Accessories Corporation), Kings Highway West, Southport, Connecticut 06490. Telephone (203) 255-1526.

Spatial Data Systems, Inc., P.O. Box 249, 508 S. Fairview Avenue, Goleta, California 93017. Telephone (805) 967-2383.

Summagraphics Corp., 35 Brentwood Avenue, Fairfield, Connecticut 06430. Telephone (203) 384-1344.

Talos Systems, Inc., 7311 East Evans Road, Scottsdale, Arizona 85260. Telephone (602) 948-6540.

Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005. Telephone (503) 644-0161.□

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MANUFACTURER AND MODEL	Auto-trol 3480 Series	Auto-trol 3400 Series	Auto-trol 3900 Series	Bendix Computerized Digitizer	Bendix Datagrid Digitizer (BDD)
TYPE	Restrained cursor (Opti-track)	Restrained cursor	Free cursor	Free cursor	Free cursor
MARKETING ORIENTATION	OEM; end user	OEM; end user	OEM; end user	End user	End user
INTERFACES	Minicomputer; logic level; free standing	Minicomputer; logic level; free standing	Minicomputer; logic level; free standing	Data General Nova 1210 interface standard	Serial to TTY, RS-232 CRT, key-punch, paper tape, mag. tape, Nova, PDP-11, HP 2100
DIGITIZED OUTPUT	16 bits each axis	16 bits each axis	16 bits each axis	16-bit binary	8-bit bytes; 6 digits each axis
SYSTEM OUTPUT	200/556/800-bpi tape; 8-level punched tape; 80-col. cards	200/556/800-bpi tape. 8-level punched tape; 80-col. cards	200/556/800-bpi tape; 8-level punched tape; 80-col. cards	800 or 1600-bpi tape	TTY, CRT, data comm., 80-col cards, punch. tape, 7/9-tk, 556/800-bpi tape
SIZE OF INPUT DOCUMENT, inches	Up to 48 x 60	Up to 37.5 x 60	Up to 36 x 48	Up to 42 x 60	Up to 42 x 60
SPEED	Over 200 pts/min.; 100 in./sec. max. slew speed	125 pts./min.; 75 in./sec. max. slew speed	Over 225 pts./min.	Operator-determ.; slew speed is 300 in./sec. max.	Operator-determ.; slew speed is 300 in./sec. max.
DIGITIZING METHOD	Linear optical encoders	Mechanical linkage to rotary shaft	NA	Phase measurement of magnetically induced signals	Phase measurement of magnetically induced signals
RESOLUTION, points per inch vertical and horizontal	1000	1000	1000	1000	1000
DIGITIZING MODES	Manual	Manual	Manual	Manual; time or distance stream digitizing opt.	Manual; time or distance stream digitizing opt.
GRAPHIC SYSTEM SUPPORT	Full system incl. control console & output devices avail. Full graphic systems avail.	Full system incl. control console & output devices avail. Full graphic systems avail.	Full system incl. control console & output devices avail. Full graphic systems avail.	Can be included in Interactive Drafting System 100	Can be included in Interactive Drafting System 100
PRICING AND AVAILABILITY					
Purchase price	$12,000-$30,000	$11,000-$30,000	$15,000-$30,000	$55,000 up	$12,000-$30,000
Monthly rental	$480-$1,200	$440-$1,200	$600-$1,200	Third party	Third party
First delivery	1971	1972	1973	1972	1969
Number installed to date	100	25	5	5	600
Serviced by	Auto-trol	Auto-trol	Auto-trol	Bendix	Bendix
COMMENTS	Recomm. appl. include printed/integrated circuits and num. control; accuracy is 0.003 in.; backlighted board available	Recommended for general-purpose digitizing; accuracy is 0.01 in.; backlighted board available	Recommended for mapping, geology, geophysical work; accuracy is 0.01 in.	Backlighted 36 x 48 board available	Accuracy is 0.005 in.; backlighted 36 x 48 board available

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MANUFACTURER AND MODEL	Bendix Digitizer Terminal (BDT)	Bendix Graphscan Digitizer (BGD)	Bendix OEM Products	Broomall Industries BII Model D100	Broomall Industries BII Model D200
TYPE	Free cursor	Free cursor	Free cursor	Restrained cursor; free cursor opt.	Restrained cursor; free cursor opt.
MARKETING ORGANIZATION	End user; OEM	End user	OEM	OEM; end user	OEM; end user
INTERFACES	Logic level, 16-bit mini-computer	Serial to TTY, CRT, modem, key-punch, 16-bit minicomputers	Pulse, parallel buffered, or serial fly register logic level interface	Free standing with interface to most minicomputers	Free standing with interface to most minicomputers
DIGITIZED OUTPUT	8-bit bytes	8-bit bytes; 4-digits plus sign each axis	5 digits plus sign each axis	6 digits plus sign each axis	24 bits each axis
SYSTEM OUTPUT	Customer-provided minicomputer	TTY ASR 33; 80-col. cards	Customer-supplied	800-bpi tape; 80-col. cards; 8-level punched tape; printed listing	800-bpi tape; 80-col. cards; 8-level punched tape; printed listing
SIZE OF INPUT DOCUMENT, inches	Up to 42 x 60	Up to 40 x 60	Up to 42 x 60	Up to 37.5 x 72	Up to 37.5 x 72
SPEED	Operator-determ.; slew speed is 300 in./sec. max.	Operator-determ.; slew speed is 300 in./sec. max.	Operator-determ.; slew speed is 300 in./sec. max	Operator-determ.	Operator-determ.
DIGITIZING METHOD	Phase measurement of magnetically induced signals	Phase measurement of magnetically induced signals	Phase measurement of magnetically induced signals	A/D conversion derived from mechanical link-age to cursor	A/D conversion derived from mechanical link-age to cursor
RESOLUTION, points per inch vertical and horizontal	1000	100	1000	1000	1000
DIGITIZING MODES	Manual; time or distance stream digitizing opt.	Manual	Manual	Manual	Manual
GRAPHICS SYSTEM SUPPORT	–	–	–	–	–
PRICING AND AVAILABILITY Purchase price	$9,900-$18,000	$7,150-$13,000	Contact vendor	$4,000-$18,000	$4,000-$26,000
Monthly rental	Third party	Third party	–	Contact vendor	Contact vendor
First delivery	September 1974	1970	1970	May 1974	June 1974
Number installed to date	10	80	1000	6	2
Serviced by	Bendix	Bendix	OEM customer	BII	BII
COMMENTS	Special-purpose version of Data-grid Digitizer, especially oriented as minicomputer peripheral unit		Accuracy is 0.005 in.	Hard-wired controller	Minicomputer-controlled

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MANUFACTURER AND MODEL	Broomall Industries BII GP100	Calma Digitizers	Compunetics, Inc. Grafacon 1010	Compunetics, Inc. 2020	Computek GT/50
TYPE	Automatic image digitizer	Restrained cursor	Free cursor (pen)	Free cursor (pen)	Free cursor (pen)
MARKETING ORIENTATION	End user	Part of Calma interactive graphics systems	OEM and end user	OEM and end user	OEM and end user
INTERFACES	Free standing w. interface to most minicomputers or data comm. interface	Data General Nova	PDP-8, 11; Nova; 360/370; 1108; RS-232; free standing	PDP-8, 11; Nova; 360/370; 1108; RS-232; free standing	Parallel; Computek 300/400 graphic CRT
DIGITIZED OUTPUT	16 bits each axis plus 16-bit gray shade value (16 or 64 levels)	NA	11 bits each axis	11 bits each axis	10 bits each axis
SYSTEM OUTPUT	800-or 1600-bpi tape; printed listing; graphic matrix display; plot	Pen, scribe, and photo plots; CRT; mag. tape; punched tape; printed listing	11-bit parallel; 800-bpi tape; punched cards; punched tape; serial comm.	11-bit parallel; 800-bpi tape; punched cards; punched tape; serial comm.	10-bit parallel bit stream
SIZE OF INPUT DOCUMENT, inches	Up to 36 x 48	48 x 60	10.24 x 10.24	20.48 x 20.48	11 x 11
SPEED	Approx. 30 sec. per 8.5 x 11 page	Operator-determ. in manual mode; selectable in cont. mode	4500 pts./sec.	4500 pts./sec.	1250 pts./sec.
DIGITIZING METHOD	Image scan	Precision encoders driven by cable from cursor	RAND principle	RAND principle	Electromagnetic detection
RESOLUTION, points per inch vertical and horizontal	50, 100, 200, & 400;operator-set	1000	25, 50, 100, or 200	100	91
DIGITIZING MODES	Image scan only; selection of 1 to 64 gray levels plus 4 or more colors	Manual; cont. for time or distance increments	Manual positioning of pen	Manual positioning of pen	Strobe: output when pen is moved to new position; Free: output every 800 microsec.
GRAPHICS SYSTEM SUPPORT	Available as part of full interactive graphics system	Available as part of full interactive graphics system	Available as part of full interactive graphics system		
PRICING AND AVAILABILITY					
Purchase price	$75,000-$175,000	$17,500	$4,950-$9,650	$12,500	$1,100-$2,400
Monthly rental	Contact vendor	NA	NA	NA	NA
First delivery	October 1972	January 1971	NA	NA	1969
Number installed to date	5	Approx. 300	10	30	Over 2000
Serviced by	BII	Calma	Compunetics	Compunetics	Computek
COMMENTS	Complete graphics & image processing system with full software to suppt. automated drafting and automatic inspection		Available as table model or in free-standing cabinet	Available as table model or in free-standing cabinet	Price shows range including OEM and quantity discounts

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MANUFACTURER AND MODEL	Computer Equipment Co. PORT-A-GRID	Computer Equipment Co. MAN-U-GRAPH	Computer Equipment Co. DIGI-GRID	Computer Equipment Co. MINI-GRID	Computer Equipment Co. DATAVERTER
TYPE	Restrained cursor	Restrained cursor	Free cursor	Free cursor	Free cursor
MARKETING ORIENTATION	End user	End user	End user	End user	OEM
INTERFACES	PDP-11, Nova, logic level, RS 232, free standing	PDP-11, Nova, logic level, RS-232, free standing	PDP-11, Nova, logic level, RS-232, free standing	PDP-11, Nova, logic level, RS-232, free standing	Parallel BCD or binary; RS-232C
DIGITIZED OUTPUT	4 digits plus sign, each axis	5 digits plus sign, each axis	4 digits plus sign, each axis	4 digits each axis	4 or 5 digits each axis, sign optional
SYSTEM OUTPUT	800-bpi tape, 80-col. cards, 8-level punched tape, CRT, printed listing, bit stream	800-bpi tape, 80-col cards, 8-level punched tape, CRT, printed listing, bit stream	800 bpi tape, 80ocol. cards, 8-level punched tape, CRT, printed listing, bit stream	800-bpi tape, 80 col. cards, 8-level punched tape, CRT, printed listing, bit stream	Parallel or serial bit stream
SIZE OF INPUT DOCUMENT, inches	24 x 24 to 36 x 36	36 x 48 or 42 x 60	30 x 36 to 42 x 60	11 x 11 to 36 x 48	11 x 11 to 42 x 60
SPEED	1.5 or 15 points/sec.	Up to 15 points/sec.	Up to 200 points/sec.	1.5 or 15 points/sec.	Up to 200 points/sec.
DIGITIZING METHOD	Mechanical linkage with optical encoding	Mechanical linkage with optical encoding	Electromagnetic grid	Electromagnetic grid	Electromagnetic grid
RESOLUTION, points per inch vertical and horizontal	20, 40, or 100	100	1000	100	100 or 1000
DIGITIZING MODES	Manual; cont. for time increments	Manual; cont. for time or distance increments	Manual; cont. for time or distance increments	Manual; cont. for time increments	Manual; cont. for distance increments; remote
GRAPHICS SYSTEM SUPPORT	—	Available as part of full COMP-U-GRID graphics system	Available as part of full COMP-U-GRID graphics system	Available as part of full COMP-U-GRID graphics system	—
PRICING AND AVAILABILITY					
Purchase price	$3,000-$11,000	$7,000-$18,000	$16,000-$26,000	$5,000-$16,000	$1,000-$5,000
Monthly rental	$150-$550	$350-$900	$800-$1,300	$250-$800	—
First delivery	January 1973	January 1974	June 1972	August 1973	January 1974
Number installed to date	NA	NA	NA	NA	NA
Serviced by	CEC	CEC	CEC	CEC	CEC
COMMENTS	Portable unit				

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MANUFACTURER AND MODEL	Dest Data DSD120/240	Dest Data DSD500	Dest Data Micron Mensuration Stage	Digital Equipment VW01	Faul-Coradi Digirail
TYPE	Automatic image scan	Automatic image scan	Free cursor	Data tablet	Restrained cursor
MARKETING ORIENTATION	OEM; end user	OEM; end user	End user	End user	End user
INTERFACES	Logic level or custom	Logic level or custom	IBM 2740	PDP-8, 12, 11, 15	Most minicomputers; free standing
DIGITIZED OUTPUT	One bit per point; fixed grid array	One bit per point; fixed grid array	17 bits each axis	10 bits each axis	6 digits each axis
SYSTEM OUTPUT	Serial bit stream or custom	Serial bit stream or custom	Display; printed listing	10-bit parallel bit stream	800-bpi tape, 80-col. cards, punched tape, tape cassette, printed listing, digital display
SIZE OF INPUT DOCUMENT, inches	Up to 8.5 x 14	Up to 8.5 x 14	Up to 4 x 4 film plates	11 x 11; up to 60 x 60 on special order	56 x 40
SPEED	1.35 (120 pts/in.) or 4 (240 pts/in.) sec. per 8.5x11 page	48 sec. per 8.5 x 12 page	250,000 points/sec.	200 points/sec. max.	Manual
DIGITIZING METHOD	Photodiode array; dynamic thresholding	Photodiode array; dynamic thresholding	Photoelectric linear motion metering	Time measurement of sonic pulses	Optical shaft encoders with rack and pinion drive
RESOLUTION, points per inch vertical and horizontal	120 or 240	500	25,400 (1 micron)	93.1	1000
DIGITIZING MODES	Document scan	Document scan	Manual	Manual; continuous	Manual
GRAPHICS SYSTEM SUPPORT	–	–	–	Available with PDP series minicomputers	Can be expanded to include CRT and full-feature plotter
PRICING AND AVAILABILITY					
Purchase price	$16,000-$24,700	$47,500	$53,400	$3,780	$22,935-$70,000
Monthly rental	–	–	–	–	–
First delivery	April 1971	September 1973	1968	1971	June 1971
Number installed to date	36	1	43	NA	35
Serviced by	Dest Data or OEM	Dest Data	Dest Data	DEC	Faul-Coradi
COMMENTS	Models available with single 120 or 240 pt./in. resolution or dual resolution; price range shown is for end users	Designed for merging illustrations with text in photocomposition system	Dual version for measurement of 3 dimensions via stereopairs costs $142,000; stage is supported on air bearings; mfd. under license from Singer		

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MANUFACTURER AND MODEL	Faul-Coradi Coradograph	Gerber Model GCD-1	Gerber Model 24	Graph-Data Digitizing DI 3000	Instronics TSD
TYPE	Restrained cursor	Restrained cursor	Free cursor with trailing carriage on each axis	Restrained cursor	Passive probe (finger)
MARKETING ORIENTATION	End user	End user; OEM	OEM; end user	End user	OEM; end user
INTERFACES	Most mini-computers; free standing	IBM 29, UNIVAC VIP keypunches; Singer SP2, Flexowriter	HP-2100; logic level	Free standing	RS-232; logic level; many minicomputers
DIGITIZED OUTPUT	6 digits each axis	5 digits plus sign, each axis	10 bits each axis	10 bits each axis	12 bits each axis
SYSTEM OUTPUT	800-bpi tape, 80-col. cards, punched tape, tape cassette, listing, etc.	80-col. cards, punched tape, magnetic tape	Bit stream	8-level punched tape	Parallel or serial bit stream; binary or BCD
SIZE OF INPUT DOCUMENT, inches	20 x 20 to 80 x 60	42 x 60	36 x 48	30 x 40 and larger	Up to 20 x 20
SPEED	Manual	Manual	Manual	30 pts./min.	Approx. 100 pts./sec. max.
DIGITIZING METHOD	Optical shaft encoders with rack & pinion drive	Cursor mechanically linked to photoelectric encoders	NA	Time-based optical encode linkage system	Time measurement of elastic surface wave
RESOLUTION, points per inch vertical and horizontal	10,000	1000	1000	500	10 to 50
DIGITIZING MODES	Manual	Manual	Manual	Manual; cont. for time increments	Manual
GRAPHICS SYSTEM SUPPORT	Can be expanded to include CRT & full-feature plotter w. wide range of boards, including rotary	Can be included in PC-700 Automatic Artwork Generator for printed circuits	Can be included in Interactive Design system for drafting applications	–	–
PRICING AND AVAILABILITY					
Purchase price	$22,935-$70,000	$13,900 up	Contact vendor	$5,000-$10,000	$1,800-$5,000
Monthly rental	–	–	–	$150-$250	–
First delivery	June 1971	1966	1973	August 1975	1973
Number installed to date	50	Approx. 100	5	–	Approx. 30
Serviced by	Faul-Coradi	Gerber	Gerber	Graph-Data	Instronics
COMMENTS			Unit is combination digitizer and plotter	Previous Model DI 1400, a portable unit for digitizing charts up to 12 feet long has been discontinued	Tablet is transparent glass overlay; no connection between probe (finger or stylus) and controller is required

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MANUFACTURER AND MODEL	Istronics Gradicon	Numonics 220 Series	Optronics P-1000	Optronics M-10/14
TYPE	Free cursor	Restrained cursor	Rotating drum, image scan	Flat bed, image scan
MARKETING ORIENTATION	OEM and end user	End user	End user	End user
INTERFACES	Many minicomputers; free standing	Parallel logic level; RS-232; TTY; IBM 29; PDP-8, 11, 12; Nova; HP 2100, 9800; Wang 600, 700, 2200	Free standing	Free standing
DIGITIZED OUTPUT	16 bits each axis; serial BCD codes	4 digits each axis	12 bits each axis plus 256 gray levels (8 bits)	4 or 5 digits each axis
SYSTEM OUTPUT	800-bpi 9-tk. tape, 556-bpi 7-tk. tape, 80-col. cards, punched tape, others	Parallel or serial bit stream	CRT, printed listing, mag. tape	CRT, printed listing, mag. tape
SIZE OF INPUT DOCUMENT, inches	24 x 26 to 48 x 60	24 x 24 to 36 x 30	16mm. to 17 x 22 in. film	10 x 10 (M-10); 14 x 14 (M-14)
SPEED	0.5 to 20 pts./sec.	Manual	Up to 480 rpm; 30 kbps	Up to 5 in./sec.; 5 kbps
DIGITIZING METHOD	Optical encoders; see Comments	Optical detection of linear grids	Electromechanical image scan	Electromechanical image scan
RESOLUTION, points per inch vertical and horizontal	1000	40 or 100	508 to 2032 (50 to 12.5 microns)	Up to 15,240
DIZITIZING MODES	Manual; cont. for time or distance increments	Manual; cont. for time or distance increments	Continuous image scan; one axis selectable increment	Continuous image scan
GRAPHICS SYSTEM SUPPORT	FORTRAN support programs available	Contact vendor	–	–
PRICING AND AVAILABILITY				
Purchase price	$15,000-$25,000	$1,995-$3,645	$25,000-$35,000	$15,000-$65,000
Monthly rental	–	–	Negotiable	–
First delivery	1970	November 1971	NA	NA
Number installed to date	Approx. 200	250	See Comments	See Comments
Serviced by	Instronics	Numonics	Optronics	Optronics
COMMENTS	X-Y frame under table is driven by closed-loop servos; signal is induced in cursor from coil under table	Unit is available with fixed logic for digitizing, measuring area, measuring length of sinusoidal path, or combinations	P-1700 includes P 1000 and P 1500 film writer at about $20,000 more than P 1000; Optronics specializes in image scanning equipment; the company has installed over 500 units	

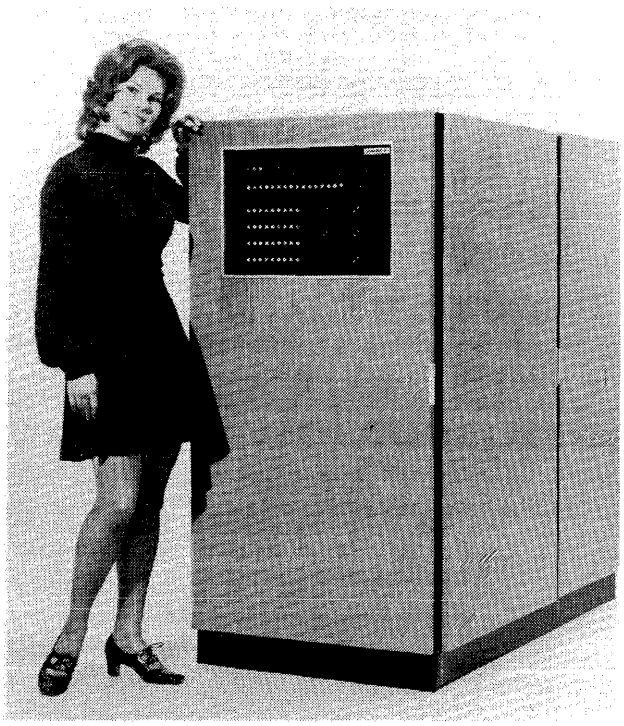
All About Graphic Digitzers

MANUFACTURER AND MODEL	Ruscom Logics Ltd. Model 11	Ruscom Logics Ltd. Model 11 W/M	Ruscom Logics Ltd. Model 21	Ruscom Logics Ltd. Model 21 W/M	SAC GRAPH/PEN GP-3
TYPE	Restrained cursor	Restrained cursor	Restrained cursor	Restrained cursor	Free cursor (stylus)
MARKETING ORIENTATION	End user	End user	End user	End user	End user and OEM
INTERFACES	IBM 26/29 key-punch; Digi-Data mag. tape; TTY	Wang 600, 700, 2200 (11W) or Monroe 1800 (11M) calc.	IBM 26/29 key-punch; Digi-Data mag. tape; TTY	Wang 600, 700, 2200 (21W) or Monroe 1800 (21M) calc.	IBM 26/29 key-punch; RS-232C; TTY; most popular mag. tapes, mini-comp. & calc.
DIGITIZED OUTPUT	4 digits each axis	4 digits each axis	4 digits each axis	4 digits each axis	11 to 14 bits or 4 digits each axis
SYSTEM OUTPUT	200/556/800-bpi 7-tk. tape; 800/1600-bpi 9-tk. tape; 80-col. cds; 8-level punched tape; listing	Printed listing plus output via calculator	200/556/800-bpi 7-tk. tape; 800/1600-bpi 9-tk. tape; 80-col. cds. 8-level punched tape; listing	Printed listing plus output via calculator	800-bpi mag. tape; 75-cps punched tape; serial bit stream; analog signal
SIZE OF INPUT DOCUMENT, inches	12 x 28	12 x 28	36 x 60	36 x 60	14 x 14 to 60 x 72
SPEED	Manual	Manual or calculator-driven	Manual	Manual or calculator-driven	Up to 140 points/sec.
DIGITIZING METHOD	Optical shaft encoders mechan. linked to cursor via taut wire	Optical shaft encoders mechan. linked to cursor via taut wire	Optical shaft encoders mechan. linked to cursor via taut wire	Optical shaft encoders mechan. linked to cursor via taut wire	Time measurement of air-conducted hypersonic wave front
RESOLUTION, points per inch vertical and horizontal	100	100	100	100	100, 254, or 25.4; others on special order
DIGITIZING MODES	Manual; incre. stepping or cont. drive for X axis opt.	Manual; incre. stepping or cont. drive for X axis opt.	Manual; incre. stepping or cont. drive for X axis opt.	Manual; incre. stepping or cont. drive for X axis opt.	Manual; contin. for time increments; remote
GRAPHICS SYSTEM SUPPORT	–	–	–	–	–
PRICING AND AVAILABILITY					
Purchase price	$5,400-$5,800	$3,820	$7,000-$7,500	$5,420	$2,400-$4,000
Monthly rental	–	–	–	–	–
First delivery	May 1969	August 1973	February 1970	Late 1974	August 1969
Number installed to date	See Comments	See Comments	See Comments	See Comments	Approx. 900
Serviced by	Ruscom	Ruscom	Ruscom	Ruscom	SAC, Honeywell
COMMENTS	Ruscom has delivered over 75 units; hand or foot pedal logging is standard; backlighted board is standard on Models 11, 11W, and 11M; larger tables are available; Models 11, 11W, and 11M can be adapted for film scanning on special request; prices are in Canadian dollars				

All About Graphic Digitizers

MANUFACTURER AND MODEL	Spatial Data Systems Computer Eye 108	Summagraphics HW-112	Talos 500 Series	Tektronix 4953/4 Graphics Tablet
TYPE	Automatic; image scan	Free cursor or stylus	Free cursor or stylus	Free cursor or stylus
MARKETING ORIENTATION	OEM and end user	OEM and end user	OEM and end user	End user
INTERFACES	Logic level; PDP-8, 11; Nova; HP 2100; other minicomputers on special request	RS-232; PDP-8, 11; Nova; Wang, HP, Tektronix calc.; logic level; TTY; others; free standing	PDP-8, 11; Nova; Varian; HP; GA; other minis; RS-232; calc.; TTY others	Tektronix 4010 family or graphic CRT terminals
DIGITIZED OUTPUT	9 bits, each axis, address plus 8-bit gray scale value	Binary or BCD; length depends on tablet size	Binary or BCD	10 or 12 bits each axis
SYSTEM OUTPUT	8-bit parallel bit stream; 800-bpi mag. tape	Per customer request	800-bpi tape; 80-col. cards; 8-level punched tape; serial bit stream; 8, 11, 16 or 22-bit parallel stream	8-bit parallel bit stream
SIZE OF INPUT DOCUMENT, inches	Variable; input image obtained from video camera	11 x 11 to 36 x 48	11 x 11 to 42 x 60; others on request	11 x 11 (4953) or 40 x 30 (4954)
SPEED	Full scan to tape takes 35 sec.; 5 to 17 sec. typical partial scan for logic level output	Up to 200 pts./sec.	Up to 200 pts./sec.	166 pts./sec. max
DIGITIZING METHOD	Time and amplitude measurement of TV scan	Time measurements of magnetrostrictive strain wave	Frequency measurement of closed-loop, negative feedback electric field	Measurement of electromagnetic signal induced in cursor/pen
RESOLUTION, points per inch vertical and horizontal	512 x 480 or 512 x 512 grid; resolution varies	100 or 200	100 or 200	100
DIGITIZING MODES	Image scan; manual via optional joystick/cursor	Manual; continuous for time increments; remote	Manual; continuous for time increments; remote	Manual; continuous
GRAPHICS SYSTEM SUPPORT	Software library available	–	–	Subsystem including CRT and diskette drive is software-supported for many minis and major computers
PRICING AND AVAILABILITY				
Purchase price	$8,600-$24,500	$1,000-$4,000	$2,250-$4,500	$2,995 or $4,995
Monthly rental	–	–	Contact vendor	$150 or $250
First delivery	1973	April 1973	May 1974	Fall 1974
Number installed to date	Over 20	Approx. 1500	75	NA
Serviced by	Spatial Data Systems	Summagraphics	Honeywell	Tektronix
COMMENTS		OEM and quantity discounts available	OEM and quantity discounts available	

Ampex ARM Series Add-On Main Memory



The ARM-3360, used with System/370 Models 155 and 165, is one member of the broad Ampex line of add-on core memory units for IBM, UNIVAC, and DEC computers.

Ampex offers replacement core memory for IBM System/370 Models 155 and 165 and for System/360 Models 22 and 30 through 75 at substantially lower prices than the equivalent IBM memory. Ampex also supplies replacement memory for UNIVAC 418 III, 494, and 1100 Series computers and for DECsystem-10 computers.

MANAGEMENT SUMMARY

The Ampex ARM Series of magnetic core memories includes all-on and replacement memories for IBM System/360 Models 22 and 30 through 75, IBM System/370 Models 155 and 165, UNIVAC 400 and 1100 Series and DECsystem-10 computers. These memories are designed to extend the storage capacity of existing main memory and/or to replace all memory down to the minimum storage capacity specified for the particular processing unit model; in some cases, such as System/360 Models 65, 67, and 75 and System/370 Models 155 and 165, all existing IBM memory can be replaced by Ampex memory.

Besides providing all IBM-standard storage capacities for the various System/360 models, the Ampex memories are available in capacities that provide up to twice the maximum memory capacity available from IBM for Models 22, 30, and 40; three times the maximum IBM capacity for Model 50; and four times the maximum IBM capacity for Models 65, 67, and 75.

Ampex memories for System/370 Models 155 and 165 are available in 512K-byte increments only. Enhancement capacities (storage capacities above the IBM-imposed maximum capacities) are not currently available for the System/370 computers.

The ARM Series product line also includes replacement memories for the UNIVAC 400 and 1100 Series com- ➢

CHARACTERISTICS

MANUFACTURER: Ampex Corporation, Computer Products Division, 13031 West Jefferson Boulevard, Marina del Rey, California 90291. Telephone (213) 821-8933.

MODELS

IBM System/360: Five models are available—ARM-22, ARM-30, ARM-40, ARM-50, and ARM-2365. Each model is available in standard IBM and enhanced module capacities.

IBM System/370: Two models—ARM-3360 Model 3 for the 370/155 and Model 5 for the 370/165.

UNIVAC 400 and 1100 Series: Four models—ARM-1108, ARM-1106, ARM-494, and ARM-418 III.

DECsystem-10: Two models—ARM-10, Models I and S.

COMPATIBILITY

IBM System/360: The ARM Series core memories, Models ARM-22 thru ARM-50 and ARM-2365, are designed as add-on and/or replacement memories for IBM System/360 Model 22, 30, 40, 50, 65, 67, and 75 computers. The Ampex core memory can be used to extend the core storage capacity of an existing IBM System/360 processing unit and/or to replace all core storage down to the minimum mainframe capacity as specified for the particular processing unit. In addition to the standard capacities available from IBM, Ampex offers enhancement capacities that, combined with existing mainframe storage, provide storage capacities ranging up to 64K bytes for the Model 22, up to 128K bytes for the Model 30, up to 448K bytes for the Model 40, up to 1536K bytes for the Model 50, and up to 4096K bytes for Models 65, 67, and 75. The ARM-2365 is designed as a direct replacement for IBM 2365-2 and -3 Processor Storage, which is used with IBM System/360 Models 65, 67, and 75. Like its IBM counterparts, the ARM-2365 is available in module capacities of 256K bytes.

Effective cycle times of the 360-compatible Ampex memories are the same as those of the corresponding IBM processing units: 1.5 microseconds per byte for Model 22, 1.5 or 2.0 microseconds per byte for Model 30, 2.5 microseconds per 2 bytes for Model 40, 2.0 microseconds per 4 bytes for Model 50, and 750 nanoseconds per 8 bytes for Models 65, 67, and 75.

IBM System/370: The ARM-3360 core memory is designed as a direct replacement for the IBM 3360 Processor Storage used with IBM System/370 Models 155 and 165, and can be used to extend the existing storage capacity of a ➤

Ampex ARM Series Add-On Main Memory

puters. Salient features of these units include storage protection, interleaved or overlapping operation, and error detection.

A recent addition to the ARM Series product line is a replacement for DECsystem-10 memory and is available in two models. One of the models contains four individual memories per cabinet, and the other contains one memory. Salient features include two- or four-way storage interleaving, four ports, and expansion to 256K words in 32K-, 64K-, or 128K-word increments.

Each of the ARM Series memories is equipped with a sophisticated off-line diagnostic capability, including a maintenance panel, to facilitate the isolation of malfunctions by service personnel.

Ampex prices its replacement memories substantially below those of IBM and UNIVAC. For example, the savings under a two-year lease for extending core storage on a System/360 Model 30 from 16K to 64K bytes amount to about $1,550 per month. The System/370 user stands to save $2,520 per month (under a two-year lease) per 512K bytes of ARM-3360 memory over the monthly rental price of an IBM 3360 Model 3 or 5.

Deliveries of the Ampex ARM Series memories began in 1971. Initial deliveries of the ARM-30 and the ARM-2365 were made in April and May of 1971, respectively, with the ARM-40 and ARM-50 following in July 1971. Deliveries of the ARM-22 began in December 1971.

Ampex installed the industry's first IBM System/370 replacement memory on May 14, 1972. To date, Ampex has installed over 200 of its System/360 and 370 replacement memories. Initial customer deliveries of the ARM 400 and 1100 Series memories were made in late 1972.

Service is provided by Ampex through its own maintenance organization, with service points throughout the U.S. and Canada.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 9 users reported on their experience with a total of 10 Ampex replacement memories for System/360 Models 40 (3), 50 (4) and 65 (1); System/370 Model 165-II (1); and DECsystem-10 (1). These memories had an aggregate capacity of 4,960K bytes. The users' ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	7	3	0	0	3.7
Equipment reliability	5	4	1	0	3.4
Maintenance service	4	1	4	1	2.8
Ease of installation	4	2	4	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

Judging by the marks assigned by these nine Ampex users (which are consistent with the results of last year's

System/370 processing unit and/or to replace all of the unit's existing core storage. The ARM-3360 is available in storage capacities of 512K bytes per module. The System/370 Model 155 can accommodate up to four ARM-3360 Model 3 modules of 512K bytes each to provide a total storage capacity of 2048K bytes; Model 165 can accommodate up to six ARM-3360 Model 5 modules to provide a total storage capacity of 3072K bytes.

Effective cycle times of the ARM-3360 memories are the same as those of the corresponding IBM processing units: 2.07 microseconds per 16 bytes for Model 155 and 2.0 microseconds per 8 bytes for Model 165. The ARM-3360 Model 3 memories also include 8192 bytes of bipolar monolithic (semiconductor) "bump" storage, which is dedicated to the storage of Unit Control Words and is inaccessible to the user.

UNIVAC 400/1100 Series: The ARM-1108, ARM-1106, ARM-494 core memories are designed as add-on or replacement mainframe memories for the UNIVAC 1108, 1106, and 494 computers, respectively, and can be used to extend the computers' existing main memory capacity and/or to replace all of the existing main storage. The memories are available in module capacities of 64K words for both the 1100 Series and 400 Series computers. Compatibility features include a 750-nanosecond (ARM-494 and -1108) or 1.0 or 1.5-microsecond (ARM-1106) read/restore cycle time, overlapped/interleaved main storage access, access by any combination of up to three processors and/or I/O controllers, parity generation and checking, and storage protection. Three ports (data paths) are standard, and five are optional.

DECsystem-10: The ARM-10 Series core memories, Models I and S, are designed as add-on or replacement main memories for Digital Equipment Corporation's DECsystem-10 computer systems, Models 1040, 1050, 1055, 1060, and 1070, and 1077. The ARM-10 memories are plug-to-plug-compatible with DEC's MD10, ME10, and MF10 memories, and can be used to expand the main memory capacity in 32K- 64K-, 128K-, or 256K-word increments up to the maximum capacity for all KA and KI processor models (256 words for the KA10 and 4096K words for the KI10). Either Ampex model can be used with either DEC processor. Model S is available with a maximum per-cabinet capacity of 32K, 64K, or 128K words consisting of a single sector, which precludes internal interleaving. Model I is available with a maximum per-cabinet capacity of 128K or 256K words consisting of two to four 64K-word sectors, and provides two- or four-way internal interleaving. Both models provide four memory ports (data paths) and two- or four-way external interleaving (between cabinets). Memory cycle times of 1150 (Model I) and 1100 (Model S) nanoseconds are compatible with those of the DEC processors. Both Ampex models are composed of 16K-word plug-in memory modules. All logic is implemented via semiconductor circuits; the memory stack consists of 18-mil lithium ferrite cores. The ARM-10 interface is completely transparent to both the KA10 and KI10 processors.

All Ampex memories contain integral power supplies that satisfy the memory power requirements and diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode. Power supply voltages can be switched to plus or minus five percent of the normal operating voltage to determine marginal operating conditions. The external maintenance panel provides controls for addressing any memory location, reading from the addressed memory location, or writing new data entered via panel switches. Indicators are provided for reading the current memory address, the data stored at the current address, and error status. Controls are

Ampex ARM Series Add-On Main Memory

survey), Ampex memories offer an attractive cost/performance alternative as replacement memory. The mixed ratings for maintenance service tend to suggest that Ampex could improve its service support in some areas. However, only two of the nine users reported serious problems during installation and testing, and no serious difficulties were reported in diagnosing malfunctions and obtaining service. The average time required for installation and testing was reported as 13 hours (1 to 3 days). □ .

also provided for writing a specific data pattern and for selecting specific memory operating models.

Physical specifications and heat dissipation for each of the Ampex memory cabinets are presented in the following table:

Model	Maximum Storage, bytes	Cabinet Size: Depth, inches	Width, inches	Height, inches	Weight, inches	Heat Dissipation, BTU/hr.
ARM-22	40K	32	23	60	300	3,000
ARM-30	48K	32	23	60	300	3,000
ARM-40	256K	32	23	60	550	3,500
ARM-50	256K	32	23	60	550	4,000
ARM-50	512K	28	60	64	700	7,000
ARM-50	1024K	28	78.5	64	1,200	10,000
ARM-2365	1024K	32.5	76	71	1,650	11,935
ARM-3360	512K	31.5	62	60	1,200	10,000
ARM-1100/400	512K*	28.5	63	64	700	10,000
ARM-10:						
Mdl. I	256K*	32	48	68	1,234	15,345
Mdl. S	128K*	32	23	60	490	7,000

*Storage capacity per cabinet in 36-bit words.

Ampex Models ARM-2365, ARM-3360, ARM-1108, and ARM-10 are powered from a 208-volt, three-phase source. All other models are powered from a 115-volt, single-phase source. Model ARM-3360 for the 370/155 can also be powered from a 230-volt, single-phase source.

PRICING: Ampex memories are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Ampex offers lease contracts for one to five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and complete maintenance. A separate maintenance contract is available for purchased units.

Model & Storage Capacity, bytes (1)	Monthly Rental (2): 2-Year Lease	5-Year Lease	Purchase	Monthly Maint.(3)
ARM-22:				
32K	$ 560	$ 470	$ 19,600	$ 70
40K	615	495	21,525	90
ARM-30:				
16K	505	415	17,675	50
32K	600	485	20,650	100
48K	680	555	23,800	110
64K	825	675	25,200	185
80K	1,250	1,000	39,600	210
96K	1,400	1,120	44,300	230
112K	1,650	1,330	52,600	250
ARM-40:				
64K	725	560	24,000	105
128K	1,310	970	45,000	135
192K	1,750	1,310	62,000	165
256K	2,360	1,695	80,000	260
320K	2,690	2,015	95,000	370
384K	3,060	2,300	110,000	400
ARM-50:				
128K	1,610	1,240	56,400	185
256K	2,260	1,745	79,200	300
384K	2,915	2,255	102,000	390
512K	3,565	2,755	124,800	425
640K	4,220	3,265	147,600	520
768K	4,870	3,770	170,400	540
896K	5,520	4,270	193,200	725
1024K	6,170	4,770	216,000	780
ARM-2365:				
256K	2,900	2,400	87,000	405
512K	4,400	3,600	131,000	545
768K	5,950	4,800	175,000	690
1024K	7,500	6,000	220,000	835
ARM-3360 (for 370/155 and 165):				
512K	3,600	2,925	117,500	520
1024K	7,000	5.880	234,000	775
1536K	10,200	8,290	335,500	1,035
2048K	13,200	10,725	435,000	1,295
370/155 Expansion (4):				
512K to 768K	450	450	16,400	40
512K to 1024K	475	475	17,200	45
512K to 1536K	695	695	25,200	65
512K to 2048K	915	915	33,200	85
1024K to 1536K	220	220	8,000	20
1024K to 2048K	430	430	15,600	40
1536K to 2048K	475	475	17,200	45
ARM-494/1106/1108:				
64K words	4,230	3,610	145,000	490
Spare 16K words	112	91	3,500	0
ARM-10, Mdl. I:				
128K words	–	–	80,000	1,000
256K words	–	–	140,000	1,500
ARM-10, Mdl. S:				
32K words	–	–	30,000	400
64K words	–	–	43,500	500
128K words	–	–	73,500	1,000
ARM-10 Expansion Mdl. I:				
128K to 256K words	–	–	70,000	–
Mdl. S:				
32K to 64K words	–	–	17,500	–
64K to 128K words	–	–	35,000	–

(1) All entries indicate the storage capacity of the Ampex memory only.
(2) Monthly rental under a 2- or 5-year lease includes maintenance for 24 hours/day, 7 days/week.
(3) Complete maintenance for 24 hours/day, 7 days/week.
(4) For attaching more than 1024K bytes to a single Storage Adapter of the 370/155. These lease, purchase, and maintenance prices are to be added to the prices for the ARM-3360. This upgrade does not apply to the 370/165.■

Ampex TC-38/TM-34 Magnetic Tape Subsystem

These magnetic tape drives and the associated microprogrammed controller are offered individually as plug-to-plug replacements for IBM's 3420, 2420, and 2401 Series drives and 2803 Tape Control, and also as a complete subsystem replacement for IBM's 3420/3803 Magnetic Tape Subsystem. The Ampex drives are available as single-drive units or in the new twin-drive arrangement.

MANAGEMENT SUMMARY

The TM-34 Series Magnetic Tape Drives and TC-38 Tape Controller provide Ampex with an IBM-replacement capability on a subsystem basis as well as on an individual component basis. As a complete tape subsystem, the combined TC-38 Controller and TM-34 Drives provide a plug-to-plug replacement for the IBM 3420/3803 Magnetic Tape Subsystem. As an individual component, the TC-38 Controller can be used to replace IBM's 2803 controller and can accommodate a mixture of both Ampex and IBM drives. Also, the TM-34 Drives can be used as add-ons or replacements at existing IBM magnetic tape installations.

Ampex introduced the TC-38/TM-34 Subsystem in June 1972, and customer deliveries began in September 1972. Physically, the tape drives were originally available only as single-drive units (i.e., one drive per cabinet). At the 1972 FJCC, Ampex introduced a repackaged version of its TM-34 Series Drives that contains two drives per cabinet. The new twin-drive unit occupies just over one-half the space occupied by two single-drive units. By comparison with IBM's 3420 drives, which require 13.75 square feet including service area, the Ampex twin-drive modules occupy only 8.75 square feet of space, a 40 percent saving in floor space.

The Ampex drives and controller incorporate state-of-the-art features including a radial interface (which permits each drive to be independently connected to the controller instead of in the "older" conventional series arrangement), a microprogrammed controller (which provides greater operating flexibility), MSI integrated cir- ▷

CHARACTERISTICS

MANUFACTURER: Ampex Corporation, Computer Products Division, 13031 West Jefferson Boulevard, Marina del Rey, California 90291. Telephone (213) 821-8933.

TAPE DRIVES: Ampex Models TM-343, TM-344, and TM-345. Each model is available as a single-drive or dual-drive unit.

TAPE CONTROLLER: Ampex Model TC-38.

COMPATIBILITY: The Ampex TM-34 Series Drives are designed as plug-compatible replacements for the IBM 3420, 2420, and 2401 Series drives. They can be used with an existing IBM 2803 Tape Control or with the Ampex TC-38 Tape Controller, which is designed for connection to a Multiplexer, Selector, or Block Multiplexer Channel on IBM System/360 Models 30 through 195 and IBM System/370 Models 135 through 195.

The Ampex TM-34 Series drives are characterized in the table (next page), together with the equivalent IBM drives and their characteristics. The TM-34 Series drives are available as 7- or 9-track units. The 7-track drives read and write at selectable densities of 200, 556, or 800 bits/inch using the NRZI recording technique. The basic 9-track drives read and write at a single density of 1600 bits/inch. The optional Dual Density feature enables the 9-track drives to operate at 1600/bits/inch using the phase-encoding technique or at 800 bits/inch using the NRZI technique.

Options available with the IBM drives are also available with the Ampex drives; these options include Mode Compatibility, which allows 800 bpi operation on an IBM controller designed for 1600 bpi operation; Dual Density, which allows 800 bpi operation in addition to the standard 1600 bpi operation; and Simultaneous Read-While-Write (SIMS), which allows simultaneous read and write operations to be performed on two separate tape drives connected to a dual-channel controller.

Standard features include automatic threading of standard reels or cartridges, single-capstan operation, vacuum-column rewind, and a radial interface.

The Ampex TC-38 Tape Controller is designed as a plug-compatible replacement for the IBM 2803 Tape Control when used with IBM drives and for the IBM 3803 Tape Control when used with the Ampex TM-34 Series drives. The TC-38 can accommodate any mix of up to eight Ampex TM-34, TM-20, and TM-16 drives and IBM 2401 and 2420 drives. Standard features include microprogram control and error detection and correction. Microprograms ▶

Ampex TC-38/TM-34
Magnetic Tape Subsystem

CHARACTERISTICS OF THE AMPEX TM-34 SERIES TAPE DRIVES

Ampex Tape Drive	IBM Equivalent Drive	Tape Tracks	Tape Speed, ips	R/W Access Time, msec	Rewind Time, seconds**	Interlock Gap, inches	Tape Density, bits/inch	Transfer Rate, K bytes/sec
TM-343	3420-3, 2401-2, or 2401-5	7	75	4.0	70	0.75	800/556/200	60/41.7/15
		9	75	4.0	70	0.6	1600/800**	120/60*
TM-344	2401-3 or 2401-6	7	112.5	3.5	70	0.75	800/556/200	90/62.5/22.5
		9	112.5	3.5	70	0.6	1600/800*	180/90*
TM-345	3420-5	7	125	2.9	60	0.75	800/556/200	100/69.5/25
		9	125	2.9	60	0.6	1600/800*	200/100*

*Dual Density operation is optional. **For 2400-foot reel.

cuitry, and automatic threading for both tape reels and cartridges.

Microprogram control, the key feature of the TC-38 Controller, is implemented via an integral tape cassette drive and combined logic, including two RAM semiconductor memories that implement the execution of magnetic tape functions and an auxiliary memory designed to implement the execution of subroutines and functions independently of the main memory. The cassette-based microprogram is automatically loaded during the power-up sequence, and also includes diagnostic and error-checking routines (including system-independent diagnostics).

Still another important feature of the TC-38 Controller is its error detection and correction capability, which can correct up to six consecutive errors in any one track and any number of single-bit, single-track errors without reverting to dead-track operation.

On a one-year lease, Ampex prices its drives and controller 10 percent below IBM's prices for its 3803 Control Unit and 3420 Series drives. Increased savings can be realized through extended lease terms.

Ampex provides its own service support through a worldwide network of sales and service offices. Response time to service calls within an Ampex service area is currently quoted at 2 hours. □

stored on cassette tape are automatically loaded into memory during the power-up sequence. Microprogram control is implemented via two random-access semiconductor memories which store all operating programs and diagnostic routines read from cassette tape; one is also used to perform cyclical redundancy checks on data read from tape. A smaller auxiliary memory, with an access time of 60 nanoseconds, supplements the microprogram memory by providing a capability for performing subroutines. The TC-38's error detection and correction feature is capable of correcting up to six consecutive errors in any one track and any number of single-bit, single-track errors without reverting to dead-track operation.

Pooling options permits up to 16 drives to be manually switched among two, three, or four TC-38 Controllers to provide concurrent operation of two, three, or four tape drives over as many Selector Channels on the same or different computers.

The physical characteristics of the Ampex drives and controller are as follows:

	Width, inches	Depth, inches	Height, inches	Weight, lbs.
TM-34 Drives:				
Single-drive unit	30	29.5	60-64.6*	800
Dual-drive unit	30	41	60-64.6*	1400
TC-38 Controller	30	28.5	60	500

*With operator control panel.

The TC-38 Controller is powered from a 208/230-volt three-phase source.

PRICING: The Ampex TC-38 Controller and TM-34 Drives are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Ampex offers leases for 30 days and for one, two, three, four, or five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and full-coverage maintenance (24 hours/day, 7 days/week, excluding holidays). A separate maintenance contract is available for purchased units.

	Rental (1-Yr. Lease)	Rental (3-Yr. Lease)	Purchase	Monthly Maint.
TM-34 Drives:				
TM-343*	365	310	13,500	65
TM-344*	450	370	16,000	70
TM-345*	465	390	17,500	70
TC-38 Controller	560	475	21,000	95
Drive options:				
Dual Density	20	15	800	10
Mode Compatibility	10	8	500	0
Simultaneous Read/Write	10	8	500	0
Controller Options:				
Dual Density	50	46	2,000	10
7-Track Operation	60	50	2,600	10
Dual Density and 7-Track Operation	110	96	4,600	20
Two-Channel Switch	105	93	5,000	20
Controller Switch:				
Two controllers	105	94	5,000	10
Three controllers	155	141	7,500	15
Four controllers	210	188	10,000	20

*Price per single drive; multiply each price by a factor of two to find price of each dual-drive unit. ■

MARCH 1973

Ampex DS-330 Disk Subsystem

Designed as a direct replacement for the IBM 3330 Disk Storage Facility, the Ampex DS-330 Disk Subsystem features a microprogrammed controller that can accomodate up to 16 spindles.

MANAGEMENT SUMMARY

Ampex recently entered the IBM 3330 replacement market with its DS-330 Disk Subsystem. The Ampex subsystem offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and operating characteristics. No hardware or software modifications to existing IBM equipment are required. Disk packs recorded by Ampex drives can be read by the equivalent IBM drives, and the converse.

Ampex is offering its users a direct replacement for the IBM 3330 subsystem. The DS-330 subsystem does not boast any features that are not already provided by the IBM 3330, nor does it lack any of the 3330's features. Its performance characteristics are about the same as those of the 3330, but the Ampex subsystem is priced about 15 percent below its IBM counterpart.

The Ampex subsystem does offer a 7 percent improvement in average positioning time. Rotational speed, data transfer rate, and storage capacity, however, are identical ➢

CHARACTERISTICS

MANUFACTURER: Ampex Corporation, Computer Products Division, 13031 West Jefferson Boulevard, Marina del Rey, California 90291. Telephone (213) 821-8933.

DISK DRIVES: Model DM-330, a single-spindle upright module.

DISK CONTROLLER: Model DC-830 Storage Control Unit, a microprogrammed controller.

CONFIGURATION: The Ampex DS-330 Disk Subsystem includes a DC-830 Storage Control Unit and one to sixteen DM-330 Disk Drives.

The optional Two-Channel Switch provides two channel interfaces, which serve as alternate paths to the controller and its attached disk drives.

COMPATIBILITY: The Ampex DS-330 subsystem is designed for connection to an IBM System/360 computer, Models 85 and 195 only, or an IBM System/370 computer, Models 135 through 195, via the Block Multiplexer Channel as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The DS-330 provides complete compatibility with the IBM 3330 command structure and requires no changes to the existing operating software.

STORAGE CAPACITY: The data storage capacity of the Ampex DM-330 drives is 100.018 million bytes per spindle, which is identical with the per-spindle storage capacity of the IBM 3330. Total on-line storage capacity of a 16-drive subsystem is 1.6 million bytes.

ACCESS ARRANGEMENT: Each spindle provides access to 404 recording cylinders (19 tracks/cylinder) via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

DISK PACK: Each Ampex DM-330 drive accomodates one IBM 3336 Disk Pack or an equivalent pack. The 3336 contains 12 disks and provides 19 recording surfaces.

FILE ORGANIZATION: Identical with that of IBM; each disk pack corresponds to one logical file. Address (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

PERFORMANCE: The performance characteristics of the Ampex DM-330 drives are compared with those of the IBM 3330 drives in the following table. ➤

Ampex DS-330 Disk Subsystem

with those of the IBM units. Like its IBM counterpart, the DS-330 Subsystem features Rotational Position Sensing (RPS), Multiple Requesting, and Command Chaining.

Also, like their IBM counterparts, the Ampex DM-330 drives are capable of fully overlapped seek operations on any combination of up to 16 on-line drives, and of multi-track searching through a cylinder without loss of any disk revolutions.

The IBM 3330 and Ampex DS-330 subsystems have different physical configurations. IBM has maintained the multiple-spindle-per-cabinet design which it used for the earlier 2314 subsystem and the later 2319 units. Although this packaging technique conserves floor space, it restricts the subsystem to a limited number of configurations—two, four, six, or eight spindles per string in the case of the 3330. The one spindle-per-unit approach used by Ampex requires at least 20 percent less floor space (including service area) on a per-spindle basis and allows any number of spindles, up to 16 per subsystem, to be used.

The Ampex DC-830 Storage Control Unit features microprogrammed operation and extensive use of integrated circuitry. Microprogramming is implemented via a writable control store, a 4096-word semiconductor memory that stores the unit's control and diagnostic programs and is loaded during the power-up sequence from a "floppy" disk. The microprogrammed diagnostics can be interfaced with normal system programs in such a way that diagnostics can be performed on one drive while the other drives remain in normal operation.

Two-channel selection is available, permitting the DC-830 Controller to be connected to two computers for shared operation or between two controller positions on the same computer. Switching is performed under program control.

First deliveries of the Ampex DS-330 Disk Subsystem are scheduled for July 1973. □

Head Positioning Time, Milliseconds

Disk Drive	Track to Track	Average (400 cyl.)	Maximum (400 cyl.)	Tracks per Inch
Ampex DM-300	10	28	55	192
IBM 3330	10	30	55	192

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically by both the Ampex and IBM drives. Start-up and shut-down times for the Ampex drives are 15 seconds each, which is about equivalent to those of the IBM 3330 drives.

PHYSICAL CHARACTERISTICS: The physical arrangement of the Ampex DS-330 subsystem is quite different from that of the IBM 3330. Unlike the 3330, the Ampex subsystem consists of discrete components with the following cabinet dimensions:

Device	Width, inches	Depth, inches	Height, inches	Weight, pounds
DM-330 Drive	19.25	34	38*	550
DC-830 Controller	27	34	60	610

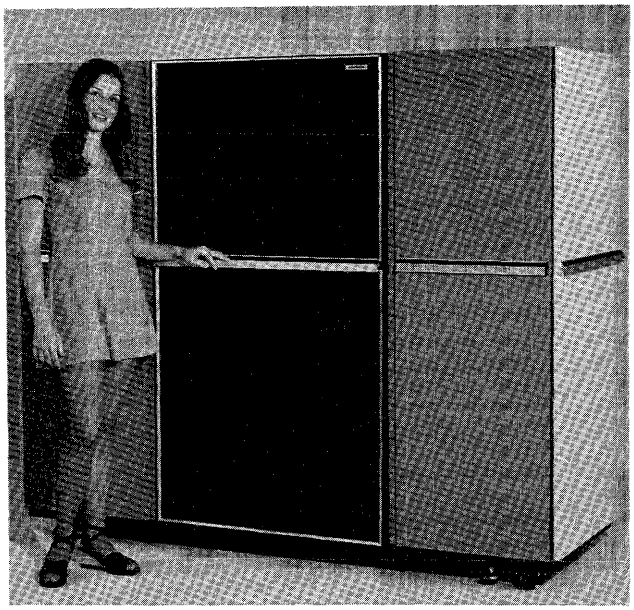
* Disk pack access height is 32 inches.

PRICING: The Ampex DS-330 Disk Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Ampex offers lease contracts for two, three, four, or five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and maintenance on a 24-hour, 7 days/week basis. A separate maintenance contract is provided for purchased units.

	Monthly Rental*	Purchase	Monthly Maintenance
DC-830 Controller	$1,750	$95,000	$115
DM-330 Drive	475	25,000	85
Two-Channel Switch	145	16,000	8

* For two-year lease; includes service for 24 hours/day, 7 days/week. ■

Ampex Mainframe-ECM Memory



This novel main memory unit, designed for use as a replacement for IBM 2365 Processor Storage on System/360 Models 65, 67, and 75, combines 1 million bytes of core storage with a 32K-byte MOS cache memory. The result is enlarged memory capacity at comparatively low cost, with no sacrifice in performance.

MANAGEMENT SUMMARY

Ampex has formed a new product line by combining its one-million-byte Extended Core Memory, a replacement for IBM's 2361 Large Core Store and Ampex's initial entry in the replacement memory market, with a 32K-byte MOS semiconductor memory that acts as a buffer or "cache" between the ECM memory and the processing unit. Ampex is marketing its Mainframe-ECM for use with IBM System/360 Models 65, 67, and 75 as a replacement for IBM 2365 Processor Storage. The key advantage offered by Mainframe-ECM is fast, large-capacity random-access storage priced far below IBM's prices for equivalent capacity and performance.

The presence of cache memory significantly upgrades the performance of the ECM memory, which has a cycle time of 1.8 microseconds. Filled from ECM memory during the initial run of a program, cache memory is accessed whenever a processor fetch operation requests an operand or instruction that is already residing in cache; this is defined as a "hit." If the requested data is not residing in cache, ECM memory is accessed and the 8-byte operand is transferred to both processor and cache to provide immediate access at the next request. Failure to access requested data from cache is defined as a "miss."

Each miss costs a full 1.8 microseconds, whereas a hit costs only 400 nanoseconds, the cycle time of the cache. The hit (to miss) ratio is dependent upon the program being run, the storage capacity of the ECM, and the capacity of the cache memory. A hit ratio of 80 percent results in an average memory cycle time of 650 nanoseconds, which is below the 750-nanosecond cycle time of ▷

CHARACTERISTICS

MANUFACTURER: Ampex Corporation, Computer Products Division, Marine del Rey, California 90291. Telephone (213) 821-8933.

COMPATIBILITY: The Ampex Mainframe-ECM with cache memory is designed as an add-on or replacement memory for IBM System/360 Model 65, 67, and 75 computers, as a direct replacement for IBM 2365 Processor Storage. A total of eight Mainframe-ECM memories, each providing one million bytes of storage, can be attached to any of the three System/360 processor models. The entire Mainframe-ECM system interfaces the processor via an IBM 8080 2361 Attachment.

The Ampex Mainframe-ECM combines a 1024K-byte Extended Core Memory having a cycle time of 1.8 microseconds with a 32K-byte semiconductor cache memory having a cycle time of 400 nanoseconds and an access time of 150 nanoseconds. The effective cycle time of the Mainframe-ECM typically matches that of the IBM processor – 750 nanoseconds.

The semiconductor cache memory is connected between the processor and core memory. For all processor fetch operations, the cache storage control determines whether the referenced data is available in cache memory. If so, cache memory is accessed; if not, ECM storage is accessed, and the addressed data is both transferred to the processor and loaded into cache memory. The cache is loaded in units of 8 bytes (one doubleword). A continuously updated index array provides rapid references to the main storage addresses of all data contained in cache memory. All accesses of cache-memory are automatic and completely transparent to the programmer.

Mode selection controls, located on the maintenance panel, provide control over all processor and channel store operations.

Processor store operations are performed in the "store through" or "non-store through" modes. In the "store through" mode, data stored in ECM memory is also stored in the corresponding location with cache memory (contingent upon the current existence of a corresponding cache location). In the "non-store through" mode, data is stored in cache, but not in ECM memory. This operating mode conserves cycle time and increases system performance. Data stored in the "non-store through" mode is automatically written into ECM memory when activity at that address subsides.

Channel store operations are performed in the "freeze" or "non-freeze" mode. In the "freeze" mode, data transferred from an I/O channel is written into the ECM only; cache ➤

Ampex Mainframe-ECM Memory

IBM 2365 Processor Storage. Because of the large capacity of the Ampex cache memory, it is reasonable to expect a hit ratio of 80 percent or better for many programs.

Besides providing fast access for processor fetch operations, the Ampex cache is designed to respond to processor store operations and to channel transfers in either of two modes. A manual control provides the option of storing processor data in both ECM and cache or in cache only, which requires less than 25 percent of the time required to access ECM; changes made in the contents of cache only are automatically made in ECM when activity at that address subsides. Another manual control provides the option of storing channel data in both ECM and cache or in ECM only; this option safeguards active programs within cache.

IBM endorsed the technique of operating with cache (or buffer) storage by making it a key architectural element of the System/360 Model 85 and 195 computers and the later System/370 Models 155, 165, 158, 168, and 195. All of the IBM models except the super-scale Model 195 offer only 8K to 16K bytes of cache, but IBM's cache cycle times are a comparatively fast 54 to 115 nanoseconds.

The Mainframe-ECM's effective speed matches that of IBM 2365 Processor Storage in most applications. Existing IBM System/360 Models 65 through 75 can accommodate up to eight Mainframe-ECM memories providing a total storage of 8 million bytes. Except for a slight modification to existing hardware (a few wire changes), no hardware or software changes are necessary. Operation with cache memory is automatic and completely transparent to the program and programmer.

The new cache memory capability can also be added to installed ECM memories that are already in service. Ampex states that the field change can be performed over a weekend.

Ampex provides its own service through its nationwide service organization.

Ampex Mainframe-ECM will be available for initial customer deliveries during the first quarter of 1973. □

memory is not affected, but the data contained within the corresponding cache location is flagged as being invalid. This mode prevents the alteration of active programs within cache. In the "non-freeze" mode, channel data is written into both the ECM and the corresponding location in cache (contingent upon the current existence of a corresponding cache location).

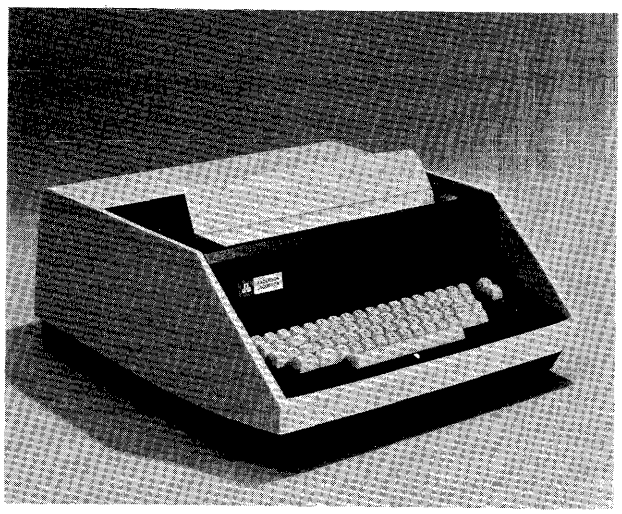
Each Mainframe-ECM contains an integral power supply that satisfies all memory power requirements and diagnostic circuitry that, via an external maintenance panel, provides an off-line diagnostic capability to facilitate the isolation of malfunctions within the unit.

The physical specifications for each Mainframe-ECM memory are: height, 64 inches; width, 78.5 inches; depth, 27.6 inches; and weight, 1,850 pounds. The maximum heat dissipation is 9,500 BTU/hr.

PRICING: The Ampex Mainframe-ECM memory is available for purchase or on a one- through five-year lease. The lease prices include all cables, installation, diagnostic performance checks, unlimited usage, and complete maintenance for 24 hours/day, 7 days/week.

The Mainframe-ECM sells for $248,600 and leases for $7,200/month (1-year), $6,600/month (2-year), $6,000/month (3-year), $5,400/month (4-year), and $4,800/month (5-year). Maintenance and installation charges for purchased units are $600/month and $2,000, respectively. ■

Anderson Jacobson AJ 630 Keyboard Printer Terminal



A portable, high-performance teleprinter terminal, the AJ 630 features selectable speeds up to 30 char/second, a 140-character print line, silent printing, an optional acoustic connection to the telephone network, and a tape cassette option.

MANAGEMENT SUMMARY

Anderson Jacobson's AJ 630 Keyboard Printer Terminal, a 36-pound, portable high-performance teleprinter, is designed for compatibility with Teletype's line of ASCII teletypewriters. The AJ 630 is available in an RO (receive-only) as well as a KSR (keyboard send/receive) configuration. Its salient features include:

- Three operator-selectable asynchronous operating speed – 10, 15, and 30 characters per second.
- A non-impact printer that prints any of 95 ASCII symbols, including true upper- and lower-case alphabetics.
- A standard 140-character print line.
- Horizontal tabulation.
- A full 128-character ASCII keyboard.
- An optional 300-bps integral modem.
- An optional acoustic telephone coupler adapter.
- An optional cassette recorder.

The printer, designed and built by Anderson Jacobson, employs the electrothermal printing technique and requires special thermographic paper, which is available from AJ or other sources. The key disadvantages of this printing technique are, of course, the inability to use ordinary paper and to obtain multiple printed copies simultaneously. Copies can be generated through the use of an office copier or multiple printing passes. The key advantage of the non-impact technique is its nearly silent operation, which makes it especially suitable for operation in a quiet office environment. ▷

CHARACTERISTICS

MANUFACTURER: Anderson Jacobson, Inc. 1065 Morse Avenue, Sunnyvale, California 94086. Telephone (408) 734-4030.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode at switch-selectable transmission rates of 10, 15, and 30 characters/second (110, 150, and 300 bits/second).

The 8-level (including parity) ASCII transmission code is used. The code structure at 10 char/second is 11 bits/character, including one start and two stop bits. At 15 and 30 char/second, the code structure is 10 bits/character, including one start and one stop bit.

Connection to a voice-grade communications facility via an external modem is provided by an EIA Standard RS-232C interface. An internal modem, compatible with the Bell System 103 Series Data Sets, is optional and can be used with an optional external acoustic telephone coupler. The optional internal modem is designed to interface a Bell System Data Access Arrangement as an alternative to the acoustic coupler.

Transmission characteristics are compatible with those of the Teletype Model 33 or 35 teletypewriters.

DEVICE CONTROL: Designed for query/response operation, the AJ 630 provides for data entry via a keyboard and for data output via a non-impact printer. The terminal transmits any of 128 ASCII characters and prints 95. Data is printed as it is received and transmitted as it is keyed. The unit can also operate in an off-line or local mode as a conventional typewriter, or it can be used with customer-supplied peripheral attachments.

The unit will respond to keyed or received control codes, including line-feed, carriage-return, backspace, bell, tab stop set or clear, tab, ignore, enquiry (if the Answerback option is installed), and device-control codes used to operate an attached peripheral such as the optional Model 4100 Cassette Recorder. A break key is provided to interrupt a computer message.

The Answerback option transmits a user-determined terminal-identification message of up to 20 characters in response to a received inquiry (ENQ) code or keyed "Here Is" code.

When the optional Model 4100 Cassette Recorder is employed, keyed or received data can be recorded on tape; recorded data is transmitted at the selected operating speed or at 120 char/second (optional). Printing is limited to 30 char/second.

The 4100 contains dual 100-character serial MOS buffers that are alternated (toggled) between the recorder and the ▶

Anderson Jacobson AJ 630
Keyboard Printer Terminal

Horizontal tabulation is a standard feature. Tab stops can be set anywhere along the print line by keyed or received control codes, which can also clear the stops, but not selectively. Horizontal tab control codes, interspersed within the computer message, position the print head to the next tab stop.

An internal 300-bps modem is available as an option and provides a wired connection to a Bell System Data Access Arrangement; however, the user may elect to communicate with his computer via a standard office telephone, which he can do by plugging the optional Acoustic Adapter into the internal modem.

The optional cassette recorder is built by Techtran Industries of Rochester, New York, to Anderson Jacobson specifications. (Techtran also markets an off-the-shelf Model 4100 Cassette Recorder, but its characteristics are not identical with those of the Anderson Jacobson model.) A single-cassette recorder, the unit is double-buffered and can be connected between a communications line (via a modem) and the AJ 630 Terminal; or it can be connected to the AJ 630 and operate through its internal modem. The data transfer rate for the standard unit coincides with the terminal's speed: 10, 15, or 30 cps. In addition, operation at 120 cps is optional for on-line communications only. The cassette recorder can be controlled remotely via control codes, but it cannot be switched on or off remotely, which may be a limiting factor in some cases.

Customer deliveries of the AJ 630 Terminal began in July 1970. Deliveries of the cassette option began in September 1972. Shipment of orders for small quantities is quoted as "immediate" (4 to 5 days).

Anderson Jacobson provides its own service through 26 nationwide service points.□

line or AJ 630 keyboard or printer; as one buffer fills, the other empties.

Besides the standard read, write, and rewind operating modes, the 4100 includes a line-by-line Edit mode and a high-speed Search mode. In the Edit mode, each tape record corresponds to a print line and, when played back, prints one line and halts; editing is performed by reversing the tape to the beginning of the line and rekeying a new line. A carriage-return control code defines the end of each line. In the Search mode, the first two characters of each record are compared with a keyed or received search key; a find stops the tape at the beginning of the record.

ERROR CONTROL: Selectable even or no (marking) character parity is generated and accompanies each character transmitted. Parity checking of received data is performed only when selected. A special error code is substituted for a detected error and an error symbol is printed.

KEYBOARD: 68-key typewriter style. The keyboard can produce any of 128 ASCII characters, including upper- and lower-case alphabetics, numerics, punctuation, special symbols, and control codes.

PRINTER: Prints any of 95 ASCII symbols, including upper- and lower-case alphabetics, numerics, and special symbols (ASCII columns 2 through 7) at selected speeds of 10, 15, or 30 characters per second. The non-impact printer employs the electrothermal printing technique. Characters are formed within a 5-by-8 dot matrix; nominal character size is 0.110 inch high by 0.072 inch wide.

Line length is 140 characters, spaced at 10 characters/inch. Vertical spacing is 6 lines/inch. If selected, carriage return and line feed are performed automatically after 140 characters are printed.

The printer has a friction-feed drive and accommodates a 400-foot roll of thermographic printing paper, from 8 to 15 inches wide, which is loaded from the top of the unit.

CASSETTE TAPE RECORDER: The Model 4100 Cassette Recorder records data on a Philips-type cassette, which contains 300 feet of 0.15-inch magnetic tape. Total cartridge capacity is rated at 70,000 characters; rated data transfer speed is 30, 15, or 10 char/second, as selected, or 120 char/second between recorder and line when the 1200 Baud option is incorporated. Off-line printing is limited to 30 char/second. The cassette recorder is a self-contained unit that cable-connects the AJ 630 or directly interfaces the communications facility via its RS-232C interface and an external modem. A 20-ma. Teletype interface is also available as an option.

The 4100 records data serially by bit on two tracks at a density of 800 bits/inch, using a modified NRZ recording technique. Read/write speed is 6 inches/second, and search/rewind speed is 40 inches/second. Standard features include remote or local control, BOT/EOT Sensing, File Protect, and No-Tape Sensing.

PRICING: The AJ 630 Keyboard Printer Terminal is available for purchase or on a month-to-month, one-year, two-year or three-year lease. Leases include on-call maintenance up to a distance of 25 miles from an Anderson Jacobson service center. The minimum lease period is 3 months. A purchase-credit option is available for leased equipment. A one-time charge of $65 is applied for transportation and installation of each terminal; the charge is reduced for multiple-unit installations as well as for receive-only printers.

	Monthly Rental*			
	Month-to-Month Lease**	3-Year Lease	Purchase	Monthly Maint.
AJ 630 KSR Terminal	$155	$115	$3,700	$25
AJ 630 RO Printer Only	–	–	2,500	25
Integral Modem	8	8	250	5
External Telephone Coupler	2	2	100	–
Answerback Feature	7	5	150	–
4100 Cassette Recorder	80	90	2,146	–
1200 Baud Capability	15	15	2,441	–
Teletype Interface	–	–	–	–

* Includes on-call maintenance up to 25 miles from a service location.
** Minimum lease is 3 months.■

Badger DTS-100 Remote Batch Terminal

MANAGEMENT SUMMARY

The Badger DTS-100 is a programmable remote batch terminal designed around a minicomputer. The terminal configuration is flexible and can include any combination of up to six peripheral devices, such as low- or medium-speed card readers, low- or high-speed line printers, card punch, and as many as four (via a common controller) 7- and 9-track computer-compatible magnetic tape drives. The peripherals, in addition to a communications line, are multiplexed onto the direct memory access channel of a DEC PDP-8/L minicomputer via the Badger-designed I/O communications processor. This arrangement permits data to be transferred directly between core memory and the associated I/O devices using the DEC data break (cycle-stealing) feature, and, in addition, permits simultaneous device operation through interleaved data streams.

Badger is emphasizing the use of its DTS-100 terminal as a replacement for any of several prominent batch terminals supplied by the mainframe manufacturers. Currently, these include the CDC 200 User Terminal under SCOPE or MACE, the IBM 2780 and 3780, the IBM System/360 Model 20 under OS/HASP, the Honeywell G-105 and G-115 under GERTS, and the UNIVAC 1004 under EXEC II, EXEC 8, or CSCX (Computer Sciences Corporation). Support for these applications is available from Badger in the form of communications software designed to emulate the counterpart terminal which the Badger Terminal is to replace.

Aside from its prime functions as a communications terminal, the Badger terminal can be used to perform a limited amount of off-line processing. Badger provides its own version of DEC's PAL III Assembler, the TAL-100A Assembler, which essentially performs all PAL III operations in two passes instead of three. TAL-100A permits the user to develop his own applications programs via symbolic-language statements. A high-level language for off-line processing, the Terminal Program Generator (TPG), is also available.

To date, Badger has about 25 installations, most of which are dedicated to remote batch operation with one or more different computer systems. At least one of these installa- ▷

The programmable DTS-100 can emulate several other popular batch terminals via Badger-supplied software. Features include fast I/O, high-speed communications, and magnetic tape input/output.

CHARACTERISTICS

MANUFACTURER: Badger Meter, Inc., Electronics Division, 150 E. Standard Avenue, Richmond, California 94804. Telephone (415) 233-8220.

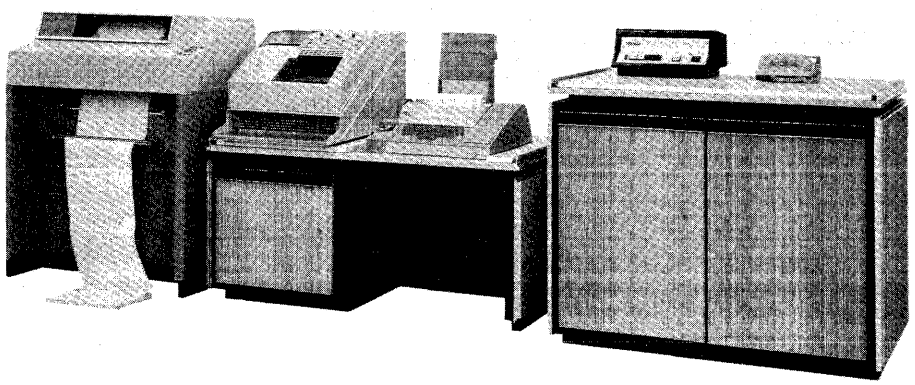
CONFIGURATION: The basic DTS-100 Remote Batch Terminal is constructed around a general-purpose minicomputer with a 4096-word core memory and includes an I/O communications processor, a Teletype Model 33 ASR teleprinter, a 300-cpm card reader, and a 300-lpm printer. The basic memory can be expanded to 8,192 or 12,288 words through the addition of optional 4096-word memory modules. All communications packages can run on the basic 4K unit.

Peripheral options include a 1000-lpm printer (in place of the 300-lpm unit), a 100-cpm card punch, a 400-cpm card reader (in place of the 300-cpm unit), a magnetic tape controller and any mix of up to four 7- and 9-track magnetic tape units, and a Teletype-compatible CRT display unit (in addition to the 33 ASR teleprinter).

COMMUNICATIONS: Transmission is synchronous in the half- or full-duplex mode at 2000 bits/second over the public switched network, up to 9600 bits/second over a leased or private voice-grade line, or up to 50,000 bits/second over a broad-band communications facility. The communications interface is designed to EIA Standard RS 232B/C. The transmission parameters such as speed, code, control signals, line discipline, blocking-deblocking, etc., are a function of the communications software. Hardware capability is provided for 6- through 9-level transmission codes.

DEVICE CONTROL: The PDP-8/L general-purpose minicomputer, produced by Digital Equipment Corporation, forms the nucleus of the Badger DTS-100 terminal. In combination with the I/O communications processor, the minicomputer executes all terminal operations under the direction of the operating software.

The I/O communications processor multiplexes up to six peripheral devices and a communications line (via a ▶



The basic Badger DTS-100 terminal includes (left to right) a 300-lpm printer, 300-cpm card reader, Teletype Model 33 ASR, and terminal cabinet which houses the system's DEC minicomputer and I/O processor.

Badger DTS-100 Remote Batch Terminal

tions has been operational for four years. Badger now maintains the DTS-100 through its own service organization.

Peripheral units for the DTS-100 terminal are manufactured by Data Products (printers and card equipment), PEC (tape units), and Mohawk (printers).

The Badger DTS-100 is no longer offered for purchase, in deference to the reality that terminal users mainly want to lease. Reductions in lease costs have made the terminal cost-competitive with the IBM 2780, which, of course, is a hard-wired terminal designed to communicate with a specific computer. In contrast, operating flexibility is the key attraction of the DTS-100. By simply reloading the communications software, it can emulate any one of several terminals to communicate with a variety of different computers. The provision for generating application programs and for specifying printer formats, although providing added flexibility, will usually be a secondary or bonus feature. Other strong points of the DTS-100 include I/O simultaneity, optional magnetic tape I/O, faster readers and printers (also optional), and a wide range of communications speeds up to 50,000 bits per second.

USER REACTION

Although the legion of DTS-100 terminal users is small, it appears to be loyal. Particular admiration was expressed for the compactness and effectiveness of Badger software support and its ability to perform many communications functions with only 4K words of memory. The convenience of effectively having many terminals in one was appreciated especially by software houses. Downtime was described as infrequent and due more to breakdowns of peripheral devices than to the DTS-100 terminal itself. On the negative side, one former user disclosed that he had abandoned the terminal because it cannot use tape drives that record at 1600 bits/inch. □

modem) onto the minicomputer's direct memory access channel.

The DTS-100 can function either as a remote batch terminal or as a free-standing system for remote processing. Badger provides three types of software packages: Standard, Diagnostic, and Communications.

The Standard package includes an assembler, a combined lister and editor, an input/output control system, and various utilities. A wide variety of paper-tape-oriented programs is also available from Digital Equipment Corporation.

The Diagnostic packages include paper-tape test routines that aid in isolating and diagnosing terminal malfunctions.

The Communications package contains programs that simulate the following remote batch terminals for use with the corresponding central processor:

- Control Data 200 User Terminal – for communication with CDC 6000 or Cyber 70 Series computers.
- IBM 2780 or 3780 Data Transmission Terminal – for communication with IBM System/360 or System/370 computers.
- IBM System/360 Model 20 – for communication with IBM System/360 or System/370 computers as a HASP multileaving terminal.
- Honeywell G-105 or G-115 Terminal – for communication with a Honeywell Series 600/6000 computer under GERTS.
- UNIVAC 1004 – for communication with UNIVAC 1100 Series computers.

TAL-100A (Terminal Assembly Language) is a two-pass assembler that requires 4K words of memory. The assembler's first pass defines and places all user symbols in the assembler's symbol table. The second pass generates and punches the binary equivalent (object code) of the input source language and also prints a listing of the source program.

Operating software can be loaded from punched cards or paper tape via a basic loader program.

The DEC PDP-8/L minicomputer has a memory cycle time of 1.6 microseconds and a word length of 12 bits. Its minimum and maximum core storage capacities are 4,096 and 12,288 words, respectively. (See Report 70C-010-20 for further information on the PDP-8/L.)

CARD INPUT/OUTPUT: Reads and punches (optional) standard 80-column cards in Hollerith or binary mode under program control. Reader speeds are 300 and 400 (optional) cards/minute. Punch speed is 100 cards/minute. Reader hopper and stacker capacities are 600 and 1000 (faster reader) cards. The punch has a capacity of 1000 cards.

PRINTER: Line printers are available for operation at 300, 600, or 1000 (optional) lines/minute. All print up to 132 columns and provide a 64-character set of ASCII symbols.

MAGNETIC TAPE INPUT/OUTPUT: Records in 7- or 9-track industry-compatible format at 556 or 800 bits/inch. Tape speed is 25 inches/second; reel size is 10.5 inches.

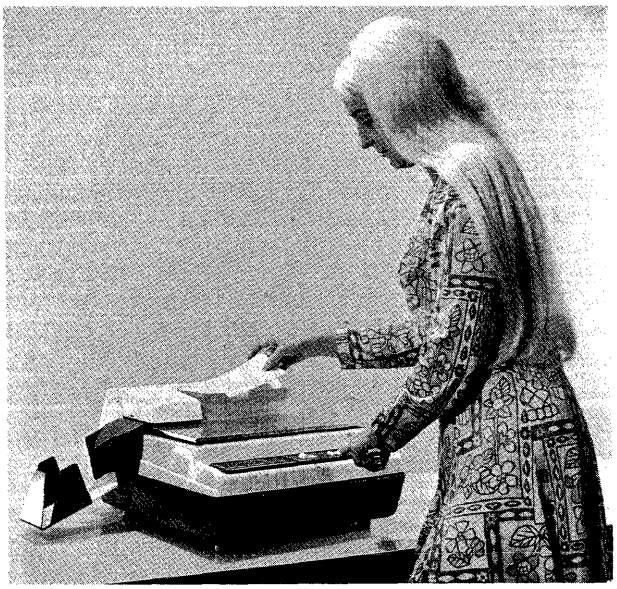
CRT DISPLAY: The Datapoint 3300 is available as an option. See DATAPRO 70 Report 70D-214-01 for detailed information.

PRICING: The Badger DTS-100 is available on a one-year lease, which includes prime-shift maintenance.

Device	Monthly Rental (1)
Basic DTS-100 Terminal (2780/3780 only) (2)	$ 798
Multilingual DTS-100 (same as above with Multilingual Interface)	883
HASP Multileaving DTS-100 (3)	1,183
Communications Options:	
CDC 200 Simulation	75 (4)
UNIVAC 1004 Simulation	75 (4)
G-105/115 Simulation	75 (4)
Peripheral Equipment Options:	
Line Printer (700-1800 lpm) (5)	165
Card Punch (120 cpm)	585
Magnetic Tape Controller Unit (with added 4096-word core memory)	345
Data Set, Short Range (2400 to 19,200 bps)	28

(1) Includes prime-shift maintenance.
(2) Includes 4096-word core memory, general-purpose computer, 7-port communications processor unit, and data set interface (less data set) in free-standing cabinet; card reader rated at 300 cpm, line printer rated at 300 lpm, and teleprinter.
(3) Same as Basic and Multilingual DTS-100 Terminals, but with HASP Multileaving Interface and CDC 200 Simulation, Univac 1004 Simulation, and G-105/115 Simulation.
(4) Add to price of Multilingual Terminal.
(5) Replaces 300-lpm Line Printer. ■

Bell & Howell MDR Document Readers



The MDR units read holes, handmade marks, and preprinted marks from standard punched-card size documents or from a punched-card size area on a larger document. Several series are available with different interfaces for use as communications terminals or for incorporation into larger units. Rated reading speeds range from 6 to 180 cards per minute.

MANAGEMENT SUMMARY

Originally developed and marketed by Motorola Instrument and Control, Inc., a subsidiary of Motorola, Inc., the MDR series document readers are now produced and marketed by Bell & Howell's Electronics & Instruments Group, which purchased the MDR product line from Motorola on July 12, 1971. The acquisition also included all sales and service operations; Bell & Howell's nationwide service organization currently consists of 16 service centers located in major cities.

Bell & Howell has enhanced the original Motorola MDR product line, which now features a substantial increase in document throughput and an extended character recognition capability to provide for the full range of ASCII or EBCDIC characters. The skip feature associated with the Motorola readers was eliminated to implement the faster card feed. B & H has also eliminated the MDR 3000 series (an MDR 1000 with added telephone acoustic coupler) from its product line.

Additional enhancements now in consideration include a variety of interface units to meet a broader range of applications and internal buffering. A batch capability with IBM System/360 compatibility is also under study.

Billed as "the incredible reader," the MDR document reader should suggest a host of possibilities to a systems analyst. Available in several models as communications terminals for the end user market and as components for the OEM market, the MDR acts very much like a mark-sense-equipped card reader. In addition, it brings much the same convenience to the punched card layout as edge-punched document readers bring to punched tape.

CHARACTERISTICS

MANUFACTURER: Bell & Howell, Electronics & Instruments Group, 360 Sierra Madre Villa, Pasadena, California 91109.

MODELS: Four series at present–MDR 1000, 2000, 8000, and 9000. Distinguishing characteristics are presented in the table below:

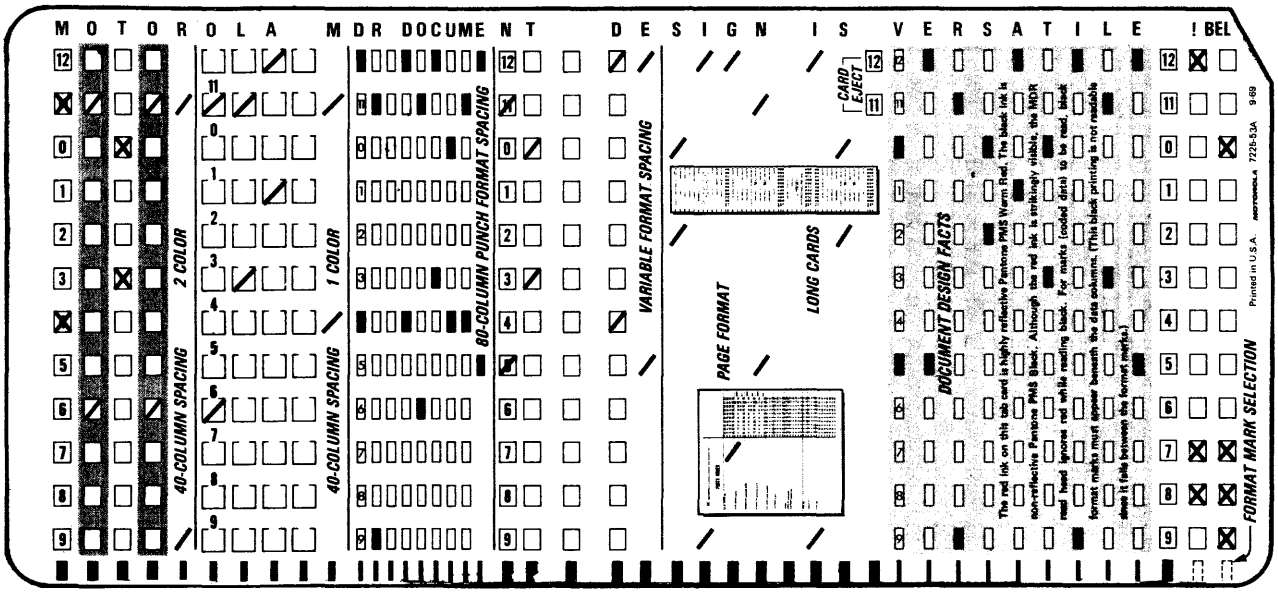
Model	Spacing, columns	Card Length, inches	Scan Rate, char/sec	Card Speed, cpm	Data Rate, bits/sec
MDR-1000/ MDR-9000**	40	7-3/8	10	12	110
			15	20	134.5/150
			30	40	300
	40	11	10	8	110
			15	12	134.5/150
			30	25	300
	80	7-3/8	10	6	110
			15	10	134.5/150
			30	20	300
MDR-2000	40	7-3/8	105/120	100/115	1050/1200
	40	11	105/120	75/90	1050/1200
	80	7-3/8	105/120	50/55	1050/1200
MDR-8000	40	7-3/8	10	12	*
			15	20	*
			70	75	*
			120	115	*
			200	180	*
	40	11	10	8	*
			15	12	*
			70	55	*
			105	85	*
			200	135	*
	80	7-3/8	10	6	*
			15	10	*
			70	37	*
			120	55	*
			200	90	*

* Unit has parallel interface for 7-, 8-, or 12-level code.
** Same as MDR-1000, but includes a contact-closure interface for Teletype equipment in place of the EIA Standard RS-232C interface.

Various models within each series include combinations of features such as output code, manual or automatic operation, and attended or unattended operation. On appropriate models, the transmission speed can be adjusted to match specific terminals such as Teletype teleprinters and IBM 1050 terminals.

In general, a user can select from several different output codes, including ASCII alphanumeric (128 characters),

Bell & Howell MDR Document Readers



The range of input form layout possibilities is clearly shown in this illustration reproduced from a sample card. The row of marks along the bottom are indications to the reader to cause a scan of the corresponding column. The "x's" represent preprinted entries, while the slashes are hand-marked entries.

Although this document is the size of a standard punched card, wider and longer documents can also be accommodated. The reading width is fixed at 12 rows, but data can be entered along the full length of a document.

The result is a device that can read standard punched-card size documents or can read a punched-card size area on a larger document. Hand-made marks, punched holes, and preprinted marks can all be read.

The MDR is not particularly fast. The highest-speed model can read 180 partially punched (marked) cards per minute; the slowest, 6 fully punched cards per minute. This speed range is adequate for the intended uses.

The reading principle is based on reflected light. A pencil mark or punched hole prevents the light from being reflected and is treated as a "punch". Preprinted data, in the form of a series of marks, can be read if printed in non-reflective ink. Instructions, field identifiers, etc. can also be printed within the read area if a reflective ink is used. The accompanying illustration gives a good idea of what can be done in the way of forms layout.

The chief advantages of the MDR readers are the simplicity of operation, flexibility of system design permitted, and ease of data entry. Bell & Howell particularly stresses the ease and accuracy of entry. The company visualizes a one-step operation; the person collecting the information marks the form, thus eliminating errors due to transcription. The person marking the form can also easily check to see if it was done correctly.

The MDR may be just the thing for outlying offices (with no data processing equipment) to use to transmit data

ASCII numeric (11 characters), IBM PTTC/BCD (72 characters), IBM EBCDIC (256 characters) and Honeywell BCD (64 characters).

INPUT DOCUMENTS: The acceptable reading format is based on the familiar 80-column punched card. The document feed mechanism will accept regular-size punched cards, long cards, or paper documents. There are no real limitations on the size of document that can be handled other than thickness, but the reading area is always restricted to the width of a punched card (3.25 inches); the length can vary according to need. Documents up to 8.5 inches wide are supported by the flat bed. Oversized documents could be handled, and have been in some installations, but Bell & Howell does not recommend this practice in general.

Information is encoded based on the conventional 12-row card layout. Horizontal spacing is variable, with the minimum recommended being that of the 80-column punched card format.

Recommended horizontal formats include 80-column (0.087-inch centers), 40-column (0.174-inch centers), typewriter/line printer (0.10-inch center).

With the typewriter (or line printer) format, the data is typed lengthwise; line spacing of 4 or 8 lines/inch must be used to register with the 12 rows, which are on 0.25-inch centers. This format will be used mostly for line printers, since typewriters with spacings other than 6 lines per inch are not common; most line printers can be adjusted to print 8 lines/inch.

The example included in this report will give you an idea of the format possibilities.

Bell & Howell MDR Document Readers

back to home base. However, specially printed documents are required.

The transmission characteristics and codes of the communications models are compatible with conventional modems and can be tailored to match almost any of the more popular terminals, such as Bell System Data-Speed Type II paper tape terminals, Tally 1024 terminals, Teletype teleprinters (including Inktronic), Friden 7100 typewriter terminals, and IBM 1050 and 2740 communications terminals. Interfaces are available for card keypunches and computer- compatible magnetic tape units. □

If the conventional card row interpretations were maintained, they would read 9, 8, . . . 0, 11, 12 from left to right. For entering numeric data, this is awkward. Therefore, an inverted format that reverses this order for easier entry was implemented.

Because the reading technique is based on reflectance, careful attention must be given to the printing of the documents. In addition, the format marks required at the bottom edge mean that documents used must be specially printed for use with the MDR.

Data can be entered by hand with a soft pencil (recommended) or with some brands of felt-tip pens. Punched holes and preprinted data can also be read.

DEVICE CONTROL: Utter simplicity–almost. For manual transmission, all that is normally required is turning the unit on, establishing a connection with the receiving end, and positioning the document. For automatic models, a start switch must be depressed to begin reading of cards after the hopper is loaded.

Two items complicate the operation: the Page/Card switch and the automatic card feed hopper and stacker.

The Page position of the switch is for reading inverted code layout, the normal layout for documents larger than card size. The Card position is for reading the normal layout for cards.In the rare cases where a non-inverted code layout is used on a page-size document, an operator could make a mistake. Such a layout might be used for marking non-numeric items (such as multiple-choice answers, for example). The operator might also forget to set the switch in the correct position for the type of document being read.

In automatic models, a removable card hopper and stacker are used to read decks of cards. These must be removed and a flat bed inserted when page-size documents are to be read. These lead to the minor problems of switching the pieces and storing them when not in use; the MDR does not have any storage compartments.

Two control codes are generated as the leading edge of each document enters the read-head areas, and one control code when it exits. All three codes can be different, and the user can select from 10 codes (or from 4 when ASCII numeric output is selected).

Reading of cards on demand can be controlled in the higher-speed MDR-2000 from the receiving end via the reverse channel furnished by the modem.

ERROR CONTROL: Character parity can be generated and sent with the data on all models; parity can be odd, even, or none, at the user's option.

None of the MDR models include a buffer, and the nature of individual documents prevents the reader from "Backing up." Retransmission of data automatically is therefore not possible.

READER: The same basic mechanism is used by all MDR models. It senses light reflected from the document being read. The presence of a black mark, a hole, or a very rough spot (such as that caused by a heavy, coarse erasure) keeps light from being reflected.

The absence of reflected light from a location is interpreted as a "punch." A total of 13 light sources and sensors are included, corresponding to the 12 rows of a standard punched card and the bottom ("nine") edge of the card. Preprinted marks are used along the bottom edge to indicate columns and initiate scanning.

The actual operating speed of the reader is variable, depending on document transport speed, document length, and column spacing. Typical arrangements are 6 80-column cards/min for the slowest models and 180 80-column cards/min for the fastest model. The spacing between cards for a normal card feed operation is 1/8 inch.

The Blanking code (a 12 and 11 "punch") causes reading to be suspended for the remaining card columns.

The Shift code (an 11 and 0 "punch") causes marks in rows 1-6 (BCD), 1-7 (ASCII), or 1-8 (EBCDIC) to be used directly for output (i.e., this column is not decoded). This feature allows the full ASCII (128) or EBCDIC (256) character complements to be encoded.

The input hopper included in the automatic models can hold 250 cards. Cards can vary from 4.875 to 11 inches in length.

Visual and audible alarms indicate "hopper empty" or "card jam" conditions.

PRICING: All models are available for purchase or lease. The range of prices is shown below. A maintenance contract is available for purchased equipment.

	Rental*	Purchase
MDR–1000 Series	$136 to $184/mo.	$3,998 to $5,424
MDR–2000 Series	$143 to $194	$4,213 to $5,693
MDR–8000 Series	$133 to $179	$3,933 to $5,278
MDR–9000 Series	$138 to $183	$4,052 to $5,375

*Does not include maintenance, which is priced at $25 to $40/month depending on model and geographical distance from a Bell & Howell Service Center.

The minimum prices shown above are for manual feed, attended devices with numeric (11-character) ASCII output code. Options include hopper feed for card-size documents, unattended operation, and choice of output codes. ■

Bunker Ramo Series 2200 Data Display System

The Bunker Ramo Model 2212 Display Station, a small desktop unit, contains a 6-inch CRT and an alphanumeric keyboard arranged for non-typists. The Model 2210 Display Station is similar in appearance, but contains a 3-inch CRT.

The Series 2200 System is available as a stand-alone display station or as a flexible multiple-display system in which as many as 36 devices, including printers and display stations, share a common controller. The system offers compatibility with the IBM System/360 and 370 and other popular computers.

MANAGEMENT SUMMARY

Bunker Ramo is one of the oldest suppliers of CRT display devices. Its Series 200 Data Display System, the forerunner of the 2200 System, was initially delivered in the Spring of 1964.

The Series 2200 Data Display System is available in single-station or multi-station terminal configurations. The multi-station version can also be employed as a directly connected computer peripheral subsystem.

Geared primarily to the IBM System/360 and 370 marketplace, but not as an IBM 2260-compatible replacement, the 2200 System is supported under OS and DOS for both System/360 and 370 computers and under OS/VS and DOS/VS for System/370 computers. Under OS, the 2200 System is supported by BTAM when operating in a polled environment and under GPS Basic or GPS Express when operating in a non-polled environment. Under DOS, the 2200 System is supported by BTAM or BTAM Local when operating as a remote terminal or peripheral subsystem, respectively, in either a polled or non-polled environment. The Device Dependent Module for the IBM 2260 must be altered to ➢

CHARACTERISTICS

MANUFACTURER: Bunker Ramo Corporation, Information Systems Group, Trumbull Industrial Park, Trumbull, Connecticut 06609. Telephone (203) 377-4141.

MODELS: The Series 2200 Data Display System is available in single-station or multistation display configurations; both types are compatible with one another.

SINGLE-STATION CONFIGURATION: Includes a single-station controller (Model 2221, 2223, or 2225), a keyboard/display unit (Model 2210, 2212, or 2206/17), and an optional printer for printed output. The controller contains a character generator, communications interface, and one or two (optional) 960-character buffer modules.

The printer and display can be configured so that: (1) each has access to a separate half of the basic buffer module, (2) each uses its own buffer module (buffer option), (3) each has access to the entire storage of the basic buffer module, or (4) each has access to its own buffer module with the added capability to permit the printer to access the display memory (2223 and 2225 Controllers only).

MULTISTATION CONFIGURATION: Includes a multi-station controller (Model 2220 or 2222) and any combination of up to 9, 18, or 36 devices that include keyboard/display units (Models 2210, 2212, or 2206/17), display monitors, and non-display devices. The non-display devices include a variety of printers with rated speeds ranging from 10 to 165 char/second, and a punched tape reader and punch.

The basic multi-station controller contains a single 960-character buffer module with the capability to add up to eight additional buffer modules, each providing 960 characters of storage. Two types of buffer modules are available: those equipped for both display and non-display devices, and those equipped for non-display devices only. The buffer module contained in the basic controller is equipped for both display and non-display devices. The first two additional buffer modules must be the same type, but the six remaining modules can be any combination of the two types.

Each buffer module can accommodate one, two, or four devices. To accommodate two or four devices, the buffer's total storage capacity is equally divided among the devices to provide two 480-character segments or four 222-character segments, respectively. Unless the optional Mixed Format feature is incorporated, all buffer modules within a controller must accommodate an identical number of devices.

The Mixed Format feature allows one or two three-buffer groups to accommodate a different number of devices than the first group of three buffers; however, all buffers within a group must accommodate an identical number of devices. The Mixed Format feature is required when mix- ➢

Bunker Ramo Series 2200
Data Display System

provide compatibility with the 2200 System. Bunker Ramo provides a replacement DDM which is installed via a sysgen operation.

Bunker Ramo provides its own communications control unit (Model 2228 or 2228S) to be used in place of an IBM 270X controller or IBM 3705. The Bunker Ramo controller attaches to a selector, multiplexer, or block multiplexer channel of an IBM System/360 or 370 computer via an IBM-compatible interface. When the unit is used with a non-IBM computer, the user must supply his own channel interface.

Three standard models of display stations are available for use with the 2200 System. Two of the models are small, self-contained keyboard and CRT units designed for operators who are non-typists and use the "hunt-and-peck" technique to enter data. Their 3- and 6-inch CRT's are intended for handling short, simple formats. The third display station has a 12-inch CRT, a more conventional appearance, and a separate typewriter-style keyboard with numeric inset that is better suited for operators with typing skill.

Important standard features and no-cost options include single-line data insertion and deletion with automatic expansion and contraction, remote format entry, and format display.

Of considerable importance are the insert and delete functions, a standard feature. These functions allow data to be entered into or deleted from existing text (though the two functions are restricted to a single display line). As the user enters data into existing text, the text spreads to allow the insertion; deleted data causes the text to close up. The user should note that during the insert function, text spread beyond the limits of a line will be lost. While probably not essential when working to a fixed format (although both functions operate within a variable field with the Tab feature), the insert and delete functions are very valuable when working in a free format with large data entries.

Optionally, fields of text can be programmed to blink in order to focus attention on important entries.

In keeping with the one-supplier concept, Bunker Ramo provides its own modems for use with the Series 2200 System. The modem can be integrated within the display controller or it can be specified as a self-contained unit.

The 2200 product line was announced in May 1968, and deliveries began in 1969. Bunker Ramo is currently quoting three months' lead time on orders. Besides marketing the 2200 System to end users, BR supplies it to Honeywell Information Systems Inc., which markets it as the Honeywell Series 2300 Visual Information Projection System (VIP).

ing different display units on the same controller; e.g., the Model 2210, which displays up to 198 characters and the Model 2206/17, which displays up to 960 characters.

The Variable Format feature permits the display program stored within the remote computer to override the standard display format and redefine the display-format parameters; i.e., the number of characters per line and number of lines per display.

The multi-station Series 2200 System can be used in a computer environment as a local peripheral subsystem or in a communications environment as a remote terminal. Bunker Ramo provides a special-purpose parallel interface unit for the IBM System/360 or 370 computers and a general-purpose parallel interface for other computers. The multi-station controller is connected to the parallel interface when operating as a peripheral subsystem. Bunker Ramo also provides a multi-line controller that, when combined with the parallel interface, provides connection for eight voice-grade lines; the controller can handle any combination of up to 31 Series 2200 single-station and multi-station terminals per line.

COMMUNICATIONS: Asynchronous or synchronous in the half-duplex mode. Asynchronous transmission rates are 1200, 1800, 2000 or 2400 bits/second; synchronous transmission rates are 2000, 2400, or 4800 bits/second.

The transmission code is 8-level ASCII (including parity). With asynchronous transmission, a 10-unit code structure is used, which includes the ASCII character bracketed by a start bit and a stop bit.

The controller connects to a voice-band communications facility via a modem compatible with the Bell System 200 Series Data Sets. Bunker Ramo provides synchronous and asynchronous, integrated (plug-in) or self-contained modems for the Series 2200 System.

CRT DISPLAY: Three display station models are available: Model 2210, an integrated CRT and keyboard, provides a 3-inch (diagonal measurement) CRT with a 2-inch-high by 2.25-inch-wide viewing area; Model 2212, an integrated CRT and keyboard, provides a 6-inch (diagonal measurement) CRT with a 3-inch-high by 4-inch-wide viewing area; Model 2206/17, composed of separate CRT and keyboard units, provides a 12-inch CRT with a 6.25-inch-high by 8.75-inch-wide viewing area.

Monitors provide screen sizes of 12, 23, and 27 inches. Viewing areas for the 23- and 27-inch models are 13 inches high by 18 inches wide and 15 inches high by 20 inches wide, respectively.

The display arrangement is determined by the number of devices (display and non-display units) that share a common buffer module, with two exceptions: Models 2210 and 2212 are limited by screen size to a display format of 198 and 144 characters, respectively. The standard display arrangements are as follows:

Devices per Module	Lines per Display	Characters Per Line	Total Characters Per Display
1	12	80	960
1	24	40	960
2	6	80	480
2	12	40	480
4	6	40	240
4	10*	20*	198*

*Model 2210 only.

Bunker Ramo Series 2200
Data Display System

Bunker Ramo maintains its own nationwide network for sales and service support.

The 2200 System is being used for a wide variety of applications, including airline reservations systems, airline check-in and load control, customer-service information retrieval, stock exchange trading records and market data, retail credit information, transaction reporting, order entry, and hospital automation.

A Datapro survey of System/360 and System/370 installations using the Bunker Ramo Series 2200 System showed that most users are quite satisfied with the system's overall performance and feel that it satisfies their particular needs more than adequately on a cost performance basis. Most of the users that Datapro talked to have sizeable installations that receive heavy usage; these installations include up to 220 display terminals operating in a remote environment. Although service has ranged from good to excellent in most cases, one large user reported that his service has varied from good to poor as a result of high turnover within BR's customer service staff. One user commented that in his opinion the lack of an "ack-nak" acknowledgement between computer and terminal is a significant weakness of the 2200 System. Another user mentioned an annoying problem concerning keytops which pop off as a result of heavy usage. But no major faults were reported.□

A character set of 92 ASCII symbols, including upper- and lower-case alphabetics, numerics, and special symbols, is displayed in green against a dark background. Characters are generated by a 5-by-7 dot matrix.

DEVICE CONTROL: The 2200 System is designed to operate in a polling/addressing environment where all communications traffic is under control of the stored program in the remote computer, or in a non-polling environment where communications functions are controlled by the station operator. Polling includes controllers only; individual devices cannot be polled. A broadcast address is recognized in addition to each unit's unique address.

Cursor direction controls move the cursor forward or backward one position for each key depression or at a sustained rate of 27 positions/second; the cursor advances from line to line as it reaches the end of each line. The cursor can also be returned to the home position (initial display position) and to the beginning of the next line (new line).

The Tab feature allows a fixed format to be stored and displayed to facilitate message composition. The format, received from the computer, is interspersed with Tab control characters that define the beginnings of variable data fields. With the Tab feature, the cursor can be positioned at the beginning of subsequent variable data fields to enter data relating to the displayed format descriptors. When transmitting, only the variable data is transmitted; the fixed format remains displayed for the next entry operation.

Erasure controls include screen and line erase. With the Tab feature, two controls provide for the erasure of variable data only and erasure of the entire screen. Line erase removes an entire line or variable field (with the Tab feature), beginning at the cursor location.

Line insert and delete functions permit data to be entered into or deleted from an existing line of text, which expands or contracts to compensate for the entered or deleted data. With the Tab feature, insert and delete functions act only on the data within the variable field occupied by the cursor.

Selective blinking permits selected fields within a message or the whole message as received from the computer to blink.

When operating in a conversational mode, the Multi-message feature allows only the last entered query to be transmitted to the computer while the previous queries and replies remain displayed.

The Display Print feature permits displayed or print-only messages to be printed. The print function can be initiated locally (Controller Models 2220, 2222, 2223, and 2225 only) or remotely.

The standard display arrangements can be overridden by a computer-generated format that redefines both line and character parameters when the Variable Format feature is incorporated. The number of characters per line and lines per display can be varied, but cannot exceed 80 characters per line, 24 lines per display, or the assigned display buffer capacity. With this feature, each display unit attached to the multi-station controller can employ a different display format. The Variable Format feature can be specified for Controller Models 2222 (multi-station) and 2223 (single-station) only.

ERROR CONTROL: Character and longitudinal (optional) parity accompany each transmitted message and are checked for each received message. The operator is alerted to a detected parity error by a blinking mode indicator. Message retransmission in response to a retransmission request is performed manually without rekeying the message.

KEYBOARD: The Model 2210 (3-inch display) provides a 58-key keyboard arranged in a 6-column by 10-row matrix. (Two double-size keys, space and zero, are in the bottom row of four keys.) The slanted keyboard, designed for non-typists, can produce any of 48 characters, which include 26 alphabetics, 10 numerics, and 12 special characters plus space. Six of the 12 special characters are intended to be used for programmed special functions. These keys, arranged in a 6-key block, can be fitted with specially engraved keytop legends to suit specific applications.

The Model 2212 (6-inch display) provides a special keyboard arrangement; three separate keygroups form a reversed "L" arrangement about the CRT screen to separate alphabetic, numeric, and control functions. Control keys include cursor, edit, erasure, and transmit functions. The keyboard can generate any of 62 characters including upper-case alphabetics, numerics, and special symbols.

The Model 2206/17 (12-inch display) provides a 54-key typewriter-style keyboard; a 10-key numeric keygroup is located to the right of the main keygroup. A group of 24 additional keys located above the main keygroup provides control functions. The keyboard can generate any of 92 characters, including upper- and lower-case alphabetics, numerics, and special symbols.

PRINTER: Printers can be obtained from Bunker Ramo or supplied by the user. Bunker Ramo offers three types of printers: a 10-cps Teletype Model 35 RO teleprinter (Model 2292), a 30-cps GE TermiNet 300 (Model 2298), and a 165-cps Centronics 101 (Model 2299). A printer

Bunker Ramo Series 2200
Data Display System

control module is required to interface a printer with the controller.

PUNCHED TAPE READER/PUNCH: Punched tape reader and punch control modules provide punched tape input/output capability for the multi-station controller only. Both units can accommodate 5-, 6-, 7-, or 8-level punched tape. Reading is performed at 100 char/second and punching at 110 char/second. Parity check bits (odd or even) can be read, punched, or ignored.

PRICING: The Series 2200 Data Display System is available for purchase or on a two-, three-, or five-year lease, which includes maintenance. A separate maintenance contract is available for purchased equipment. Pricing for the multi-station system is complex and is dependent on the size of the configuration, which can range from a single display station and controller with one buffer module to a controller with maximum buffering and up to 36 display stations.

Pricing for the single-station configuration is shown below. The pricing ranges between the basic terminal, which includes a 12-inch CRT with keyboard and controller, and an expanded terminal with the second buffer module, printer, controller, and Model 35 RO teleprinter including sprocket feed.

Controller	Rental (2-year lease)	Purchase	Monthly Maintenance
2223	$125-200	$4,925-8,060	$38-68
2225	$125-203	$4,925-8,215	$38-68

The 6-inch display station (Model 2212) can be substituted for the 12-inch display station with no increase in system rental and a decrease of $45 in system purchase price.

The 12-inch display with keyboard (Model 2206/17) leases for $35 per month (2-year lease) and sells for $1,390; maintenance for the purchased unit is $35 per month.

The 12-, 23-, and 27-inch display monitors range in lease price from $21 to $50 per month (2-year lease) and in purchase price from $950 to $2,010; maintenance for purchased units is $14 per month.

The multi-station controller (Model 2222) ranges in lease price from $231 to $543 per month (2-year lease) and in purchase price from $7,965 to $19,285. Maintenance for purchased units ranges from $38 to $122 per month. The price range includes the maximum of eight additional 960-character buffer modules equipped for display or non-display devices.

The Tab and Variable Format features are no-cost options, but can be specified only for the Model 2220, 2222, 2223, and 2225 Controllers.

The Mixed Format feature leases for $10 per month (2-year lease) and sells for $435; monthly maintenance is $2.

The printer controller leases for $29 per month (2-year lease) and sells for $1,290; monthly maintenance is $7. Printer prices are: Teletype Model 35 RO teleprinter with sprocket feed–$64 per month, $2,650 purchase, and $28 monthly maintenance; G.E. TermiNet 300–$87 per month, $3,785 purchase, and $33 monthly maintenance; Centronics 101–$107 per month, $3,825 purchase, and $33 monthly maintenance. All lease prices are for 2-year leases.

The punched tape reader with controller leases for $80 per month (2-year lease) and sells for $3,605; maintenance for purchased units costs $23 per month. The punched tape punch with controller leases for $125 per month (2-year lease) and sells for $5,715; maintenance for purchased units costs $61 per month.

Bunker Ramo modems range from $9 per month for asynchronous modems that operate from 1200 to 1800 bits/second to $91 per month for self-contained synchronous modems operating at 2400 bits/second. Maintenance for purchased modems is $3 to $7 per month.

Prices of typical Series 2200 system configurations are shown in the table below. Each configuration includes a multi-station controller with a half-duplex, synchronous communications interface operating at 2000 or 2400 bits/second. The keyboard/display stations are Model 2206/17 (12-inch) displays. Printers or punched tape devices are not included. A Bunker Ramo plug-in synchronous modem can be added to each configuration for an additional $42/month ($1,440 purchase); maintenance is increased by $4/month.■

Typical Series 2200 System Configurations

Number of Keyboard/ Displays	Average Cost Per Display	Memory Per Display	Monthly Rental (2-yr. lease)	Purchase	Monthly Maintenance
6	$75/mo.	960 chars.	$453	$18,140	$129
6	$61	480 chars.	$366	$14,540	$116
8	$81	960 chars.	$647	$26,035	$174
8	$69	480 chars.	$550	$22,195	$158
16	$58	480 chars.	$927	$36,945	$295
16	$52	222 chars.	$830	$33,315	$278
36	$46	222 chars.	$1,643	$59,695	$597

Burroughs TC Series Terminal Computers

The TC 500 carriage is capable of feeding two side-by-side continuous forms. The keyboard includes a typewriter-style keygroup, a numeric keygroup, and a long row of control keys and indicator lights.

The TC Series units, designed as remote terminals for Burroughs computers, combine the capabilities of stored-program computers and communications terminals. Each model includes a keyboard and 20-char/sec printer with a sophisticated forms-feed arrangement, and other I/O capabilities are optional.

MANAGEMENT SUMMARY

Burroughs' original TC 500 Series has proliferated into three additional product lines – the TC 700, TC 1500, and TC 2500 – each including several models. Product-line differences are few; essentially, each of the three additional lines can be characterized as a TC 500 with application-oriented features. Within each product line, the minor differences among models are mainly in user-memory capacity, the capability to add I/O options (such as paper tape and punched card equipment), and the number of Program Select keys, which relate to operating flexibility.

Burroughs also markets a series of small accounting computers, the L Series, with product lines that parallel those of the Terminal Computers except that a communications capability is not included as standard equipment. The L Series computers are described in Feature Report 70F-420-01.

Recently, Burroughs added a computer-compatible magnetic tape unit to its list of I/O options for the Terminal Computers. The new tape unit records 9 tracks at 800 bits per inch and can be shared by up to eight Terminal Computers in any combination of models. Reel size is six inches.

The TC 500 was originally developed to function as a "teller-type" computer terminal for the British banking industry. In the Spring of 1967, Burroughs announced its largest order ($32 million) from Barclays Bank, which included 2500 of the TC 500 Terminal Computers. In the wake of this extremely favorable acceptance in Great Britain, Burroughs announced the TC 500 to the U.S. ➢

CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, 6071 Second Avenue, Detroit, Michigan 48232.

MODELS: The Burroughs family of Terminal Computers includes four distinct product lines, of which the TC 500 is the basic member. The remaining members combine the essential characteristics of the TC 500 with features unique to each product line. Several models are available within each product line that differ in user memory capacity, I/O capability, and the number of Program Select keys; all models provide a communications capability. Features common to each model are identified in the pricing table.

The major differences between the basic TC 500 and the remaining family members are as follows:

- TC 700 – A repackaged TC 500 with added special features applicable to its operation as a teller terminal for the banking and savings and loan industries.
- TC 1500 – A TC 500 with a front-forms handler and a fixed communications option for transmission speeds up to 150, 600, 1200, or 1800 bits/second.
- TC 2500 – A TC 500 with a front-forms handler that accommodates forms up to 26 inches wide, a printing capability of 255 print positions, provision for up to 24 Program Select keys, and a communications option for transmission speeds up to 150, 160, 1200, or 1800 bits/second.

COMMUNICATIONS: Asynchronous in the half-duplex mode at speeds up to 1800 bits/second. A rate of 1200 bits/second is standard; optional rates are available for 150, 600, or 1800 bits/second.

The transmission code is 8-level ASCII, including even character parity. The unit code structure totals 10 bits and includes the ASCII character bracketed by start and stop bits.

The Terminal Computers are designed to act as communications terminals for the Burroughs line of computers. They operate over the public telephone network or a leased or privately-owned voice-grade facility via a modem compatible with the Bell System 200 Series Data Sets.

PRINTED OUTPUT: Produced by a removable 64-character print sphere at a peak printing rate of 20 char/second. The print line can contain up to 150 or 255 characters.

The 64-character print set includes upper-case alphabetics, numerics, punctuation, fractions, and special symbols. Horizontal spacing is 10 char/inch; vertical spacing is 6 lines/inch. Printing can be performed in red or black via a dual-color ribbon. ➢

Burroughs TC Series Terminal Computers

market early in 1968. Deliveries of the TC 500 with communications capabilities began in August of the same year.

Each of the TC Series units is a desk-style, stored-program computer combined with communications control logic to serve as a computing unit and communications terminal. The unit includes a large keyboard featuring both a typewriter-style keygroup and a numeric keygroup styled in an adding-machine arrangement; a 150- or 255-column printer featuring a removable print sphere; a sophisticated forms-feed arrangement featuring three styles of detachable forms-feed devices; and peripheral options that include a paper tape/edge punched card reader and punch, an 80-column card reader, and a card punch (keypunch).

All external and internal operations are controlled by a stored program that resides in disc memory. Program entry is provided by an integral paper tape reader, which reads 8-level paper tape at 15.5 rows per second. Programs can also be entered via the peripheral devices or through the communications facility.

The TC Series instruction repertoire is implemented by the Burroughs General Purpose 300 Firmware (GP 300). The Firmware, a Burroughs name for a composite of recorded micro-programs, is recorded at the factory, but may be changed or modified in the field.

The Systems Firmware contains a number of subsets, each of which is responsible for a specific instruction category such as data communications, peripheral units, and internal operations.

User programs for the Terminal Computers are generally written with the aid of the TC 500 Basic Assembler Language, a symbolic programming language. Programs written in this language can be assembled on a TC or a B2500/3500 or B5500 computer. Burroughs has also announced a COBOL compiler to compile TC programs on a B3500. Application packages available from Burroughs include software for order entry and on-line banking applications.

TC Series internal coding is ASCII, but any code can be read or punched by the paper tape peripheral devices via a stored code translation table constructed by the user. Translation tables for common codes such as BCL, Friden, IBM 046, and Baudot (5-channel Teletype) are available from Burroughs.

The available memory devoted to user application programs is quite limited (3584 bytes maximum) compared with the power provided by the standard instruction repertoire; this, in addition to severe I/O limitations, will usually rule out the use of the TC 500 as a general-purpose computer.

Each TC Series unit is indeed, a highly sophisticated accounting machine. Emphasis is on keyboard data entry, forms handling flexibility, and operator control of data processing. The included communications capability

The printing element is horizontally positioned at 20 inches/second. Paper is advanced at 20 lines/second.

Forms are fed by a friction-feed, 15.5- or 26-inch platen capable of operating in a "split" or normal fashion (split operation accommodates two forms). Split positions are normally 11.5 inches from the left end; however, several split locations are available.

Burroughs provides three variations of continuous-forms, pin-feed attachments, which are easily attached or removed from the printer mechanism. The attachments feature arrangements such as synchronized or independent movement of both pin-feed mechanism and platen, and dual pin-feed mechanisms to accommodate the independent movement of two forms.

DEVICE CONTROL: Each Terminal Computer contains two functionally independent processing units dedicated to internal operation and data communication control.

Control is furnished by a compilation of microprograms referred to by Burroughs as "System Firmware." Each microprogram consists of a sequence of microinstructions, each of which initiates one step in the execution of a "macroinstruction", a term which defines a single instruction in the instruction list.

Firmware for the two processing functions resides in discrete sections of disc memory and is inaccessible to normal programming operations. Initially recorded by Burroughs, the Firmware can be changed in the field.

The System Firmware is composed of Firmware subsets, each of which implements a specific class of instructions that include internal, input/output, and data communications functions. At present, Burroughs provides a total of nine standard Firmware subsets.

The user-storage capacity depends upon the model. User storage is accessible to the programmer and provides storage for data and programs written with the macroinstructions included in the Firmware. Macroinstructions exercise all facets of Terminal Computer capabilities, including arithmetic and logical functions, keyboard and printer functions, forms-handling functions, data communications functions, and paper tape and card read and punch functions.

Programs are normally entered into disc memory via an integral 8-level paper tape reader designed to automatically load a user program at 15.5 rows/second from a tape cartridge. Programs can be punched and also read from the optional peripheral paper tape equipment.

Programming flexibility is augmented by a total of 16 Program Select keys, each of which can be assigned a unique function by the user program. Key assignments can be altered any number of times during the course of program execution. Program Select keys are used only with keyboard operation. They permit the operator to enter a specific subroutine when the stored program encounters a defined condition. The operator is alerted to program-enabled keys by individual indicator lamps, each associated with its own key. Key depression of an enabled key causes the program to enter the appropriate subroutine via a stored program keytable, which contains one instruction per program key. A number of keytables can be stored and individually selected through a base address register.

The operator can also direct the user program to an alternate routine by manually setting one of four program-testable indicators (flags) through the Operation Control keys that are included in both alphanumeric and numeric keygroups.

Burroughs TC Series Terminal Computers

substantially increases the potential usefulness of the device.

Because the Terminal Computers are very specialized devices, it is difficult to evaluate the memory size provided. Proper structuring of the Firmware could result in significant savings of user memory required for frequently occurring operations; however, not many installations are taking advantage of this possibility, and Burroughs does not provide a convenient method for user microprogramming.

The printer is solely a Burroughs design. Its printing speed (20 characters per second) is well above the printing speed of other typewriter-style printers such as the IBM Selectric, which prints at a peak rate of 15.5 characters per second. The print sphere, although it appears to be an IBM Selectric print element, is again a Burroughs design and is not interchangeable with IBM print elements. □

Keyboard entry is under program control. Data entered through the alphanumeric or numeric key group is intermediately stored in a 7- to 35-character buffer register; transfer from the buffer is controlled by the user program.

Numeric data entered from either keygroup is transferred from the keyboard buffer to an accumulator having a storage capacity of 15 digit positions plus a sign position. The accumulator serves as a working register for addition, subtraction, multiplication, division, and shift operations and for numeric print operations. Data can be transferred between the accumulator and memory and between the accumulator and the transmit and receive buffers during data communications operations.

Instructions are provided for transferring alphanumeric data from the keyboard buffer to a designated memory location, printing alphanumeric data, or printing and storing the data. A single instruction provides for printing a full line of 150 characters directly from keyboard entry.

System Firmware also includes four index registers, which can be used to modify a base address or numeric data or perform logic functions. The storage capacity of each index register cannot exceed the number 255.

Provisions are made for printing alphanumeric data from memory or from the alphanumeric keygroup or for printing numeric data from the accumulator. Numeric printing is masked to produce an acceptable format, such as deleting leading zeros and adding punctuation to indicate the decimal point. Up to 16 discrete print masks can be accessed via a base address register; programs that exceed the accessible maximum must manipulate the base address register contents.

The Terminal Computers are designed for a polling and addressing environment; recognition of Poll and Select messages from the remote computer is performed by the Data Communications Firmware. Poll and Select messages are identical except for the Poll or Select command; both message types include a two-character address of the terminal for which the Poll or Select message is intended. The user program is responsible for preparation and use of messages transmitted between the TC and the remote computer.

Data messages also include a two-character terminal address followed by a message number to identify the message sequence. The text can include up to 255 data characters.

All messages received are acknowledged by the Terminal Computer via a positive or negative acknowledgment. An acknowledgment is expected in response to all message transmitted from the terminal.

The data communications processor contains two 256-character buffers, one for receiving messages and the other for transmitting messages. Received messages are accumulated in the receive buffer and transferred to memory or the accumulator, as directed by the user program. Messages to be transmitted can be constructed in the accumulator or memory and transferred to the transmit buffer. A single instruction can transfer all 256 characters between buffers and memory or 15 digits between buffers and accumulator.

ERROR CONTROL: Character and longitudinal parity accompanies all messages transmitted and is checked on all messages received. Parity errors detected in a received message cause the Terminal Computer to transmit a negative acknowledgment. The terminal automatically retransmits the last message in response to a received negative acknowledgment.

Data-entry checking is performed on data read from the card reader or paper tape/edge-punched card reader by comparing input codes to codes within a stored translation table. The error condition sets a testable indicator to alert the program and an error lamp is lighted.

Echo checking, which ensures that the correct punch dies are selected, is performed on data to be punched into paper tape or edge-punched cards. Echo check errors alert the program via a testable indicator and an error lamp is lighted.

Incorrect keying on the part of the operator (keys depressed that are not anticipated by the program) results in an error condition; an error lamp is lit and the user program is alerted.

DISC MEMORY: The Terminal Computer contains a single magnetic disc memory, which revolves at 6000 rpm, or 10 milliseconds per revolution; average access time is 5 milliseconds.

The disc contains 40 tracks organized into 5 blocks of 8 tracks each. Each of the 40 tracks provides storage for 32 words and is serviced by its own read/write head. A word can contain 15 digits plus sign, 8 alpha characters, or 4 instructions composed of 4 digits/instruction.

The disc is divided into three major areas to provide storage for the Data Communications Firmware in addition to transmit and receive buffers (one block), internalprocessing Firmware (two blocks), and the user-program area, which varies in size depending on model.

KEYBOARD: Contains three main key groupings: numeric, alphanumeric, and program selection. The numeric keygroup consists of 21 keys, including 12 numerics, a decimal point, and 8 special codes.

The alphanumeric keygroup, consists of 53 keys in a typewriter-style arrangement. The keyboard can produce 66 character codes that include upper-case alphabetics, numerics, punctuation, and special symbols.

Program selection keys are located above the alphanumeric keygroup as a row of up to 24 keys.

PUNCHED TAPE/EDGE-PUNCHED CARD READER: Reads fully punched 11/16- or 1-inch, 5-, 6-, 7-, or 8-level paper tape or edge-punched cards photoelectrically at a rated speed of 40 char/second.

The reader can accommodate individual, fanfold, or Mylar-reinforced edge-punched cards from 3 to 5 inches

Burroughs TC Series Terminal Computers

wide; card widths of up to 11 inches can be used with an optional card support.

The reader can accommodate reeled, strip, or fanfold (oiled or dry) paper tape. One- or two-ply Mylar or aluminized Mylar tape can also be read.

As an option, the basic reader can be equipped with a tape supply that can accommodate up to an 8-inch reel, and a power-driven take-up reel that can accommodate a reel size of 5.5 to 8 inches.

PUNCHED TAPE/EDGE-PUNCHED CARD PUNCH: Punches 5-, 6-, 7-, or 8-level codes into paper tape or cards at a rated speed of 40 char/second.

The punch can accommodate individual, fanfold, or Mylar-reinforced edge-punched cards from 3 to 5 inches wide.

The punch can accommodate reeled, strip, or fanfold (oiled or dry) paper tape 11/16 inch or 1 inch in width. One- or two-ply Mylar or aluminized Mylar tape can also be punched.

As an option, the basic punch can be equipped with a tray to supply continuous edge-punched cards to the punch and a tray for stacking finished cards; the trays will accommodate 250 cards each. Card length cannot exceed 7 inches.

The tape supply reel can accomodate an 8-inch roll of tape; a power-driven take-up reel produces an 8-inch roll with a 3-inch inside diameter. Optional 5.5- to 7-inch reels are available.

CARD READER: Reads standard 80-column cards coded in BCL at a rated speed of 100 cards/minute. BCL or EBCDIC card code is translated to the internal ASCII code via a stored translation table, which is limited to 64 character codes. Cards are read column by column; feeding and stacking hoppers have a capacity of approximately 350 cards.

CARD KEYPUNCH: Punches standard 80-column cards in BCL code at a rated punching speed of 25 columns/second. The internal ASCII code is translated to BCL card code via a stored translation table, which is limited to 64 character codes.

The keypunch, manufactured by Bull-GE, can be used as a free-standing unit or under control of the Terminal Computer. The keypunch includes stacker selection for normal and reject stackers.

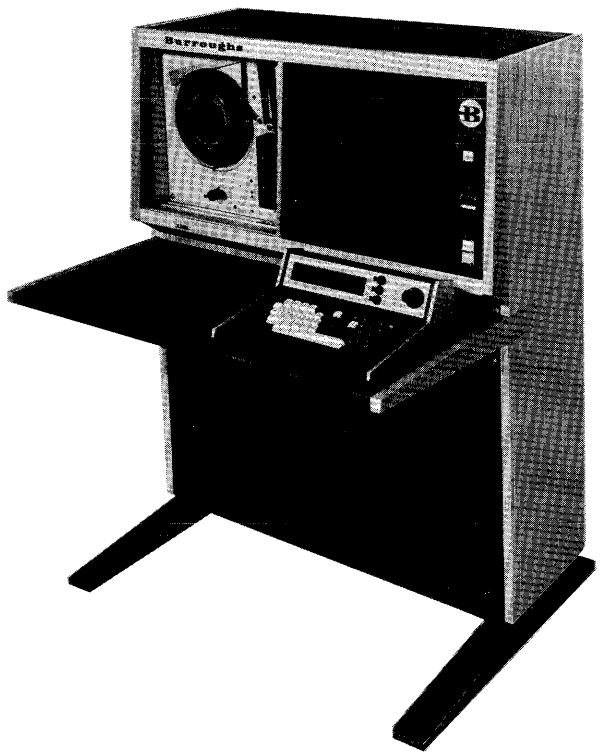
PRICING: The TC 500, TC 1500, and TC 2500 Series terminals are available for purchase or on a one-, three-, or five-year lease, which includes prime-shift maintenance. The TC 700 Series terminals, also available for purchase, are available on a one-year lease only, which includes prime-shift maintenance. All purchase prices include prime-shift maintenance for the first year; a separate maintenance contract is available for purchased units thereafter.

TC SERIES CHARACTERISTICS AND PRICES

TC Model	I/O Capability	Memory, words (1)	Program Select Keys	Monthly Rental (2) 1-Yr. Lease	Monthly Rental (2) 5-Yr. Lease	Purchase (3)	Monthly Maintenance (4)
501	No	64	8	$247	$191	7,945	$473
502 (5)	No	64	8	262	203	8,445	539
503	Yes	64	8	284	220	9,145	473
504 (5)	Yes	64	8	299	232	9,645	539
521	Yes	128	12	313	240	9,990	554
522	Yes	256	12	344	264	10,990	554
525	Yes	384	16	375	288	11,990	554
531	No	128	12	265	211	8,790	554
532	No	256	12	295	235	9,790	554
534	No	384	16	338	259	10,790	554
535	No	416	16	350	270	11,250	554
725	Yes	288	16	346	NA	12,790	554
732	No	256	12	278	NA	10,290	554
735	No	320	16	319	NA	11,790	554
1542	Yes	256	12	370	300	12,490	554
1545	Yes	384	16	400	324	13,490	554
1552	No	256	12	320	271	11,290	554
1555	No	416	16	375	306	12,750	554
2542	Yes	256	16	425	336	13,990	630
2545	Yes	384	24	450	360	14,990	630
2552	No	256	12	370	307	12,790	630
2555	No	416	24	430	342	14,250	630
I/O OPTIONS:							
A562	Paper Tape/Edge-Punched Card Punch			52	40	1,590	11
A581	Paper Tape/Edge-Punched Card Reader			46	35	1,390	9
A595	Card Reader (BCL)			97	74	2,950	20
A596	Card Reader (EBCDIC)			115	87	3,490	20
A149	Card Punch (keypunch)			120	120	5,990	?
A509	Control Unit (for A149)			33	25	1,000	?
A1495	Basic Magnetic Tape Unit & Controller (two ports)			365	280	11,500	37
—	Two-Port Expansion (for A1495; up to 3 allowed)			8	6	250	1
—	EBCDIC Code (replaces ASCII)			—	—	500	0

(1) User memory capacity.
(2) Includes prime-shift maintenance (8 hours/day, 5 days/week).
(3) Includes maintenance for first year.
(4) Prime-shift maintenance for second year and thereafter.
(5) Includes 1200 bps modem. ■

Burroughs Series N Magnetic Tape Encoders



Burroughs, a late-comer to the keyboard-to-magnetic-tape market, offers a Mohawk-like device available in 7- and 9-track models. Auxiliary devices are available to expand the Series N capabilities.

MANAGEMENT SUMMARY

The Burroughs Series N Magnetic Tape Encoders are individual, self-contained units designed for direct transcription of data from a keyboard to computer-compatible magnetic tape. They are logical substitutes for keypunches and verifiers in tape-oriented installations.

Burroughs was the fourth large mainframe manufacturer to announce a keyboard-to-magnetic tape device. Others that have been marketing key-to-tape devices include NCR (OEMed from Mohawk Data Sciences), Honeywell, and IBM, in order of announcement.

The Burroughs Magnetic Tape Encoder is very much another Mohawk-like device, but with a few distinct differences. Like Mohawk, it uses a non-pressurized tape bin in place of a take-up reel—a practice that has been widely criticized. Unlike Mohawk, but like Honeywell, it uses a vacuum-capstan tape drive to allow a higher operational speed with less tape wear than the pinch-roller drive technique. The Burroughs device moves tape at 31.25 inches per second for the 7-track models and 15.625 inches per second for the 9-track model.

CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, 6071 Second Avenue, Detroit, Michigan 48232.

MODELS: N 7200 (7-track at 200 bpi); N 7500 (7-track at 556 bpi); and N 9800 (9-track at 800 bpi).

TAPE OUTPUT: 7-track models are fully compatible with IBM 729 Series tape units; 9-track model is fully compatible with IBM 2400 Series tape units.

Tape movement is reel-to-bin; bin holds up to 1800 feet of magnetic tape. Accommodates a 10.5-inch supply reel.

Recording densities are 200 or 556 bits/inch (7-track) and 800 bits/inch (9-track). Record length is fixed at 80 characters. Variable Record Length, an optional feature, permits dial selection of record length in 10-character increments from 80 to 160 characters.

DEVICE CONTROL: Programs are stored in an independent core buffer. Provision is made for storing two programs simultaneously in addition to an alternate program. Either of the two programs can be manually selected or both can be disabled. When both are disabled, the unit is placed in alphabetic mode and Program One supplies field definitions for manual duplicate, skip, and field modify functions.

The key-selected alternate program is substained until the end of the record or until it is key-disabled; program control then reverts back to the selected program.

The program controls the format of data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or right justification (left zero fill). In addition it controls the optional check-digit function and the to-be-released auxiliary devices.

Modes of operation include Entry, Verify, Search, Program Entry, and Program Read. In the Entry mode, all data for a complete record is accumulated in a data buffer prior to writing on tape. In the Verify mode, a complete record is read from tape into the buffer memory and compared character for character with the data keyed by the operator from the source document. The Search mode allows a record to be found with the same identifier as that keyed in by the operator; any portion of a record can be used as an identifier. Program Entry/Read modes permit programs to be entered via keyboard or read from magnetic tape.

Display of current location within a record, data character stored in the current location, program code stored at the current location, and error status is provided by a keyboard display panel. Buffer location or contents can be read directly from a two or three position alphanumeric display. Display of the contents of the current buffer location in place of its location number is sustained for the duration of key depression. The program for the current buffer location is displayed, in addition to a first-character-of-field indication by name via a five-position indicator. The program display is not active in the Program Entry or Program Read modes; Program One is displayed when both programs are manually disabled. Status information is supplied through separate indicator lamps.

Burroughs Series N
Magnetic Tape Encoders

Other features that merit significance in evaluating the Magnetic Tape Encoder against competitive devices include: dual program capability, buffer expansion with variable record length, and alphanumeric display.

The dual program capability is a standard feature and allows the operator to select either of two stored record formats in addition to an alternate program capability. The key-selected alternate record format is sustained only for the duration of one record, after which program control reverts back to the selected program.

As an option, the 80-character buffer can be doubled in size; this option includes the capability to vary the record length between 1 and 160 characters.

The alphanumeric display integrated within the keyboard provides a clear presentation of the current memory location or contents in addition to five illuminated program labels, which light to define the current field and the start of the field.

Burroughs began deliveries of its basic Magnetic Tape Encoders in January 1970. Current lead time on orders is about 30 days. □

ERROR CONTROL: Conventional read-after-write checking as tape records are written, plus several additional provisions. Character parity is produced along with character generation for each data key depression, and is checked when transferred to the buffer. Character parity is also checked when read from memory.

Following the writing of each record, the tape is backspaced and the record is read and compared bit for bit with the data retained in the buffer. This feature applies equally in the Verify mode when a record is corrected.

Keying errors detected by the operator can be corrected by backspacing and rekeying the character.

KEYBOARD: 54-key keypunch style; the keyboard can produce any of 48 (Model N 7200 only) or 64 character codes that include 10 numerics, 26 alphabetics, and special characters. Up to 18 control keys provide for initiating functions such as spacing forward or backward through memory, manual duplication and skipping, alternate program selection, error correction, etc. Repetitive entry of a character or initiation of a function corresponding to the keytop is performed by depressing the repetitive entry key and the appropriate character or function key.

COMMUNICATIONS: Data is transmitted asynchronously in the half-duplex mode at 1200 bits/second over the dial network or at 1800 bits/second over a leased line, using modems equivalent to Bell System Data Sets 202C or 202D, respectively. The transmission code is 10-unit BCD for the 7-track models and 11-unit EBCDIC for the 9-track model. Each character includes parity, one start, and two stop bits. Modems must be wired for reverse-channel operation or a full-duplex facility must be used to accommodate error signaling. A translation feature on the 9-track model permits communications between 7- and 9-track models. Modems must include a handset for voice coordination.

PRINTER: A buffered, 132-column chain printer rated at 165 lines/minute prints data from magnetic tape in the off-line mode or prints data received directly from a remote Magnetic Tape Encoder via a communications facility. Vertical formatting is implemented via a 4-channel punched format tape. Horizontal spacing is 10 char/inch; vertical spacing is 6 or 8 lines/inch. The character set includes 64 characters: 26 alphabetics, 10 numerics, and 28 specials including blank for horizontal spacing. The printer operates in Non-Edit or Edit mode to permit listing or formatting the printed data, respectively. It accommodates continuous, pin-fed, 4-part forms from 4 to 18.5 inches wide and up to 22 inches long.

CARD READER: Transfers data from 80-column punched cards to the magnetic tape at 100 cards/minute. Hopper and stacker capacities are 200 cards each. Data fields on the cards can be selectively interspersed (but not rearranged) with data entered from the keyboard. Magnetic Tape Encoders that include a card reader can perform off-line card-to-tape transcription. Records can be modified under control of the stored programs.

PAPER TAPE READER: Transfers data from 11/16-, 7/8-, or 1-inch paper or Mylar tape punched in any 5-through-8-level code to the magnetic tape via the core buffer at 40 char/second. Punched tape data can be translated via a plugboard; on BCL machines, BCL paper tape codes are translated to BCL magnetic tape codes. Parity checking can be switch-selected as none, odd, or even.

POOLING: Allows short tapes to be consolidated onto one longer tape. Up to three pooler models can be interconnected. In a three-station pooling system, the operator can be reloading one station while the second is transferring data. A moderate amount of editing can be performed via the main and alternate stored programs. A pooler Master/Converter translates 7-track tape formats to a 9-track format.

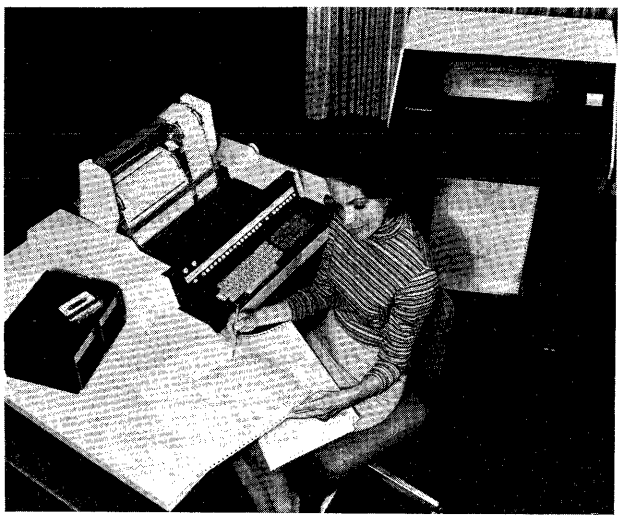
CHECK DIGIT: Allows validation of check digits for numeric fields. Check-digit capability is optional and is available for either modulo 10 or modulo 11 check digit validation. This check digit function is identical with that of IBM keypunches.

PRICING: The Burroughs Series N Magnetic Tape Encoders are available for purchase or on a one-, three-, or five-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units. ■

	Monthly Rental* 1-Year Lease	5-Year Lease	Purchase
Tape Encoder			
N 7200 (7-tk., 200 bpi)	$173	$154	$ 8,910
N 7500 (7-tk., 556 bpi)	178	159	9,090
N 9800 (9-tk., 800 bpi)	185	165	9,290
I/O Devices			
Data Communications	54	48	2,100
Card Reader**	97	74	2,950
Punched Paper Tape Reader**	53	48	2,170
Line Printer**	415	369	18,800
Options			
Pooler Slave	23	21	600
Pooler Master	53	48	1,580
Pooler Master/Converter	51	46	1,680
Check Digit Verify:			
Modulo 10	22	20	1,100
Modulo 11	25	23	1,225
Variable Record Length	16	15	600

*Includes prime-shift maintenance.
**Prices include device interface.

Burroughs TC 3500 Terminal Computers



These keyboard-oriented intelligent terminals substantially extend the performance range of Burroughs' popular TC Series while maintaining compatibility with the earlier models. Available facilities include dual communications interfaces, BSC transmission, magnetic-stripe ledger cards, and a wide range of input/output equipment.

MANAGEMENT SUMMARY

Burroughs Corporation, which pioneered the intelligent terminal concept with its TC 500 in 1967, has strongly reasserted its leadership in this increasingly important product class by introducing the TC 3500 Terminal Computers. The TC 3500 line was announced in October 1972, and customer deliveries began in the first quarter of 1973.

Burroughs' earlier TC Series Terminal Computers and the closely related L Series Accounting Computers have quickly become one of the industry's most successful product lines. More than 60,000 of these machines are already in use.

The new TC 3500 Terminal Computers represent an effective upward extension of the TC Series product line. As compared with the earlier TC models (Report 70D-112-01), the TC 3500 offers a 30-to-1 internal speed advantage, increased memory capacity, improved input/output capabilities, new BSC line discipline procedures, and optional dual data communications interfaces—all at a modest increase in price. Moreover, the TC 3500 retains the convenient console control and forms-handling facilities of the earlier TC Series models and provides upward compatibility of programs, data, and operating procedures.

The TC 3500 is a keyboard-oriented, stored-program computer that can function effectively as an interactive communications terminal, a remote batch terminal, and/or a free-standing small accounting computer. In all respects except its data communications facilities, the TC 3500 line is identical with the Burroughs L 8000 Series Accounting Computers. Therefore, a detailed discussion of the TC 3500 processing facilities, peripheral equipment, and software can be found in the L 8000 Series report, 70C-112-21.

In contrast to the disk memories used in all the earlier TC and L Series computers, the TC 3500 uses MOS ➢

CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000.

MODELS: The price list at the end of this report lists the standard facilities of each of the TC 3500 models. The TC 3520, TC 3530, and TC 3540 Terminal Computers have the same forms handling facilities as the earlier TC 500, TC 1500, and TC 2500, respectively. The TC 3570 and TC 3580 Magnetic Record Terminal Computers feature a 26-inch forms handler that can accommodate magnetic-stripe documents with single or dual 352-digit data tracks, respectively.

COMMUNICATIONS: Asynchronous or synchronous, in half-duplex mode, at speeds up to 9600 bits/second. For asynchronous transmission, the standard speed is 1200 bps, with optional speeds of 75, 100, 110, 150, 200, 300, 600, or 1800 bps available. For synchronous transmission, the standard speed is 2400 bps, with optional speeds of 2000, 4800, or 9600 bps available.

The transmission code is ASCII. For asynchronous transmission, a 10-bit code is used for each character: 1 start bit, 7 data bits, 1 even parity bit, and 1 stop bit. For synchronous transmission, an 8-bit code is used: 7 data bits and 1 odd parity bit. In either mode, the message length is variable and each message includes a longitudinal parity check.

The TC 3500 is designed to act as a communications terminal for computers manufactured by Burroughs, IBM, or other companies. It can operate over the public telephone network or over leased or privately owned voice-grade facilities via suitable modems that meet the EIA RS-232C interface specification. Burroughs offers a variety of internal and external modems.

When used with other Burroughs equipment, a TC 3500 can be directly connected via a 2-wire cable up to 1000 feet long; no modem is required in this case. Up to 9 terminals can be multidropped off a single direct-connect circuit.

Line control procedures available for the TC 3500 include: Burroughs standard Poll/Select, Burroughs standard Point-to-Point, Burroughs CTCC (Central Terminal Computer Controller), IBM Binary Synchronous, and IBM 2260 procedures (for use in 4-wire leased-line environments). Auto call and auto answer options are available for use on switched lines.

The optional Second Data Communications Channel permits a single TC 3500 to control communications over two independent lines. Moreover, the two lines can employ different transmission modes, different speeds, different line disciplines, and/or different line connection methods.

CONSOLE: This basic unit, available in 12 different models, is the central component of every TC 3500 Termi- ➤

Burroughs TC 3500 Terminal Computers

memory and logic circuitry to achieve greatly increased internal speed. A TC 3500 can have up to 65K bytes of MOS memory with a 1.5-microsecond cycle time. The memory is divided into two sections: 12K to 20K bytes of Micro Program Memory, which holds the standard microprograms that control the system's operations, and 4K to 46K bytes of Data Program Memory (user memory), which holds the user's programs and data.

The basic TC 3500 system consists of a single compact console that houses the processor logic, MOS memory, 20-cps ball printer, basic forms handler, alphanumeric and numeric keyboards, and operating keys and indicators. The basic system is offered in 12 models, whose distinguishing characteristics are summarized in the accompanying price list.

Designed primarily for operator-attended applications that involve visible records and keyboard entry of transaction data, the TC 3500 computers feature "human-engineered" controls and flexible forms-handling facilities that can accommodate a wide variety of continuous and cut forms, either singly or in various combinations. In addition, the TC 3570 and TC 3580 Magnetic Record Terminal Computers can read and write data on magnetic-stripe documents, which can be fed and stacked automatically by novel console attachments.

In addition to the flexible console facilities, Burroughs offers a wide array of free-standing input-output units that can significantly enhance the performance capabilities of the TC 3500 computers. These include a cassette tape subsystem, a 9-track magnetic tape unit, a paper tape reader and punch, an 80-column card reader, three I/O units for 96-column cards, two line printers, two magnetic record readers, and Burroughs' unique SELF-SCAN Panel Display unit.

A TC 3500 can transmit and receive data in either asynchronous or synchronous mode, at speeds ranging from 75 to 9600 bits per second. A single-line Data Communications Channel (DCC) is standard in all models, and an independent Second DCC is optional. A TC 3500 equipped with the Second DCC can control communications over two lines, and the two lines can employ different speeds, transmission modes, and/or line disciplines. Thus, the TC 3500 can effectively perform a wide variety of remote data concentration functions. For example, a TC 3500 could collect data from a number of smaller terminals, using the poll/select technique and 1200-bps asynchronous transmission; then the TC 3500 could retransmit the data to a larger central computer, using the BSC mode at up to 9600 bps. This dual data communications capability sets the TC 3500 apart from every other intelligent terminal currently on the market.

COBOL is the principal programming language for the TC 3500. Although the Burroughs implementation is a limited, non-compatible subset of the American National Standard COBOL language, its use should nonetheless ease the user's programming task and simplify future conversions. Unfortunately, COBOL programs cannot be

nal Computer system. It houses the system's processing logic, memory, alphanumeric and numeric keyboards, basic 20-char/second ball printer and forms handler, control keys and indicators, and basic program loader (a small paper tape reader). In some models, the console also contains Magnetic Memory Record facilities and/or a single cassette tape drive. Optional pin-feed devices provide improved feeding of marginally-punched continuous forms. For a detailed description of all the console facilities, please refer to the Burroughs L 8000 Series report, 70C-112-21.

MAGNETIC MEMORY RECORD (MMR) FACILITIES: These facilities permit data to be read from and recorded upon ledger cards and other documents containing magnetic stripes. The TC 3570 series models have a single-track MMR facility and can record a maximum of 352 digits on each document. The TC 3580 series models feature an expanded dual-track MMR facility and can record a maximum of 704 digits on each document. Please see the L 8000 Series report, 70C-112-21, for details of the MMR facilities and the optional magnetic record handlers and readers.

DEVICE CONTROL: All internal operations of the TC 3500 are controlled by microprogramming. Object programs produced by the COBOL compiler or the Assembler are expressed in an "S-level" code, which is the system's machine language from the user's point of view. The S-level language is the same as the machine language of the earlier Series L and TC computers, with extensions to permit use of the new peripheral devices and extended memory addressing capabilities of the TC 3500. The S-level instructions are decoded and executed by means of standard microprograms.

The TC 3500 uses MOS memory with a cycle time of 1.5 microseconds per byte. The memory is divided into two major sections: Micro Program Memory (MPM) and Data Program Memory (DPM). MPM holds the control microprograms, or "firmware", while DPM holds the user's programs and data. Maximum total memory capacity is 65,536 bytes. The standard microprograms occupy from 12K to 20K bytes of MPM, depending upon the system configuration; additional MPM is furnished with each peripheral device at no extra cost to the user. DPM capacity can range from 4096 to 47,104 bytes, in 2048-byte increments. The basic DPM capacity is 6144 bytes in the TC 3570 and TC 3580 Magnetic Record Terminal Computers and 4096 bytes in all other models. The A 2011 or A 2012 Extended Memory Potential feature is required for total DPM capacities in excess of 12K or 36K bytes, respectively.

The TC 3500 processors have a repertoire of approximately 250 S-level instructions, including add, subtract, multiply, divide, transfer, clear, shift, branch, skip, set flags, test flags, increment index registers, and a wide variety of I/O and control operations for the various peripheral devices. Arithmetic instructions are of the one-address, "add-to-accumulator" type, in which the result replaces the previous contents of the accumulator. All arithmetic is performed in fixed-point decimal mode upon one-word operands. Word length is 64 bits, or 8 eight-bit bytes, and each word can hold 15 decimal digits plus sign, 8 alphanumeric characters, or up to 4 instructions. ASCII is the internal code.

The TC 3500 processors have a machine cycle time of 3 microseconds. Some representative instruction execution times are: Add – 1.8 milliseconds; Multiply (two 6-digit fields) – 50 milliseconds; Transfer to Accumulator – 1.6 milliseconds; Transfer to Memory – 0.7 millisecond; Branch – 1.0 millisecond.

Standard I/O buffers permit considerable overlapping of functions within a TC 3500. The keyboard, the console printer, and each of the five peripheral controllers contain a 32-character buffer. Additional buffering capabilities are included in the line printers and 96-column card I/O units. The independent Data Communications Channel

Burroughs TC 3500 Terminal Computers

compiled on the TC 3500 itself; a medium-scale Burroughs B 3500, B 3700, or B 4700 computer, usually located at a Burroughs data center, is required for the compilation process. Burroughs is also preparing an Assembler, which will allow users to code their programs in a symbolic machine-oriented language and assemble them on the TC 3500.

The TC 3500 provides virtually all the facilities and features of the competitive IBM 3735 and NCR 399, together with a number of distinctive capabilities of its own (e.g., dual communications interfaces, COBOL programming, and display units). These impressive capabilities, coupled with Burroughs' extensive experience in designing, marketing, and supporting intelligent terminals, place the TC 3500 at the top of its class and should ensure its widespread acceptance. □

(DCC) essentially serves as a buffer between the data communications line and the main processor. The DCC performs all functions associated with line control procedures. A second independent DCC is optional. The communications transmit and receive buffers can have program-selected lengths up to the limit of user memory.

ERROR CONTROL: Character and longitudinal parity accompanies all messages transmitted and is checked on all messages received. Parity errors detected in a received message cause the TC 3500 to transmit a negative acknowledgment. The terminal automatically retransmits the last message in response to a received negative acknowledgment Parity checking is performed on each transfer of data to or from memory.

CONFIGURATION: The number of peripheral devices and/or memory modules that can be used in a TC 3500 system is limited by the capacity of the processor backplane, which can house a maximum of 100 circuit cards. There is room for 10 rows of 10 cards each. The basic processor logic, the standard Data Communications Channel, and the first 12K bytes of user memory require 6 rows of cards, leaving the other 4 rows available for additional memory and/or peripheral control logic. Row requirements for the various peripheral controllers and extended memory options are as follows:

A 7354-1	Second DCC with Inbuilt Data Set Potential	1 row
A 2331	96-Column Card I/O	1 row
A 2322	Paper Tape I/O and/or 80-column Card Reader	1 row
A 2391	Cassette Tape Subsystem	1 row
A 7352*	Second DCC	1 row
A 2392*	9-Track Magnetic Tape Unit	1 row
A 2361*	Line Printer and/or SELF-SCAN Panel Display	1 row
A 2011*	Extended Memory Potential (24K)	2 rows
A 2012	Extended Memory Potential (32K)	2 rows
–	Magnetic Memory Record facilities	2 rows

*Either the A 2392, the A 2361, or the A 7352 can be combined with the A 2011 and the combination will require only 2 rows rather than 3.

PERIPHERAL DEVICES: A variety of peripheral equipment can be connected to a TC 3500, as listed above and in the accompanying price list. For detailed descriptions of these devices, please refer to the Burroughs L 8000 Series report, 70C-112-21.

The A 9355 SELF-SCAN Panel Display is the one TC 3500 peripheral device that is not described in the L 8000 Series report. This novel display unit uses Burroughs' new plasma envelope technology instead of a conventional cathode ray tube. The new technology greatly reduces the amount of electronic circuitry required to drive the display, yielding reduced size, lower heat dissipation, and improved reliability. The A 9355 displays up to 256 alphanumeric characters in 8 lines of 32 characters each.

SOFTWARE: The principal programming language for the TC 3500 is a revised, upward-compatible version of Burroughs' present L/TC COBOL. The language includes a limited subset of the American National Standard COBOL facilities, but direct compatibility with other ANS COBOL compilers is precluded by numerous additional constructs that are oriented toward the operator-attended features and specific hardware characteristics of the TC 3500 computers. Compilation of programs written in TC 3500 COBOL must be performed on a Burroughs B 3500, B 3700, or B 4700 computer with at least 90K bytes of main storage. The compiler produces "S-level" object programs that can be loaded into TC 3500 user memory and executed by the standard microprograms. The COBOL compiler is scheduled for availability late in the first quarter of 1973.

Burroughs also provides an Assembler for users who wish to program in symbolic machine-oriented language. The Assembler language is fully upward-compatible with that of the earlier Burroughs L and TC Series computers, and includes additional instructions for the new TC 3500 peripheral devices and expanded addressing facilities for user memories larger than 8K bytes. Assembly–unlike COBOL compilation–can be performed on the TC 3500 itself. Output from the Assembler is an "S-level" object program that can be loaded into user memory and executed by the standard microprograms. The Assembler is scheduled for availability in mid-1973.

Burroughs also offers a wide variety of utility routines and application programs for its L and TC Series computers. For more information about these programs, please refer to the L 8000 Series report, 70C-112-21.

PRICING: The TC 3500 is available for purchase or on a one-, three-, or five-year base. Rental prices include prime-shift maintenance and permit unlimited use of the equipment. Purchase prices include prime-shift maintenance for the first year. Applications software, training courses, and technical support are separately priced. ■

EQUIPMENT PRICES

		Purchase Price	Annual Maint.	Rental (1-year lease)*	Rental (5-year lease)*
PROCESSORS AND MAIN STORAGE					
TC 3520-104	Processor with 4K bytes of user memory and 15.5" rear-feed forms handler**	13,990	605	424	382
TC 3521-104	As above, with 1 Cassette Tape Station	15,190	702	461	415
TC 3530-104	Processor with 4K bytes of user memory and 15.5" front-feed forms handler**	14,490	605	440	396
TC 3531-104	As above, with 1 Cassette Tape Station	15,690	702	476	428

Burroughs TC 3500 Terminal Computers

		Purchase Price	Annual Maint.	Rental (1-year lease)*	Rental (5-year lease)*
PROCESSORS AND MAIN STORAGE (Continued)					
TC 3540-104	Processor with 4K bytes of user memory and 26" front-feed forms handler**	15,690	635	476	428
TC 3541-104	As above, with 1 Cassette Tape Station	16,890	732	512	460
TC 3570-106	Processor with 6K bytes of user memory and 26" single-track MMR forms handler with split platen	22,990	931	697	627
TC 3571-106	As above, with 1 Cassette Tape Station	24,190	1,028	733	660
TC 3578-106	Processor with 6K bytes of user memory and 26" single-track MMR forms handler with solid platen	21,990	931	667	600
TC 3579-106	As above, with 1 Cassette Tape Station	23,190	1,028	703	632
TC 3580-106	Processor with 6K bytes of user memory and 26" dual-track MMR forms handler with split platen	23,990	961	727	655
TC 3581-106	As above, with 1 Cassette Tape Station	25,190	1,058	764	688
A 4011	2 KB Memory Module (up to 16 KB total)	1,100	21	31	28
A 4011-1	2 KB Memory Module (over 16 KB)	750	21	21	19
A 2011	24 KB Extended Memory Potential (required for total user memory capacity of 12 KB through 36 KB)	750	—	21	19
A 2012	32 KB Extended Memory Potential (required for total user memory capacity of 36 KB through 46 KB)	800	—	22	20
COMMUNICATIONS OPTIONS					
A 7352	Second DCC	1,900	59	53	48
A 7354-1	Second DCC and Inbuilt Data Set Potential (permits use of TA 311 or TA 318 Internal Data Sets)	2,000	59	56	50
—	Auto Dial	250	12	7	7
—	Auto Answer/Disconnect	125	—	4	4
—	Decoder On/Off	150	—	5	5
PERIPHERAL EQUIPMENT					
A2322	Card/Tape Controller (for A 9122-1, A 9222-1, and/or A 9114-1)	1,000	23	28	25
A 9122-1	Paper Tape Reader; 40 char/sec.	1,590	114	42	38
A 9222-1	Paper Tape Punch; 40 char/sec.	1,990	144	53	48
A 9114-1	80-Column Card Reader; 200 cpm	2,790	244	78	71
A 2331-1	Controller for A 9119-1	900	23	25	23
A 9119-1	96-Column Card Reader; 300 cpm	3,500	300	85	77
A 2331-2	Controller for A 9419-2	1,900	23	53	48
A 9419-2	96-Column Card Reader/Punch/Data Recorder	9,490	852	240	216
A 2331-3	Controller for A 9419-6	2,100	23	59	53
A 9419-6	96-Column Multi-Purpose Card Unit	11,390	1,020	285	257
A 2361-1	Controller for A 9249-1	1,400	23	39	35
A 9249-1	Line Printer; 90 lpm	8,500	720	240	216
A 2361-2	Controller for A 9249-2	1,500	23	42	38
A 9249-2	Line Printer; 180 lpm	11,200	840	280	252
A 9490-25	Cassette Tape Station	1,940	74	55	50
A 2392	Data Collection MTU Controller	1,000	23	28	25
A 1495-1	Magnetic Tape Unit: 2 ports	11,500	444	365	280
A 9355	Self-Scan Panel Display	1,990	98	54	49
A 9161	Magnetic Record Reader; single-track	4,790	305	148	112
A 9162	Magnetic Record Reader; dual-track	4,990	305	161	122
A 9361	Console Magnetic Record Handler; stacker/hold; includes PF 26 or 29	1,500	105	42	38
A 9362	Console Magnetic Record Handler; feeder/stacker/hold; includes PF 26 or 29	2,790	168	78	70
	Continuous Forms Pin-Feed Devices:				
PF 21	15.5" rear feed; single synchronous	250	—	7	6
PF 22	15.5" rear feed; single asynchronous	250	—	7	6
PF 23	15.5" rear feed; dual	500	—	14	13
PF 24	15.5" front feed; single synchronous	250	—	7	6
PF 25	15.5" front feed; single asynchronous	250	—	7	6
PF 26	15.5" front feed; dual	500	—	14	13
PF 27	26" front feed; single synchronous	250	—	7	6
PF 28	26" front feed; single asynchronous	250	—	7	6
PF 29	26" front feed; dual	500	—	14	13

*Rental prices include prime-shift equipment maintenance.

**These processors are also available in special models with only 2K bytes of user memory, at reductions of $1,100 in purchase price, $21 in annual maintenance, and $33 in monthly rentals.

Business Systems Technology
BST/3 Memory for IBM System/3

MANAGEMENT SUMMARY

Business Systems Technology is the leading independent supplier of replacement memory for the expansive IBM System/3 market. The company began deliveries of its BST/3 memory in March 1973, and in June 1975 celebrated the installation of its 1000th unit, representing an aggregate of about 16 million bytes of memory for all of the units delivered.

The BST/3 memories can be used to extend the existing storage capacity of a System/3 installation or to replace all IBM main memory down to the 8K-byte minimum mainframe capacity of the System/3 Model 6 and 10 computers. Although BST has considered replacement memory for System/3 Models 8 and 15, it has no immediate plans to offer memory for these models.

BST offers its BST/3 memory in 8K-byte increments up to 56K bytes to match the standard IBM capacities and also provide enhanced main storage capacities up to 64K bytes. The memory enhancements provide up to 4 times or up to 1.33 times the standard IBM-imposed maximum main storage capacity for the System/3 Model 6 or 10, respectively.

The BST/3 memory is equipped with an integral power supply to satisfy its power requirements, and it plugs into the System/3 to permit system control. The memory provides total systems transparency and has received IBM certification for service continuance.

BST/3 core memory, designed as replacement memory for IBM System/3 Model 6 and 10 computers, is available in 8K-byte increments up to 56K bytes to provide enhanced mainframe storage capacities of up to 64K bytes. These units have earned outstandingly high marks from users.

CHARACTERISTICS

MANUFACTURER: Business Systems Technology (BST), Inc., 1215 West Katella Avenue, Orange, California 92664. Telephone (714) 997-1450 or (800) 854-3111 (toll-free).

COMPATIBILITY: The BST/3 Core Memory is designed as a plug-compatible add-on or replacement core memory for IBM System/3 Model 6 and 10 computers. The BST/3 memory can be used to extend the existing storage capacity of an IBM System/3 and/or to replace all storage down to the minimum mainframe capacity of the System/3 Model 6 and 10 computers–8K bytes.

BST/3 memory is available in 8K-byte increments and provides the following range of standard and enhanced main storage capacities:

IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	Enhanced BST Capacities, bytes
5406	8K	8K, 12K, or 16K	24K to 64K
5410	8K	8K to 48K	56K or 64K*

***Available from IBM as an RPQ.**

Up to 56K bytes of BST/3 core memory fits neatly beneath the System/3 operator console as shown here.

Business Systems Technology
BST/3 Memory for IBM System/3

The BST/3's small physical size permits it to occupy an otherwise unused space beneath the System/3 operator console, as shown in the photograph. A single cabinet can contain up to 56K bytes.

BST prices its replacement memory well below IBM's prices for equivalent storage capacities. The BST/3 memory typically rents for about 30 to 40 percent below and sells for about 33 percent below the IBM rental and purchase prices.

Service is provided by Sorbus and by Memorex (at installations that include both BST/3 memory and BST/45 disk drives) within the continental United States, and by Control Data Corporation in Canada, Hawaii, and Puerto Rico.

Delivery time is currently quoted as 30 days after receipt of order for a complete unit and 7 days for a memory upgrade.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 10 users reported on their experience with a total of 17 BST/3 replacement memories. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	10	0	0	0	4.0
Equipment reliability	10	0	0	0	4.0
Maintenance service**	7	1	0	0	3.9
Ease of installation	9	1	0	0	3.9

* Weighted Average on a scale of 4.0 for Excellent.
**Two users had not required service as yet.

These excellent ratings speak for themselves. Obviously, BST users are delighted with the replacement memory and with the supporting service. No problems were cited in installation and testing, and, with the exception of one user who reported minor problems, no problems were cited in diagnosing malfunctions and obtaining the necessary service. The users reported installation and test periods ranging from as little as one hour to a maximum of only six hours.

The BST memory units clearly deserve their "overnight" success and merit serious consideration by virtually all users of System/3 Model 6 and 10 computers. □

The effective cycle time of the BST/3 memory is the same as that of the corresponding IBM memory–1.52 microseconds per 1-byte fetch.

The BST/3 memory contains up to 56K bytes of core storage in a single cabinet that measures 18 inches wide by 6 inches deep by 24 inches high and weighs a maximum of 45 pounds. The BST/3 memory contains its own power supply and is powered via a 208/230-volt ac CPU-switched connection on the System/3. Total power required for 56K bytes of BST/3 core storage is 150 watts. The BST/3 cabinet fits beneath the System/3's operator console. A switch on the memory permits instant disconnect from the CPU.

PRICING: The BST/3 memory is available for 30-day rental, lease, or purchase. BST offers lease contracts for one through five years. Lease and rental rates include installation, diagnostic performance checks, unlimited usage, and complete 24-hr/day, 7-day/week service. A separate maintenance contract is available for purchased units. BST's standard rental agreement requires a 30-day notice of cancellation or downgrade; upgrades are performed on a 7-day notice. BST prices the BST/3 memory as follows:

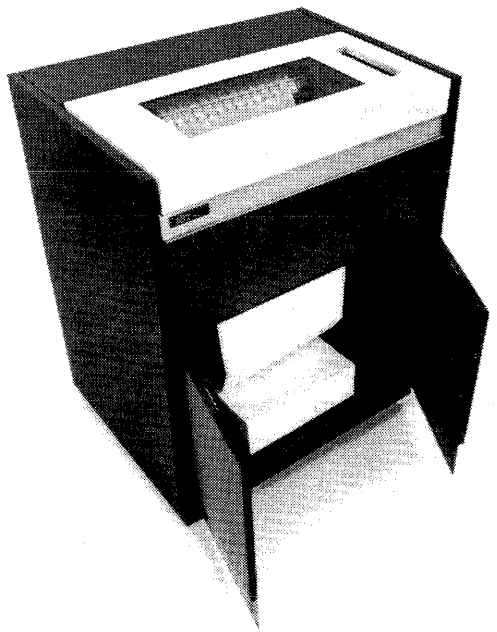
IBM Processor Conversion	Monthly Rental* 30-Day Rental	1-Year Lease	2-Year Lease	Purchase	Monthly Maint.**
From 8K to:					
12K	***	***	***	***	–
16K	174	160	157	5,700	25:50
24K	349	321	314	14,000	25:50
32K	534	491	480	18,000	25:50
48K	779	717	701	28,000	40:64
64K	999	919	899	38,000	40:64
From 16K to:					
24K	174	160	157	8,000	25:50
32K	349	321	314	14,000	25:50
48K	657	604	591	23,000	40:64
64K	889	818	800	33,000	40:64
From 24K to:					
32K	174	160	157	8,000	25:50
48K	534	491	480	18,000	40:64
64K	779	717	701	28,000	40:64
From 32K to:					
48K	349	321	314	14,000	40:64
64K	657	604	591	23,000	40:64
From 48K to 64K	349	321	314	14,000	40:64

*Includes maintenance for 24 hrs/day, 7 days/week. Monthly rental under a three-year and a four- or five-year lease is priced 12 and 13 percent, respectively, below that for 30-day rental.

**Prime-shift maintenance for 9 hrs/day, 5 days/week (1st column); and complete maintenance for 24 hrs/day, 7 days/week (2nd column).

***Available from IBM only. ■

Business Systems Technology
Model 400 & 750 Printers for IBM System/3



These chain/train printers, rated at 400 and 750 lpm, are available for all models of the IBM System/3 except Model 6 as direct replacements for the IBM 5203 and 1403 Printers. Both BST printers attach directly to the System/3 I/O channel and offer significant price/performance advantages.

MANAGEMENT SUMMARY

In June 1975 Business Systems Technology, the leading independent producer of add-on memory for IBM System/3 computers and a vendor of disk drives for the same market, introduced two printer models designed as replacements for the IBM 5203 and 1403 Printers on System/3 Model 8, 10, 12, and 15 computers. Both printer models employ chain/train technology, widely considered to be superior to that of drum printers, and offer price/performance advantages over their IBM counterparts.

The BST printers offer complete compatibility with the IBM System/3, and—of major significance—either printer model can be used on any System/3 computer except Model 6. No hardware or software changes are required to incorporate the BST printers. The BST printers attach directly to the processing unit, eliminating the need for the device attachment features required for connecting IBM's own System/3 peripherals and thereby yielding a significant cost saving. Additional savings can be realized when replacing IBM's 1403 Printer with the BST Model 750 because the 750 includes its own controller, precluding the need for the separate control unit required for the IBM 1403.

The BST printers are produced by Data Printer Corporation. BST adds the interface and control logic necessary to attach the printers to the System/3 processing unit. Data Printer is a leading OEM manufacturer of chain/train printers for the computer industry. The two printers are identical in appearance.

Both the BST printers and the IBM printers they replace employ chain/train technology, but the BST units provide ▷

CHARACTERISTICS

MANUFACTURER: Business Systems Technology, Inc., 3015 Daimler Avenue, Irvine, California 92705. Telephone (714) 549-9961 or (800) 854-3111 (toll-free).

MODELS: Models 400 and 750; both are chain/train printers rated at 400 and 750 lpm, respectively.

COMPATIBILITY: The BST chain/train printers are plug-compatible printers for the IBM System/3 Model 8, 10, 12, and 15 computers. Model 400 is a replacement for the IBM 5203 Printer; and Model 750 is a replacement for the IBM 1403 Printer. The printers interface directly to the Input/Output Channel of the IBM processing unit, eliminating the need for an IBM Printer Attachment and separate control unit (in the case of the 1403 Printer). Either BST printer model can be used on any model of the System/3 computer except Model 6. By contrast, IBM restricts its 5203 Printer to System/3 Models 8, 10, and 12 and its 1403 Printer to Models 10, 12, and 15.

No software or hardware changes to existing IBM equipment are required to attach the printers. The printers are compatible with existing System/3 software and operate under the standard System/3 Supervisor and normal I/O support routines. The 48-character print trains available correspond to IBM's AN, HN, and LC character arrangements; the 64-character train corresponds to the GN arrangement; and the 96-character train to the UC set.

MODEL 400: The BST Model 400 Line Printer is a chain/train printer that features single-line buffering, EBCDIC coding, and a standard 48-character print set. The salient characteristics of the Model 400 are compared with those of the IBM 5203 in the following table:

	BST Model 400	IBM 5203*
Print positions:	132	96; 120 or 132 opt.
Print speed, lines/min.:	400	100, 200, or 300
Skipping speed, inches/sec:	20	16.7 (6 lpi); 12 (8 lpi)
Single-line advance, msec:	20	?
Character spacing, char/inch.:	10	10
Line spacing, lines/inch:	6 or 8	6 or 8
Paper width, inches:	3-1/2 to 19-1/2	3-7/8 to 16-3/4
Paper length, lines:	1 to 127	1 to 114
Character set, chars:	48; 64 or 96 opt.	48; 49 to 120 opt.
Max. form thickness, inches:	0.020	0.020

*Models 1, 2, and 3.

Business Systems Technology
Model 400 & 750 Printers for IBM System/3

increased performance over their IBM counterparts. Model 400, rated at 400 lpm using a 48-character print set, is 33 percent faster than the IBM 5203 Model 3, the fastest of the three 5203 models. A 132-character print line is standard on the BST Model 400 but is optional on the IBM 5203, which has a standard line length of 96 postions. The BST 400 is available with an optional 64- or 96-character print set. By contrast, IBM's 5203 Printer can accommodate up to 120 print symbols via the optional Universal Character Set feature.

The BST Model 750, rated at 750 lpm using a 48-character print set, is about 1.6 times as fast as the IBM 1403 Model 5 and 1.25 times as fast as the 1403 Model 2; however, the IBM 1403 Model N1 (available on System/3 Models 10 and 15 only) is 47 percent faster than BST's Model 750, a decided advantage for high-volume printing. Both the IBM 1403 and BST 750 feature a 132-character print line, and both provide end-of-paper sensing; but BST has added a Low Paper indicator for increased operator convenience. The BST 750 is available with optional 64- and 96-character print sets. IBM's 1403 is available with a 120-character print set for those jobs that require additional print symbols, but larger character sets result in reduced print speeds.

IBM options of significance not currently provided by the BST printers include the Universal Character Set feature (optional for both IBM printer models), which provides accommodation for any character/code set, and the Dual Feed Carriage for the IBM 5203 Printer, which handles two forms simultaneously.

BST offers substantial dollar savings on its printers as compared to IBM's 5203 and 1403 Printers. The BST Model 400 leases for 13 percent (under a one-year lease) to 35 percent (under a five-year lease) below the monthly rental cost of IBM's top-of-the-line 5203 Model 3 Printer (including 132 print positions and Printer Attachment), and sells for 20 percent below the 5203 Model 3's purchase price. This represents a saving of from $84 to $229 per month on a leased unit or almost $5,000 on a purchased unit. Even larger savings can be realized on the BST Model 750 Printer, which leases for 27 percent (under a one-year lease) to 47 percent (under a five-year lease) below the monthly charge (under IBM's Fixed-Term Plan) for the IBM 1403 Model 2 Printer (including the Printer Control Unit and Attachment), and sells for about 40 percent less than the purchase price of the 1403 Model 2. This represents a saving of from $313 to $543 per month on a leased unit or almost $20,000 on a purchased unit.

Initial production deliveries of the BST printers are slated for August 1975. Lead time on orders is currently quoted at 90 to 120 days after receipt of order.

Service is provided by Sorbus and by Memorex within the continental United States, Canada, and Hawaii.□

MODEL 750: The BST Model 750 Line Printer is a chain/train printer that features single-line buffering, EBCDIC coding, and a standard 48-character print set. The salient characteristics of the Model 750 are compared with those of the IBM 1403 in the following table:

	BST Model 750	IBM 1403*
Print positions:	132	132
Print speed, lines/min:	750	465, Mdl. 5; 600, Mdl. 2; 1100, Mdl. N1
Skipping speed, inches/sec:	20	33; 75 (more than 8 lines)
Single-line advance, msec:	20	?
Character spacing, char/inch:	10	10
Line spacing, lines/inch:	6 or 8	6 or 8
Paper width, inches:	3-1/2 to 19-1/2	3-1/2 to 18-3/4
Paper length, lines:	1 to 127	1 to 114
Character set, chars:	48; 64 or 96 opt.	120 opt.
Max. form thickness, inches:	0.020	0.020

Models 5, 2, and N1.

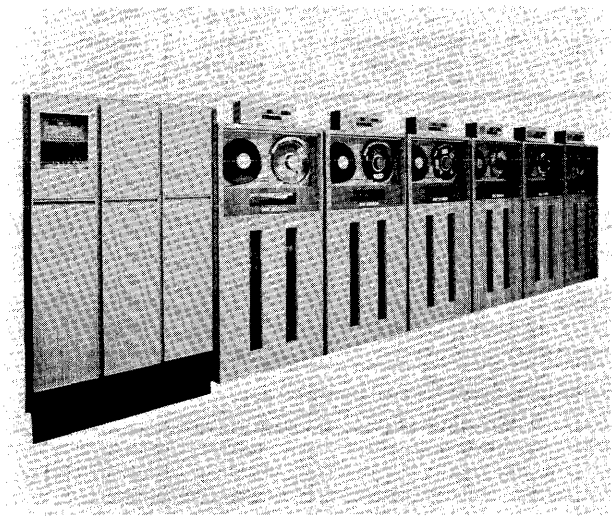
PHYSICAL CHARACTERISTICS: The physical characteristics of the two BST printers are identical and are listed below:

Width:	36 inches
Height:	42 inches
Depth:	26 inches
Weight:	570 pounds

PRICING: The BST printers are available for purchase or on a one- through five-year lease, which includes installation and prime-shift maintenance. A separate maintenance contract is available for purchased units.

	Model 400	Model 750
Lease period:		
One year	$575/mo.	$850/mo.
Two years	555	785
Three years	510	720
Four years	475	680
Five years	430	620
Purchase	19,840	28,760■

CalComp 8820 Magnetic Tape System



CalComp's 8820 System is a high-performance plug-to-plug replacement for the Uniservo tape subsystems used with UNIVAC's 400 and 1100 Series computers. The CalComp 8820 offers price/performance advantages over its UNIVAC counterparts.

MANAGEMENT SUMMARY

CalComp, well known as a supplier of replacement disk and tape drives for the IBM System/360 and 370 market, now offers a high-performance replacement tape subsystem for UNIVAC 400 and 1100 Series users as well. Introduced in October 1973, the CalComp 8820 is an attractive alternative to UNIVAC's Uniservo family of tape subsystems, including the Uniservo VI C, VIII C, 12, 16, and 20.

The CalComp subsystem includes a microprogrammable controller and any mix of CalComp 316 and 320 tape drives up to 8 units, or 16 when the Control Expansion feature is added. The CalComp drives offer a marked improvement in performance over most of the UNIVAC drives through tape speeds of 125 or 200 inches per second and sharply reduced rewind times of 60 or 45 seconds.

CalComp's standard 300 series drives are 9-track phase-encoded units that read and write at a recording density of 1600 bits per inch. Options permit Dual Density operation or Seven Track Compatibility. Drives incorporating these options can be mixed on the same CalComp controller.

Key features of the CalComp drives include automatic tape loading, single-capstan operation, pneumatically operated reel/hub loading for ease of loading and correct reel alignment, and fixed air bearing surfaces, which guide the tape at all turning points and substantially reduce tape wear via friction-free contact, loop-position sensing, and in-column rewind.

The 8820 Controller features MSI integrated circuit construction, microprogrammed operation for greater operating flexibility, microprogrammed diagnostics, error detection and correction, and radial drive attachment.

CHARACTERISTICS

MANUFACTURER: California Computer Products, Inc. (CalComp), 2411 West La Palma Avenue, Anaheim, California 92801. Telephone (714) 821-2011.

TAPE DRIVES: Models 316 and 320.

TAPE CONTROLLER: Model 8820.

COMPATIBILITY: The CalComp 8820 Magnetic Tape System is a plug-compatible replacement for the following UNIVAC magnetic tape subsystems as used with the UNIVAC 400 and 1100 Series computers:

- Uniservo VI C
- Uniservo VIII C
- Uniservo 12
- Uniservo 16
- Uniservo 20

The CalComp 8820 subsystem consists of an 8820 Controller and any mix of up to 16 CalComp 316 and 320 Magnetic Tape Units. The characteristics of the CalComp drives are compared with those of the equivalent UNIVAC drives in the table.

The basic CalComp 300 Series drives are 9-track, phase-encoded units that read and write at a density of 1600 bits/inch. Options include Dual Density, which also permits reading and writing 9-track tape at a density of 800 bits/inch using NRZI encoding, and Seven Track capability, which permits reading and writing in the 7-track, NRZI-encoded format at selectable densities of 200, 556, or 800 bits/inch.

Standard features of the Model 316 and 320 drives include automatic threading, single-capstan operation, fixed air bearing surfaces, pneumatically-operated reel/hub loading, power window, read backward capability, beginning-of-tape indication, write pre-emphasis with read equalization, and precision tape speed control via a digitally controlled capstan.

The basic CalComp 8820 Controller provides a single-channel computer interface and, therefore, a single data access path to any one of up to 8 radially attached drives. The 8820 Controller can accommodate up to 16 drives when the Controller Expansion feature is added. The Model 316 and 320 drives can be mixed on the same controller. The basic controller is designed for single-density operation at 1600 bits/inch using the phase-encoding recording technique. Dual Density and Seven Track operation are optional.

The Dual Access feature, a pooling option, permits concurrent data transfers between any two drives and two controllers. Both the drives and controllers must be equipped with the optional feature.

The Shared Peripheral Interface options are two- or three-channel switches that provide a second or third I/O channel interface.

CalComp 8820 Magnetic Tape System

CHARACTERISTICS OF THE CALCOMP AND UNIVAC TAPE DRIVES

Tape Subsystem & Drive Model	Tape Format tracks	Tape Speed, ips	Tape Density, bits/inch	Transfer Rate, K frames/sec	Rewind Time, seconds	Write Access, msec
CalComp 8820–						
316	9 or 7	125	1600/800* (9 tk), 800/556/200* (7 tk)	200/100 (9 tk), 100/69.5/25 (7 tk)	60	2.9
320	9 or 7	200	1600/800* (9 tk), 800/556/200* (7 tk)	320/160 (9 tk), 160/111.2/40 (7 tk)	45	2.0
UNIVAC Uniservo–						
VI C	9 or 7	42.7	800 (7 or 9 tk), 556/200 (7 tk)	34.2 (7/9 tk), 23.7/8.5 (7 tk)	180	–
VIII C	9 or 7	120	800 (7 or 9 tk), 556/200 (7 tk)	96 (7/9 tk), 66.7/24 (7 tk)	120	–
12	9 or 7	42.7	1600/800* (9 tk), 800/556/200 (7 tk)	68.3/34.2 (9 tk), 34.2/23.7/8.5 (7 tk)	180	–
16	9 or 7	120	1600/800* (9 tk), 800/556/200 (7 tk)	192/96 (9 tk), 96/66.7/24 (7 tk)	120	–
20	9	200	1600	320	60	2.0

* Dual Density operation and Seven Track Compatibility are optional.

NOTE: Interblock gap is 0.75 inch for 7-track operation and 0.6 inch for 9-track operation.

Options include the Expansion feature for connection of up to 8 additional drives; integral switching logic for pooled operation of multiple drives via two controllers; a two- or three- channel switch that provides a second or third data path to I/O channels on the same computer and/or other computers; and one of two translator features that translate between UNIVAC Fieldata code and either ASCII or EBCDIC code.

Microprogram control, a key feature of the 8820 Controller, is implemented via a floppy disk and combined logic including a random-access memory. The disk-based microprogram is automatically loaded during the power-up sequence and includes diagnostics and error-checking routines (including system-independent diagnostics). The error detection and correction facility, another important feature of the 8820 Controller, detects and corrects parity errors during all read or write operations.

First customer deliveries of the CalComp 8820 System are scheduled for the first quarter of 1974. Current lead time on orders is 120 days.

Service is provided by CalComp through a nationwide network of service locations in 39 metropolitan areas. □

The Translator options convert tapes written in Fieldata code (a 6-bit UNIVAC code) to ASCII or EBCDIC code and the converse.

The CalComp 8820 Controller employs the radial technique for connecting tape drives, which provides independent connection for each tape unit.

The physical characteristics and heat dissipation of the CalComp 300 series drives and 8820 Controller are as follows:

	Width, Inches	Depth, Inches	Height, Inches	Weight, lbs.	Heat Dissipation, BTU/hr.
300 Series Drives	30	29.5	60	900	4,000
8820 Controller	37	26	64	625	4,800

The 8820 Controller is powered from a 115-volt single-phase source. The 316 and 320 drives are powered from a 208/230-volt three-phase source. Power requirements are 0.5 KVA for the 8820 Controller and 1.8 KVA (operational) or 1.4 KVA (standby-ready) for each of the 300 series drives.

PRICING: The CalComp 8820 System is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. CalComp offers lease contracts for one through five years. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. A separate maintenance contract is provided for either leased or purchased units. CalComp refused to provide detailed pricing for the optional features, but did provide the following price ranges; the higher prices include all options for the controller and associated drives. Pricing for specific optional features is available from CalComp on a request basis.

	Monthly Rental*	Purchase	Monthly Maint.**
Model 8820 Controller	$960-1,190	$35,940-40,740	$180
Tape Drives:			
Model 316	380-450	14,000-16,680	150
Model 320	440-510	16,240-18,920	170

* Monthly rental under a one-year lease; does not include maintenance.
** Monthly maintenance is for 24 hours/day, 7 days/week. ■

CalComp 1040 Magnetic Tape Subsystem

CalComp's 1040 System is a high-performance plug-to-plug replacement for the IBM 3803/3420 Magnetic Tape Subsystem. Although new to the plug-compatible tape community, CalComp is a major supplier of IBM-compatible disk drives.

MANAGEMENT SUMMARY

CalComp, a well-established supplier of IBM-compatible disk drives, is a recent entrant in the market for IBM plug-compatible tape drives. Introduced early in 1972, the CalComp 1040 Magnetic Tape System is a high-performance subsystem that includes a controller and as many as eight tape drives and is directly compatible with IBM's 3803/3420 Magnetic Tape Subsystem. The functional characteristics of the two models of CalComp tape drives are identical to those of the IBM 3420 Models 5 and 7.

The 1040 System is a state-of-the-art product. Its controller features MSI integrated-circuit construction, radial drive attachment, and integral switching logic for pooled operation of multiple drives and controllers. The radial attachment technique, an IBM innovation currently used in competitive tape subsystems that offer compatibility with IBM's 3803/3420 subsystem, provides independent connections between the controller and each of its drives. This contrasts with the conventional "daisy-chain" or series arrangement in which all drives are connected in sequence, beginning at the controller and ending with the last drive. The radial technique is superior to daisy-chaining because it permits a drive to be switched off-line without interrupting or affecting the operation of the remaining drives.

CHARACTERISTICS

SUPPLIER: California Computer Products, Inc., 2411 W. LaPalma Avenue, Anaheim, California 92801. Telephone (714) 821-2011.

MANUFACTURER: Century Data Systems, Inc. (a Cal Comp subsidiary), 1630 S. State College Boulevard, Anaheim, California 92806.

TAPE DRIVES: Models 345 and 347.

TAPE CONTROLLER: Model 1040.

COMPATIBILITY: The CalComp 1040 Magnetic Tape System is a plug-compatible replacement for the following IBM magnetic tape subsystems:

- IBM 3803/3420, Models 5 and 7.
- IBM 2803/2420 or 2804/2420, Models 6 and 7.
- IBM 2803/2401 or 2804/2401, Models 3 and 6.

The 1040 System consists of a 1040 Controller and up to eight CalComp 340 Series Magnetic Tape Units and can be connected to a Selector Channel of an IBM System/360, Models 22 and 30 through 195 (except Model 44), or an IBM System/370, Models 135 through 195.

The CalComp 340 Series tape drives are functionally identical with IBM's 3420 Magnetic Tape Units, Models 5 and 7. The CalComp drives and the corresponding IBM drives are characterized below:

IBM 3420 Model	CalComp 340 Model	Tape Format, tracks*	Tape Speed, ips	Tape Density, bits/inch*	Transfer Rate, char/sec
5	345	7	125	800/556	100,000/69,500
5	345	9	125	1600/800*	200,000/100,000
7	347	7	200	800/556	160,000/111,200
7	347	9	200	1600/800*	320,000/160,000

*7-track drives and Dual Density operation on 9-track drives are optional features.

The basic 340 Series drives are 9-track, phase-encoded units that read and write at a density of 1600 bits/inch. Features include Dual Density, which also permits reading and writing at a density of 800 bits/inch using NRZI encoding, and Seven Track compatibility, which permits reading and writing in the 7-track, NRZI-encoded format at selectable densities of 556 or 800 bits/inch.

The Seven Track feature includes translation and data conversion functions. When selected, the translation function writes 8-bit EBCDIC-coded bytes as their 6-bit BCD-coded equivalents on 7-track tape; the converse

CalComp 1040 Magnetic Tape Subsystem

The CalComp 340 Series tape drives feature a single vacuum-capstan tape drive, vacuum tape buffers, fixed air-bearing surfaces which guide the tape at all turning points, a pneumatically-operated hub for ease of reel loading and correct reel alignment, and automatic tape loading.

CalComp prices its 340 Series drives and 1040 Controller substantially below IBM's prices for its 3420 Series drives and 3803 Controller. CalComp's one-year lease and purchase prices fall 10 and 25 percent, respectively, below IBM's prices under its Fixed-Term Plan.

First customer deliveries were made in April 1972. Current lead time on orders is 120 days, but CalComp plans to reduce this to 30 days by August 1972.

Service is provided by CalComp through a nationwide network of service locations in 45 metropolitan areas. □

translation is performed when reading. When selected, the data conversion function writes three 8-bit bytes as four 6-bit characters on 7-track tape; the converse function is performed when reading.

The CalComp 340 Series drives, although directly equivalent to the IBM 3420 Series drives, are also compatible with IBM's 2420 and 2401 Series drives with respect to data format, recording density, and recording technique. The Model 345 drives can be used with IBM System/360 Models 22 and 30 through 195 (excluding Model 44) computers; the Model 347 drives are designed for use with System/360 Models 50 through 195. Both drive models can be used with all current models of the System/370 computers.

Standard features of the Model 345 and 347 drives include automatic threading, cartridge-handling capability, automatic reel locking, power window, read backward capability, and precision tape speed control via an optional tachometer and digital capstan control.

The basic Model 1040 Controller provides a single-channel computer interface and can accommodate up to eight drives in any mix of Models 345 and 347. The basic controller is designed for single-density operation at 1600 bits/inch using the phase-encoding recording technique. Dual Density and Seven Track operation are optional.

The 1040 Controller employs the radial technique for connecting tape drives, which provides independent connection for each tape unit.

The optional Two-Channel Switch permits the 1040 Controller to be attached to a second computer for shared operations, or between two controller positions on the same computer. Switching is performed under program control.

Pooling options permit up to 16 tape drives to be switched (under program control) among two, three, or four 1040 Controllers to provide simultaneous operation of two, three, or four tape drives over as many Selector Channels on the same or different computers.

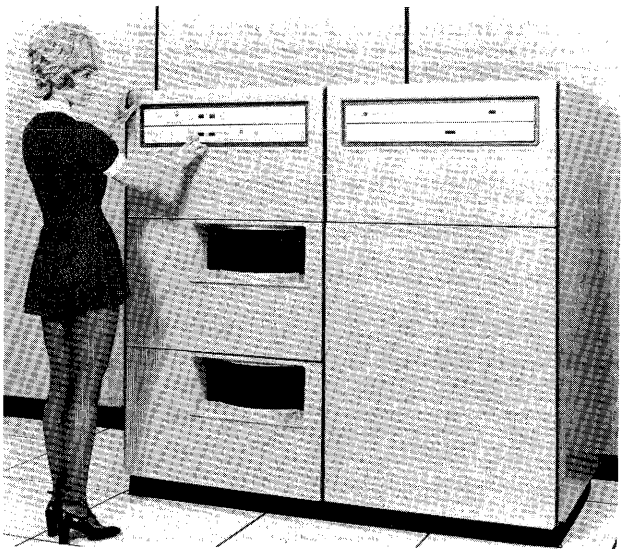
The physical, environmental, and electrical characteristics of the CalComp 1040 System are virtually the same as those of the counterpart IBM tape subsystems.

PRICING: The CalComp 1040 System is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. CalComp offers lease contracts for one, two, three, or four years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and maintenance on a 24-hour day, 7-days/week basis. A separate maintenance contract is provided for purchased units. Lease prices for terms beyond one year and prices of the optional features are available from CalComp upon request.

	Monthly Rental (1-Yr. Lease)*	Purchase	Monthly Maint.
Model 1040 Controller	$559	$19,365	$150
Tape Drives:			
Model 345	463	16,073	115
Model 347	554	19,230	130

*Includes service for 24 hours/day, 7 days/week. ■

CalComp 1030 Disk Storage Facility



CalComp's plug-compatible replacement for the IBM 3330 Disk Storage Facility matches the IBM unit's performance and is priced substantially lower.

MANAGEMENT SUMMARY

CalComp has recently entered the IBM 3330 replacement market with its new 1030 Disk Storage Facility, which is plug-to-plug compatible with the IBM 3330 Disk Storage Facility. The CalComp subsystem offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and operating characteristics. No hardware or software modifications to existing IBM equipment are required. Disk packs recorded by CalComp drives can be read by the equivalent IBM drives, and the converse.

CalComp is offering its users a direct replacement for the IBM 3330 subsystem. The 1030 subsystem does not boast any features that are not already provided by the IBM 3330, nor does it provide any fewer features. Its performance characteristics are the same as those of IBM's 3330, but the CalComp subsystem is priced substantially below its IBM counterpart.

CalComp prices its Model 230 drives at 12.5 and 58 percent below IBM's lease and purchase prices, respectively, for its 3330 drives. The CalComp 1030 controller leases and sells for 12 and 69 percent, respectively, below IBM's 3830 Controller.

Unlike the IBM 3330 subsystem, the CalComp subsystem is available with a single-spindle drive, which permits the user to configure a disk subsystem with any number of spindles from one to eight.

Conservation of floor space is still another consideration. The CalComp subsystem requires 22.4 percent less floor space (excluding service area) than IBM's 3330 Facility. ▷

CHARACTERISTICS

SUPPLIER: California Computer Products, Inc., 2411 W. La Palma Avenue, Anaheim, California 92801. Telephone (714) 821-2011.

MANUFACTURER: Century Data Systems, Inc. (a CalComp subsidiary), 1630 S. State College Boulevard, Anaheim, California 92806.

DISK DRIVES: Model 230, a dual-spindle unit, and Model 231, a single-spindle unit.

DISK CONTROLLER: Model 1030 Disk Storage Controller.

CONFIGURATION: The CalComp 1030 Disk Storage Facility includes a 1030 Disk Storage Controller and one to eight spindles, using any combination of Model 230 and 231 disk drives.

The optional two-channel switch provides two channel interfaces, which serve as alternate paths to the controller and its attached disk drives.

COMPATIBILITY: The CalComp 1030 subsystem is designed for connection to an IBM System/360 computer, Models 85 and 195 only, or an IBM System/370 computer, Models 135 through 195, via the Block Multiplexer Channel as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 1030 provides complete compatibility with the IBM 3330 command structure and requires no changes to the existing operating software.

STORAGE CAPACITY: The data storage capacity of the CalComp 230 and 231 drives is 100.018 million bytes per spindle, which is identical with the per-spindle storage capacity of the IBM 3330. Total on-line storage capacity of an 8-drive subsystem is 800.146 million bytes.

ACCESS ARRANGEMENT: Each spindle of the CalComp 230 and 231 drives provides access to 404 recording cylinders (19 tracks/cylinder) via a comb-type access mechanism with 20 vertically-aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

DISK PACK: The CalComp 230 or 231 drives accommodate one or two IBM 3336 Disk Packs or equivalent packs, respectively. The 3336 contains 12 disks and provides 19 recording surfaces.

FILE ORGANIZATION: Identical to that of IBM; each disk pack corresponds to one logical file. Address (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

PERFORMANCE: The performance characteristics of the CalComp 230 and 231 drives are compared with those of the IBM 3330 drives in the following table. ➤

CalComp 1030 Disk Storage Facility

The CalComp drives are equipped with powered drawers for easy pack access. The 1030 subsystem is capable of fully overlapped seek operations on any combination of up to eight on-line drives, and of multi-track searching through a cylinder without loss of any disk revolutions via the combined capabilities of the Rotational Position Sensing and Multiple Request features.

Two-channel selection is available, permitting the 1030 Controller to be connected to two computers for shared operation, between two controller positions on the same computer, or in a combination of both arrangements. Switching is performed under program control.

First deliveries of the CalComp 1030 disk subsystem are scheduled for July 1972. □

Head Positioning Time, Milliseconds

Disk Drive	Track to Track	Average (400 cyl.)	Maximum (400 cyl.)	Tracks per Inch
CalComp 230/231	10	30	55	192
IBM 3330	10	30	55	192

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically by both the CalComp and IBM drives.

PHYSICAL CHARACTERISTICS: The physical arrangement for the CalComp 1030 subsystem is the same as that of the IBM 3330, with the one exception that the CalComp subsystem can accommodate a single-spindle unit for which there is no IBM equivalent. The physical characteristics of the CalComp subsystem are listed below.

Device	Width, inches	Depth, inches	Height, inches	Weight, pounds
230 Drive	32	34	60	850
231 Drive	32	34	60	600
1030 Controller	32	34	60	600

Floor space requirements are 7.5 square feet for the 1030 Controller and 7.8 square feet for each of the drives. Both measurements include side panels. Maximum floor space required for an 8-spindle subsystem is 38 square feet. Compared with an 8-spindle IBM 3330 subsystem, an 8-spindle CalComp 1030 subsystem requires 22.4 percent less floor space (excluding service area).

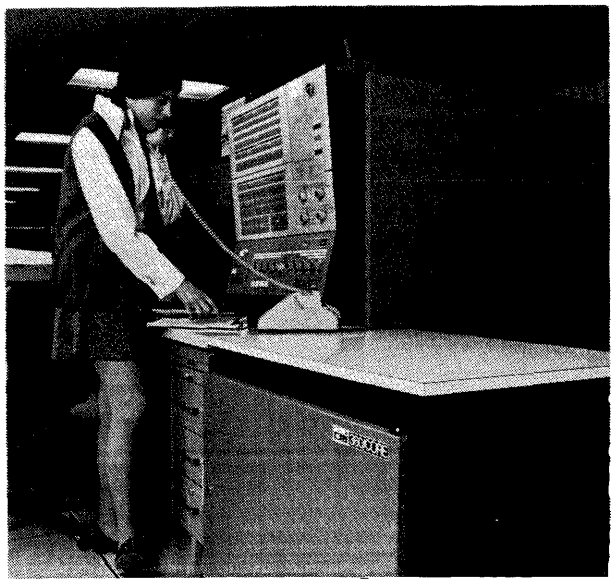
The CalComp 1030 subsystem operates in the same environment as the IBM 3330, with virtually the same power requirements.

PRICING: The CalComp 1030 Disk Storage Facility is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. CalComp offers lease contracts for one, two, three, or four years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and maintenance on a 24-hour, 7 days/week basis. A separate maintenance contract is provided for purchased units. Lease prices for terms beyond one year are available from CalComp upon request.

	Monthly Rental (1-Yr. lease)*	Purchase	Monthly Maint.
Model 1030 Controller	$1,943	$30,000	$400
Disk Drives:			
Model 230	1,052	30,000	180
Model 231	526	15,000	90
Two-Channel Switch	166	4,000	25

*Includes service for 24 hours/day, 7 days/week. ■

Cambridge Memories 370/STOR and 360/CORE Add-On Main Memory



CMI offers semiconductor memory for IBM System/370 Models 135, 145, and 158, and core memory for Models 155 and 165 and System/360 Models 22, 30, 40, 50, 65, and 67. Features include enhancement capacities (up to 8 megabytes for the 370/165) and a 370/155 accelerator. CMI also offers an enhanced semiconductor replacement for IBM's 2305 Fixed-Head Storage.

MANAGEMENT SUMMARY

CMI, a major manufacturer of main memory for end users and an OEM supplier of core and semiconductor memories, provides a broad line of add-on or replacement main memory for the IBM System/370 and 360 market.

In January 1975, CMI acquired the assets of Memory Technology, Inc., with an intent to use MTI's 145 memory; however, CMI now says it has no immediate plans for the MTI memories.

The 370/STOR, add-on or replacement memory for System/370 Models 135, 145, 155, 158, and 165, is available in most standard IBM storage capacities and in enhancement capacities that provide up to twice the available maximum IBM memory capacity for the Model 155 and up to 2.6 times that for the Model 165. CMI's 370/STOR 145, a bipolar semiconductor memory for the Model 145, is available in any combination of 128K, 256K, or 512K-byte increments up to its full 2048K-byte capacity. CMI plans to introduce replacement memory for the Model 168 in October 1975.

CMI's 360/CORE is available for System/360 Models 22, 30, 40, 50, 65, and 67 and is offered in all standard IBM storage capacities and in enhancement capacities that provide up to twice the maximum main memory capacity supplied by IBM.

CMI memories can be used: (1) to replace all IBM main memory down to the minimum storage capacity specified for each IBM processing unit model (including complete removal of all IBM main memory in the 370/155 and 165 and the 360/65 and 67); (2) to extend the storage capacity of an existing System/370 or 360 installation where main memory has been purchased; or (3) in a combination of both these procedures.

CMI memories are completely compatible with IBM memory and require no software changes. Hardware

CHARACTERISTICS

MANUFACTURER: Cambridge Memories, Inc. (CMI), 12 Crosby Drive, Bedford, Massachusetts 01730. Telephone (617) 271-6300.

370/STOR MODELS: Five models designed for use with IBM System/370 Models 135, 145, 155, 158, and 165. Except for Model 135, each model is available in all standard IBM module capacities and in extended capacities. Model 135 is available in most IBM capacities.

360/CORE MODELS: Five models designed for use with IBM System/360 Models 22, 30, 40, 50, 65, and 67. Each model is available in all standard IBM module capacities and in extended capacities.

COMPATIBILITY: CMI 370/STOR and 360/CORE are designed as plug-compatible add-on or replacement memory units for IBM System/370 and System/360 computers, respectively. CMI memory can be used to extend the storage capacity of an existing IBM System/370 or 360 processing unit and/or to replace all storage down to the minimum mainframe capacity as specified for the particular IBM processing unit.

CMI memory combined with the mainframe storage capacity of an existing IBM processing unit provides the following range of standard and enhanced mainframe storage capacities:

CMI Memory Model	IBM Processing Unit	Minimum IBM Capacity, bytes	Standard IBM Capacities, bytes	CMI Enhanced Capacities, bytes
CC22	2022	24K	24K or 32K	64K
CC30	2030	8K or 16K	16K to 64K	96K to 1024K
CC40	2040	32K	32K to 256K	384K or 448K
CC50	2050	128K	128K to 512K	768K or 1024K
65*	2065/2067	0	256K to 1024K	1280K, 1536K, 1792K, or 2048K (plus up to 1 million bytes in 512K-byte increments).
135	3135	96K	196K to 512K	Up to 2048K
145**	3145	160K	160K to 2048K	3072K or 4096K
155*	3155	0	256K to 2048K	3072K or 4096K
158	3158	512K	512K to 4096K	None
165*	3165	0	512K to 3072K	4096K, 6144K, or 8192K

* All existing IBM memory can be replaced.

**Available in any combination of 148K-, 128K-, 256K-, and 512K-byte increments.

370/STOR CHARACTERISTICS: The 370/STOR 155 and 165 core memories are designed as direct replacements for IBM 3360 Processor Storage and contain up to 2048K bytes of storage per cabinet. One or two 2048K STOR/155 cabinets can be attached to an IBM 3155 Processing Unit to provide a maximum storage capacity of 4096K bytes. Two to four STOR/165 cabinets can be attached to an IBM 3165 Processing Unit to provide a maximum storage capacity of 8192K bytes. By contrast, IBM's 3360 Processor Storage

Cambridge Memories 370/STOR and 360/CORE Add-On Main Memory

changes, however, in varying levels of complexity, are required in cases where memory capacity is upgraded or enhanced, in special cases involving the combining of CMI memory with existing IBM memory on System/370 Models 155 and 165, and in cases where memory is accelerated on System/370 Models 155 and 165. CMI assures transparency for all of its installations and has received IBM certification for standard service continuance on its 370 and 360 product lines, including enhancements above the IBM standard limits.

CMI 370/STOR Model 155 memory is available with an accelerator feature. Billed as the Excellerator, the option consists of two separate and independent features: The Buffer Management System (BMS) and the Enhanced Storage Adaptor (ESA); both features can be implemented together or separately. The BMS feature doubles the number of addressable cache cells compared to the standard IBM cache. IBM's cache is divided into 256 32-byte cells; each cell is filled with 32 contiguous bytes of main memory requiring two 16-byte memory accesses. By contrast, the CMI cache is divided into 512 16-byte cells, each filled by means of a single main memory fetch of 16 contiguous bytes. According to CMI, the BMS feature increases throughput by 10 to 12 percent because of more effective use of the cache. CMI estimates that the IBM cache contains unused data about 15 percent of the time; i.e., the second 16-byte memory fetch does not correspond to an actual program memory reference. The ESA feature is a processor speed-up feature that accelerates the cycle time of memory for the 370/155 from 2070 to 1150 nanoseconds. Both features are contained in a separate controller (Buffer Control Unit) that contains two memory ports and is a replacement for IBM's Storage Adapter. The Excellerator is priced at $30,000; monthly maintenance costs $120.

CMI also offers 370/155 and 165 users the capability to replace defective memory (including IBM's) with spare memory, simply by turning a dial. Called Auxiliary Spares, the feature includes an additional 256K or 512K bytes of memory and is available for $6,600 to $22,950.

System/370 users running under the control of a virtual storage operating system that are using or considering the use of IBM's 2305 Fixed-Head Storage can look to CMI for an alternative. CMI now offers a high-speed paging device consisting of semiconductor memory. Designed as a replacement for IBM's 2305, CMI's Direct Access Storage Hierarchy (DASH) is firmware preformatted to either 2K- or 4K-byte page data sets for compatibility with DOS/VS, OS/VS1, OS/VS2, or VM/370. It appears to the System/370 channel and software as a 3330 disk. DASH is available in capacities ranging from 2.25 to 18 million bytes (4.5 million bytes per cabinet). Data transfer rate is 1.5 million bytes per second, and the access time is 0.5 to 1.5 milliseconds. CMI currently has two DASH installations and is installing three more units. The company says the product is best suited to Model 158 and 168 installations.

CMI provides substantial price breaks below the cost of equivalent IBM memory. For example, under a two-year lease, the 370/STOR 155 memory is priced 48 percent below the cost of equivalent IBM memory, while the 370/STOR 145 is priced 30 percent below IBM's pricing.

contains up to 512K bytes of storage; up to four units can be used with an IBM 3155 Processing Unit and up to six units can be used with an IBM 3165 Processing Unit to provide maximum storage capacities of 2048K bytes and 3072K bytes, respectively.

The 370/STOR 155 is composed of up to 64 32K-byte plugable core memory boards for units in excess of 1024K bytes or of up to 64 16K-byte memory boards for units with storage capacities of up to 1024K bytes. The 370/STOR 155 features 16 bytes of "bump" (auxiliary) storage per 1024 bytes of memory.

The 370/STOR 165 is composed of up to 64 32K-byte plugable core memory boards for units in excess of 2048K bytes or of up to 128 16K-byte memory boards for units up to 2048K bytes.

The 370/STOR 145 bipolar semiconductor memory is designed as replacement or add-on memory for an IBM 3145 Processing Unit. It provides a maximum storage capacity of 2048K bytes over two cabinets (1 megabyte per cabinet) and features total system transparency, multi-level error protection, and memory back-up capability. The transparency feature permits all CMI memory to be switched off-line so that normal IBM diagnostics can be run on IBM resident memory. The multi-level error protection feature provides automatic detection and correction of all single- or dual-bit errors; multi-bit error protection, which permits the failed memory sector to be switched off-line when a multi-bit error is detected (the remaining memory continues to operate at full capability); and storage protection (identical with that provided by IBM), which guards against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage via microprograms built into the 370/STOR 145. IBM, by contrast, offers a maximum storage capacity of 1024K bytes for the 370/145 via its own bipolar semiconductor memory.

360/CORE CHARACTERISTICS: The 360/CORE 65 is designed as a direct replacement for IBM 2365-2 Processor Storage and contains up to 1024K cabinets can be attached to an IBM 2065 or 2067-1 Processing Unit via a CMI I/O module (one per memory cabinet) to provide a maximum storage capacity of 2048K bytes. By contrast, IBM's 2365-2 Processor Storage contains 256K bytes of storage; up to four units can be used with an IBM 2065 or 2067-1 to provide a maximum storage capacity of 1024K bytes. The 360/CORE 65 is composed of up to 64 16K-byte plugable core memory boards.

Each 360/CORE memory unit, Models CC22 through CC50, can contain up to sixteen 8K-byte modules, for a total storage capacity of 128K bytes per unit. The 360/CORE modules are designed for 950-nanosecond operation, but their cycle times are reduced to conform with the operating speeds of the IBM processing units. These memories also include "bump" storage, a second or auxiliary core memory that enables the System/360 computer to use multiplexer channels to address peripherals in the same manner as with the equivalent IBM memories.

Cycle times of the CMI memories are the same as those of the corresponding IBM System/370 or 360 memories.

Physical specifications and maximum power requirements for each of the System/370 and System/360 memory cabinets are presented below.

CMI Memory Model	Max. Storage per Cabinet, bytes	Cabinet Size: Height, inches	Width, inches	Depth, inches	Max. Weight, lbs.	Max. Heat Dissipation, BTU/hr.
STOR 158	3072K	60	62.5	32.5	2,200	–
STOR 155/165	2048K	60	60	30	1,350	38,000
STOR 145	1024K	60	62	31.5	1,880	45,800
STOR 135	512K	60	27	33	500	–
CORE 65	1024K	60	60	31.5	1,350	19,000
I/O Enclosure*	–	72	31.5	31.5	450	–

Cambridge Memories 370/STOR and 360/CORE Add-On Main Memory

CMI also provides substantial savings in floor space with its 370/STOR 145, 155, and 165 memory and with its 360/CORE 65. For example, CMI's 370/STOR 155 provides the storage capacity of four IBM 3360 memory cabinets, and CMI's 360/CORE 65 unit provides the storage capacity of four IBM 2365 memory cabinets.

CMI installs its own memory through its nationwide network of 18 service centers located in major U.S. cities. Supporting service is provided by independent service organization, including Comma, Sorbus, and Honeywell.

First production deliveries of CMI 370/STOR memories were as follows: Model 165, July 1973; Model 155, October 1972; and Model 145, November 1973. First production deliveries of CMI 360/CORE memories were: Model 22, June 1972; Model 30, July 1971; Model 40, May 1971; Model 50, May 1972; and Model 65, November 1972. CMI currently has about 4 billion bytes of 360/CORE and 370/STOR installed. First production deliveries of 370/STOR for Model 158 are scheduled for the third quarter of 1975, while deliveries for the Model 135 are scheduled for the fourth quarter of 1975.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 27 users reported on their experience with a total of 33 CMI replacement memories. These were divided among System/370 Models 145 (5), 155 (5), and 165 (2); and System/360 Models 30 (13), 40 (4), and 50 (4). The System/370 models had an aggregate capacity of 9472K bytes, while the System/360 models had an aggregate of 2992K bytes, for a combined total capacity of 12,464K bytes. The users' ratings of the CMI memories are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	21	4	2	0	3.7
Equipment reliability	18	7	2	0	3.6
Maintenance service**	13	11	3	0	3.4
Ease of installation	14	6	6	1	3.2

* Weighted Average on a scale of 4.0 for Excellent.
**Serviced by Comma, Sorbus, and Honeywell.

These high scores for CMI memory and its support (including that of Comma, Sorbus, and Honeywell) clearly indicate the users' high regard for CMI memory as a cost/effective alternative to IBM memory that merits serious consideration by other prospective users. Average installation and testing time was reported as 17 hours (2 days), with individual times ranging from 1.5 to 60 hours. Only 6 users reported serious problems during installation and testing (5 were S/370 memories), and only two users (both S/360's) reported serious problems in obtaining service. With this excellent record, the CMI add-on memory will undoubtedly continue to be a successful product for its vendor.□

CMI Memory Model	Max. Storage per Cabinet, bytes	Cabinet Size: Height, inches	Width, inches	Depth, inches	Max. Weight, lbs.	Max. Heat Dissipation, BTU/hr.
CORE CC22-CC50:						
Lowboy module	128K	29.5	34	28	275	3,200
Highboy module**	256K	60	34	28	550	6,400

* One required with each CORE 65 cabinet.
**Lowboy modules stacked two-high; modules can also be configured in a side-by-side arrangement or in a combination of both side-by-side and stacked arrangements when memory capacity exceeds 256K bytes.

The 360/CORE Models CC22 through CC50 are powered from either a 115-volt or 220-volt single-phase dedicated power source. The 360/CORE 65 and 370/STOR memories are powered from a 208- or 220-volt, 4-wire, 3-phase dedicated power source.

Each CMI memory contains an integral power supply that satisfies the memory power requirements and diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode.

PRICING: The CMI add-on memories are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. CMI provides lease contracts for one, two, three, four, and five years. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage, and full-coverage maintenance (24-hours/day, 7-days/week). A separate maintenance contract is available for purchased units.

Module Capacity, bytes	Rental, 2-Year Lease*	Purchase	Monthly Maintenance**
370/STOR Model 135			
96K	$ 1,560	$ 57,000	$ 120
112K	1,825	65,000	150
128K	1,590	72,300	170
144K	2,340	79,200	198
160K	2,600	83,200	185
176K	2,370	86,300	210
192K	2,130	88,400	235
224K	3,150	98,560	245
240K	2,910	100,800	270
256K	2,175	102,400	245
272K	2,440	103,400	320
288K	3,690	103,700	310
320K	3,220	108,800	360
368K	14,000	117,760	395
416K	4,780	124,800	430
370/STOR Model 145			
128K	1,095	55,400	110
256K	2,225	97,400	215
384K	3,220	325,000	512
512K	4,158	181,400	430
640K	5,120	224,000	540
768K	6,065	256,400	650
896K	6,960	304,700	755
1024K	7,860	344,000	865
1152K	8,820	386,000	970
1280K	9,770	427,500	1,080
1408K	10,715	468,900	1,190
1536K	11,650	510,000	1,250
1664K	12,585	550,800	1,330
1792K	13,550	593,150	1,410
370/STOR Model 155			
512K	3,750	115,000	625
765K	5,740	154,000	785
1024K	7,470	191,000	940
1536K	10,960	262,000	1,255
2048K	13,900	333,000	1,565
3072K	21,420	511,000	1,880
4096K	27,300	658,000	2,190
370/STOR Model 158			
512K	2,290	80,000	85
1024K	4,575	155,000	155

Cambridge Memories 370/STOR and 360/CORE
Add-On Main Memory

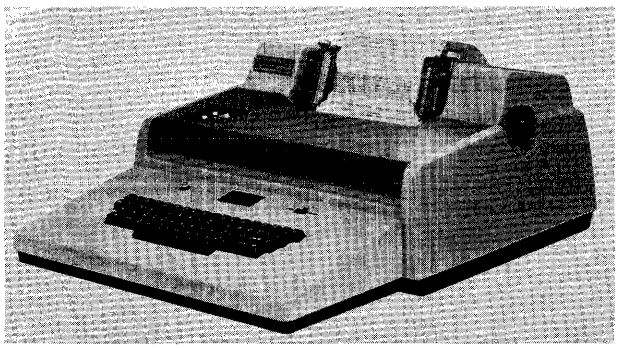
Module Capacity, bytes	Rental, 2-Year Lease*	Purchase	Monthly Maintenance**
1536K	$ 6,865	$ 230,000	$ 225
2048K	9,330	305,000	390
2560K	12,310	380,000	555
3072K	13,900	460,000	635
3584K	16,890	535,000	710
370/STOR Model 165			
512K	3,950	172,000	625
1024K	7,740	230,000	940
1536K	11,610	308,000	1,255
2048K	14,600	382,000	1,565
3074K	21,420	511,000	1,880
4096K	27,300	658,000	2,190
360/CORE Models 65 and 67			
256K	3,185	72,600	315
512K	4,580	104,500	625
768K	6,000	136,950	785
1024K	7,425	169,400	940
1536K	12,025	274,175	1,250
2048K	14,850	338,800	1,565
360/CORE Models 22, 30, 40, & 50* **			
32K	450	12,500	42
32KE***	530	14,750	42
40K	600	16,500	57
48K	675	18,500	65
64K	830	22,500	70
80K	$ 975	$ 26,500	$ 95
88K	1,130	29,000	100
96K	1,125	30,500	105
112K	1,170	31,750	110
128K	1,195	32,500	115
192K	1,800	48,500	155
224K	2,070	56,500	180
256K	2,225	60,500	195
384K	3,350	90,500	245
512K	4,100	112,500	325
768K	6,125	168,500	455
1024K	7,600	208,500	560
360/CORE Model 30 Transparent			
32K	583	16,225	42
48K	743	20,350	65
64K	913	24,750	70
96K	1,237	33,550	105
128K	1,314	35,750	115
192K	1,980	53,350	155
256K	2,447	66,550	195

* Monthly rental includes maintenance for 24 hours/day, 7 days/week.

** Monthly maintenance for 24 hours/day, 7 days/week.

***Does not include all available capacities; 32KE extends the Model 30 from 64K to 96K bytes.■

Centronics Serial Printers



Introduced in November 1973, the Model 308 is the first teleprinter produced by Centronics. The buffered unit prints 80-character lines at 120 cps and is equipped with a detachable keyboard similar to that of the Teletype Model 37.

Centronics has built a solid reputation as a manufacturer of high-quality serial printers. Its broad line of seven models includes two recently announced members: the 308, a 120-cps teleprinter; and the 500, a low-cost, 100-cps printer that features LSI electronics.

MANAGEMENT SUMMARY

In the six years since its inception, Centronics has become one of the industry's leading manufacturers of high-speed, serial impact printers. The firm has built a strong reputation as an OEM supplier of serial printers, as witnessed by the proliferation of Centronics printers among the communications terminals and computer subsystems offered by end-user vendors. It was not until the second quarter of 1973 that Centronics introduced a lease plan to entice end users.

Centronics' growing family of serial printers began with the 100 Series. Production deliveries of Model 101, the initial member, began in March 1971. It was followed in December 1971 by the more sophisticated Model 101A, which includes additional features. In 1972, Centronics introduced the Model 102A, a high-speed version of the 101 that operates at twice the 101's printing speed through the use of twin printing assemblies that print in unison. Production deliveries of the Model 102A began during the third quarter of 1972. Centronics began deliveries of its 101AL in March 1973. The 101AL is a newer version of the 101A that employs large-scale integrated circuit technology for buffering and control.

Centronics introduced its 300 Series printers in early 1973. The Model 306, an 80-column, 100-cps printer, began production deliveries in March 1973. Model 308, the latest member of the 300 Series, was introduced in November 1973 and is scheduled for deliveries in March 1974. The 308, a keyboard/printer with a printing speed of 120 characters per second, is Centronics' initial offering to the teleprinter market. The 308 is equipped with a detachable keyboard, features selectable double-width printing, and contains a 133-character print buffer. Its 120-cps printing rate and low purchase price of just under $3,000 (with RS-232 interface) makes it an attractive contender for the huge teleprinter market.

CHARACTERISTICS

MANUFACTURER: Centronics Data Computer Corporation, One Wall Street, Hudson, New Hampshire 03051. Telephone (603) 883-0111.

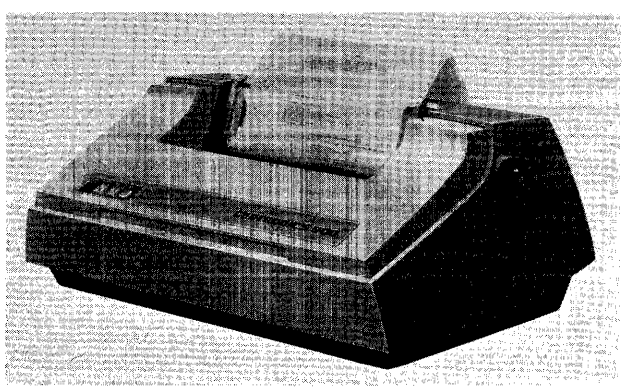
MODELS: Seven printer models, including the 100 Series printers, Models 101, 101A, 101AL (an LSI version of the 101A), and 102A; the 300 Series, Models 306 and 308; and the Model 500. All models except the Model 308 are printer-only units; Model 308 is available as a keyboard/printer or a printer-only unit. The key characteristics of each model are presented in the accompanying table.

COMMUNICATIONS: Three communications interfaces are available as options for the Centronics family of page printers: the RS-232 Interface, the Communications Adapter, and the Pollable Communications Interface. All three communications interfaces operate asynchronously in the half- or full-duplex mode using 10- or 11-unit, 8-level ASCII code (including parity). The data-rate capability is 110 to 9600 bits/second for the RS-232 Interface, 110 to 4800 bits/second for the Communications Adapter, and 110 to 2400 bits/second for the Pollable Interface.

The RS-232 Interface contains a single-character buffer and provides a reverse-channel acknowledgement for detected parity errors.

The Communications Adapter contains buffer storage for 512 or 1024 characters, operates in a blocked or unblocked mode, and responds to received messages via reverse-channel or ACK/NAK message acknowledgment.

The Pollable Communications Interface contains buffer storage for 256 characters, operates in a blocked mode with ACK/NAK message acknowledgment, and responds to a received addressing or polling sequence.



Model 500, announced in December 1973, is the latest and lowest-priced 132-column printer in the expanding Centronics product line. It features LSI electronics on a single printed-circuit board and prints 100 characters per second in a 5-by-7 dot matrix.

Centronics Serial Printers

CHARACTERISTICS OF THE CENTRONICS PRINTERS

MODEL	500	308*	306	102A	101A/101AL	101
Printing technique	Impact, matrix	Impact, matrix	Impact, matrix	Impact, matrix	Impact, matrix	Impact, matrix
Serial print rate	100 cps	120 cps	100 cps	330 cps	165 cps	165 cps
Equivalent lines/min.–						
Full lines	40 lpm	72 lpm	60 lpm	125 lpm	60 lpm	60 lpm
30-char. lines	150 lpm	180 lpm	150 lpm	125 lpm	200 lpm	200 lpm
Print positions	132	80	80	132	132	132
Character set, chars.	64; 128 opt.	64; 128 opt	64; 128 opt.	64; 128 opt.	64; 128 opt.	64
Lower-case alphabetics	Opt. or upper-case equivalent	Opt. or upper-case equivalent	Opt. or upper-case equivalent	Opt. or upper-case equivalent	Opt. or upper-case equivalent	Opt. or upper-case equivalent
Character matrix size–						
Standard, dots	5 by 7	5 by 7	5 by 7	9 by 7	9 by 7	5 by 7
Optional, dots	9 by 7	9 by 7	9 by 7	–	–	–
Double-width chars.–						
Full line	Std.	–	Std.	Std.	Std.	Std.
Selectable	Opt.	Std.	Opt.	–	Opt.	–
Character spacing–						
Horizontal, char/inch	10	10	10	10	10	10
Vertical, lines/inch	6	6	6	6	6	6
Forms feed	Sprocket	Sprocket	Sprocket	Sprocket	Sprocket	Sprocket
Forms width, inches	Up to 14-7/8	Up to 9-1/2	Up to 9-1/2	Up to 14-7/8	Up to 14-7/8	Up to 14-7/8
Vertical formatting	Opt.	Opt.	Opt.	Std.	Std.	Std.
Printed copies	5	5	5	5	5	5
Line buffer, chars.	132	133	80	132	132	132
Serial interface, RS-232	Opt.	Opt.	Opt.	Opt.	Opt.	Opt.
Character code	ASCII; EBCDIC opt.	ASCII; EBCDIC opt.	ASCII; EBCDIC opt.	ASCII; EBCDIC opt.	ASCII; EBCDIC opt.	ASCII; EBCDIC opt.
Data rate–						
Parallel, char/sec	Up to 75,000	Up to 75,000	Up to 75,000	Up to 75,000	Up to 75,000	Up to 75,000
Serial, bits/sec	110 to 9600	110 to 9600	110 to 9600	110 to 9600	110 to 9600	110 to 9600

* Model 308 is a teleprinter with removable keyboard.

Centronics unveiled the initial member of its 500 series printers in December 1973. Designated the Model 500, the printer is rated at 100 cps, provides 132 print positions, and features large-scale integration (a single board contains all circuitry).

The wire-matrix technology common to all Centronics printers has proved to be a big success for the company, which has delivered over 20,000 units to date. The key advantage offered by the wire-matrix technique over other impact printing techniques is low-cost serial printing at fairly high speeds. The key disadvantage is decreased legibility as compared with good full-character printing. The Centronics printers share the spotlight with a few competitive units as the industry's fastest wire-matrix printers.

In spite of the decreased print legibility inherent with matrix printing, printed copy produced by the Centronics printers generally exhibits a high degree of clarity. And the bold-face, double-width characters that characterize the output of the Centronics printers provide an added dimension of flexibility. According to Centronics, print head wear (a potential drawback of the wire-matrix technique) is not a problem and print heads seldom require replacement.

Double-width (elongated) characters can be produced on a full-line basis as a standard feature of all Centronics

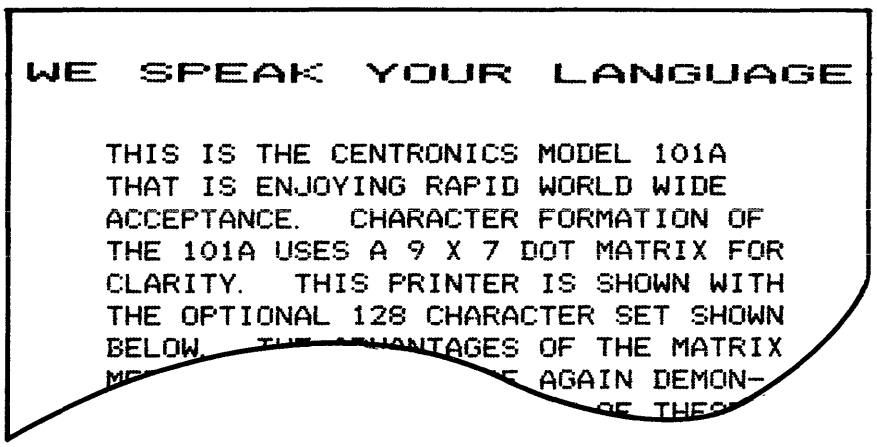
Each of the three communications interfaces contains an EIA Standard RS-232C interface and connects to a voice-grade communications facility via a modem. The following table shows the relationship between transmission speed and modem type; although Bell System modems are shown, equivalent modems from independent manufacturers can be used.

Transmission Rate	Bell System Modem
Up to 300 bps	103A/E/F; 113A/B
Up to 1800 bps	202C/D/E/R
2000 bps	201A
2400 bps	201B/C
4800 bps	208A/B
7200 bps	203A
9600 bps	203A

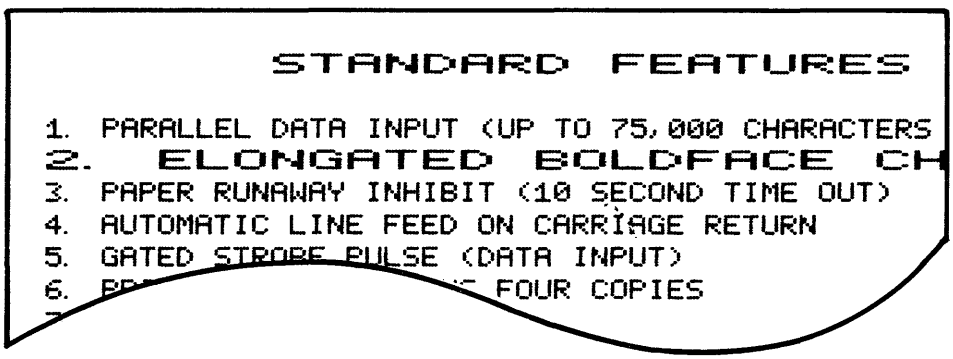
DEVICE CONTROL: The Centronics printers feature serial impact printing via the wire-matrix method of character formation and range in speed from 100 to 330 characters per second. All printer models contain a line buffer, which receives data directly from an 8-level parallel interface, standard for all models. Serial and special interfaces are available as options and attach directly to the parallel interface. Printing is performed from the line buffer and is initiated when the buffer is full or a Carriage Return character is received. An automatic line feed is initiated at the end of each printed line.

Vertical Format Control, a standard feature of the 100 Series printers, is implemented via a punched paper tape loop. The feature controls vertical tabulation and forms feed.

Centronics Serial Printers



An actual-size example of copy produced on the Centronics Model 101A printer. Note the clarity of its standard 9-by-7 dot matrix and the capability to produce double-width bold-face characters.



An actual-size example of copy produced on the Centronics Model 306 printer. The 306 can also print double-width characters. Characters are formed via a 5-by-7 dot matrix; 9-by-7 matrix is optional.

printers except the 308, which can produce double-width characters interspersed with standard-width characters. This feature, standard with the 308, is optional for the other models.

Centronics printers are equipped with a parallel interface that accepts data at a rate of up to 75,000 characters per second. Received data is transferred to a line buffer for printing. As an option, Centronics offers serial communications interfaces designed for compatibility with EIA Standard RS-232, as well as a broad variety of interfaces designed for minicomputers produced by the more prominent vendors.

Centronics gets its print mechanisms from Brother Industries, Ltd., Nagoya, Japan, which produces the mechanisms according to Centronics specifications. Brother is one of the world's major producers of sewing machines, typewriters, knitting machines, and numerous other industrial and consumer-related products.

Centronics provides its own service through a nationwide field service organization with over 40 service locations throughout the U.S.

USER REACTION

Datapro has interviewed numerous users of remote terminals that employ Centronics printers. In general,

Horizontal tabulation, an optional feature for the 308 only, permits tabs to be set at every print position. Horizontal tabs can be set or cleared remotely, through received control codes, or locally from the keyboard.

Automatic Motor Control, a standard feature of the 102A only (optional for all other models), connects power to the printer's motor when data or a paper-feed command is received, and disconnects the power when the commands are absent for any 9-second period.

The Audible Alarm feature, standard for the 100 Series printers and optional for all other models, alerts the operator to special conditions that require operator intervention, such as "out of paper."

The EBCDIC/ASCII Converter (optional for all models) translates received EBCDIC-coded characters to the ASCII code which is recognized by the printer.

PRINTED OUTPUT: The Centronics printers produce printed copy via the impact dot-matrix technique. The print mechanism is composed of a print head containing a column of 7 pins (or print wires) and 7 corresponding print solenoids arranged radially around the print head. When printing, the print mechanism moves across the paper on a "gun" carriage. Printing is performed by selectively impulsing the solenoids, thereby driving the wires against the ribbon, paper, and platen at 5 successive intervals to form a character 5 dots wide by 7 dots high.

In a 9-by-7 dot matrix, each character is formed within 9 columns of dots spaced at intervals half those of the 5-by-7 dot matrix to provide increased resolution; overall matrix width remains the same. Each character is formed by a combination of 5 of the 9 columns.

Centronics Serial Printers

> users are well satisfied with the overall performance and reliability of these printers. The widespread use of and satisfaction with the Centronics printers forms the basis for the excellent reputation the company has earned in the serial printer industry. □

➤ All current Centronics printers except the Model 102A incorporate a single printer mechanism that moves across the entire width of the paper. The Model 102A contains two print mechanisms that move in unison, bi-directionally across the paper, each printing one half of the paper. The 102A's bi-directional printing capability precludes the necessity for carriage returns.

Printed copy is produced at speeds ranging from 100 to 330 char/second, depending on the printer model, with resulting line speeds of 40 to 125 lines/minute for a full 80- or 132-character line or up to 200 lines/minute for a short line consisting of just 20 to 30 characters.

The standard character set for all current models consists of 64 print symbols, including upper-case alphabetics, numerics, and specials. Received lower-case alphabetic codes are printed as their upper-case equivalents. A 128-character set of user-specified print symbols is optional on some models.

Each character is formed by a 5-by-7 or 9-by-7 dot matrix. (The 9-by-7 matrix is optional on some models and standard on others.) Nominal character size is 0.100 inch high by 0.080 inch wide. As a standard feature, all models can produce elongated boldface (double-width) characters on a line-by-line basis. Selectable single-character elongation is standard on the 306 and optional on three other models.

Adjustable tractor feed is a standard feature for all models and accommodates continuous, 5-part, sprocket-fed forms from 4 to 9-1/2 or 14-7/8 inches wide, depending on the model.

Vertical format control, optional for most models, is implemented by means of a paper pape loop, which terminates vertical tabulation and forms feed functions.

Horizontal tabulation, optional for Model 308 only, includes both tab set and clear functions.

KEYBOARD (Model 308 only): The 66-key, "Teletype 37-style" keyboard is detachable and can produce any of 128 ASCII characters, including upper and lower case alphabetics, numerics, specials, and control codes. The keyboard includes keys for Here Is, Break, Tab, New Line, Repeat, Backspace, Line Feed, and Carriage Return control functions.

SPECIAL INTERFACES: Besides the optional serial communications interfaces described under COMMUNICATIONS, Centronics offers a line of special interfaces primarily designed for minicomputers produced by the more prominent manufacturers such as Digital Equipment Corporation (DEC), Honeywell, and Varian. Centronics also provides a controller that interfaces two Centronics printers (any models) to the IBM System/7, and an interface for the UNIVAC Uniscope 100 CRT Terminal that can accommodate up to eight Centronics 100 Series printers.

PRICING: The Centronics printers are available for purchase or lease. Lease terms are available for 1, 2, 3, 4, or 5 years and include prime-shift maintenance. Conversion from lease to purchase is available after the first year through a purchase credit option, which provides a purchase credit of 70 percent of the total lease payments for each year of lease. Short-term rentals of 30 or 60 days are also available. A maintenance contract is available for purchased units.

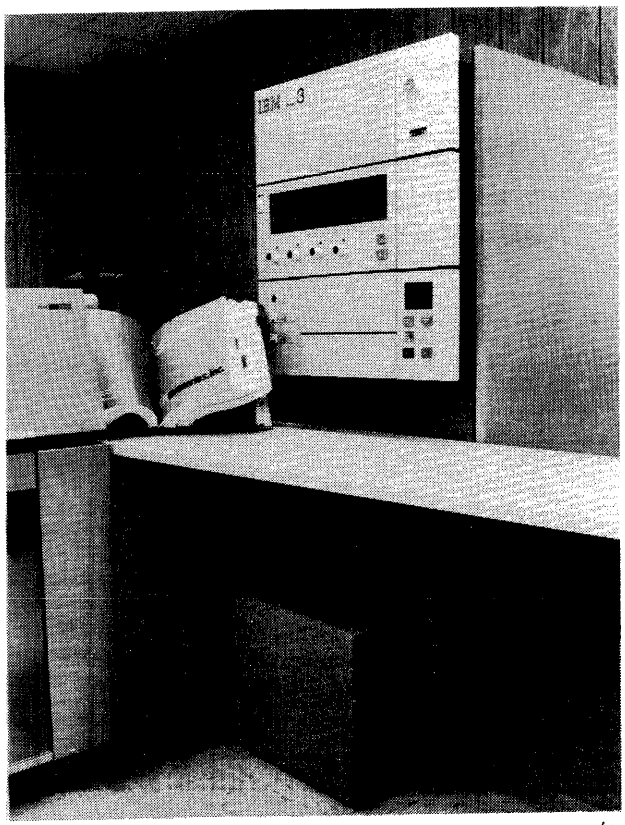
Printer Model*	Monthly Rental** 1-Year Lease***	3-Year Lease	Purchase	Monthly Maint.
101	$302	$190	$4,295	$44
101A	314	198	4,490	44
101AL	308	194	4,390	44
102A	347	218	4,975	48
306	233	115	2,350	32
308 (teleprinter)	NA	NA	NA	NA
500	198	117	2,995	NA

* Printers are priced with an RS-232C communications interface but do not include options. Pricing for options is available by request to Centronics.

** Monthly rental includes prime-shift maintenance except for Models 308 and 500, for which maintenance costs have not yet been established.

*** Monthly rental is reduced by 33 percent for leases extended to a second 12-month period. ■

CFI Memories S/3 MOSFET Memory for IBM System/3



The small box at bottom center holds up to 56K bytes of CFI S/3 semiconductor memory and fits beneath the System/3 operator console.

CFI's S/3 semiconductor memory, designed as replacement memory for IBM System/3 Model 6 and 10 computers, is available in 8K-byte increments up to 56K bytes. It can provide an enhanced main storage capacity of up to 64K bytes for the Model 10. Users assign high marks to the CFI memory.

MANAGEMENT SUMMARY

CFI Memories, Inc. manufactures semiconductor replacement memory for the IBM System/3 market. The CFI memories employ MOS technology and can be used to extend the existing storage capacity of a System/3 installation or to replace all IBM main memory down to the 8K-byte minimum mainframe capacity of the System/3 Model 6 and 10 computers.

CFI Memories offers its S/3 memory in 8K-byte increments up to 56K bytes to match the standard IBM capacities and also provide enhanced main memory capacities up to 64K bytes–or 1.33 times the IBM-imposed maximum main storage capacity of 48K bytes for the System/3 Model 10.

The CFI S/3 memory is equipped with an integral power supply to satisfy its own power requirements, and it plugs into the System/3 to permit system control. The memory is designed to provide total systems transparency.

The CFI S/3's small physical size permits it to occupy an otherwise unused space beneath the System/3 operator console, as shown in the photograph. A single cabinet can contain up to 56K bytes.

CHARACTERISTICS

MANUFACTURER: CFI Memories, Inc. (a subsidiary of Lencor International), 305 Crescent Way, Anaheim, California 92801. Telephone (714) 776-8571 or (800) 854-3290 (toll-free).

COMPATIBILITY: The CFI S/3 MOSFET Memory is designed as a plug-compatible add-on or replacement semiconductor memory for IBM System/3 Model 6 and 10 computers. The CFI S/3 memory can be used to extend the existing storage capacity of an IBM System/3 and/or to replace all storage down to the minimum mainframe capacity of the System/3 Model 6 and 10 computers–8K bytes.

The CFI S/3 memory is available in 8K-byte increments and provides the following range of standard and enhanced main storage capacities:

IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	Enhanced CFI Capacities, bytes
5406	8K	8K or 16K	–
5410	8K	8K to 48K	56K or 64K*

*Available from IBM as an RPQ.

The effective cycle time of the CFI S/3 memory is the same as that of the corresponding IBM memory–1.52 microseconds per 1-byte fetch.

The CFI S/3 memory contains up to 56K bytes of semiconductor storage in a single cabinet that measures 14.5 inches wide by 6 inches deep by 17 inches high. It weighs 25 pounds for the initial 8K bytes plus 1 pound for each additional 8K bytes of memory, for a maximum weight of 31 pounds. The CFI memory contains its own power supply and is powered via a 115-volt CPU-switched ac outlet on the System/3. Total power required for 56K bytes of semiconductor storage is 100 watts. The CFI S/3 memory fits into the physical space beneath the System/3's operator console.

Each memory card provides 8K bytes of storage and is constructed from 72 MOSFET storage devices, each storing 1024 bits to total 8192 bytes, plus 32 MOSFET devices that perform error detection and correction.

The CFI S/3 memory performs electronic error detection and single-bit error correction. The memory unit generates five error detection/correction bits for each 9-bit byte (including parity). The IBM System/3 Models 6 and 10 do not provide this feature.

PRICING: The CFI S/3 memory is available for purchase or lease. CFI offers short-term lease plans for 30 days to 6

CFI Memories S/3 MOSFET Memory for IBM System/3

CFI introduced its S/3 memory in September 1973, and production deliveries began in January 1974. CFI had 125 units installed at this writing.

The CFI memories are installed and serviced by Sorbus, Inc., a nationwide service organization with over 90 service locations in major U.S. cities.

CFI Memories prices its S/3 memory well below IBM's price for equivalent storage. The CFI S/3 memory rents for 30 to 40 percent below and sells for about 26 percent below IBM's rental and purchase prices. Extended lease terms provide further dollar savings.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, five users reported on their experience with a total of five CFI replacement memories having an aggregate capacity of 64K bytes. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	5	0	0	0	4.0
Equipment reliability	3	1	0	0	3.8
Maintenance service**	3	1	0	0	3.8
Ease of installation	2	2	0	0	3.5

* Weighted Average on a scale of 4.0 for Excellent.
**Service provided by Sorbus.

These high scores for the CFI memory and for CFI's support (including Sorbus) clearly express the feeling of these users that the CFI memory is an excellent, cost/effective alternative to IBM's own System/3 memory. Thus, it clearly merits serious consideration by other prospective users. Installation and testing time was typically reported as between 15 minutes and 2 hours, although one user reported a surprisingly long 8 hours. Only one user experienced a serious problem in the diagnosis of malfunctions, which he said was performed on a "trial and error basis" and cost him much time.

If CFI can satisfy all of its customers as well as it has these five, its MOSFET memory should continue to be a successful product for the company. □

months and extended lease plans of up to 3 years. Lease rates include installation, diagnostic performance checks, unlimited usage, and complete 24-hr/day, 7-day/week service. A separate maintenance contract is available for purchased units.

IBM Processor Conversion	Monthly Rental* 30-Day Rental	1-Year Lease	2-Year Lease	Purchase	Monthly Maint.**
From 8K to:					
12K	***	***	***	***	–
16K	$170	$165	$160	$ 5,700	$25; 50
24K	345	325	310	10,500	25; 50
32K	530	510	495	14,800	25; 50
48K	775	770	765	24,500	40; 64
64K	995	970	945	34,000	40; 64
From 16K to:					
24K	185	175	160	5,700	25; 50
32K	370	345	320	10,500	25; 50
48K	610	570	525	20,000	40; 64
64K	865	800	740	28,700	40; 64
From 24K to:					
32K	180	170	155	5,700	25; 50
48K	420	390	360	14,800	40; 64
64K	675	625	580	24,500	40; 64
From 32K to:					
48K	240	225	210	10,500	40; 64
64K	490	460	425	20,000	40; 64
From 48K to:					
64K	200	200	200	10,500	40; 64

* Includes maintenance for 24 hours/day, 7 days/week. Monthly rental under a three-year lease is priced 8 to 13 percent below that for 30-day rental.

** Prime-shift maintenance for 9 hours/day, 5 days/week (1st column); and complete maintenance for 24 hours/day, 7 days/week (2nd column).

***Available from IBM only.■

Codon CB-100 Intelligent Terminal

MANAGEMENT SUMMARY

The significance of the Codon CB-100 Intelligent Terminal and systems of its type is that minicomputer systems today are so powerful that they can be used for much more than data entry. Naturally, data entry is a vast field in itself and offers many opportunities for employing minicomputers to expand throughput and save substantial sums of money. But the Codon system goes considerably farther by handling the processing and organization of far-reaching categories of data that concern the management of a distribution center. Of this host of activities, data entry is but one element.

Consider an activity structured in the following way: a receiving/shipping dock, a warehouse, an order entry activity, and an inquiry center. New items come in and have to be stored; administration must know how many items were received and where they are kept. Orders are received and shipments must be made; administration must know the items involved, their identification and amounts, their destination, and the revised inventory after shipment is made. The facility must maintain accounts receivable records. It must know the credit rating of customers. It must place orders and enter confirmations. It must keep a back order record file. And then there is the mountain of accounting paper work that must be printed. There are monthly statements, cash receipts reports, inventories, accounts receivable reports, audit trails, inventory listings, picking lists, etc.

Obviously, a tremendous library of program formats and application routines, as well as system executive

This system of up to 12 CRT data terminals, a minicomputer, disk drives, printers, comprehensive software, and communications options is capable of providing total information management for a distribution activity. Individual functions of the system include data entry, multiprogram processing, inventory control, sales analysis, invoicing, account posting, and inquiry.

CHARACTERISTICS

MANUFACTURER: Codon Corporation, 11 De Angelo Drive, Bedford, Massachusetts 01730. Telephone (617) 275-2000.

CONFIGURATION

A Codon Distribution Management System consists basically of up to 12 Video Data Terminals, a minicomputer processor, a disk controller and dual-disk drive, a communications controller, and one or more of several printer options. Many configurations also include a magnetic tape drive, but many others do not, especially those stressing communications.

VIDEO DATA TERMINAL: Combines a typewriter-style keyboard, supplemented by a 10-digit pad to speed numeric data entry, and a CRT display that holds 20 lines containing up to 80 characters per line. The keyboard implements a set of 64 alphanumeric characters and various system functions, such as duplication, skipping, operating mode selection, various override functions, format call-up, zero fill, blank fill, etc.

The human side of CB-100 activity takes place primarily at the Video Data Terminals where clerks key in data and observe system messages on the screen. Not shown are the various printers, which also provide important system output, or the minicomputer processor and disk drives.

Codon CB-100 Intelligent Terminal

programming, must be created and stored in both the processor and on a disk file for the control and operation of such a facility. Although no heavy data processing, such as the kind associated with large computer mainframes, need be executed on the site, many computations involved in accumulations, totaling, and balancing must be routinely performed. The Digital Equipment PDP-8/E minicomputer used in the Codon system is equal to this challenge.

Referring again to the distribution center previously described, a Video Data Terminal can be installed in the receiving/shipping section, another can be installed in the warehouse, one or two can be situated in a sales/inquiry station, and two or three can be operating in the order entry department. All of the terminals funnel information to the central processor, or minicomputer; and it, in turn, manipulates the data, stores information on the disk file, or recalls information from it. A communications link can be established between the central processor and the central processors of other distribution centers, or between the central processor and a headquarters MIS facility. Except when certain high-powered calculations must be made by a large, centrally located computer, transmissions serve for the purpose of exchanging information necessary to the operation of the various distribution centers. The Codon system, therefore, is essentially a stand-alone operation that enables the distribution center to function entirely with its own on-site facilities. It no longer has to be linked to a shared central or regional system.

A system of this kind requires a CRT display capable of presenting detailed information; accordingly, 20 lines with up to 80 characters per line can be displayed. The characters are 0.15 inch high by 0.10 inch wide to make reading easy. Characters are formed at the rate of 120 per second. Page roll, or scrolling, is provided so that the operator can refer back to preceeding entries. Formats are displayed in detail, and the system requests the categories of needed data at the proper time; this is known as conversational, or interactive, data entry.

The keyboard resembles a typewriter, with a 10-digit pad to the side to speed numeric data entry. An audible error signal and an Escape key that returns the transaction to a convenient starting point while cancelling the transaction just preceding are two features that facilitate high-speed input. Hence, an order can be cancelled in the middle of an entry operation and then restarted. Persons who use the keyboard do not need keypunch experience. Indeed, they are usually regarded as clerks rather than operators.

A number of printer options are available with the Codon system. Each printer is geared to specific printing requirements, such as printing picking lists, packing labels, shipping documents, invoices, monthly statements, and management reports. One or more printers may be needed in a particular installation.

The 80-line CRT display presents keyed data, system messages, running-total counters, and instructions to the operator when questioned. After the 20th line is completed, the page on the display screen starts to "roll" upward, enabling the operator to refer back to prior lines. Interactive dialogue between the operator and the system is a feature of this terminal.

CENTRAL PROCESSOR: The system's central component is a DEC PDP-8/E minicomputer that has from 4K to 64K bytes of core storage capacity and a 1-microsecond cycle time. In a typical system configuration it contains 24,576 bytes. Some helpful additional features are memory protect, a key-lock feature to improve security, 8 auto-index registers, a hardware bootstrap loader for automatic system start-up, and a link feature for multiple-precision arithmetic.

DISK DRIVE: The basic system can include from one to four Diablo Model 33 drives with a data storage capacity of 6.4 million bytes each, for a total of 25.6 million bytes (or 51.2 million bytes with an additional controller). Each disk drive contains one fixed disk and one removable disk pack. Each removable pack is permanently enclosed to prevent damage or contamination. The average access time for a track-to-track seek is 35 milliseconds.

MAGNETIC TAPE DRIVE: Can be ordered specially for use where industry-compatible magnetic tape is required as a system output. Any tape drive compatible with the DEC PDP-8/E minicomputer is acceptable.

ON-LINE PRINTERS: Printers with the following basic characteristics are available: 1100 lines/minute with 132 character positions (makes up to 6 copies); 350 lines/minute with 80 character positions (makes 7 copies); 250 lines/minute with 132 character positions (makes 7 copies); 100 lines/minute with 100 character positions (makes 6 copies); 75 lines/minute with 132 character positions (makes 6 copies); 20 lines/minute with 80 character positions (makes 3 copies); and 8 lines/minute with 80 character positions (makes 7 copies).

COMMUNICATIONS CONTROLLERS: Codon supplies suitable interfaces for various communications as described under System Operation, below.

SYSTEM OUTPUT

- Displays – System messages, inquiry replies, and operator prompting messages are displayed on the Video Data Terminal screens.
- Printed output – Various messages, reports, and documents are produced on one or more printers.
- Communications – Disk-to-disk transmission and exchange of data among CB-100 installations, or transmission of data from disk to computers or terminals employing BSC protocol.
- IBM-compatible tape when desired – The standard record length in the system is 127 characters, but can be less; longer records are formed by joining part or all of a 127-character segment to another. If one disk drive is employed, 51,200 127-character data records can be stored.

SOFTWARE

The extensive software of the CB-100 is divided into an operating system, two language processors, a sort/merge

Codon CB-100 Intelligent Terminal

The disk I/O software permits random and sequential access to disk files, as well direct access by record number. Temporary and/or newly added records can be accessed directly. Space allocated for files can be adjusted automatically by means of the File Allocation program. A full set of diagnostics and utilities is furnished.

SOFTWARE

Software for the CB-100 terminal has a number of noteworthy attributes.

First, Codon states that it will adapt and dedicate its general software applications library to the individual needs of the installation to be served.

Second, Codon assembles on its premises the hardware components of the system in the configuration scheduled for each installation, and proceeds to integrate and test the applications software. The customer need not accept the system until he is satisfied that it works. Hence, he can see his system in full operation while it is still at Codon's plant and be virtually assured of successful operation after the system is shipped to his own site. (Of course, even these provisions do not necessarily assure full operation immediately, as the physical transfer of the parts can sometimes cause unpredictable changes.)

Third, Codon has developed two language processors so that the user can modify the system programming and structure his own unique programs for any special application function that may arise. One language, RPG-8, is primarily intended for nonprogrammers, who can insert parameters into programs that control the formats of particular reports such as invoices, sales reports, receipts, acknowledgment forms, etc. The second language, DEAL, is intended for programmers capable of developing full-fledged application programs. Frequently, this programming is relatively simple in that only commands to call macro routines supplied by Codon need be specified. DEC's PAL-8 Assembler is an integral part of Codon's DEAL language.

Fourth, the software of the CB-100 system makes it interactive with clerks operating the Video Data Terminals at all times. Input can also be received via communications from another distribution center, from a large computer, or from a terminal if so desired. The system reacts to such data just as responsively as it does to locally keyed data.

Fifth, access to the system's on-line files is immediate, and information is retrieved in a matter of seconds. Two methods are available: a modified index-sequential method or direct access by record number. Even when customers have similar names or products have similar descriptions, the proper record can

utilities section, a program development system (TS/8), and applications software. The last section may be thought of as programs and formats that are highly refined and specialized to the peculiar requirements of an individual data entry environment.

OPERATING SYSTEM: Comprises all of the multiprogramming necessary to implement and govern all system operations. It includes the following elements: Re-entrant Multiprogramming Monitor, Utility Routines, Scheduler, Core Allocation Supervisor, Device Allocation Program, I/O Supervisor, Disk Handler, Application Interface Routines, and Disk Error Recovery Routines.

The monitor controls peripheral device utilization and forestalls clashes in their operations. It also provides program exits to protect file integrity and prevent operator/system error and ambiguous file accesses. A partition of core memory adequate to accommodate the largest possible overlay associated with the required application functions is allocated to each operator.

The only nonconversational functions are disk dumps and major sorting operations, which are normally performed on a once-daily or once-weekly basis. Individual files are sorted before printing to preclude interaction with other system operations. Daily transmissions, even when conducted concurrently with local keying, also do not disrupt other system operations.

Additional useful features of the operating system include:

- Direct File Access – Video Terminals can simultaneously access and modify any number of files and the records within these files. Up to 26 million characters of on-line file data are directly available.
- Security – The operating system utilizes the fixed/removable disk configuration to prevent loss of files, file data errors, or other damage to permanent files. Disk control software can detect access errors and recover valid data. A fresh backup disk, which can be collected in four minutes, must be created with each new system operation or it will not function. Only one operator can modify the same record at the same time. If necessary, each operator can be assigned a set of passwords or a table of acceptable employee numbers that give access to the system and prevent unauthorized access. Each application program can contain certain provisions that protect individual files from illicit access or modification.
- Data Entry – Input is entered in a conversational mode so that the operator can check and correct data as it is entered. Value checks enable input data to be checked for content and magnitude. If a table lookup is required, the pertinent data is not only found but also displayed on the CRT screen for operator verification.
- Input Editing – The following edit checks can be performed on input entries: numeric-only fields, alpha-only fields, check digits, field boundary checks, mandatory entry and completion fields, range checks, zero balance, data emitting, right and left justification, and data correction.
- Disk Files – File accessing is accomplished by a modified index-sequential method or by directly accessing a specified record number. Single or multiple sets of file keys can be used to facilitate accessing a

Codon CB-100 Intelligent Terminal

generally be found without supplemental tub files or other manual editing.

Sixth, many protective features are furnished to preserve the security of system information.

Seventh, a comprehensive array of editing and validation routines is furnished to insure the integrity of incoming data.

In its entirety, the CB-100 software permits all operations of a distribution center to be controlled and administered by an on-site installation. No communications dependence on a time-shared computer or any other remotely located system is necessary. In many respects, the CB-100 operates like a large-scale computer system with a multiprogramming capability that implements many different applications concurrently. The term *distribution management system* can be better understood in this light.

COMPANY INFORMATION

Codon was founded in 1967 as a systems consulting and software house. Because the company is privately held, it is not required to report its financial condition. Nevertheless, a company spokesman told Datapro that Codon has been profitable in every year of its operation except in 1970, when disposal of a time-sharing subsidiary caused a loss. He also cited the company's relationships with the brokerage firm of W. E. Hutton and with the First National Bank of Boston as evidence of financial stability. In addition to providing financial support, the First National Bank also places leases for the CB-100 Terminal.

Codon initiated a study of distribution operations in 1969 and culminated this investigation in October 1972 with the release of the CB-100 terminal. The company markets the system for installation in any part of the United States or overseas from its corporate headquarters and from sales offices in Chicago, New York, and New Jersey. Codon specializes in systems for distribution management and declares that it will install the CB-100 system only in a distribution environment.

According to the company, 13 systems are operating fully at the present time, 6 are in the debugging stage, and 31 are on order. Delivery time is placed at approximately six months from the date of the order.

Digital Equipment Corporation has been contracted to service and maintain the Codon terminals. This ensures both national and worldwide servicing support from DEC's 120 service locations.

USER REACTION

Users evidently regard the Codon CB-100 terminal as unique in its class. When asked what alternative systems

master file of records. This method is said to reduce search time and also to reduce the need for a "housekeeping" cycle to once a week or even once a month.

LANGUAGES: Codon offers two language processors: RPG-8 (Report Program Generator) and DEAL (Distribution Extended Assembler Language). RPG-8 is a report program generator similar to IBM System/360 RPG; this language is utilized simply by filling in parameters on preprinted forms. Users with programming experience can employ DEAL to modify and/or add to their Codon installation as desired. DEAL includes DEC's PAL-8 assembler augmented with commands, data editing facilities, and processing operations relevant to the Distribution Management System.

SORT/MERGE: These special utilities are provided:

- Housekeeping – Checks file sizes, directories and available filing space before initiating the sort; then sorts all disk files in one operation.
- Interactive Sort – Creates a temporary file in which records are sorted in accordance with various key fields for the convenience of the operator.
- In-Line Sort – Processes open orders and fillable back orders to create multiple output sequences in accordance with the user's needs.

APPLICATION SOFTWARE: A large array of programs to meet individual application requirements is available from Codon. A number of examples are described in the following paragraphs.

The *Order Entry* module provides automated assistance to the order entry clerk. Entry is performed in an interactive entry/response mode. Specific functions include initial input of customer order data, validation of input data, credit checking, pricing, and adjustment of inventory levels.

The system and the operator work together. For example, the system "asks" for each item of information as it is required. When changes in orders are necessary, computerized assistance is provided. A separate *Order Change* module allows the operator to modify portions of an order without deleting or rewriting the entire order. The required changes are not only made in the open-order file, but a notation in the transaction file is also inserted and a complete audit trail of the change is therefore available.

Invoicing is flexible to permit numerous decisions and alternatives. The proper invoice format is accessed, and entered data is organized accordingly. Each item is called for by the system, and the operator can readily respond.

The *Receipts* module posts stock as it is received to the inventory file of the system. This module also informs the receiving clerk where the new stock is to be stored. Receipts are posted against open requisitions to check for delivery errors as well as to validate entries made by the receiving clerk. Audit totals insure correctness.

Back Orders are accumulated when received. Transmission to another location is made when the back order is for an item held by a regional or central warehouse. Whenever pending back orders cannot be filled automatically from newly received stock, the Back Order List program prints out the net stock quantity and the back orders. Overriding of the system when required is possible.

Codon CB-100 Intelligent Terminal

they originally considered, some indicated that the only alternative was batch processing, and others said that large mainframes would have to be specially programmed to duplicate the CB-100's functions. The power and price/performance of the Codon system as a total distribution management system commanded immediate interest, they said, and the confidence of the company, indicated by its willingness to debug the proposed configuration on its own premises prior to acceptance by the user, was impressive.

All users liked the versatility of the system and stressed the entire range of its capabilities. A book distributor was particularly pleased with the ability to question the system concerning how many copies of a particular book were in inventory and how many could be released to a particular customer – and to receive a reply within seconds. The query is keyed at a video terminal, and the reply appears on the CRT screen. The ability to situate a terminal up to 1000 feet from the central processor makes effective placement of the terminals throughout the premises possible.

During conversations with users, the system's flexibility of filing and promptness of retrieval arose several times. It is clear that the file of the Codon system has the real-time quality of tub files, but that its organization and ease of retrieval are orders of magnitude better.

Most Codon installations are interfaced to other similar installations, disk to disk, and most communicate with a larger headquarters computer mainframe. One of the earliest users employs teletypewriters instead of Video Data Terminals to enter system data. This user also reports that order turnaround never exceeds 48 hours and is usually no longer than 24. Since his inventory is always known so exactly, it can be shrunk so that space is made available for a greater variety of items than was possible before the system was installed.

The attitude of the interviewed users seemed to be summed up by the remark made by one. "After searching for something that would serve all our needs," he said, "seeing the Codon terminal work is really a joy." □

The *Inquiry* module displays item prices, determines stock status, and displays in-process order records as well as customer credit information and order status at the operator's request. *Order Picking and Shipping* produces a sequenced picking list to aid in the selection of warehouse merchandise for movement to the shipping area. A variety of picking list formats are available, according to the demands of the application. From the weight entered for each item to be shipped, the correct weight for each order is calculated and entered on the bill of lading. In many cases the Codon system can automatically determine the correct number of cartons or packages.

The *Credit* module prints credit memos and makes necessary adjustments to accounts receivable files and/or warehouse inventory files.

File Maintenance programs automatically check data validity and search for and prevent duplication of records when new records are entered in the system. These special programs are intended to prevent operator errors from impacting on the files. For audit trail and error recovery purposes, transaction records are created for each modification.

The *Accounts Receivable* option enables cash receipts to be posted to customer accounts. The computer helps in determining which invoice to credit, and it checks discounts, applies partial payments, and processes accounts based on credit memos and the like in accordance with specified procedures. The Cash Receipts Worksheet simplifies the posting of cash received to accounts receivable by assembling all necessary reference information on the Video Display Terminal screen. Open and partially paid invoices are displayed. Other reports, such as Credit Limit Exceeded and Accounts Receivable Aged Trial Balance, are available. Monthly customer statements are generated automatically by the system for all open accounts. Each statement shows all open invoices for the new month, as well as partial payments credited to date.

SYSTEM OPERATION

The Codon CB-100 system is intended to maintain total administrative control over a distribution activity, and it should not be mistaken for a data entry system. To be sure, much data is entered and stored, but this data is processed by the minicomputer into forms, receipts, invoices, inventory lists, and accounts receivable, and is also used to update the system's extensive files. Thus, when anything new happens at the facility, such as receipt of a new shipment or a new order, this information is keyed into the system, and the elaborate application and system software then updates the various files and causes appropriate reports to be printed. Up to 12 operators can simultaneously utilize the system at the Video Data Terminals. These operators should be regarded as clerks rather than as the equivalent of keypunch operators.

Using the terminals, clerks can request customer order or stock status in response to sales inquiries, or initiate report printouts, or communicate with another distribution center, or dump part or all of the contents of a disk file onto magnetic tape if a tape drive is employed. Freight rate summaries, back orders and future shipping orders, replenishment orders and receipts, and customer order data are further examples of the kind of information that a clerk might enter into the system.

It is entirely possible, therefore, for the use of the Video Data Terminals to be intermittent rather than intensive. On the other hand, there may be a sufficient volume of data entry to justify hiring operators whose function is to key all day. In this situation, there could be a full-time system supervisor, but usually there is none.

A record can contain up to 127 characters. For longer records, two or more 127-character records can be linked. Although the necessary formats that organize incoming data are initially installed by the manufacturer, a format compiler is incorporated in the software so that new formats can be entered. Any format program in the library can be recalled in response to a code keyed by the clerk operating the terminal.

One of the strengths of the system is its ability to call up a data file at any time and modify all or part of it. Entry of new data is accomplished conversationally as an aid to

Codon CB-100 Intelligent Terminal

inexperienced operators. An experienced operator can forego interactive entry, which consists of having the system call for different kinds of data as specified by the formats, by simply keying the data in accordance with a familiar format.

COMMUNICATIONS: Data can be transmitted in disk-to-disk fashion from one CB-100 installation to another, or from a CB-100 to computers or terminals employing BSC line protocol. One communications system handles up to four channels of multiplexed, synchronous communications primarily for the purpose of automatic polling of other distribution centers. Another available communications mode is asynchronous at speeds of up to 1800 bits/second; an additional feature is automatic answer and detection of various line errors. Binary Synchronous Communications (BSC) operation allows direct communication with IBM or equivalent computers or terminals observing this protocol, at speeds of 2400 or 4800 bits/second. Synchronous communication with an off-line or on-line receiver at 2400 bits/second is also available. Supporting software is provided for each of these communications modes.

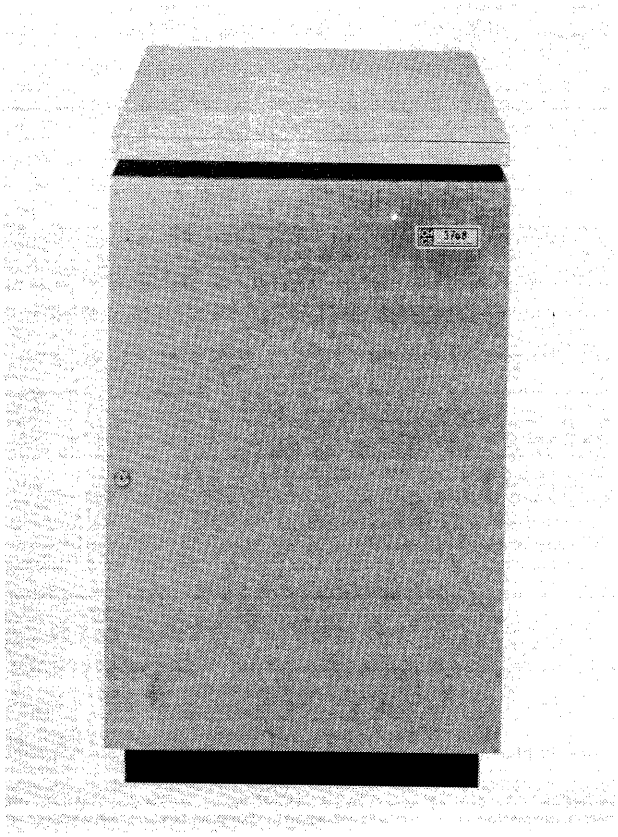
PRICING

The Codon CB-100 Intelligent Terminal can either be purchased or obtained under a 5-year lease. Maintenance charges are included in the indicated lease costs, but a separate contract must be arranged for purchased items. Service is provided by Codon at normal rates during the user's prime shift; emergency service incurs extra charges. Contract rates for extended coverage are available. The table below lists prices for CB-100 installations according to the number of Video Data Terminals they contain. A single 6.4-million-byte disk drive is assumed in all cases.

Video Data Terminals	Cost per Terminal	Monthly Rental	Purchase	Monthly Maint.
6	$271/mo.	$1,626	$ 72,085	$504
8	$231/mo.	1,850	$ 81,975	588
12	$192/mo.	2,298	$101,755	756

The basic system, which includes a 10 character/second console printer, one Video Data Terminal, a minicomputer with 24K bytes of storage, one disk drive (6.4 million bytes of storage), and standard software, costs $1,066/month under a 5-year lease and sells for $47,360. A separate maintenance contract costs $294/month. Each additional Video Data Terminal leases for $112/month, sells for $4,945, and costs an additional $42/month when a maintenance contract is obtained. Detailed price data for the other system components is not currently available. ■

CHCS System/360-Compatible Main Memory



CHCS offers replacement core memory for IBM System/360 Models 30, 40, and 50. Enhancements for the 360/30 include add-on memory to 512K bytes (8 times IBM's maximum capacity) and a novel Accelerator that improves the performance of a 360/30 CPU by as much as 33 percent.

MANAGEMENT SUMMARY

CHCS, a manufacturer of add-on or replacement core memories for the IBM System/360 market, provides plug-compatible main memories for System/360 Models 30, 40, and 50, with strong emphasis on the Model 30 market. The CHCS core memories are available in all IBM-standard storage capacities, and also in enhancement capacities that offer up to eight times the maximum memory capacity provided by IBM for its Model 30 – or 512K bytes – and up to twice the IBM maximum capacities for Models 40 and 50.

The CHCS memories are interchangeable with standard IBM memory on a plug-to-plug basis. No programming changes are necessary, but about 200 changes must be made in the backboard wiring. These can be easily detected because CHCS uses the IBM special blue-wire code to contrast with the processor's yellow backboard wiring. In the Model 30 CPU, the card capacitor read-only storage (CCROS) must also be modified to reflect the change in total main memory capacity. Out of a total of roughly 300 CCROS cards, CHCS replaces about 196. All changes require a partial regeneration of the operating system; site documentation must also be updated to reflect the changes.

CHCS gets its memories from Datacraft Corporation in modules of 16K bytes. Datacraft also builds the power supplies and power sequencing/desequencing units, all to ▷

CHARACTERISTICS

MANUFACTURER: Computer Hardware Consultants and Services, Inc., Pheasant Run, Newtown, Pa. 18940. Telephone (215) 968-5900.

MODELS: Three models of replacement core memory, each available in several module capacities:

- Model 3768 – for IBM System/360 Model 30.
- Model 4768 – for IBM System/360 Model 40.
- Model 5768 – for IBM System/360 Model 50.

COMPATIBILITY: The CHCS 3768, 4768, and 5768 are designed as plug-compatible add-on or replacement mainframe memory units for IBM System/360 Models 30, 40, and 50, respectively. The CHCS units can be used to extend the core storage capacity of an existing IBM System/360 processing unit and/or to replace all existing core storage down to the minimum mainframe capacity as specified by IBM for the particular IBM System/360 model.

The CHCS memories are available in all standard storage capacities currently offered by IBM, in addition to enhancement capacities that extend the mainframe storage of a System/360 Model 30 or 40 up to 512K bytes and a Model 50 up to 1024K bytes.

Effective cycle times of the CHCS memories are the same as those of the corresponding IBM processing units: 1.5 or 2.0 microseconds per byte for Model 30, 2.5 microseconds per 2 bytes for Model 40, and 2.0 microseconds per 4 bytes for Model 50.

Physical specifications and maximum power requirements for each of the CHCS memory cabinets are as follows:

CHCS Model	Max. Storage, bytes	Depth, inches	Width, inches	Height, inches	Max. Weight, lbs.	Max. Heat Dissipation, BTU/hr.
3768	256K	27.75	23.25	38	281	3060
3768	512K	27.75	23.25	52.5	495	6120
4768	256K	27.75	23.25	38	281	3060
4768	512K	27.75	23.25	52.50	495	6120
5768*	512K	27.75	23.25	52.50	500	6800

*Requires two cabinets for Model 50 upgrades to 1024K bytes using more than 512K bytes of CHCS memory.

The CHCS memories each contain an integral power supply and power sequencing control that satisfies memory power and voltage sequencing/desequencing requirements. Power is derived from a 115 or 230 volt single-phase source and is sequenced on and off from the host system.

The CHCS Accelerator is installed via an additional gate within the 360/30 processor and does not require additional floor space.

PRICING: CHCS core memories are available for lease or purchase; conversion from lease to purchase is available ►

CHCS System/360-Compatible Main Memory

CHCS specifications. Monolithic integrated circuits are used extensively. These components, including the computer interface, which is CHCS-fabricated, are assembled within the memory cabinet at CHCS's main plant. The units do not include an off-line diagnostic capability to facilitate the isolation of malfunctions, but CHCS emphasizes that diagnostic routines can be run on the computer system.

CHCS also offers a "transparency switch" that, via a read-only memory (ROM), permits CHCS memory to be isolated from the processing unit. With the installation of this feature, IBM has continued to provide maintenance of the unaltered portion of the computer system under a regular maintenance contract on CHCS upgrades to 256K bytes of storage. Without the transparency feature, IBM has continued to provide maintenance at Model 30 installations with CHCS upgrades to 128K bytes on a "best efforts" basis. The transparency feature sells for $6,000 and leases for $155 per month under a 2-year lease.

CHCS continues to offer its Accelerator feature, which is designed to enhance the performance of a Model 30 CPU. The Accelerator increases the processor's internal speed by an overall average of roughly 25 percent and reduces the processor delays imposed by multiplexer channel I/O operations even more dramatically. This is accomplished by adding a new 2-byte-wide Arithmetic and Logic Unit (ALU) to augment the 360/30's original 1-byte ALU, adding new shift registers to hold the processor registers' contents while processing I/O, and making extensive alterations to the microcode in the 360/30's read-only storage. The Accelerator requires a minimum main storage capacity of 128K bytes. The CHCS Accelerator is used in Greyhound's Phoenix X-30, an enhanced 360/30 with up to 1 million bytes of main memory. CHCS sells its Accelerator for $14,000 and leases it for $800 per month (under a 2-year lease). Production shipments began in May 1973.

CHCS was among the pioneers in providing memory enhancements for the 360/30. It was among the first to upgrade 360/30 memory to 128K bytes, which it later increased to 256K bytes. CHCS now offers a 512K-byte upgrade for 360/30's which it claims has a maximum performance degradation of only 1.02 percent. By contrast, IBM notes a performance degradation of approximately 5 percent on its 96K RPQ for the Model 30.

CHCS has concentrated largely on the 360/30, with more than 100 installations to date, 20 of which are 160K bytes or above. The aggregate capacity of all the units installed to date is about 8.5 megabytes. The first 360/30 installation, in July 1971, upgraded an 8K-byte Model 30 to 32K bytes. The first Model 40 installation was made in December 1971, and there are now seven. The first 360/50 memory was installed in January 1974. In June 1972, CHCS installed the industry's first Model 30 enhancement to 256K bytes by upgrading a 360/30 from 64K bytes. And in June 1973, CHCS demonstrated the industry's first 512K-byte 360/30 at the National Computer Conference.

Service is provided by CHCS; by Comma Corporation (a subsidiary of Control Data Corporation); by Sorbus, Inc., an independent service organization headquartered in King of Prussia, Pa. with over 90 service locations in major cities throughout the U.S.; and by Raytheon Service Company. Service on 360/30's with the Accelerator is provided by CHCS, Comma, and Raytheon. CHCS has service locations in Anaheim, Chicago, Phoenix, Philadelphia, and Toronto.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 8 users reported on their experience with a total of 14 CHCS replacement memories, including 11 units for the IBM 360/30 with an aggregate capacity of 560K bytes and 3 units for the IBM 1130 with an aggregate capacity of 32K bytes. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	5	3	0	0	3.6
Equipment reliability	5	3	0	0	3.6
Maintenance service	1	5	1	0	3.0
Ease of installation	5	1	1	0	3.6

*Weighted Average on a scale of 4.0 for Excellent.

These ratings are consistent with the results from our 1974 survey of CHCS users and are reflective of the company's lengthy experience in the System/360 environment, especially the 360/30. Only one user reported serious problems during installation and testing (since resolved), which caused the process to take 168 hours (7 days). The other users reported an average of 7.4 hours for installation and on-line testing. No serious problems were reported in diagnosing malfunctions and obtaining the necessary service. □

through a purchase-credit arrangement. CHCS offers lease contracts for two, three, four, or five years. Lease rates include all cables, diagnostic performance checks, unlimited usage, and prime-shift maintenance. A separate maintenance contract is available for purchased units.

CHCS was unwilling to release complete pricing information on its core memories, but offered the following representative prices:

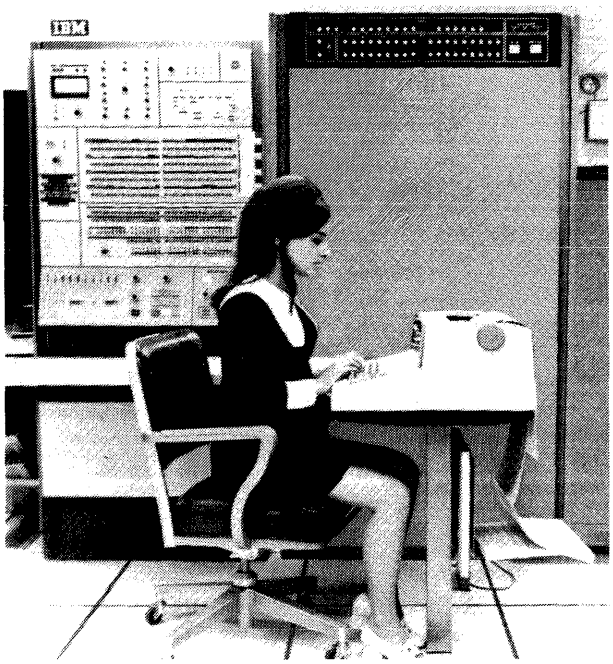
IBM Processor Conversion		Monthly Rental* 2-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
From 2030F	(64K) to:				
G	(128K)	$ 977	$ 727	$17,825	$ 85
H	(256K)	1,825	1,361	33,200	165
I	(512K)	3,705	2,753	68,000	305
From 2040G	(128K) to:				
GF	(192K)	750	559	13,700	65
H	(256K)	1,163	867	21,150	105
HG	(384K)	2,237	1,668	40,635	205
From 2050H	(256K) to:				
HG	(384K)	1,469	1,087	27,265	105
I	(512K)	2,378	1,764	43,860	185
IH	(768K)	4 613	3,424	84,955	365

* Includes prime-shift maintenance (9 hours/day, 5 days/week).

**Prime-shift maintenance: complete maintenance on a 24 hours/day, 7 days/week basis is priced at about 1.5 times the cost of prime-shift maintenance.

Initial installation is included in the lease and purchase prices. ■

CIG Computer Products
Add-On Main Memory



CIG offers a broad line of core and semiconductor add-on memories, including models for the IBM System/370 Models 135, 145, 155, 158, and 165; IBM System/360 Models 22 through 67; IBM System/3; and UNIVAC 494 and 1100 Series computers.

MANAGEMENT SUMMARY

CIG, a pioneer in the add-on memory business, now offers a broad family of replacement memory for IBM System/360, IBM System/370, IBM System/3, and UNIVAC 1100 and 490 Series end users. The company's current lease base includes about 500 installations. In addition to its lease base, CIG has installed about 300 purchased units. The total amount of CIG memory installed to date is about 250 megabytes.

CIG's add-on or replacement memory for System/370 Models 135, 145, 155, 158, and 165 is available in all IBM-standard incremental capacities, as well as in enhancement capacities that provide up to twice the maximum IBM memory capacity for Models 135, 155, and 158. The CIG memories for Models 155 and 165 currently employ core technology and were produced by Fabri-Tek. Semiconductor technology is employed in the CIG memories for Models 135, 145, and 158, which are currently produced by Intel, a major manufacturer of semiconductor memory components and complete memories. But with the fluidity of today's memory market, CIG may well be shipping units produced by other manufacturers in the future.

The semiconductor memories are constructed from 1024-bit or 4096-bit MOS memory chips. Up to 64 chips occupy a single pluggable memory card.

CIG provides add-on or replacement memory for System/360 Models 22, 25, 30, 40, 44, 50, 65, and 67. The 360 memories, built by Fabri-Tek, employ core technology and are available in all IBM-standard incremental capacities and in enhancement capacities that provide up to twice the IBM-imposed maximum capacity for Models 22, 30, and 50; up to 448K and 768K bytes for Models 40 and 44, respectively; and up to four times the IBM maximum for Model 65—4096K bytes.

CHARACTERISTICS

SUPPLIER: CIG Computer Products, Inc. (a subsidiary of Computer Investors Group, Inc.), 1351 Washington Blvd., Stamford, Connecticut 06902. Telephone (203) 359-2100.

MANUFACTURERS: Core memories—Fabri-Tek, Inc., Memory Products Division, 5901 South County Road 18, Minneapolis, Minnesota 55436; telephone (612) 935-8811. Semiconductor memories—Intel Corporation, 3065 Bowers Avenue, Santa Clara, California 95051; telephone (408) 246-7501.

IBM SYSTEM/370 MODELS: Five models of replacement memory are available in IBM-standard incremental storage capacities for IBM System/370 Models 135, 145, 155, 158, and 165. Enhancement capacities are also available for Models 135, 155, and 158. The models are:

- CIG/135 Plus—for IBM System/370 Model 135.
- CIG/145 Plus—for IBM System/370 Model 145.
- CIG/155 Plus—for IBM System/370 Model 155.
- CIG/158 Plus—for IBM System/370 Model 158.
- CIG/165 Plus—for IBM System/370 Model 165.

IBM SYSTEM/360 MODELS: Seven models of replacement memory are each available in IBM-standard incremental storage capacities and in enhancement capacities. The models are: 22+ (for the 360/22), 25+ (360/25), 30+ (360/30), 40+ (360/40), 44+ (360/44), 50+ (360/50), and 60+ (360/65 & 67).

IBM SYSTEM/3 MODEL: Mod 10+ is designed as replacement memory for the IBM System/3 Model 10 and is available in all IBM-standard incremental storage capacities.

UNIVAC 494 AND 1100 SERIES: Four CIG (Data Recall) models of replacement core memory are each available in several module capacities. Models 6600 and 6600II are designed for UNIVAC 1106 and 1106-II computers, Model 8800 for UNIVAC 1108, and Model 9800 for UNIVAC 494.

COMPATIBILITY: CIG memories are designed as plug-compatible add-on or replacement memory for IBM System/370, System/360, and System/3 and for UNIVAC 494 and 1100 Series Computers. CIG memory can be used to extend the storage capacity of an existing IBM or UNIVAC CPU and/or to replace all storage down to the minimum mainframe capacity as specified for the particular CPU model.

CIG memory combined with the mainframe storage capacity of an existing IBM System/370 or 360 processing

CIG Computer Products
Add-On Main Memory

CIG also provides add-on or replacement memory for IBM System/3 Model 10 users in standard IBM capacities ranging from 8K to 64K bytes. The CIG core memory for the System/3 is also produced by Fabri-Tek.

CIG memories can be used to replace all IBM main memory down to the minimum storage capacity specified for the particular IBM processing unit (including complete removal of all IBM main memory in the 370/155, 370/165, and 360/65), to extend the storage capacity of an existing System/370 or 360 installation, or for a combination of both procedures. CIG memories are completely compatible with IBM memory and require no software changes. Hardware changes, however, in varying levels of complexity, are required in cases where the memory capacity is upgraded or enhanced, in special cases involving the combining of CIG memory with existing IBM memory on System/370 Models 155 and 165, and in cases where memory is accelerated on the 370/155. CIG assures transparency for all of its installations and has received IBM certification for standard service continuance on its 370 and 360 product line, including enhancements above the standard IBM limits.

Replacement core memory for the UNIVAC 494 and 1100 Series computers is available from CIG in all UNIVAC standard increments, with functional capabilities identical to those provided by the UNIVAC memories. The CIG memories require one-third less floor space than their UNIVAC equivalents.

IBM 370/155 installations are implemented via CIG's own storage adapter, which occupies a vacant slot within IBM's Power Distribution Unit (Frame 2) and is internally connected to IBM's primary Storage Adapter. The CIG storage adapter can accommodate up to 4 megabytes of CIG memory and spares the user from having to purchase a second Storage Adapter from IBM at a cost of $84,500 (for a 3rd port) or $110,800 (for a 4th port), as is normally required when a user has one megabyte (or more) of purchased IBM memory.

Doubled main memory speed, a key CIG enhancement feature for the 370/155, offers 155 users throughput which is claimed to be equivalent to or better than that of a comparable 370/158. The CIG enhancement feature is implemented via an Accelerated Storage Adapter that replaces the IBM Storage Adapter. The Accelerated Storage Adapter, produced by Fabri-Tek, operates at half the IBM standard memory cycle time of 2.07 microseconds, or 1.035 microseconds per 16-byte fetch. CIG states that its memory with the Accelerated Storage Adapter is totally transparent to the IBM 370/155 processor.

Pricing, the prime justification for turning to an independent supplier, is substantially below IBM's pricing for equivalent capabilities. Rentals under a two-year lease range from 18 to 67 percent below IBM prices. Added monthly savings can be realized through CIG's unlimited usage (no extra-use charges) and extended lease terms; CIG offers lease contracts for up to four years. Purchase prices range from 30 to 80 percent below IBM's prices.

CIG provides service through its own service organization, CIG Computer Service, Inc., which is supplemented with service provided by Comma Corporation and Sorbus, Inc. In all, service for the CIG memories is available from over 200 locations nationwide.

unit provides the following range of standard and enhanced mainframe storage capacities:

CIG Memory Model	IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	Enhanced CIG Capacities, bytes
135 Plus	3135	96K	96K to 512K	Up to 1024K
145 Plus	3145	160K	160K to 2048K	None
155 Plus*	3155	0	256K to 2048K	Up to 4096K
158 Plus	3158	512K	512K to 4096K	Up to 8192K
165 Plus*	3165	0	512K to 3072K	None
22+	2022	24K	24K to 32K	64K
25+	2025	16K	16K to 48K	None
30+	2030	8K or 16K	16K to 64K	96K or 128K
40+	2040	32K	32K to 256K	384K or 448K
44+	2044	32K	32K to 256K	384K, 512K, or 768K
50+	2050	128K	128K to 512K	768K or 1024K
60+*	2065	0	256K to 1024K	Up to 4096K

*All existing IBM memory can be replaced.

The 155 Plus and 165 Plus core memories are direct replacements for IBM 3360 Processor Storage and contain up to 2048K bytes or 3072K bytes, respectively, per cabinet. One or two 2048K-byte 155 Plus cabinets can be attached to an IBM 3155 Processing Unit via the IBM primary Storage Adapter to provide a maximum storage capacity of 4096K bytes. Only one 165 Plus cabinet can be attached to a 3165 Processing Unit to provide a maximum storage capacity of 3072K bytes. By contrast, IBM's 3360 Processor Storage has a maximum capacity of 512K bytes per cabinet; up to four cabinets can be connected to an IBM 3155 Processing Unit, and up to six cabinets to an IBM 3165 Processing Unit, to provide a maximum storage capacity of 2048K bytes or 3072 bytes, respectively.

The 135 Plus, 145 Plus, and 158 Plus bipolar or MOS semiconductor memories are designed as add-on or replacement memory for an IBM 3135, 3145 or 3158 Processing Unit, respectively. The 135 Plus provides a maximum storage capacity of 1024K bytes in a single cabinet that attaches to the rear of the 3135 processor. The 145 Plus provides a maximum storage capacity of 2048K bytes in one cabinet. The 158 Plus provides a maximum storage capacity of 8192K bytes in one cabinet. The 135 Plus and 145 Plus units feature plug-in memory cards, each containing 64 1024-by-1 bit semiconductory memory chips. The 145 Plus is divided into two gates, each containing up to four Basic Storage Modules (BSM). Each BSM can accommodate up to 36 plug-in memory cards to provide a total storage capacity of 256K bytes.

Effective cycle times of the CIG 370-compatible memories are the same as those of the corresponding IBM memory: 540 nanoseconds per 8-byte fetch for Model 145, 2.07 microseconds per 16-byte fetch for Model 155, and 2.0 microseconds per 8-byte fetch for Model 165. The effective cycle time of the CIG 155 Plus memory when using the CIG Accelerated Storage Adapter is 1.035 microseconds per 16-byte fetch.

The CIG 60+ is a direct replacement for IBM 2365-2 Processor Storage and contains up to 1024K bytes of storage per cabinet; up to four cabinets can be attached to an IBM 2065 Processing Unit to provide a maximum storage capacity of 4096K bytes. By contrast, IBM's 2365-2 Processor Storage contains 256K bytes of storage; up to four units can be used with an IBM 2065 to provide a total storage capacity of 1024K bytes.

Effective cycle times of the CIG 360-compatible memories are the same as those of the corresponding IBM processors: 1.5 microseconds per byte for Model 22, 0.9 microsecond per 2 bytes for Model 25, 1.5 or 2.0 microseconds per byte for Model 30, 2.5 microseconds per 2 bytes for Model 40, 1.0 microsecond per 4 bytes for Model 44, 2.0 microseconds per 4 bytes for Model 50, and 750 nanoseconds per 8 bytes for Model 65.

CIG Mod 10+ core memory for the IBM System/3 Model 10 is available in IBM-standard 8K-byte increments from 16K to 64K bytes. Effective cycle time is the same as that of the IBM memory: 1.52 microseconds per byte. The Mod 10+ memory can be used to replace all existing IBM memory down to the 8K-byte minimum.

CIG Computer Products
Add-On Main Memory

CIG memories were initially installed in February 1970 under the Data Recall name. CIG acquired Data Recall in late 1973, and in October of the same year CIG acquired Fabri-Tek's entire installed base of IBM-compatible memories. At that time, CIG also announced an exclusive marketing agreement between itself and Fabri-Tek. The two firms terminated the exclusive agreement in mid-1974, and now Fabri-Tek also markets its memories directly to end users and to other vendors, such as Control Data, who remarket the memories to end users.

CIG began production deliveries of its add-on memories to IBM 360/30 installations in the second quarter of 1971, to 360/22, 40, and 50 installations in the fourth quarter of 1972, and to 360/25 and 44 installations in the second quarter of 1973. CIG started making production deliveries to System/370 installations in the second quarter of 1972 for the 370/155, and followed with deliveries to 370/165 and 370/145 installations in the second and fourth quarters of 1973, respectively. Deliveries to 370/135 installations began in the first quarter of 1974. CIG began making System/3 add-on memory installations in May 1973. Deliveries to UNIVAC installations began in the first quarter of 1972 for the 1108 and in the second quarter of 1973 for the 494. Current lead time on orders for CIG memories (standard or enhanced) ranges from 30 to 60 days.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 22 users reported on their experience with a total of 30 CIG replacement memories. This sizable sample included 15 units for System/360 Models 30, 40 and 50 having an aggregate capacity of 2.7 megabytes, 8 units for System/370 Models 135, 145, 155, and 165 having an aggregate capacity of 11.7 megabytes, and 7 units for UNIVAC 1108 computers having an aggregate capacity of 1,612 words. The users' ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	10	8	3	1	3.2
Equipment reliability	11	6	3	2	3.2
Maintenance service	6	7	7	2	2.8
Ease of installation	3	10	7	2	2.6

*Weighted Average on a scale of 4.0 for Excellent.

The majority of users are satisfied with the CIG replacement memory, as indicated by the large number of Good to Excellent ratings in the overall performance and equipment reliability categories. Though more users gave Good to Excellent ratings to maintenance service and ease of installation than didn't, several users experienced difficulties in these areas. However, only two of the 22 users reported an installation and test period of more than three days; the two exceptions reported a two-week installation and testing period—one an IBM 360/50 site and the other a UNIVAC 1108 site. Perhaps now that plug-compatible memory units are commonplace, users are no longer willing to tolerate the kinds of problems that were common in the early days of IBM replacements. Vendors, beware. □

The CIG Model 6600, 6600II, and 8800 core memories are designed as add-on or replacement mainframe memory for UNIVAC 1106, 1106-II, and 1108 computers, respectively, and can be used to extend the computers' existing main memory capacity and/or to replace all of the existing main storage. These memories are available in UNIVAC-standard incremental capacities of 64K 36-bit words to provide a maximum storage capacity of 256K words. The memories exhibit complete hardware and software compatibility with their host UNIVAC computers, including corresponding read/restore cycle times of 1 microsecond (1106 and 1106-II) and 750 nanoseconds (1108).

The CIG Model 9800 core memory is designed as an add-on or replacement mainframe memory for the UNIVAC 494 computer, and can be used to extend the computer's existing main memory capacity and/or replace all of the existing main storage. The 9800 is available in UNIVAC-standard incremental capacities of 32K 30-bit words to provide a maximum storage capacity of 128K words. The 9800 exhibits complete hardware and software compatibility with the host UNIVAC computer, including a corresponding read/restore cycle time of 750 nanoseconds.

All CIG memories contain integral power supplies that satisfy the memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode. Power supply voltages can be switched to plus or minus five percent of the normal operating voltage to determine marginal operating conditions. The external maintenance panel provides controls for addressing any memory locations, reading from the addressed location, or writing new data entered via panel switches.

Physical specifications and heat dissipation for each of the CIG memories are shown in the following table.

Memory Model	Maximum Storage, bytes	Depth, inches	Width, inches	Height, inches	Weight, lbs.	Max Heat Dissipation, BTU/hr.
22+	32K	23.25	25.25	52.125	350	2,200
22+	40K	24.25	31.25	52	400	2,750
30+	32K	23.25	25.25	52.125	350	2,200
30+	112K	24.25	31.25	52	400	7,700
40+	384K	36.25	31	70.25	600	8,400
50+	384K	36.25	31	70.25	600	8,400
65+	1024K	32	30	72	1,000	12,000
MOD 10+	56K	20	27	29	300	2,000
MOD 25+	32K	20	27	29	270	1,500
MOD 44+	256K	32	32	72	700	6,000
MOD 44+	480K	32	32	72	800	8,000
135 Plus	1024K	30.5	15	60	850	24,000
145 Plus	2048K	31.50	53.50	60	900	18,500
155 Plus	2048K	32.35	47.81	63.81	1,000	18,000
158 Plus	8192K	38	34	56	1,100	8,700
165 Plus	3072K	32.25	58.81	63.81	1,000	22,000
6600	256K*	32	64	70	1,280	8,500
6600II	256K*	32	64	70	1,280	8,500
8800	256K*	32	64	70	1,280	8,500
9800	128K*	32	64	70	1,280	8,500

CIG memories are powered from a 115-volt single-phase source for capacities up to and including 128K bytes and from a 208/220/230-volt single-phase or three-phase source for all larger capacities.

PRICING: CIG memories are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. CIG offers lease contracts, for one, two, three, four, and five years. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. A separate maintenance contract for prime-shift or complete maintenance is available for leased or purchased units.

Model upgrades for IBM System/370 Models 145, 155, and 165 include CIG's standard storage adapter and are included in the price of the memory.

IBM Processor Conversion			Monthly Rental* 2-Year Lease	4-Year Lease	Purchase	Monthly Maint.**
From 2022DC	(24K)	to:				
F	(64K)		$ 560	$ 490	$ 19,500	$ 55
From 2025D	(16K)	to:				
ED	(48K)		1,350	1,140	59,125	60
From 2030C	(8K)	to:				
FE	(96K)		1,240	1,050	36,500	115
G	(128K)		1,520	1,285	44,700	130
From 2030D	(16K)	to:				
FE	(96K)		1,215	1,030	35,750	115
G	(128K)		1,490	1,260	43,875	130

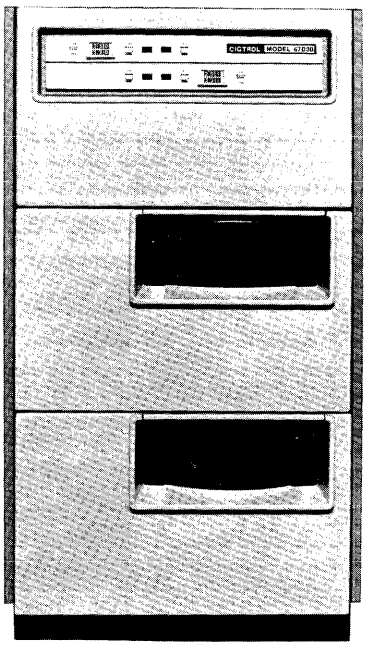
CIG Computer Products
Add-On Main Memory

IBM Processor Conversion			Monthly Rental* 2-Year Lease	4-Year Lease	Purchase	Monthly Maint.**
From 2040E	(32K)	to:				
H	(256K)		$ 2,350	$ 1,990	$ 69,250	$ 185
HG	(384K)		3,790	3,210	111,650	270
HGF	(448K)		4,365	3,695	128,575	370
From 2040G	(128K)	to:				
H	(256K)		1,545	1,310	45,500	130
HG	(384K)		2,815	2,380	82,875	220
HGF	(448K)		3,480	2,945	102,375	360
From 2040G	(128K)	to:				
H	(256K)		1,545	1,310	45,500	130
HG	(384K)		2,815	2,380	32,875	220
HGF	(448K)		3,480	2,945	102,375	360
From 2044E	(32K)	to:				
HG	(384K)		6,300	5,330	171,250	330
I	(512K)		7,355	6,225	200,000	400
IH	(768K)		10,305	8,720	280,000	550
From 2050G	(128K)	to:				
I	(512K)		3,190	2,700	90,310	320
IH	(768K)		5,080	4,295	149,500	480
J	(1024K)		6,495	5,497	191,125	660
From 2050I	(512K)	to:				
IH	(768K)		2,265	1,915	66,625	220
J	(1024K)		3,755	3,180	110,500	400
From 2065	(0K)	to:				
H	(256K)		2,760	2,335	81,250	400
I	(512K)		4,415	3,740	137,500	600
IH	(768K)		5,520	4,670	166,250	800
J	(1024K)		6,900	5,840	206,250	1,000
K	(2048K)		13,800	11,680	396,875	1,750
KJ	(3072K)		20,700	17,520	587,500	2,450
L	(4096K)		27,600	23,360	775,000	3,150
From 3135	(96K)	to:				
	(144K)		810	686	36,544	80
	(192K)		1,474	1,123	60,206	130
	(240K)		2,230	1,793	95,397	175
	(256K)		2,338	1,895	96,547	215
	(320K)		2,808	2,176	108,344	275
	(384K)		3,429	2,775	147,363	335
	(512K)		4,455	3,607	192,455	430
	(768K)		6,880	5,616	300,596	785
	(1024K)		9,061	7,420	397,889	1,105
From 3135	(144K)	to:				
	(192K)		810	686	36,544	80
	(240K)		1,474	1,123	60,206	130
	(256K)		1,658	1,285	64,370	150
	(320K)		2,198	1,777	94,823	235
	(384K)		2,565	2,030	104,751	295
	(512K)		3,672	2,970	158,313	370
	(768K)		6,097	4,979	250,464	725
	(1024K)		8,273	6,782	333,434	1,045
From 3135	(192K)	to:				
	(240K)		810	686	36,544	80
	(256K)		1,069	891	45,493	95
	(320K)		1,463	1,183	63,189	170
	(384K)		2,133	1,744	94,309	240
	(512K)		3,181	2,630	141,396	365
	(768K)		5,600	4,639	249,830	420
	(1024K)		7,781	6,448	346,830	1,040
From 3135	(240K)	to:				
	(256K)		NA	NA	NA	NA
	(320K)		1,015	848	39,420	115
	(384K)		1,501	1,269	61,409	175
	(512K)		2,570	2,133	118,378	320
	(768K)		4,995	4,142	226,519	675
	(1024K)		7,177	5,940	323,812	995
From 3135	(256K)	to:				
	(320K)		NA	664	29,877	95
	(384K)		1,129	950	52,545	170
	(512K)		2,111	1,744	94,038	310
	(768K)		4,531	3,753	202,179	665
	(1024K)		6,712	5,562	299,472	985
From 3135	(384K)	to:				
	(512K)		1,183	972	53,968	170
	(768K)		3,607	2,981	162,109	525
	(1024K)		5,783	4,790	259,402	845
From 3135	(512K)	to:				
	(768K)		2,425	2,009	108,141	355
	(1024K)		4,606	3,812	205,434	675
From 3145	(256K)	to:				
	(384K)		1,318	1,134	55,087	155
	(512K)		2,306	1,868	107,350	290
	(768K)		3,985	3,229	194,360	530
	(1024K)		6,372	4,876	283,630	720
	(1536K)		10,595	8,575	419,263	1,330
	(2048K)		14,861	12,031	588,311	1,710
From 3145	(384K)	to:				
	(512K)		1,291	1,134	52,545	155
	(768K)		3,429	2,797	140,685	450
	(1024K)		5,054	4,115	237,300	635
	(1536K)		9,796	7,954	395,274	1,245
	(2048K)		14,062	11,405	564,322	1,625
From 3145	(512K)	to:				
	(768K)		2,306	1,863	94,920	290
	(1024K)		4,055	3,305	190,292	530
	(1536K)		8,797	7,139	395,274	1,140
	(2048K)		13,063	10,589	518,331	1,520
From 3145	(768K)	to:				
	(1024K)		2,306	1,863	101,700	290
	(1536K)		7,047	5,702	279,675	900
	(2048K)		11,308	9,148	448,723	1,280
From 3145	(1024K)	to:				
	(1536K)		4,741	3,839	187,693	610
	(2048K)		9,007	7,290	356,741	990
For IBM 370/158						
512K			NA	NA	111,320	500
1024K			4,210	3,801	209,825	800
1536K			6,415	5,790	313,500	1,100
2048K			8,583	7,749	431,200	1,500
2560K			10,615	9,581	473,000	1,800
3072K			12,636	11,408	644,100	2,100
3584K			13,991	12,626	723,250	2,400
From 3155	(0K)	to:				
I	(512K)		2,940	2,490	97,200	450
J	(1024K)		5,980	5,065	186,630	1,050
K	(2048K)		10,600	8,990	374,885	2,000
KJ	(3072K)		15,795	13,055	549,285	2,700
L	(4096K)		20,280	17,165	705,335	3,300
From 3155I	(512K)	to:				
J	(1024K)		3,310	2,805	106,830	700
K	(2048K)		8,550	7,255	286,110	1,600
KJ	(3072K)		13,735	11,625	477,635	2,400
L	(4096K)		18,215	15,420	633,735	3,000
From 3155J	(1024K)	to:				
K	(2048K)		5,745	4,865	197,355	1,150
KJ	(3072K)		10,940	9,255	383,555	2,075
L	(4096K)		15,445	13,055	539,645	2,675
From 3155JI	(1536K)	to:				
K	(2048K)		3,315	3,805	127,890	700
KJ	(3072K)		8,500	7,200	285,145	1,600
L	(4096K)		12,990	11,000	442,330	2,300
From 3155K	(2048K)	to:				
KJ	(3072K)		5,700	4,825	196,125	1,150
L	(4096K)		10,190	8,625	347,580	1,950
From 3165	(0K)	to:				
JI	(1536K)		7,600	6,430	261,775	1,400
K	(2048K)		9,815	8,300	354,500	1,900
KJ	(3072K)		15,255	12,915	540,150	2,800
From 3165I	(512K)	to:				
K	(2048K)		9,680	8,190	350,535	1,800
KJ	(3072K)		15,315	12,965	520,240	2,800
From 3165J	(1024K)	to:				
K	(2048K)		9,680	8,190	350,535	1,800
KJ	(3072K)		15,110	12,790	536,180	2,800
From 5410C	(8K)	to:				
DC	(24K)		345	280	11,000	30
E	(32K)		460	375	15,000	40
ED	(48K)		730	615	24,860	60
F	(64K)		965	820	32,890	75
From 5410D	(16K)	to:				
E	(32K)		345	280	11,000	30
ED	(48K)		570	480	18,700	45
F	(64K)		755	640	25,960	70
From 5410E	(32K)	to:				
ED	(48K)		345	280	11,000	30
F	(64K)		550	465	18,700	45
CIG Accelerated Storage Adapter:						
For 0 to 1M bytes			–	–	77,500	500
Above 1M bytes			–	–	44,000	100
UNIVAC 494:						
From 32K to 96K words			5,640	4,445	175,000	400
UNIVAC 1106/1106-II:						
From 64K to 128K words				3,080	140,000	400
UNIVAC 1108:						
From 64K to 128K words			5,720	4,680	175,000	400

* Monthly rental under a 2- or 4-year lease does not include maintenance.

**Maintenance for 24 hrs./day, 7 days/week. ■

CIG Computer Products
Cigtrol 6730/67D30 Disk System



This replacement for the IBM 3330 Disk Storage Facility offers equivalent performance at worthwhile savings. It features a microprogrammed controller and can be used with System/360 Models 30 through 195 as well as with the System/370 computers.

MANAGEMENT SUMMARY

Computer Investors Group, a leading supplier of replacement main memory for IBM System/360 and System/370 computers, recently entered the market for IBM-compatible disk drives and disk subsystems by introducing replacements for IBM's 2314 Direct Access Storage Facility and 3330 Disk Storage Facility.

The Cigtrol 6730/67D30 Disk System is designed as a plug-to-plug replacement for the IBM 3330 Disk Storage Facility. The Cigtrol System offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and functional capabilities. No hardware or software modifications to existing IBM equipment are required when the Cigtrol System is used with the IBM System/370 or System/360 Models 85 and 195; however, changes to the operating system (OS or DOS) via a Sysgen operation are necessary when used with other System/360 models. Disk packs recorded by IBM drives can be read by CIG drives, and the converse.

The Cigtrol 6730/67D30 Disk System incorporates the same modular construction as the IBM 3330 and provides the standard IBM 3330 features, including Rotational Position Sensing (RPS), Multiple Requesting, and Command Chaining. Performance characteristics of the 67D30 Drives match those of IBM's 3330.

The key element of CIG's 6730/67D30 System is the Cigtrol 6730 controller, a microprogrammed unit that features extensive use of integrated circuitry. Microprogramming is implemented via a writable control store, a semiconductor memory that stores the unit's control and diagnostic microprograms and is loaded ➢

CHARACTERISTICS

SUPPLIER: CIG Computer Products, Inc. (a subsidiary of Computer Investors Group, Inc.), 1351 Washington Boulevard, Stamford, Connecticut 06902. Telephone (203) 359-2100.

MANUFACTURERS: Disk drives–Century Data Systems, Inc. (a CalComp subsidiary), 1270 North Kraemer Avenue, Anaheim, California 92806; telephone (714) 632-7111. Controller–International Peripherals and Computer Corporation, 633 East Young Street, Santa Ana, California 92705. Telephone (714) 546-9212.

MODELS: Cigtrol Model 67D30 Disk Drive; Cigtrol Model 6730 Disk Storage Controller.

CONFIGURATION: The Cigtrol 6730/67D30 Disk System includes a 6730 Disk Storage Controller and two to eight spindles in two-spindle increments. Each 67D30 Disk Drive contains two spindles. The operating arrangement is identical with that of the IBM 3330.

The optional Two-Channel Switch provides two channel interfaces, which serve as alternate paths to the controller and its attached disk drives.

STORAGE CAPACITY: The data storage capacity of the Cigtrol 67D30 drives is 100.018 million bytes per spindle, which is identical with the per-spindle storage capacity of the IBM 3330 subsystem. Total on-line storage capacity of an 8-drive subsystem is 800.146 million bytes.

ACCESS ARRANGEMENT: Each spindle of the Cigtrol 67D30 drives provides access to 404 recording cylinders (19 tracks/cylinder) via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

COMPATIBILITY: The 6730/67D30 Disk System is designed for connection to an IBM System/360 computer, Models 85 and 195 only, or to an IBM System/370 computer, Models 135 through 195, via a Block Multiplexer Channel as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. A special feature permits the 6730/67D30 System to interface the Selector Channel of a System/360 Model 30, 40, 44, 50, 65, 67, or 75 computer. The data transfer rate between computer and disk subsystem for Models 30 through 50 is adjustable to compensate for the limited channel speeds. Speed adjustment is implemented via a semiconductor buffer with a capacity large enough to store one track of data. The 6730/67D30 System interfaces System/360 Models 65, 67, and 75 via a channel adapter, which is equivalent to IBM's 2880 Block Multiplexer Channel.

The 6730/67D30 System provides complete compatibility with the IBM 3330 command structure, and, except for operation with System/360 Models 30 through 50, requires no changes to the existing OS operating software.

The 6730/67D30 System is supported by standard IBM OS for subsystems connected through IBM's Block Multiplexor Channel or CIG's equivalent. A proprietary software product also marketed by CIG, EDOS (see Report 70E-841-01), is being adapted to support subsystems under DOS. Support of subsystems operating ➢

CIG Computer Products
Cigtrol 6730/67D30 Disk System

during the power-up sequence from a "floppy" disk (supplied by Century Data Systems). The 6730 Controller can also accommodate CIG's 67D14 Drives (see Report 70D-183-01).

System/360 compatibility, a unique feature of the 6730 Controller, permits the use of 67D30 Drives with a System/360 computer, Models 30 through 75. The capability is primarily intended for the Model 50 and up, but it can be used effectively with the smaller models where comparatively little processing is required. Models 50 and below require buffering to accommodate the differences in data transfer rate between drives and computer; a channel adapter, functionally equivalent to the IBM 2880 Block Multiplexer Channel, is used with the larger computer models.

Software support for the IBM System/360, Model 65 and larger, and System/370 models is provided through IBM OS. Support for System/360 Models 30, 40, and 50 will be provided under DOS through the next release of EDOS, an enhancement package for DOS created by The Computer Company and exclusively marketed by CIG. Support will be provided by a new access method; see Report 70E-840-01 for a discussion of EDOS.

Software support under OS for subsystems without the Block Multiplexor Channel facility is being planned. This capability would be oriented to users of System/360 Models 30, 40, and 50 who take advantage of the possibility for expanding main memory well beyond IBM restrictions through independent offerings such as the CIG/Data Recall Add-On Main Memory (see Report 70D-320-01 and the Index under "memories, IBM-compatible").

CIG has priced its 6730/67D30 System below IBM's price "umbrella" for equivalent storage capacities. Unfortunately, CIG refused to disclose its maintenance charges for leased or purchased equipment, so precise price comparisons are not possible. Two-year lease prices for an eight-drive Cigtrol subsystem should be up to 10 percent or more below IBM's lease prices under its Extended Term Plan for equivalent storage, while CIG's purchase prices range from 21 to 38 percent below IBM's. These price ranges reflect both IBM attachment techniques: integrated and channel attachment. Further savings can be realized through CIG's extended lease terms. IBM can accommodate up to sixteen 3330 drives on System/370 Models 135 and 145, and up to 32 drives on Models 158 and 168, via integrated attachment. CIG'S pricing shows significant savings for equivalent numbers of purchased, channel-attached 8-drive subsystems; but the price break for leased CIG equipment in comparison with IBM's integrated attachment subsystems may be very small, depending on CIG's maintenance charges.

CIG provides service through its own service organization, which is supplemented with service by Honeywell Information Systems and Sorbus, Inc. In all, service is available from over 200 locations nationwide.

Initial customer deliveries of the 6730/67D30 System are scheduled for the first quarter of 1973.

CIG is pulling together the products from several companies in which it has a financial interest to simultaneously offer alternatives to users going along with IBM in the migration to the System/370 line and also to users who wish to stretch their System/360 installations. Main memories from Data Recall, 2314 and 3330 style disk subsystems from IPC, and software enhancements from The Computer Company put CIG right in the middle of the most active portions of the market for IBM-compatible facilities. □

with System/360 Models 30, 40, and 50 under IBM OS is being planned.

DISK PACK: Each spindle accommodates one IBM 3336 Disk Pack or an equivalent disk pack. The 3336 contains 12 disks and provides 19 recording surfaces.

FILE ORGANIZATION: Identical with that of IBM; each disk pack corresponds to one logical file. Address (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

PERFORMANCE: The performance characteristics of the Cigtrol 67D30 drives are compared with those of IBM's 3330 drives in the following table.

Head Positioning Time, msec.

Disk Drive	Track to Track	Average (400 cyl.)	Maximum (400 cyl.)	Tracks per Inch
Cigtrol 67D30	10	30	55	192
IBM 3330	10	30	55	192

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Start-up and shut-down times for the Cigtrol 67D30 drives are 15 seconds each, compared with 15 and 10 seconds, respectively, for the IBM 3330. Head-positioning is performed electromagnetically by both the Cigtrol and IBM 3330 drives.

PHYSICAL CHARACTERISTICS: The physical characteristics of the 6730/67D30 System are presented in the following table.

	Width, inches	Depth, inches	Height, inches	Weight, pounds	Heat Dissipation, BTU/hr.
67D30 Drive	32	32	60	800	7,000
6730 Controller	40	30	60	700	10,000

PRICING: The Cigtrol 6730/67D30 Disk System is available for lease or puchase; conversion from lease to purchase is available through a purchase-credit arrangement. CIG offers lease contracts for one, two, three, and four years. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. A separate maintenance contract is available for lease or purchased units.

	Monthly Rental*	Purchase
67D30 Drive (two spindles)	$670 to 930	$38,800
6730 Controller (for System/370)**	930 to 1,195	47,800
6730 Controller (for System/360)***	1,515 to 1,945	73,000

*Does not include service. Maintenance charges are available from CIG upon request.
**Includes System/360 Models 85 and 95.
***Models 30 through 75. ■

CMC KeyProcessing Systems

MANAGEMENT SUMMARY

Since its founding in 1968 and delivery of the first KeyProcessing system to Blue Cross of Southern California in July 1969, Computer Machinery Corporation (CMC) has steadily expanded its product line and has become a dominant force in the shared-processor key-to-disk data entry field.

The company added the CMC 5 KeyProcessing system late in 1971 and the CMC 103 Video Keystation in 1972 to its original CMC 7 and 9 models. Communications was also introduced in 1972. The CMC 7 and CMC 9 are both aimed at medium- to high-volume facilities, while the CMC 5 is intended for smaller environments, but which are still too large and/or too progressive for old-fashioned keypunching or single-station key-to-tape systems. The relative places of these three systems in the marketplace can be roughly gauged from the fact that the CMC 5 services up to 16 stations and the CMC 7 and CMC 9 service 32 stations each, with the CMC 9 having the largest disk capacity of the three systems.

In June 1973 the first delivery of a CMC 18 system was made. This mammoth system, which can be configured with virtually any desired disk capacity, can accommodate up to 64 keystations. It can execute an impressive set of keystroke-saving operations and can implement many complex editing and validation procedures. Additionally, it offers an RPG II compiler that enables users to code individualized data processing and edit routines. The CMC 18 system is targeted for large data ▷

The CMC 5, 7, 9, 12, and 18 KeyProcessing Systems form a family of multiple-station data entry systems controlled by a shared minicomputer with extensive software support. Various shared disk drives provide intermediate storage. Output consists of industry-compatible magnetic tape. From 5 to 64 keystations are employed.

CHARACTERISTICS

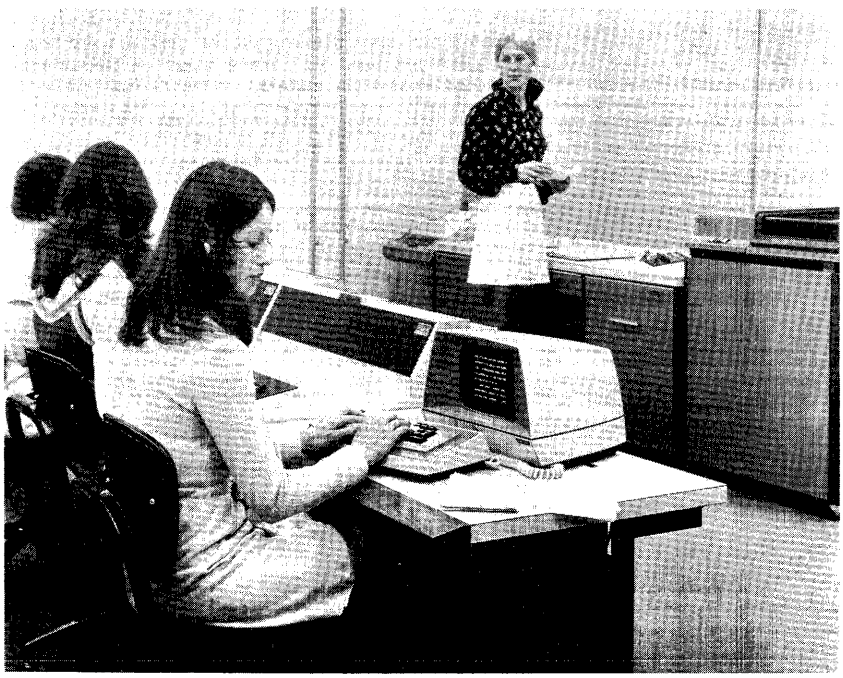
MANUFACTURER: Computer Machinery Corporation, 100 Wilshire Boulevard, Santa Monica, California 90401. Telephone (213) 829-2926.

MODELS: CMC 5, CMC 7, CMC 9, CMC 12, and CMC 18. (Note: The CMC 11 KeyProcessing System is described separately in Report 70D-186-03.)

CONFIGURATION

Each of the KeyProcessing systems consists of supervisory console, a disk drive and storage unit, operator keystations, a console teleprinter, various print stations, and an optional card reader for the CMC 18. Keystations for the CMC 5, CMC 12, and CMC 18 can be of either the panel-display type or the CRT type, while the CMC 7 and CMC 9 employ only the panel-display type.

As the heart of each KeyProcessing system, the supervisory console houses the system minicomputer, the system disk drive, various control circuits, the supervisory control panel, and, in some of the systems, one of the installed magnetic tape drives. Additional tape and disk ➤



Like the CMC 7 and 9 KeyProcessing Systems, the recently announced CMC 12 can also handle a mix of up to 32 video (CRT) or panel-display keystations. A typical 17-station CMC 12 configuration leases for $2,690 per month on a 1-year lease.

CMC KeyProcessing Systems

entry facilities, such as those of banks, insurance companies, and mass-media publications, where even a small reduction in keystrokes on each transaction translates into significant savings.

The latest system, the CMC 12, fits between the 9 and the 18. Although less powerful than the CMC 18, it offers considerably more disk space and therefore more functional flexibility than the CMC 9 Announced in June 1973, the CMC 12 is scheduled for delivery in December 1973.

A study of CMC's pricing shows that the company now offers systems at competitive prices to span virtually the entire spectrum of data entry volumes. Generally speaking, KeyProcessing configurations can be expanded as required by simply adding components. KeyProcessing's inherent advantage, however, is the range over which this expansion can be effected. For a low-volume application, an inexpensive CMC 5 can be installed rather than a larger system that is cost-effective only at volumes higher than those that the user actually processes. Eventually, the system can be expanded – right up to a CMC 18 if necessary, although this last step does entail some significant component substitutions.

KeyProcessing and its competitors have in common the goal of expediting data entry at each keystation. Hence, all companies offer software designed to eliminate keystrokes. An unusual feature that CMC offers is the ability to duplicate certain types of randomly recurring information. Numerous edit and validation checks decrease the need for standard verification. Automatic format chaining is supplemented by the simple alternative of programming a succession of record levels as an integrated group and identifying them with an entire job. Because skilled operators often find a video (CRT) station distracting, CMC provides keystations with indicator panels that display basic information. Compatible video stations are also available. CMC emphasizes close supervision to ensure that the labor-saving features of KeyProcessing are effectively utilized and that operators concentrate on keying and little else.

The software functions of KeyProcessing systems are so numerous that a division into foreground and background partitions is a necessity. The advantage of the background partition is that many vital system functions, such as balancing performed on a closed batch and reformatting prior to writing to tape, can be carried out without impacting an operator's keying. On the other hand, edit and validation routines in the foreground detect errors while an operator is still keying the batch. Experience has shown that prompt detection and correction of keying errors saves considerable time from an overall systems operation standpoint.

Concurrent verification is a KeyProcessing capability that saves time in emergencies. Data can be keyed at

drives are situated in separate cabinets. Various controllers are required to operate the disk drive, the magnetic tape drive, and the line printer. A special communications controller gives the KeyProcessing systems a communications capability.

Duplex and triplex control units are supplied when requested for the interconnection of independent KeyProcessing configurations.

All KeyProcessing keystations can be located up to 1000 feet from the central processor.

CMC 5: Includes a supervisory station and up to 16 CMC 101, 103, or 105 Keystations. The optional Multimode Controller is required when the number of keystations exceeds 12. The supervisory station includes a supervisory console, which contains a minicomputer, a magnetic disk drive, a magnetic tape drive, and a controller for an optional 80- or 132-column printer; and a Teletype Model 33 ASR teleprinter. Options also include a communications capability.

CMC 7 and CMC 9: Includes a supervisory station and up to 32 CMC 101 or 105 Keystations. The supervisory station includes a supervisory console, which contains a minicomputer and magnetic tape unit, an external magnetic disk drive, and a Teletype Model 33 ASR teleprinter. Options include an additional tape drive, an 80- or 132-column printer, and communications.

CMC 12: The basic hardware of this system is essentially the same as that for the CMC 7 and 9. Software and hardware enhancements, however, enable larger disk drives to be utilized compared with those of the 7 and 9, and permit the CMC 103 Keystation to be connected. The CMC 12 can employ up to 2 IBM-2311-type disk drives or 1 IBM-2314-type disk drive. Like the CMC 7 and 9, it can operate up to two magnetic tape drives and can form a record block length of up to 1024 characters.

CMC 18: Includes a supervisory station and up to 64 CMC 107 or CMC 108 Keystations. The supervisory station is a large work-desk and enclosure which houses the central processor. Resting on the desk are the supervisor's CRT monitor and control panel. A free-standing supervisory console teleprinter, 1 to 4 disk drives, as many as 8 tape drives, and an optional card reader are situated in the vicinity. This system employs the CMC 764 Console Printer described below rather than the Teletypewriter mentioned previously. The optional CMC 763 Line Printer can be operated as well. A communications controller can also be installed.

CMC 101: This station is a worktable with integral keyboard and backlit display panel. The keyboard layout is similar to that of the IBM 64-character 29 Card Punch, except that control keys are used in place of switches. Information is displayed alphanumerically in English words or abbreviations and includes current operating mode and status; last character keyed (character in current memory location); record format level, name, and number; field name, length, and type for up to 16 fields of the record format in use (field name panel); a record position indicator (three-character numeric display) that via key-selection displays the current character position (column number) within a record or the current record number within a batch; and error status indicators.

CMC 103: This station is a desk-top CRT display unit with detached keyboard. The unit displays 128 characters arranged in four lines of 32 characters each. Of the 128 displayable characters, 16 are constantly in use to display

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one keystation and verified concurrently at another. The verifying operator must lag the keying operator by about one record.

Computer Machinery has not as yet incorporated optical scanner input, and publicly states that it feels the time for multimedia input is not yet ripe. At the same time, CMC pledges to add OCR when its users can benefit from it.

EDP managers planning conversions to key-to-disk systems are usually fearful of processor or disk failure. To provide a "fail-soft" capability, therefore, duplexing or triplexing of two or three separate KeyProcessing configurations is available. This interconnection allows half the maximum number of allowable stations in each configuration. Normally, business is transacted at all keystations in the usual way, but if a breakdown occurs in a processor or disk drive, the associated keystations can be switched into another configuration. The supervisory console of that configuration then controls the affected stations.

Acceptance of CMC hardware, software support, service, and overall market strategy is evidenced by the company's emergence into the black in the final quarter of 1972 and the first six months of 1973. CMC asserts that in the first half of 1973 the total value of its installed equipment on an "if-sold" basis surpassed $100 million. Keystation installations are now said to exceed 13,000 in number. In less than a year of deliveries, more than 500 CMC 5 systems have been shipped. Three CMC 18 systems were delivered in June 1973. These achievements speak well of Computer Machinery's status in the data entry field.

The company provides its own service and customer training through 56 nationwide sales and service points. A 3- to 6-month lead time is presently required for delivery of KeyProcessing systems.

USER REACTION

The consensus of KeyProcessing users is that their equipment has materially improved their throughput while lowering operating costs. This view was common to users of CMC 5, 7, and 9 systems.

There were CMC 5 users who processed relatively modest volumes of data and supported a limited number of keystations compared with those of the larger KeyProcessing systems. It was interesting to discover that the CMC 5 not only upgraded keypunching operations, but also replaced some single-station key-to-tape units. These users appeared satisfied that the productivity of their operators had increased substantially as a result of simplified manual operations, improved personnel control through close supervision, and the imposition of system discipline. These users also felt that the video

the following: column number, field number, operating mode (read, write, verify, program entry, or program select), record format level, auto skip/dup on or off, auto-balance status, and text messages indicating current record number or conditions such as verify miscompare, rewrite, backspace verify, and batch limit. The keyboard layout is the same as that of the CMC 101 Keystation.

CMC 105: This station is a desk-top keyboard and display unit that, with a few minor exceptions, provides a backlit display and keyboard arrangement identical with that of the CMC 101 Keystation. The CMC 105 differs from the CMC 101 as follows: absence of field name panel, addition of an error indicator, relocation of first character indicator, and addition of power on/off and column/field switches on keyboard.

CMC 107: This station consists of a desk, keyboard, and backlit display panel. The construction of the movable display panel and separate keyboard housing allows the operator to position them to her convenience.

CMC 108: This station consists of a desk, keyboard, and video (CRT) display, which presents 256 characters arranged in 8 rows of 32 characters each. Of the 256, 16 positions display operator control and status information. The movable video display and separate keyboard housing can be arranged to the operator's convenience.

PDP-8 CENTRAL PROCESSOR: Operates in a shared, real-time mode to control all system functions, including keying of all data input and subsequent formatting, validation, error checks, data transfer, I/O device control, and panel displays. Controllers for operating the tape drives and disk drives must interface the processor. The processor has a 1.2-microsecond cycle time, a 12-bit word length, and a storage capacity of 4,096 to 32,768 words. The PDP-8 is used in all of the KeyProcessing systems except the CMC-18.

PDP-11 CENTRAL PROCESSOR: The processor used in the CMC 18 has a 1.2-microsecond cycle time, uses 16-bit words, and has a minimum capacity of 4,096 words and a maximum capacity of 32,768 words. It has 8 program-accessible general registers available for use as accumulators and a 45-instruction repertoire.

DISK DRIVES: These units are of the moving-head, removable pack design. The capacity of the disk file in the CMC 5 system is 2.2 million bits. In the CMC 7 and 9 systems, 7.25-million bit storage units are employed. In the CMC 12, an extra extended disk capacity doubles the disk storage. The indicators on the supervisory console notify the supervisor when 75 percent of the available storage area is filled. The supervisor can also request a teleprinter report that indicates the amount of storage area currently filled and the number of tracks still available for data. These units have an average head movement time of 50 milliseconds and an average rotational delay of 12.5 milliseconds.

The CMC 18 uses a moving-head disk pack unit with a capacity of 29 million bits, an average head movement time of 40 milliseconds, and an average rotational delay of 12.5 milliseconds. A total of four such disk drives can operate in the system.

MAGNETIC TAPE DRIVES: These units write formatted, validated data on 0.5-inch, IBM-compatible, 7- or 9-track tape. The CMC 18 can operate up to 8 tape units, while the other systems can operate up to 2 drives. The tape

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keystation is useful because it assists the transition from individual keypunching to coordinated KeyProcessing system activity.

Two operating philosophies prevailed among CMC 5 EDP managers. One school believed in exploiting processor power to apply extensive formatting, reformatting, and other operations that validate output data. In contrast, a minority school staunchly preferred mainframe error routines. A particular KeyProcessing feature consistently endorsed by both factions was Multiple Format Groups (format chaining). Another was tape entry.

CMC 7 and 9 users have apparently progressed beyond the stage of simply improving keypunch performance. The managers interviewed were largely responsible for turning over substantial volumes of data. Their experience with the key-to-disk, shared-processor concept has whetted their appetities for even greater gains in operating efficiency and productivity. Those who had incorporated the more sophisticated edit and validation options expressed satisfaction with the improved reliability of data delivered by their data entry installations. They also confirmed that the need for standard verification was significantly reduced. Among the features cited were various levels of accumulation and balancing, extended duplication capability, conditional restrictions on data entry, range checks, and table look-ups. Some users expressed interest in the RPG II compiler announced for the CMC 18 and the opportunity it would give them to write their own validation programs in accordance with special entry requirements.

It is worth noting that among managers with high-production requirements, there is a distinct preference for indicator-panel keystations. They expressed the opinion that video displays are a distraction and impede high-production keying. These managers also like the CMC philosophy of tight supervisory control. In addition, they disclosed that operators usually accept statistical reports produced by the system as a valid evaluation of their performance, and respond constructively as a result.

Users are satisfied with the reliability of the CMC hardware and repeatedly reported their down-time as less than 2 percent. The responsiveness and competence of CMC field engineers was described as outstanding. Users of duplexed and triplexed systems regard the added expense as worthwhile insurance for maintaining unbroken operational continuity. □

drives can also serve as input devices by reading files and transferring data to disk storage for eventual updating. The 7-track drive records at 556 or 800 bits/inch. One 9-track drive-records at 800 bits/inch NRZI, and the other records at 1600 bits/inch in phase-encoded format. The drives for the CMC 18 system operate at 37.5 inches/second except for the 1600-bpi unit, which operates at 25 inches/second. All reel sizes are the standard 10.5 inches in diameter and hold 2400 feet of tape.

CMC 116 SUPERVISOR'S CRT MONITOR: The supervisor of the CMC 18 system communicates with other system components by using the keyboard CRT monitor mounted on the desk. The keyboard has a typewriter arrangement of keys, of which 43 enter data and 18 perform system functions.

ASR 33 TELEPRINTER: This supervisory printer is employed in all KeyProcessing systems except the CMC 18. It consists of a keyboard, printer, paper tape punch, and tape reader mounted in a free-standing floor console. The device prints 10 characters/second from a character set of 63 printable characters. Standard typewriter roll paper, single or multicopy, can be used. The keyboard conforms to the familiar 4-row teletypewriter style.

CMC 761 PRINTER: This drum-type printer is designed for continuous heavy-duty operation. It prints at the rate of 356 lines/minutes and has 80 print positions. The printer accepts standard fanfold forms from 4 to 9-7/8 inches wide and 11 inches high. One CMC 761 can service up to four KeyProcessing systems provided that each system employs a CMC 768 Print Controller, which must always be present to interface the printer to a system. The CMC 761 is not used by the CMC 18.

CMC 764 CONSOLE PRINTER: This printer, which is provided with the CMC 18, has a 64-character set and prints 132-column lines at the rate of 60 lines/minute. A 2-channel vertical forms control feature is standard.

CMC 763 LINE PRINTER: This optional printer produces 132-column lines at the rate of 250 lines/minute. It has a 12-channel vertical format control tape.

CMC 152/153 CARD READER: Two optional card readers are identical in appearance and differ only in speed. One reads at the rate of 300 cards/minute and the other at 600 cards/minute. They can accept 51-column or 80-column cards. Each reader has a hopper capacity of 1,000 cards and a stacker capacity of 1,000 cards.

CMC 512 BINARY SYNCHRONOUS COMMUNICATIONS CONTROLLER: This controller, which serves as a synchronous interface to a Bell System 201A modem or its equivalent, can operate at rates of up to 19,200 bits/second.

OPERATING MODES

- **Write (consists of keying data into the system following specification of job and batch names; usually called data entry in other systems).**
- **Verify (character-by-character rekeying of data previously recorded by the same or a different operator for the purpose of direct comparison; usually performed only on fields that contained previously overridden errors or are out of balance; concurrent entry and verification are possible).**
- **Correction (enables operator to insert a new character or field at the indicated position; this mode can be entered from either the Write or Verify mode. If flagged records are being corrected, the operating system positions the keyboard at the first of these records; after the correction is made, the system proceeds to the next flagged record. This automatic feature can be suppressed by the operator at any time.)**

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- Search (batches can be searched by record identifier or by key identifier field content).
- Batch Append/Record Insert (enables records to be added at the end of a batch or inserted within the batch).
- Display (at any time and in any mode, the Write or Verify operator can switch to the display mode by depressing the DISPLAY key. She can now position anywhere within the batch and display the desired data. To leave the Display mode, she depresses the DISPLAY key again. The system then returns to the last previous mode and position.)
- Format Entry (operator enters codes that define a record format from a format specification sheet provided by the supervisor; formats can also be entered by reading in a magnetic tape. The operating system compiler then structures the format control program and stores it in the format library on the disk. A utility program copies the library contents onto format tape, which can later re-enter the formats or enter them into another KeyProcessing system.).

SYSTEM OUTPUT

- Industry-Compatible Magnetic Tape (see Magnetic Tape Drives).
- Direct transmission of processed data to an IBM System/360 or 370 computer.

SYSTEM PROFILE

For the disk capacities that lead to the figures presented below, please refer to Disk Drives. Figures offered for the CMC 18 System should be regarded as nominal, since the assumed 29-million-byte storage can be readily expanded. Record length and record storage information are given in the adjoining table.

- Record formats – the CMC 5 can store 199 formats; the CMC 7 can store 199 or 899 (optional); and the CMC 18 can store over 1000 formats if desired. Additional formats can be stored on tape and entered into the system at any time.

There is ample storage capacity in all KeyProcessing systems for edit routines and implementing executive programming for applications appropriate to the particular model. Storage capacities that are available for keyed data records of various lengths in the various KeyProcessing models appear in the table below.

The CMC 5 supervisory console contains a minicomputer, disk drive, and magnetic tape drive. Introduced in May 1971, the CMC 5 system handles up to 16 keystations and provides most of the capabilities of the larger KeyProcessing systems at a considerably lower price.

SOFTWARE

All system operations, from controlling basic data entry at the keyboard and presenting both video and indicator-panel displays to carrying out editing procedures and validation checks, are performed under software control in each of the KeyProcessing systems. Each of the KeyProcessing models functions under the control of an executive operating system that is organized into a real-time or foreground partition and an independent background partition.

The real-time partition of the operating system governs all operations associated with the entry of data at the keyboard, such as keying itself, duplication, skipping, generation of system and error status messages for display on the video screens, display of field prompters, and various editing and validation procedures.

Operations not immediately related to data entry, such as the dynamic allocation of data records to the disk files, transfer of data between system components, error checks, compiling of record formats for storage in the format library, searching for records stored on the disk, reformatting of records prior to writing them on tape,

DATA RECORD CAPACITIES OF CMC KEYPROCESSING SYSTEMS

Record Length, characters	Standard Storage, records					Optional Storage, records	
	CMC 5	CMC 7	CMC 9	CMC 12	CMC 18	CMC 7	CMC 12
1 to 48	–	24,800	100,200	97,797	–	50,000 or 100,200	219,597
1 to 112	18,000	–	–	–	–	–	–
49 to 112	–	12,300	52,800	48,898	–	24,900 or 50,100	109,798
113 to 176	–	8,100	35,100	32,598	–	16,500 or 33,300	73,198
177 to 240	–	6,000	26,250	24,448	84,000	12,300 or 24,900	54,898

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blocking these records, assigning headers and trailers to them, and finally dumping a completed batch to tape, are carried out in the background partition. Another background function is the generation of statistical management reports on jobs and keystation operators. System functions performed in the background partition cannot interfere with the operators as they enter data.

KEYSTROKE REDUCTION FEATURES: An effective means of increasing data entry throughput is through KeyProcessing's keystroke reduction features. Each of the following features affects keying activities by either eliminating keystrokes completely, decreasing the number of keystrokes, or making operation easier and more logical for operators:

- Auto Dup/Skip (fields designated in format are automatically filled from the previous record or skipped).
- Auto Insert (permits automatic insertion of designated alpha, numeric, or alphanumeric fields in foreground operation).
- Aux Dup (CMC 18 only–permits automatic insertion of randomly recurring fields).
- Left Zero (permits right justification by preceding the data field with zeros).
- Field Stop (CMC 18 only–permits skipping of fields by striking the release key once).
- Boundary Check (CMC 18 only–requires striking of the Left Zero or Skip key to terminate a field).
- Reformatting (permits reorganization of data records prior to release to tape).
- Correction (enables operators to rekey incorrect characters or fields; this mode can be entered from the Write or Verify mode; rekeying to verify the correction can be either automatic or manual).
- Search (Batches opened in Verify mode can be searched for record identifiers, field content, or flag indicators; reverts to Verify when the specified record is found.)

EDIT AND VALIDATION: Standard verification is avoided, not only by keystroke reduction features, but also by edit and arithmetic validation checks performed on the data. On the CMC 18, data is edited and checked in the foreground while the operator is keying. The CMC 5, 7, 9, and 12 systems perform simple checks in the foreground and more extensive checking when a batch is closed through the Data Validation package.

Editing functions available in KeyProcessing systems include: field qualification, check digits, value checks, range tests, conditional field testing, table look-up, sequence checking, crossfooting, balancing, and totaling.

RECORD AND BATCH CHECKS: The following checks are performed on records released to the processor.

- Downfooting–Extends the concept of crossfooting by accumulating totals across format level boundaries and determining whether the sums, differences, or products agree with document totals.
- Batch checks–If the total of selected fields within a batch is known, it can be entered into the KeyProcessing system as a control total. As keying proceeds, the system accumulates the contents of a field or group of fields in each record and at batch closure compares the accumulated total with the control total. An error is announced by the system so that the operator can retrace her entries and by suitable corrections bring the batch into balance. Sometimes it is preferable to close the batch in an out-of-balance condition and flag it for later attention.

RPG II COMPILER: For those users who can benefit from special data preprocessing or from particular edit routines, the CMC 18 offers an RPG II compiler. The user writes his programs on special RPG II forms, and the operator keys these instructions into the system in the usual way. The system then compiles the user programs and incorporates them into the program library.

BACKGROUND EDIT FEATURES: Occasionally, the presence of too many validation routines in the foreground partition causes interruptions to operator keying. In this situation many of the check routines in the KeyProcessing systems can be performed in the background partition. Hence, no real-time interruptions are occasioned by these routines. A major background operation is reformatting. Fields can be rearranged relative to the order in which they were keyed. Fields can be abstracted from records and assembled into new records that are organized into formats different from that of the keyed record. Constant data can be inserted into the proper fields at this time instead of during the keying operation as described previously. Records to be written on tape can be blocked up to 1024 characters by all models except the CMC 18, which can block to any length.

OPERATOR STATISTICS: The statistics accumulated by the system for a batch consist of the batch number, format number, date, keystation number, keystrokes, total time for entry, and total time for verification. The supervisor can have this information printed, recorded on tape, or displayed on her CRT screen.

SYSTEM OPERATION

The supervisor of the KeyProcessing systems exerts a tight rein over all system activity. She assigns jobs in their associated formats to individual keystation operators. She also controls the entry, modification, and deletion of all formats entered into the system. Still another of her responsibilities is the deletion of jobs and batches of data once it has been processed by the mainframe.

A major function of the supervisor is the transfer of data from disk to tape. This procedure might also include specification of reformatting and tape labels. The following media conversions can be performed through the supervisory console: tape entry, print functions, and (in the CMC 18 only) card entry print.

SYSTEM REPORTING: Supervisors initiate all reports via the Teleprinter on the CMC 5, 7, 9, and 12 and through the Supervisory Control Console CRT on the CMC 18. The following reports are available: Job Status, Operator Status, Keystation Status, Disk Status, Event Log, Operator Analysis, Performance Report, and Job Analysis.

FORMAT CONTROLS: All data entered into KeyProcessing systems is under format control. Format control defines each field by length and by type of content

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as it structures multilevel format groups. It also specifies fields to be automatically skipped, duplicated or right justified (left zero filled). Finally, format control specifies whether the type of validation to be performed is by field, record, or batch.

Formats on the CMC 5, 7, 9, and 12 systems can be entered into the format library via a Keystation or the teleprinter. CMC 18 formats are entered via a Keystation and compiled into the format library via the Supervisory Control Console. Formats can also be entered via magnetic tape. A utility program for each KeyProcessing system can copy existing library contents onto a format tape; the tape can later be used to re-enter these formats or to enter them into another KeyProcessing system. An exception is the CMC 18, which can accept its own programs from tape but cannot accept the format structure of the other KeyProcessing systems.

ERROR CONTROL: Parity generation and checking is performed on data transferred between the computer and disk and between the disk and tape or other output devices. Odd or even parity is written on 7-track tape and odd parity is written on 9-track tape. Longitudinal and cyclic redundancy characters are generated and written on both disk and tape. A read-after-write check is performed on both tape and disk. Data written on a disk is read during the next revolution and compared with the original data in core; erroneous data is immediately rewritten. Validation and other errors disable the system and cause error messages to appear. In the CMC 18 KeyProcessing system, records containing errors can be flagged for subsequent correction.

COMMUNICATIONS: Communications are effected through the CMC 512 BiSynchronous Communications Controller, which operates at up to 19,200 bits/second. IBM binary synchronous (BSC) transmission protocol is observed. The user must provide a Bell System 201A or equivalent modem. KeyProcessing systems can communicate with other BSC devices, such as IBM 2780 terminals and IBM 360/370 computers, as well as with other KeyProcessing systems.

PRICING

The CMC KeyProcessing systems can be purchased or leased for a 1-year, 3-year, or 5-year term. Maintenance for purchased components must be contracted separately, but maintenance is included in the quoted lease figures. Normally, the maintenance agreement applies to the user's prime shift on weekdays. If the installation is located outside of a 50-mile radius of a CMC service center, or if maintenance is required during hours other than the prime shift, additional charges will be made. Preventive maintenance is usually performed every two weeks during the prime shift. As a rule it takes about two hours.

The following tables list charges for various KeyProcessing systems according to the number of incorporated Keystations. For the CMC 5, CRT stations are assumed. For the CMC 7 and 9, panel-display stations are assumed. A mix of three panel-display stations for every CRT station is assumed for the CMC 12 and CMC 18 systems. Charges are included for the appropriate control groups, which consist of the minicomputer, one 9-track magnetic tape drive, and disk drives of suitable capacities. The cost per data station for each of the five systems is given in terms of monthly rental for a 1-year lease term.

For the CMC 5:

Data Stations	Cost per Station	Monthly Rental	Purchase	Monthly Maint.
8	$141/mo.	$1,130	$45,200	$128
16	106/mo.	1,690	67,600	176

For the CMC 7:

Data Stations	Cost per Station	Monthly Rental	Purchase	Monthly Maint.
15	$170/mo.	$2,550	$105,750	$230
24	133/mo.	3,315	134,000	284
32	125/mo.	3,800	158,500	332

For the CMC 9:

Data Stations	Cost per Station	Monthly Rental	Purchase	Monthly Maint.
15	$195/mo.	$2,925	$125,000	$270
24	154/mo.	3,690	153,300	324
32	137/mo.	4,370	178,000	370

For the CMC 12:

Data Stations	Cost per Station	Monthly Rental	Purchase	Monthly Maint.
15	$199/mo.	$3,000	$134,000	$290
24	155/mo.	3,725	155,000	344
32	137/mo.	4,375	180,000	392

For the CMC 18:

Data Stations	Cost per Station	Monthly Rental	Purchase	Monthly Maint.
15	$257/mo.	$3,850	$153,700	$480
24	187/mo.	4,480	179,000	534
48	129/mo.	6,160	246,000	678
64	114/mo.	7,280	291,000	770

Charges for individual system components and features are listed below.

Device	Monthly Rental (1)	Purchase	Monthly Maint.
KeyProcessing Systems:			
CMC 5 (2)	$ 570	$ 22,800	$ 80
CMC 7 (3)	1,000	48,000	110
CMC 9 (3)	1,375	67,300	150
CMC 12 (3)	1,500	71,000	170
CMC 18 (3)	2,500	100,000	350
Keystations:			
CMC 101	85	3,150	6
CMC 103	70	2,800	6
CMC 105	70	2,800	6
CMC 107 (panel display; includes desk)	70	2,800	6
CMC 109 (CRT display; includes desk)	70	2,800	6
Magnetic Tape Units (for CMC 18):			
7-track, 556/800 bpi	300	11,700	40
9-track, 800 bpi	300	11,700	40
9-track, 1600 bpi	300	11,700	40

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Device	Monthly Rental (1)	Purchase	Monthly Maint.
Tape Controllers (for CMC 18):			
Controller for NRZI units (controls up to 4 units)	N/C	N/C	N/C
Controller for 1600 bpi (controls up to 4 units)	125	5,000	15
Magnetic Tape Units (for CMC 7/9/12):			
7-track, 556/800 bpi	275	10,500	30
9-track, 800 bpi	275	10,500	30
1600 bpi Feature (4)	300	11,400	35
Tape Controllers (for CMC 7/9/12):			
Dual Tape Controller	140	5,500	7
Dual Tape Controller with 1600 bpi feature	175	6,650	10
Magnetic Tape Units (for CMC 5):			
7-track, 556/800 bpi–			
12.5 ips, 8.5-inch reels	N/C	N/C	N/C
25 ips, 10.5-inch reels	75	3,000	10
9-track, 800 bpi–			
12.5 ips, 8.5-inch reels	N/C	N/C	N/C
25 ips, 10.5-inch reels	75	3,000	10
9-track, 1600 bpi–			
25 ips, 10.5-inch reels plus controller	175	7,000	50
Line Printers:			
80-column	375	13,800	50
132-column	500	18,500	60
Printer Controller (for 132-col. printer)	75	2,800	8
Data communications (for Bell System 201A-type modem)	95	3,330	15
Keystation Desk (for CMC 103/105)	8	280	–
Duplex Control Unit (5)	275	10,500	15
Triplex Control Unit (5)	500	19,000	25
Features:			
For CMC 18–			
Card Reader (300 cpm)	175	6,000	25
Card Reader (600 cpm)	225	9,000	35
Line Printer (132-column, 250 lpm)	575	21,300	85
Memory Module (4096 bytes core memory)	185	7,100	25
RPG II Compiler	N/A	150	N/A
For CMC 7–			
176-Character Record	100	4,000	7
240-Character Record	200	8,000	15
Record Format Module	100	4,000	5
2.8-Million-Character Disk Storage	200	8,000	12
5.6-Million-Character Disk Storage	400	16,000	25
For CMC 7 and 9–			
Extended Performance Module	75	3,000	8
For CMC 5–			
20,000-Record Disk Storage	200	8,000	12
Record Format Module (100 additional formats)	25	1,000	2
Multimode Controller	100	4,000	8
Tape Entry	50	2,000	N/C
Reformatting	50	2,000	8

(1) For 1-year lease; includes prime-shift maintenance.

(2) Pricing includes supervisory console with minicomputer, magnetic disk unit (10,000-record storage capacity), a Teletype Model 33 ASR Teleprinter, an 80-column printer controller, and a 7- or 9-track, 12.5-ips tape unit.

(3) Pricing includes supervisory console with minicomputer, a magnetic disk drive, and a Teletype Model 33 ASR.

(4) Requires 9-track tape drive and Dual Tape Controller with 1600 bpi feature.

(5) The Duplex Control Unit interconnects two CMC 7 or CMC 9 KeyProcessing Systems so that any of 64 Keystations can operate with either of two supervisory consoles (restricted to no more than 32 Keystations per console); the Triplex Control Unit interconnects three CMC 7 or CMC 9 KeyProcessing Systems.

N/C–No Charge. ■

CMC KeyProcessing Systems
New Product Announcement

CMC 6: In April 1975, Computer Machinery Corporation added another member to its already large family of shared-processor data entry systems. Introduced as the CMC 6 KeyProcessing System, the new system is essentially a CMC 5 with massive disk storage capacity—amounting to 10 times that of the CMC 5—and significantly improved operating software. The CMC 6 can store up to 200,000 80-character records and over 1000 record formats. In addition, the CMC 6's disk storage capacity can accommodate extensive user libraries and system management aids. According to CMC, a CMC 5 can be field-upgraded to a CMC 6.

System configuration for the CMC 6 is virtually the same as that of the CMC 5 except for disk storage. The CMC 6 consists of a supervisory station, up to 16 CMC 101, 103, or 105 Keystations, a Teletype Model 33 KSR teleprinter, one tape drive, and an IBM 2314-style disk drive. Unlike the CMC 5, a CMC 6 system cannot include CMC 103 Keystations mixed with CMC 101 and/or 105 Keystations. Options include a second tape drive, a 115-lpm (CMC 781) or 300-lpm (CMC 791) printer, a duplex control unit for multisystem installations, and TeleBatch data communications.

With TeleBatch, the CMC 6 functions as a HASP 2780-type workstation, communicating at up to 19,200 bps with a remote computer, other KeyProcessing Systems, or IBM 2780-compatible devices. Data communications is concurrent with key entry.

Operating software for the CMC 6 includes all standard and optional CMC 5 operating software plus several enhancements. The CMC 6 features expanded foreground and background editing capabilities, including a substantial number of foreground editing functions not provided by the CMC 5. The expanded operating software includes increased support for tape-entered applications (such as turnaround documents and OCR/MICR rejects) and numerous reports and procedural aids (such as output reformatting, operator analysis, hard-copy audit trail, application security features, and media conversion routines).

The optional Data Validation software has also been expanded for the CMC 6 to provide twice the number of capabilities offered for the CMC 5. Data Validation features user-programmable routines for balancing and totalling numeric data, for performing alphanumeric range and value tests, and for interfield, interrecord, and interbatch dependency tests.

The CMC 6 is available for purchase or lease under a one-, two-, three- or five-year term. A typical 10-keystation CMC 6 leases for $1,660 per month (including maintenance) under a two-year lease, and sells for $52,000.

Preproduction deliveries began in June 1975, and about six systems have been installed to date. Production deliveries are scheduled to begin in September 1975. □

CMC 36 DataPrint System

MANAGEMENT SUMMARY

Off-line printing is an important alternative to expanding one's existing on-line printing capability. Yet the present market for off-line printers is surprisingly small as compared with that for tape and disk drives marketed by the independents as IBM plug-compatible peripherals. As a result, only a handful of manufacturers produce off-line print systems. Of these, CMC is one of the most significant entries with its CMC 36 DataPrint System.

The DataPrint System is by no means a run-of-the-mill off-line printer system; on the contrary, it exhibits considerable sophistication in its design and implementation. It combines the ubiquitous IBM 1403 Printer, Model N1, with a mix of up to eight 7- and 9-track magnetic tape drives operating at densities ranging from 200 to 1600 bits per inch, a minicomputer with 8K to 64K bytes of core memory, and a Teletype Model 33 ASR teleprinter, which acts as a system/operator interface.

Operation is under control of an operating program loaded from magnetic tape prior to job processing. Supplied as part of the DataPrint System, the operating software is designed to respond to simple keyed commands entered directly from the teleprinter keyboard or recorded on paper tape for repetitive usage. During job processing, the system software advises the operator of job status and of contingencies that require operator intervention via teleprinter messages.

The DataPrint System is capable of reading virtually any tape code and format written in any of the conventional tape densities, and of organizing the tape data within the framework of virtually any print format through the use of operator-defined parameters. Block lengths can range ➢

This off-line printer system uses a minicomputer for program-controlled job processing and outputs the data via the familiar IBM 1403-N1 Printer. The DataPrint System can accommodate any mix of up to eight 7- or 9-track magnetic tape devices. A second printer is optional.

CHARACTERISTICS

MANUFACTURER: Computer Machinery Corporation, 100 Wilshire Boulevard, Santa Monica, California 90401. Telephone (213) 829-2926.

CONFIGURATION: The CMC 36 DataPrint System consists of the DataPrint Processor, one or two (optional) customer-supplied IBM 1403 Model N1 Line Printers, any combination of up to four 7- or 9-track tape drives operating at different recording densities up to 800 bits/inch, and up to four additional 9-track, 1600-bpi drives. The DataPrint Processor includes a 16-bit minicomputer with a basic 8K-byte core memory (expandable to 64K bytes in 4K-byte increments), a print controller, system control console, and Teletype Model 33 ASR teleprinter.

TAPE INPUT: 7- or 9-track industry-compatible magnetic tape units. The 7-track drives are dual-density units that record at the following densities: 200/556, 556/800, or 200/800 bits/inch. The 9-track drives record at 800 bits/inch, using the NRZI recording technique, or at 1600 bits/inch, using the phase-encoding technique.

The tape drives are reel-to-reel units that accommodate standard 10.5-inch tape reels containing 2400 feet of 0.5-inch magnetic tape. The read-only, single-capstan drives read at 37.5 inches/second and rewind at 150 inches/second. Tape tension is applied via tension (dancer) arms; only the non-oxide surface of the tape contacts the capstan.

PRINTED OUTPUT: The IBM 1403-N1 Printer, a train printer, provides 132 print positions and has a rated speed ➤

The DataPrint System couples the widely respected IBM 1403-N1 Printer (left) with a minicomputer-based control unit, a supervisory teleprinter, and from one to eight magnetic tape drives.

CMC 36 DataPrint System

from 10 to over 16,000 records, while record size can range from 1 to 256 characters.

Other salient features of the DataPrint System can be summarized as follows:

- List–processes the tape data according to defined parameters and prints the data according to a defined report format.
- Dump–prints all tape data in hexadecimal or octal form.
- Selective Printing–prints only operator-defined records and/or blocks from an input file, using any or all of the characters within a record as a selection key.
- File Positioning–the job tape can be positioned to any operator-defined block or file of data.
- Page Formatting–any carriage control code set can be accommodated; horizontal formatting permits the operator to define the first and last character of a record to be printed and to define the beginning print position.
- Train Compatibility–code-compatible with any train cartridge of the IBM 1416 type.
- Second Printer–a second IBM 1403-N1 Printer can be accommodated via the Dual Printer Module, which provides control and additional core memory.
- Forms Registration – positions inserted forms and paper precisely so that print falls into prescribed areas.
- Train Cleaning – effects automatic cleaning of the print chain.
- Upper and Lower Case Print – trains containing both upper and lower case characters are available.
- Tape Copy – enables data from an alternative tape drive to be copied onto another tape in a different format from that of the original; the system accepts 7- or 9-track tape and all recording densities, as well as both NRZI and phase-encoded formats.

First deliveries of the CMC 36 DataPrint System were made in mid-1971, and over 100 units have been delivered to date.

USER REACTION

The following attractive attributes of the CMC 36 were elicited from conversations with its users: excellent operational reliability, dependable servicing, and relatively high throughput.

of 1100 lines/minute. A character set of 48 symbols is standard and includes upper-case alphabetics, numerics, and 12 specials. Other sets of varying sizes are available, as well as custom-designed sets. The 1403-N1 Printer employs the IBM 1416 Interchangeable Train Cartridge, which contains a 240-character type array consisting of five sections of identical 48-symbol character sets.

Character and line spacing is 10 chars/inch and 6 or 8 lines/inch, respectively. Vertical formatting (forms spacing and skipping) is governed by a 12-channel tape loop. Skipping is performed at 33 inches/second, and at 75 inches/second on skips of more than 8 lines. The printer accommodates continuous, pin-fed forms from 3-1/2 to 18-3/4 inches wide and up to 22 inches long (at 6 lines/inch) or 16-1/2 inches long (at 8 lines/inch).

DEVICE CONTROL: The CMC 36 DataPrint System is a programmable, off-line printer system that executes all operations under program control as directed by operator-entered commands. The CMC 36 accepts data written on magnetic tape in virtually any format and computer code, translates the data, and prints the data in a specified format.

Commands are entered via the teleprinter and can be keyed directly or punched into and read from paper tape. Keyed in DataPrint Control Language, the commands initiate loading of the operating program from the system tape, define operating parameters for processing the job tape, and initiate system operation. Commands are grouped into five categories: Job Description, Tape Positioning, Tape-to-Print, Summary Reporting, and Operator Intervention.

Job Description commands define the job tape to be processed and the output format. These commands permit the operator to (1) preassign a supplied system response for program-defined events that occur during job processing, (2) define tape, printer, and statistical-count-control parameters, and (3) selectively print or omit records identified by a keyed character string.

Program-defined events are counted. These include statistical events such as record- and block-handling operations between tape and printer; user errors such as an unspecified block length, an over-sized record or print line, etc.; and system errors such as internal machine faults. The DataPrint program, in addition to counting the events, responds in one of three pre-selected ways: stop processing until an operator decision has been made to abort or continue processing, report (via teleprinter) and continue processing, or continue processing.

Program-definable tape and printer parameters permit tape unit, recording density (high/low), record format, and printer format assignments. Record lengths can be defined as fixed, variable, or undefined, in which case an end-of-record code defines record length. Record and block lengths of from 1 to 256 characters and 10 to 16,383 records, respectively, can be defined. Any of 256 codes can define the single-byte end-of-record code. Tape record and block offsetting can be defined for up to 255 characters or records, respectively.

Printer formats are defined through use of carriage-control code tables; any of five can be defined for the processing of a particular job. The location of a carriage control code within a tape record can be defined for any of the allowable 255 character positions within a record. Other definable parameters include line spacing (1 to 15 lines), first and last print columns, non-printable or substitute print characters (any of 256 tape codes), line overflow (over-printing the defined line length), page overflow (channel 12 overflow on vertical format tape), and page ejection at end of job. A line-overflow condition can cause truncation or spacing (up to 15 lines), as defined. The status counters, which record the number of program-defined events during job processing, are initialized by parameter definition.

Record selection and omission functions can also be defined prior to job processing. These functions correspond to

CMC 36 DataPrint System

> Users said the machine is durable and time-proven at this stage of its operating history, and that downtime averages less than 2 percent of operating time. When failures did occur, the users were generally well pleased with CMC's maintenance service.

An especially interesting slant was users' praise for the effectiveness of the off-line printing concept. Consistent speeds of 950 lines/minute and frequent speeds of up to 1100 lines/minute were reported. Continuous operation from tape input, unimpeded by "noise" from selector channel programming interruptions, was credited for these impressive throughput rates.

The recent emphasis on multiprogramming and on spooling of low-speed input/output operations by the mainframe vendors has naturally tended to reduce user interest in off-line printing systems, which may at first glance appear to represent a needless additional hardware expense. But users should recognize that spooling is far from free; it normally imposes significant system overheads in terms of increased main memory demands, CPU time, channel time, and on-line peripheral equipment requirements. Therefore, users who need to increase their throughput or shave their equipment costs should undertake a careful cost/performance comparison of on-line versus off-line printing. Among the currently available off-line printers, the CMC 36 DataPrint System is a particularly attractive and versatile offering. □

➤ a keyed character string, which identifies a selected or omitted record. The functions cause printing to begin with the first block or record that contains the identifying character string, blocks or records to be printed that contain or do not contain the character string, omission of records that contain the character string, and termination of job processing after or before printing records or the block that contains the character string designated as an end-of-job identifier.

Tape Positioning commands direct forward or reverse tape movement by a defined number of blocks or until the next tape mark is encountered.

Tape-to-Print commands include List and Dump functions. The List function initiates processing of the job tape according to the defined parameters. The Dump function prints each tape character as two hexadecimal (9-track tape) or octal (7-track tape) characters.

Summary Reporting commands print the totals recorded by the statistical event counters. One command prints the contents of all counters via the teleprinter.

Operator Intervention commands permit the operator to interrupt, terminate, or continue job processing.

The operator is informed of job status via teleprinter messages. These messages, resulting from operating contingencies, inhibit further input from the keyboard or paper tape until printed; the data in process is stored until control is returned to the operator.

ERROR CONTROL: Each character read from tape is checked for correct parity. A detected parity error automatically reverses the tape to the beginning of the block and re-reads the error block. After three unsuccessful attempts to read the block, the event is reported and the program-defined response is executed. Parity is also checked internally.

PRICING: The CMC 36 DataPrint System is available for purchase or on a one-year lease, which includes maintenance. A separate maintenance contract is provided for purchased units. The CMC 36 is priced as follows:

Device	Monthly Rental (1)	Purchase	Monthly Maint.
DataPrint Processor (2)	$750	$30,000	$110
Core Memory Module (4,096 bytes)	185	7,100	25
Magnetic Tape Controller (3)	125	5,000	15
1600 bpi Adapter (4)	125	5,000	15
Magnetic Tape Unit: 7-track, 200/556, 556/800, or 200/800 bpi	300	11,700	40
9-Track, 800 bpi	300	11,700	40
9-Track, 1600 bpi	300	11,700	40
Dual Print Module (5)	435	17,400	60
Extra Cables (1403-N1 Printer to DataPrint)	50	1,100	10

(1) Includes prime-shift maintenance.

(2) Includes minicomputer, 8K bytes of core memory, Teletype Model 33 ASR teleprinter, print control, and control console.

(3) Accommodates up to four 7-track or 9-track, 800 bpi drives.

(4) Accommodates up to four 9-track, 1600 bpi drives; the Magnetic Tape Controller is a prerequisite.

(5) Accommodates a second IBM 1403-N1 Printer; includes 8K bytes of core memory and print controller. ■

CMC 11 KeyProcessing System

The CMC 11 display panel is informing the operator that the character just entered was an "x" and that the station is in the Data Entry mode and is ready to accept the next entry, which will be the third character in the eighteenth field of the record.

MANAGEMENT SUMMARY

The CMC 11 KeyProcessing System was conceived and initially marketed as KeyLogic by Penta Computer Associates, Inc. In July 1970, Redcor Corporation, a manufacturer of minicomputers, acquired KeyLogic through a merger with Penta. Early in 1972, Redcor filed for bankruptcy under Chapter 11. In May 1972, CMC acquired the installed Redcor customer base (some 50 KeyLogic systems owned by Transamerica Computer Company), existing spare parts, and the entire Redcor field service organization and programming staff.

CMC has fully integrated the KeyLogic system into its existing development and support organization as the CMC 11, an extension of its successful KeyProcessing family of shared-processor key-to-disk systems. Although CMC does not plan to produce additional CMC 11 systems, it has established a planned program of software enhancements with the objective of making each feature operationally similar to other CMC family members. The CMC 11 is available on an "as returned" basis only.

The CMC 11 is based upon the Redcor RC 70 computer system. Data keyed from each station is transferred to the disc unit by way of the computer and stored in an area reserved for that station. The output from each station is assigned a unique identifier called a batch number. The output from a group of stations can be assigned a file name. These assignments are made from the supervisory typewriter station. When the supervisor is ready, all batches within a file can be transferred to magnetic tape, again by way of the computer.

The CMC 11, formerly the Redcor KeyLogic System, is now a member of CMC's family of KeyProcessing Systems. CMC continues to support existing customer installations through additional software packages and field service. Availability of the CMC 11 is on an "as returned" basis only.

CHARACTERISTICS

MANUFACTURER: Computer Machinery Corporation, 2231 South Barrington Avenue, Los Angeles, California 90064. Telephone (213) 477-1585.

CONFIGURATION: The CMC 11 KeyProcessing System consists of the central station equipment (which includes a small computer, a fixed-head disc unit, a magnetic tape drive, and supervisory typewriter station) and from 1 to 40 keyboard stations.

For application of a critical nature, where any equipment down-time in unacceptable, the elements of the central station can be duplicated for redundant backup.

TAPE OUTPUT: 7- or 9-track, compatible with IBM 729 or 2400 Series magnetic tape units. Recording density of the 7-track drive is 556/800 bits/inch; recording density of the 9-track drive is 800 or 1600 bits/inch.

Present software design allows record lengths of 14 to 199 characters. The 14-character length represents the minimum record readable by the IBM tape units. Records can be blocked to a maximum block length of 2048 characters.

DEVICE CONTROL: There are two aspects to control: system and individual station.

The key elements for system control are the file name and batch number. The operator selects the modes of operation for each batch within a file; a unique batch number accompanies the output from each operator. Modes of operation for individual keyboard stations include Data Entry Verify, Correction, and Update.

The Data Entry Mode is conventional.

In the Verify mode, data is rekeyed and compared with data previously recorded. Data being verified is not displayed—only the data keyed. This is a design consideration to eliminate "sight verification," which CMC feels is detrimental to accuracy and speed.

During the entry of data, many programmed checks can be performed. If these checks fail and the operator cannot resolve the problem (such as an alphabetic on the source document when a numeric was called for), the field can be passed and work contained. A table is constructed by the computer containing the location of such errors. At a later time, when the correct information is available, the batch can be recalled and corrected in the Correction mode. In this mode, the error table is used to automatically position the record at the field requiring correction.

CMC 11 KeyProcessing System

Features of the CMC 11 that aid in usability include programmed, step-by-step display of procedures, sophisticated validation procedures, removal of any card or tape handling requirements from the individual operators, and centralization of control with a consequent reduction in the number of decisions required by the individual keyboard operators.

Each keyboard operator is guided by a series of fixed messages that appear on her display panel. The supervisor is guided by a series of typewritten messages. These messages are direct English statements, not mnemonic codes.

Multiple-format capability allows simultaneous data entry for a variety of jobs. Programmed checks provide validation of data and reduce the need for character-by-character verification. CMC plans to implement an arithmetic capability that will enable elementary arithmetical operations to be performed between fields and intermediate results to be used in further calculations; in effect, this will allow the execution of many of the functions that some installations now perform, prior to computer entry, on EAM equipment when data is recorded on cards.

To properly evaluate the CMC 11, keep in mind the area of application for the system. It is specifically designed to replace multiple keypunch installations for the high-volume preparation of data for a computer from orderly and well-designed source documentation. It lacks the format and data display usually required to accommodate efficient point-of-transaction data recording, a natural inclination when the entry station is reduced to a keyboard and display panel.

Because the format is not displayed, the operator must either know the format or have a "cheat sheet", or the source document must provide the format. Keypunch installations have lived with this situation for years and have developed procedures for coping with it. In fact, it can be demonstrated that reference to a displayed format seriously slows input and is not desirable for high-volume work.

Throughput is, of course, of prime interest. Experience with key-to-tape units such as those produced by Mohawk or Honeywell has shown that increases in productivity over keypunches can bary between 5 and 80 per cent, primarily depending on the amount of data entered per record. Improvement tends to be greatest when extensive duplication and skipping are used. A commonly used figure for that mythical "average installation" is 30 percent improvement. CMC is claiming a 20 to 50 percent improvement over keypunches. This appears to be a reasonable estimate if one considers the elimination of card handling, the elimination of many decisions on the part of the operator, and the reduction in verification possible when the value, range, or check-digit checks can be used effectively. But again, this is an average; smaller or greater gains may be realized for specific installations.

In the Update mode, the operator can manually skip through fields within a set of records to locate specific fields for changes.

The Add mode allows work to be continued on a batch of records that had been temporarily suspended. Suspension of work is accomplished through the Partial Batch key on the keyboard; the batch is temporarily closed, allowing the keyboard station to do another job or to prevent misentry while the operator is away from the keyboard.

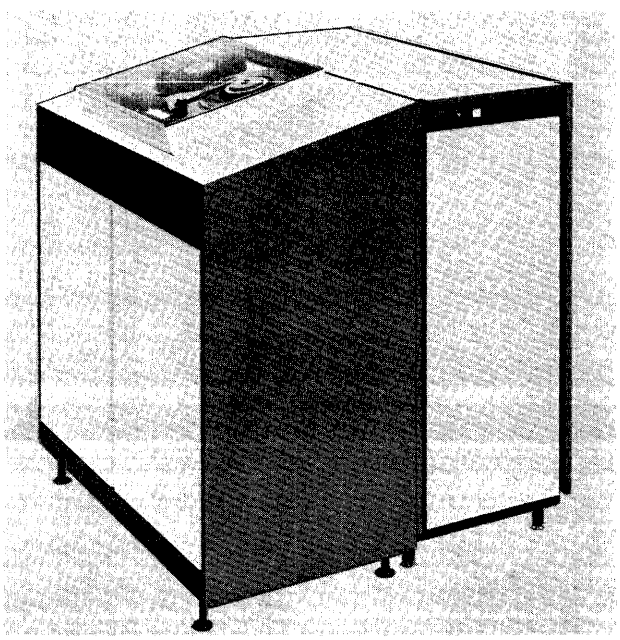
Instructions for operation of the keyboard station are controlled directly by the stored program in the computer as directed by the supervisor.

When seated at a keyboard station, the operator sees only the keyboard and a display panel. Information displayed includes the character entered, the position within a record, a set of error messages, a set of mode messages, and a set of instruction messages.

By following the instruction messages, the operator is stepped through the inputs necessary to set up the station and computer for the job.

Format of the records is controlled by tables held in computer memory. A library of format tables can be stored on a reel of tape and selectively read in under control of the supervisory station. Up to 1,000 formats can be stored on the library tape. Up to 200 formats can be retained in the system at any one time; up to 40 can be active simultaneously. Formats are compiled and the library tape created from formats keyed at the supervisory station.

The individual keyboard station operator selects the formats for her particular job assignment from any of the 200 formats residing in the system. Normally, two formats (primary and alternate) are accessed under a given file name, and the operator can alternate between the



The computer in a CMC 11 system is located in the cabinet below the tape drive. The disc unit is in the cabinet to the rear and can be separated from the tape cabinet if desired.

CMC 11 KeyProcessing System

This increase in productivity can reduce the number of operators required by one-third. Without considering savings on the purchase of punch cards, CMC states that, in general, CMC 11 systems containing 12 or more stations are competitive with corresponding keypunch installations of 18 or more units. Again, this appears to be a reasonable general estimate. □

two. The optional Multi-Level Feature provides 10 format levels; each having a primary and alternate. In effect, up to 40 different jobs or files can be in process at once.

Conventional functions include automatic duplication, skipping, left zero fill, and alphabetic/numeric/alphanumeric field definition. A total of 57 fields, including those generated by the operator and those generated by the computer, can be included in a record.

Record counts and other statistical information can be accumulated if desired.

Operation logs can be printed at the Supervisory station. These logs include information such as identification and status of each file and batch active in the system and operator performance. The later can be deleted from the system if not desired.

ERROR CONTROL: Various software checks are implemented to ensure accuracy of data entry. Field definitions are used to limit input to numerics only, alphabetics only, alphanumerics only (includes A-Z and 0-9), or any character. For alphabetic and numeric fields the appropriate shift is automatically performed.

In addition, one of three types of checks can be specified for each field: check digit, value list, or range. Check digit validation can be modulo 7, 9, 10, or 11 and is the same as on the IBM 29 Card Punch. Check digits can be generated as well as validated.

Value list checking permits a set of values to be included in the format table. Data entered in such a field is checked to see if it agrees with one of these values. This type of checking is useful to validate entries such as transaction codes.

Range checking permits a high and low value to be included in the format table. Data entered in such a field is checked to ensure that it falls between the two limits. This type of checking is useful to ensure the reasonableness of entries.

Batch totals for any field or set of fields can be accumulated and compared to a total entered by the operator from the source document.

The types of checks implemented are ones frequently used in data processing to validate data and to guard against errors. The advantage of the CMC 11 system is that checks are made at the time the data is being entered, permitting immediate correction or flagging (if the source document contains an unreconcilable error). Computer time can be saved because the checks have already been made when the data file reaches the computer.

Any error detected causes the keyboard to lock and an appropriate error message to be lighted on the display panel. The interlock condition is released by the Error Reset key.

KEYBOARD STATION: Consists of a desk with keyboard and display panel. The keyboard is an IBM 29 Card Punch keyboard purchased from IBM. The desk is the same size as an IBM 29 desk. Keyboard stations are connected to the central station by flat interconnecting cables. A bus runs from the computer; individual stations are coupled to the bus by printed-circuit, pronged sandwich connectors. The flat cables will easily fit under carpeting, or a shallow channel can be fitted over them. These features facilitate training and installation.

CENTRAL STATION: Includes a minicomputer, a magnetic disc unit, a magnetic tape drive, and a supervisory station.

The minicomputer is a Redcor RC 70 and is housed in the same cabinet as the tape drive. The amount of core storage required varies with the number of keyboard stations. For example, to handle 14 stations, 20,480 words are needed; the full complement of 40 stations would require 32,768 words.

The magnetic disc unit is obtained from Burroughs. It has a capacity of 2 million characters and an average access time of 17 milliseconds. The magnetic tape drives are obtained from Peripheral Equipment Corporation. The supervisory station is based on the proven IBM Selectric Typewriter.

PRICING: The CMC 11 KeyProcessing System is available for purchase or on a one-year, two-year, or four-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental (1)	Purchase	Monthly Maint.
CMC 11 KeyProcessing System (2)	$2,050	$38,200	$550
CMC 104 Keystation	85	1,400	10
Multi-Level Feature (One per keystation)	15	250	2
Magnetic Tape Unit:			
CMC 243 (7-tk, 556/800 bpi)	(3)	(3)	(3)
CMC 244 (9-tk, 800 bpi)	(3)	(3)	(3)
CMC 245 (9-tk, 1600 bpi) (4)	150	1,600	15
CMC 254 Magnetic Disk Unit	(3)	(3)	(3)
CMC 299 Tape Controller (for 9-tk operation at 1600 bpi)	200	1,950	30
CMC 752 Memory Module (4096 bytes)	220	2,700	20

(1) For one-year lease including maintenance. Discounts of 20 or 30 percent are available for single or multiple systems respectively, under a two-year lease and 30 or 35 percent under a four-year lease.

(2) Includes supervisory console, minicomputer, CMC 254 Magnetic Disk Unit, CMC 243 or 244 Magnetic Tape Unit, and system software. The basic system includes 20K bytes of main memory, which can support 16 keystations.

(3) Included in basic price of CMC 11.

(4) Replaces the CMC 243 or 244 Magnetic Tape Unit on a basic system and requires the CMC 299 Tape Controller. ■

Computer Optics CO:77 Information Display System

Available in local and remote cluster configurations of up to 32 devices including displays and printers, the CO:77 system is a direct replacement for IBM's 3270. Cost savings over the 3270 can be considerable, depending on the configuration.

MANAGEMENT SUMMARY

Computer Optics, a manufacturer of CRT display terminals formed in 1968, has assumed a comparatively low-profile image in the industry. And until May 1973, when Computer Optics announced its first fully compatible IBM replacement terminal, it had not seriously contended for a share of the IBM replacement market. The company's previous products include the CO:70, an ASCII terminal that is no longer in production, and the CO:75, a quasi-compatible replacement for IBM's 2848/2260 Display Station that experienced low market penetration, primarily because it was marketed for text editing applications rather than as an IBM replacement.

The CO:77 Information Display System is a direct replacement for the IBM 3270 Information Display System and provides complete software compatibility with the IBM 3270 with respect to line discipline, commands and command-code structure, and addressing sequence. Moreover, the CO:77 systems provide all features and functions that are currently available with the IBM 3270, as well as a few notable enhancements.

The CO:77 system is available as a clustered terminal for either local (computer site) or remote applications combining as many as 32 display units and printers. No remote stand-alone replacement for the IBM 3275 is currently available, and Computer Optics has no immediate plans to introduce one.

The salient features of the CO:77 system are compared with those of the IBM 3270 system in the following paragraphs.

- *Display capacity*—The CO:77 offers a choice of three screen sizes: 480, 960, and 1920 characters. IBM provides two screen sizes: 480 and 1920.

CHARACTERISTICS

MANUFACTURER: Computer Optics, Incorporated, Berkshire Industrial Park, Bethel, Connecticut 06801. Telephone (203) 744-6720 or (800) 243-1314 (toll-free).

MODELS: Model 7271, a remote cluster display system, and Model 7272, a local cluster display system.

MULTISTATION CONFIGURATION: The Model 7271 and 7272 display systems each incorporate a hard-wired control unit that can accommodate up to 32 devices, including any mix of CRT display units and printers. The control unit provides individual buffering for each device, which can be located at a distance of up to 2000 cable-feet. Each display unit can support a light pen and an ID card reader, which require one light pen and ID card reader adapter for each set of up to eight pens and readers.

The basic control unit for each of the two models of cluster display systems can accommodate up to eight devices via an integral device adapter. Eight additional devices can be accommodated by each subsequent device adapter, up to a total of four adapters. As an option, devices having 480- or 1920-character buffers can be mixed on the same device adapter via a mixed character buffer (one per device adapter).

Buffer capacity corresponds to screen size of the available display units: 480, 960, or 1920 characters.

The 7271 remote cluster system is connected to a modem via a 50-foot cable.

The 7272 local cluster system contains a channel interface for direct connection (via up to 200 feet of cable) to an IBM System/360 computer, Models 25 through 195, or an IBM System/370 computer, Models 115 through 195, via a Selector, Multiplexer, or Block Multiplexer channel. The maximum data transfer rate for local operation is 650,000 chars/sec.

COMMUNICATIONS: Transmission is half-duplex, synchronous at standard speeds of 2000 or 2400 bits/second or at optional speeds of 9600, 7200, 4800, or 1200 bits/second, using 8-level EBCDIC or ASCII (with parity). The Model 7271 remote terminals employ the IBM Binary Synchronous Communications (BSC) technique and are transmission-compatible with the BSC models of the IBM 3270 Information Display System.

The terminals provide an EIA Standard RS-232C interface and connect to a voice-grade communications facility via a modem. Bell System modems that can be used include the 202 series (1200 bps), 201 series (2400 bps), 208 series (4800 bps), and 209A (7200 and 9600 bps).

CRT DISPLAY: Via a 15-inch (diagonal measurement) CRT. The three standard display arrangements are as follows:

Display model:	7277-1	7277-3	7277-2
Characters/display:	480	960	1920
Lines/display:	12	12	24
Characters/line:	40	80	80

Computer Optics CO:77
Information Display System

- *System configuration*–The CO:77 can accommodate up to 32 directly attached devices (printers and display units). As options, each display unit can accommodate an ID card reader and a light pen. These configuration rules are identical with those of the IBM 3270, but the CO:77 device adapter accommodates twice as many devices per adapter. A lower limit on the number of devices per adapter is generally conducive to a lower-cost configuration. But even with reduced cost-effectiveness resulting from the larger adapter, the CO:77 is priced substantially below its IBM counterpart. What's more, the CO:77 permits mixing 480- and 1920-character devices on the same device adapter for increased operating flexibility.

- *Printed output*–Computer Optics has significantly enhanced the CO:77's hard-copy capability with respect to that of the IBM 3270. A full-character printer, rated at 275 cps with a 64-character print set, produces copy 4 or 7 times faster than IBM's 66 or 40 cps matrix printers, respectively. The printer, produced by Odec to Computer Optics specifications, is also available with a 96-character print set including lower-case alphabetics, which reduces its rated speed to 187 cps. Like its IBM counterpart, the CO:77 printer can function as a remote device and can be addressed separately. Local printing can be initiated at the display unit, but printing is executed only upon receipt of a print command from the computer.

- *Displayed output*–The CO:77 has essentially the same display characteristics as the IBM 3270. Clarity and sharpness (resolution) of the displayed characters are equivalent to those of the IBM 3270, since both form each character via a 7-by-9 dot matrix. Lower-case alphabetics are included in the CO:77's 96-character display option. By contrast, lower-case alphabetics for the IBM 3270 are available as an RPQ. Like its IBM counterpart, the CO:77 provides two beam intensity levels to highlight important information and beam blanking to mask confidential data for security purposes. Unlike the rigidly-mounted IBM 3270 display unit, the CO:77 display unit can be tilted or pivoted to eliminate glare and to satisfy the viewing convenience of individual operators.

- *Editing*–The CO:77 provides the same editing capability as the IBM 3270; i.e., character insertion and deletion.

- *Key entry*–Six keyboard styles that duplicate the IBM 3270 66- and 78-key EBCDIC and ASCII keyboards are available: typewriter, data entry, and operator console.

- *Communications*–Transmission speeds for the CO:77 range from 1200 to 9600 bps, compared with 1200 to 7200 bps for the IBM 3270. Speeds of 1200 bps and above 2400 bps are optional for the CO:77.

- *Software support*–CO:77 systems are compatible with and can utilize all existing IBM software for the 3270.

The CO:77 currently does not provide compatibility with IBM's SDLC protocol. However, Computer Optics, like many other independent vendors, plans to provide SDLC-compatibility before the end of 1975.

A character set of 64 or 96 (optional) EBCDIC or ASCII characters, including upper case and lower case (optional) alphabetics, numerics, and special symbols, is displayed in green against a dark background. Each character is formed by a matrix of 7 by 9 dots.

Beam intensity, via program control, can be switched between normal and bright intensity levels, or the beam can be turned off (blanked).

SOFTWARE SUPPORT: The CO:77 system is supported under existing IBM software support for the IBM 3270, which includes the following IBM access methods: BTAM under DOS, DOS/VS, OS, or OS/VS2; TCAM under OS; and VTAM under DOS/VS, OS/VS1, or OS/VS2. The CO:77 system is supported as a display console in a local environment by IBM's DIDOCS or SDS under OS (MFT or MVT). The CO:77 system is also supported for use with the following IBM Program Products: VIDEO/370, DATA/360, IMS, IQF, CICS, and TSO.

DEVICE CONTROL: The CO:77 system operates under the control of the program stored at the computer and provides complete compatibility with the addressing sequence, command code structure, and line discipline employed by the IBM 3270 Information Display System. The CO:77 system responds to and executes the full repertoire of IBM 3270 commands via a hard-wired processor.

Cursor control is functionally the same as in the IBM 3270. The controls position the cursor up, down, left, or right, either step-by-step or repetitively (if the key is held down); the cursor can also be backspaced one character position, moved to the beginning of the next line or the next unprotected data field, tabbed to the beginning of the next unprotected data field, and backtabbed to the beginning of the previous unprotected data field.

Program Function and Program Attention keys, a standard feature of the IBM 3270, are also standard in the CO:77 systems. Each of these keys generates a unique code that is recognized by the controlling software as a specific program request or data identifier. Program Function codes accompany the display data as it is transmitted to the computer, while Program Attention codes are transmitted separately.

A light pen is available as an option and functionally corresponds to IBM's Selector Pen, a 3270 option. Any one or several alphanumeric or numeric fields of fixed or variable formats can be selected by the pen, while transmits the address of the selected entry to the computer to initiate the programmed function.

KEYBOARD: Any of three keyboard arrangements can be specified: typewriter, data entry (keypunch), or operator console. The keyboards are identical in layout and key arrangement with the equivalent IBM 3270 keyboards, and include a separate group of 12 Program Function keys located to the right of the main keygroup.

A separate 10-key numeric pad is optional for use with any keyboard.

PRINTED OUTPUT: Printed copy is produced by an optional full-character impact printer, which provides 132 print positions. The printer is rated at 275 char/second for a 64-character EBCDIC print set and at 187 char/second for a 96-character EBCDIC or 64-character ASCII print set.

The printer accommodates continuous, 5-part, pin-fed forms up to 14-7/8 inches wide via an adjustable tractor. Horizontal and vertical spacings are 10 char/inch and 6 lines/inch, respectively. Vertical format control is standard and is implemented via a paper tape loop.

PRICING: The CO:77 systems are available for purchase or on a one- or three-year lease, which includes maintenance. A separate maintenance contract is available for purchased systems.

Computer Optics CO:77
Information Display System

The CO:77 system offers users substantial savings over the IBM 3270 system. A bare-bones CO:77 system (without ID card readers, light pens, and printers) leases for as much as 37 percent (one-year lease) to as much as 43 percent (three-year lease) below the cost of an IBM 3270 System of equivalent size. For example, a 16-station CO:77 with 1920-character displays and 78-key typewriter keyboards leases for $1,848 (one-year lease) or $1,693 (three-year lease) per month. This represents a monthly saving of $939 or $1,094 under a one- or three-year lease, respectively. However, the combined cost of light pens and ID card readers drives the monthly cost saving down by $138 (one-year lease) or $97 (three-year lease) per 8-station increment. Still further erosion of savings occurs by adding printers. CO's printers are 4 to 7 times faster than IBM's printers for the 3270 system, but they also cost from $48 to $133 (one-year lease) or $29 to $114 (three-year lease) per month more than the IBM printers. By adding a light pen and ID card reader to each of the 16 displays in the above example, plus one printer for each group of 4 displays (4 printers), the monthly saving would be whittled down to $364 to $24 per month under a one-year lease or to $686 to $346 per month under a three-year lease. (These price comparisons do not include cable costs for IBM or Computer Optics.)

Initial customer deliveries of the CO:77 System were made in September 1974. Computer Optics had shipped over 400 displays as of March 1975.

Service is provided by Computer Optics in major cities, and currently by Syntonic Technology, Inc. in other areas of the United States.

USER REACTION

Datapro interviewed 8 early users of Computer Optics CO:77 systems, who reported on their experience with a total of 106 displays. All replaced existing IBM 3270 installations and were operating in a local environment. Only one user was also using CO:77 displays as remote terminals. About half of the users contacted were using the displays on a trial basis. The following equipment ratings by six of the users can be considered preliminary, since their installations ranged between two and five months old.

	Excellent	Good	Fair	Poor	WA*
Overall performance	3	3	0	0	3.5
Ease of operation	4	2	0	0	3.7
Hardware reliability	3	3	0	0	3.5
Maintenance service	2	4	0	0	3.3
Technical support	3	2	1	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

These users were well pleased with the product and its support. All commented that Computer Optics has been very responsive to their needs. In all cases, installation was smooth; no software changes were reported. Little or no downtime has been experienced. However, three users reported minor printer logic problems, which have already been resolved at two of the installations.

Cost, obviously, was the chief reason for going with Computer Optics. Additional advantages mentioned by the users were fast printing speed, small and lightweight display units, tiltable screen (which reduces glare and adds to operator convenience), and better touch on the keyboard (as compared to the IBM 3270). Character clarity was reported to be as good as that of the 3270.

Users are aware that small display-unit size means larger controller size (because the logic has to be put somewhere), but they commented that finding space for the controller was no problem. Screen glare was noted as a problem at some of the installations, but Computer Optics is in the process of providing anti-glare screens.

The final word on operator convenience, a vital concern for data entry equipment, was made by one user who had occasion to shift his operators back to IBM 3270's while some changes were being made to his CO:77's. The operators liked the CO:77's much better. As a result, this user lauds the human engineering features of the CO:77 displays. □

	Monthly Rental (1) 1-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
Control Units & Adapters				
Model 7271 (remote) (2)	$290	$265	$7,424	$37
Model 7272 (local) (2)	295	270	7,424	42
Device Adapter (3)	107	98	2,778	12
Mixed Character Buffer (4)	5	4	145	0
Light Pen/ID Card Reader Adapter (5)	10	9	300	0
Display Units				
Model 7277-1 (480-char. screen)	47	43	1,168	7
Model 7277-2 (1920-char. screen)	68	62	1,702	10
Model 7277-3 (960-char. screen)	54	49	1,346	8
Keyboards				
66-key ASCII or EBCDIC Typewriter	14	13	336	3
66-key EBCDIC Data Entry	14	13	336	3
78-key ASCII or EBCDIC Typewriter	16	15	336	4
78-key EBCDIC Operator Console	16	15	336	4
10-key Numeric Pad	14	13	332	3
Printers (275 cps)				
Model 7780-1 (480-char. buffer)	253	234	6,234	40
Model 7780-2 (1920-char. buffer)	265	246	6,540	42
Model 7780-3 (960-char. buffer)	259	240	6,387	41
Printers (187 cps)				
Model 7780-5 (480-char. buffer)	261	242	6,474	40
Model 7780-6 (1920-char. buffer)	273	254	6,780	42
Model 7780-7 (960-char. buffer)	267	248	6,627	41
Options				
Transmission speeds: 9600, 7200, 4800, or 1200 bps	6	5	161	1
Dual Case (96 displayable chars.)	18	16	460	0
Selector Light Pen (6)	29	26	780	2
Operator ID Card Reader (6)	30	28	714	6
Audible Alarm	6	5	158	1
Numeric Lock	0	0	0	0
Security Keylock	75 (7)	75 (7)	75	0

(1) Includes maintenance.

(2) Does not include Device Adapters.

(3) Up to 4 per control unit; each adapter accommodates 8 devices.

(4) One per Device Adapter; permits mixing 480- and 1920-char. devices.

(5) One per Device Adapter; accommodates up to 8 pens and readers.

(6) Requires Light Pen/ID Card Reader Adapter.

(7) One-time charge. ■

Computer Transceiver Systems Execuport 300 Series Terminals

MANAGEMENT SUMMARY

Among commercial time-sharing companies, by far the most widely supported interactive data communications terminals are the Teletype Model 33 and 35 Teletypewriters. Numerous peripheral equipment manufacturers are now producing and marketing "Teletype-compatible" terminals, which have the same interface characteristics and can utilize the same software support as the Teletype units. Among portable Teletype-compatible terminals, the Execuport 300 series terminals probably boast the most widespread acceptance, with over 3000 units currently in use.

Each Execuport 300 series terminal is a 29- to 36-pound unit that can be used either in an office environment, as an attractive desk-top terminal on an oiled-walnut base, or in the field, as a portable unit contained within an attache case that measures 17 by 19 by 7.5 inches. The terminal is readied for operation by placing it on a flat surface next to a telephone and a 110-volt AC outlet. (The terminal is not battery-powered).

The Execuport 300 series terminals exhibit the following salient features:

- Full ASCII keyboard.
- Additional numeric keygroup.
- Non-impact printer.
- Three selectable transmission speeds: 10, 15, and 30 characters per second.
- 95 print symbols, including upper- and lower-case alphabetics.
- Simultaneous on- and off-line operation.
- Integral telephone coupler and modem.
- Optional use of magnetic tape cassettes or paper tape.

These portable, interactive data communications terminals, designed primarily for time-sharing applications, offer Teletype compatibility, 128-character ASCII keyboard with numeric inset, printed output, selectable transmission speeds up to 30 characters per second, and optional magnetic tape cassette or paper tape facilities.

CHARACTERISTICS

MANUFACTURER: Computer Transceiver Systems, Inc., East 66 Midland Avenue, Paramus, New Jersey 07652. Telephone (201) 261-6800.

MODELS: The Execuport 300 Series is available in six models that are distinguished by slight model differences. Models 310, 310C, and 310D include a standard ASCII keyboard with an additional numeric keygroup. Models 311, 311C, and 311D have a Teletype Model 37-type keyboard without the numeric keygroup. Models 310 and 311 are lightweight equivalents of the 310C and 311C, which are six pounds heavier. Models 310D and 311D include a walnut base and are intended for stationary use as a desk-top unit.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode at switch-selectable transmission rates of 10, 15, and 30 characters/second (110, 150, and 300 bits/second). The 8-level (including parity) ASCII transmission code is used. The code structure at 110 bits/second is 11 bits/character and includes one start and two stop bits. At 150 and 300 bits/second, the code structure is 10 bits/character, including one start and one stop bit.

Connection to a voice-grade communications facility is provided by an integral modem that contains an acoustic/inductive telephone coupler. The integral modem provides compatibility with the Bell System 103 Series Data Sets and can also be connected to a Bell System Data Access Arrangement. An EIA Standard RS-232C modem interface is also provided to permit connection to an external modem. Transmission characteristics are compatible with those of the Teletype Model 33 teletypewriters.

DEVICE ATTACHMENTS: One or two customer-supplied I/O devices and/or Execuport 420 or 425 cassette recorders can be attached to a 300 Series terminal, which is equipped with two additional EIA Standard RS-232C interfaces.

DEVICE CONTROL: Designed for query/response operation, the Execuport 300 series terminals provide for data entry via a keyboard and for data output via a non-impact printer. The terminals transmit any of 128 ASCII characters and print 95. Data is printed as it is received and transmitted as it is keyed. The units can also operate in an off-line or local mode as conventional typewriters, or they can be used with customer-supplied peripheral attachments. Through the use of the Isolate mode function, data can be keyed in an off-line mode while on-line operation between a remote computer and an attached peripheral device is in progress.

The unit will respond to keyed or received control codes that include line-feed, carriage-return, backspace, bell, enquiry (if the Answerback option is installed), and four device-control codes used to operate an attached peripheral such as a magnetic tape cassette recorder. A break key is provided to interrupt a computer message.

Computer Transceiver Systems
Execuport 300 Series Terminals

Execuport's non-impact printer, manufactured by NCR, uses the electrothermal printing technique, long indigenous to the facsimile domain. Printer operation is keyed to transmission rate. Although the printer exhibits increased reliability over the electromechanical variety, there are some drawbacks: (1) printed symbols are not as sharp and clear as those produced by most electromechanical printers, (2) multiple copies cannot be produced at the same time, and (3) special paper is required for printing. Thermographic paper is available from CTSI in 100-foot rolls at a cost of about two cents per page (in small quantities).

The printer forms lower-case alphabetics in an unusual manner: lower-case letters are printed as capitalized half-size equivalents of the corresponding upper-case letters.

The Execuport 300 was announced in mid-1968, and deliveries began in November 1969. Lead time on orders is currently quoted at 10 days after receipt of order. Lead time on orders for the Execuport 420 and 425 is currently quoted at 30 to 45 days.

Service is provided through Honeywell Information Systems, Inc. Response time to service calls is quoted at four to five hours within a 50-mile radius of most U.S. cities. Computer Transceiver Systems says it averages only 0.9 service calls per year per terminal.

Users have found the Execuport 300 to be quite satisfactory for its intended purpose as a portable terminal. Datapro talked to several users who have operated their terminals for periods of one to three years without requiring service. In one case, a print head was damaged as a result of abusive handling by baggage personnel, but service was responsive and the terminal soon functioned again. □

The Answerback option transmits a user-determined terminal-identification message in response to a received inquiry (ENQ) code or keyed "Here Is" code.

When the optional Execuport 420 or 425 magnetic tape cassette recorder is employed, keyed or received data can be recorded on tape; recorded data can be transmitted at 30 characters/second, or it can be printed at the same rate in the off-line mode.

ERROR CONTROL: Selectable odd or even character parity is generated and accompanies each character transmitted, but is not checked on received data.

KEYBOARD: 58-key ASCII, typewriter (310) or Teletype (311) style. The keyboard can produce any of 128 ASCII characters, including upper- and lower-case alphabetics, numerics, punctuation, special symbols, and control codes.

The 310 Series terminals include a 22-key numeric keygroup located to the right of the main keygroup, which includes the 10 numerics and 12 special symbols used for arithmetic operations.

The 310 Series keyboard (including the numeric inset) can be made to conform with any of eight discrete symbol formats as selected by the setting of the Qwerty Shift Lock, an upper/lower-case alphabetics control, combined with shift- and control-key functions.

PRINTER: Prints any of 95 ASCII symbols including upper- and lower-case alphabetics, numerics, and special symbols (ASCII columns 2 through 7) at selected speeds of 10, 15, or 30 characters per second. Lower-case alphabetics are printed as capitalized, half-size equivalents of the corresponding upper-case alphabetics. The non-impact printer employs the electrothermal printing technique. Characters are formed within a 5-by-7 dot matrix; nominal character size is 0.110 inch high by 0.082 inch wide.

The printer has a friction-feed drive and accommodates a 100-foot roll of thermographic printing paper, which is loaded from the top of the unit. Line length is 80 characters, spaced at 10 characters/inch. Vertical spacing is 6 lines/inch. A carriage return and line feed are performed automatically after 80 characters are printed.

CASSETTE TAPE RECORDER: The Execuport 420 and 425 record data on a Philips-type cassette, which contains 300 feet of 0.15-inch magnetic tape. Total cartridge capacity is rated at 50,000 characters; rated data transfer speed is 30 characters/second. The Execuport 420 and 425 are self-contained units that can be cable-connected to an Execuport terminal. Both models of cassette recorders are available with a remote call-up feature for unattended operation; the Execuport 425 is also available with an edit feature that permits remote searching.

PAPER TAPE I/O: Two paper tape units are available, a read-only unit and a reader/punch unit. Both include an EIA Standard RS-232C interface, are equipped with Automatic Carriage-Return Delay, and operate at all speeds up to 60 char/second; the read-only unit also operates at 120 char/second. Both units accommodate 5- to 8-level fully-punched tape.

PRICING: The Execuport 300 Series terminals are available for purchase or on a one-, two-, or three-year lease. Conversion from lease to purchase is available through a purchase-credit option.

	Monthly Rental*			
Execuport 300 Model	1-Yr. Lease	2-Yr. Lease	3-Yr. Lease	Purchase Price***
310	$155	$175	$123	$3,800
310C or D	135	153	110	3,190
311	155	175	123	3,800
311C or D	135	153	110	3,190
Table (for D Models)	5	5	5	85
Cassette Model				
Execuport 420	66	79	56	1,600
Execuport 425	68	81	58	1,650
Cassette Options				
Remote Control	4	4	4	100
Remote Search**	6	6	6	150
120-cps Operation**	6	6	6	150

*Lease prices under a one-year lease include maintenance; two- and three-year leases include maintenance for the first 90 days, and maintenance is priced at $20/month per terminal thereafter. Maintenance for the Execuport 400 Series Cassette Recorders is priced at $10/month.
**Options for Execuport 425 only.
***Maintenance prices are the same as those for leased equipment. ■

Computer Transceiver Systems Execuport 1200

The Execuport 1200 is a high-performance teleprinter terminal designed for special printing applications that require formatting and a forms handling capability. Selectable operating speeds range from 10 to 120 characters per second. The use of paper tape or magnetic tape is optional.

MANAGEMENT SUMMARY

The Execuport 1200, a high-performance teleprinter terminal, is the latest member of Computer Transceiver's Execuport family of teleprinters. Available in either an RO (receive-only) or KSR (keyboard send/receive) configuration, the Execuport 1200 is designed for compatibility with Teletype units as well as other teleprinters of the same class. Salient features include:

- Five operator-selectable, asynchronous operating speeds—10, 15, 30, 60, and 120 characters per second.
- An impact printer that prints any of 96 ASCII symbols, including upper- and lower-case alphabetics.
- A standard 132-character print line.
- A pin-feed adjustable tractor that accommodates form widths of 3-1/2 to 14-7/8 inches.
- A full 128-character ASCII keyboard plus an additional numeric keygroup.
- Optional use of magnetic tape cassettes or paper tape.

The Execuport 1200 contains an impact printer that prints by means of a 5-by-7 matrix of 35 solenoid-activated styli, which impact an ink transfer ribbon as the matrix head is moved across the paper by a motor- ▷

CHARACTERISTICS

MANUFACTURER: Computer Transceiver Systems, Inc., East 66 Midland Avenue, Paramus, New Jersey 07652. Telephone (201) 261-6800.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode at switch-selectable transmission rates of 10, 15, 30, 60, and 120 char/second (110, 150, 300, 600, and 1200 bits/second).

The 8-level (including parity) ASCII transmission code is used. The code structure at 110 bits/second is 11 bits/character and includes one start and two stop bits. At all other speeds, the code structure is 10 bits/character, including one start and one stop bit.

The communications interface is designed to EIA Standard RS-232B. The Execuport 1200 connects to a voice-grade communications facility via a modem compatible with the Bell System 100 Series (up to 300 bps) or 202 Series (up to 1800 bps) modems. Integral modems are available that provide compatibility with Bell System modems 103A2 and 202C.

DEVICE CONTROL: Designed for query/response operation, the Execuport 1200 provides for data entry via a keyboard and for data output via a non-impact printer. The terminal transmits any of 128 ASCII characters and prints 95. Data is printed as it is received and transmitted as it is keyed. The unit can also operate in an off-line or local mode as a conventional typewriter, or it can be used with customer-supplied peripheral attachments accommodated via an optional 132-character line buffer.

The unit will respond to keyed or received control codes that include line-feed, carriage-return, backspace, bell, enquiry (if the Answerback option is installed), and four device-control codes used to operate an attached peripheral such as the magnetic tape cassette recorder. A Break key is provided to interrupt a computer message.

The Answerback option transmits a user-determined terminal-identification message in response to a received inquiry (ENQ) code or keyed "Here Is" code.

ERROR CONTROL: Selectable odd or even character parity is generated and accompanies each character transmitted, but is not checked on received data.

KEYBOARD: 58-key typewriter style. The keyboard can produce any of 128 ASCII characters, including upper- and lower-case alphabetics, numerics, punctuation, special symbols, and control codes. ➤

Computer Transceiver Systems
Execuport 1200

driven belt. Characters are printed one at a time, as a group of styli are thrust forward simultaneously to form a character.

The user can elect to use an external storage medium with the Execuport 1200: either paper tape or magnetic tape in cassette form. Paper tape operation is available as a read-only or a read/punch capability. A special feature, Carriage-Return Delay, is incorporated into the paper tape equipment; it precludes the need to use punched null codes to wait for the printer to perform carriage-return and line-feed operations. The Execuport 425 magnetic tape cassette recorder can be operated remotely via received ASCII control codes where unattended operation is a requirement. The Execuport 425 is also equipped with the Carriage-Return Delay feature, and can perform search operations on a character basis.

The Execuport 1200's enhanced printing capabilities—including its wide print line, adjustable tractor feed, vertical and horizontal tabulation options, and five selectable operating speeds—place it in a class above conventional teleprinter terminals and help to justify its elevated price tag. With these enhancements, the Execuport 1200 is a candidate for applications that employ more than one form size and require special formats, such as billing, listing, etc.

The Execuport 1200 was introduced at the 1972 SJCC, and pilot units were delivered shortly thereafter. Production deliveries began in early 1973 to fulfill an order for 550 units placed by a leading OEM manufacturer. Current lead time on orders is 60 to 90 days after receipt of order.

Service is provided through Honeywell Information Systems, Inc. Response time to service calls is quoted as four to five hours for installations within a 50-mile radius of most U.S. cities. □

A 22-key numeric keygroup located to the right of the main keygroup includes the 10 numerics and 12 special symbols used for arithmetic operations.

The keyboard (including the numeric inset) can be made to conform with any of eight discrete symbol formats as selected by the setting of the Qwerty Shift Lock, an upper/lower-case alphabetics control, combined with shift-key and control-key functions.

PRINTER: An impact, matrix-type printer prints any of 95 ASCII symbols, including upper- and lower-case alphabetics, numerics, and special symbols (ASCII columns 2 through 7), at selected speeds of 10, 15, 30, 60, or 120 characters per second. Lower-case alphabetics are printed as capitalized, half-size equivalents of the corresponding upper-case alphabetics. Characters are formed within a 5-by-7 dot matrix; nominal character size is 0.100 inch high by 0.075 inch wide. Line length is 132 characters, spaced at 10 characters/inch. Vertical spacing is 6 lines/inch. A carriage return and line feed are performed automatically after 132 characters are printed.

An adjustable tractor-feed mechanism accommodates continuous six-part forms from 3-1/2 to 14-7/8 inches wide. Vertical and horizontal tabulation and top-of-form control are optional.

CASSETTE TAPE RECORDER: The Execuport 425 records data on a Philips-type cassette, which contains 300 feet of 0.15-inch-wide magnetic tape. Total cartridge capacity is rated at 50,000 characters; rated data transfer speed is equal to the selected transmission speed (up to 120 char/second). The Execuport 425 is a self-contained unit that is cable-connected to the Execuport 1200.

PAPER TAPE I/O: Two paper tape units are available, a read-only unit and a reader/punch unit. Both include an EIA Standard RS-232 interface, are equipped with Automatic Carriage-Return Delay, and operate at all speeds up to 60 char/second; the read-only unit also operates at 120 char/second. Both units accommodate 5- to 8-level fully-punched tape.

PRICING: The Execuport 1200 is available for purchase or on a one-, two-, or three-year lease. Conversion from lease to purchase is available via a purchase-credit option.

	Monthly Rental*				
Execuport 1200	1-Yr. Lease	2-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
Unbuffered, single speed	$212	$229	$163	$4,800	$30
Unbuffered, five speeds	221	241	172	5,035	30
Buffered, single speed	224	244	173	5,090	30
Buffered, five speeds	233	255	182	5,330	30
Options					
Vertical Tab	6	7.50	5.50	155	–
Horizontal Tab	6	7.50	5.50	155	–
Top of Form	4	5.00	3.50	105	–
Integral modem:					
103A2-Compatible	**	**	**	**	**
202C-Compatible	**	**	**	**	**
Execuport 425	78	91	68	1,650	10
Read-Only Paper Tape	31	**	**	775	7
Paper Tape Reader/Punch	72	**	**	1,800	15

*Lease prices under a one-year lease include maintenance; two- and three-year leases include maintenance for the first 90 days only.
**Prices are available upon request to the manufacturer. ■

Consolidated Computer Key-Edit 50

MANAGEMENT SUMMARY

Founded in 1968, Consolidated Computer was part of a strong attempt by the Canadian government to foster an indigenous data processing industry. Not widely available in the United States until recently, the company's Key-Edit family of shared-processor key/disk systems has nonetheless generated considerable interest. With the first delivery of a functioning system in late 1969, Consolidated Computer became one of the pioneering key/disk companies. The first systems, the Series 100, earned the company a reputation for comprehensive facilities for data manipulation and the capability to install large systems. The Series 100 could handle up to 32 keystations—a large system in 1970.

Despite financial backing by the Canadian government, the economic slowdown in 1970 and 1971 caught up with Consolidated as it did with many companies of all sizes. By 1972, end-user marketing was virtually abandoned. Substantial OEM contracts with ICL (Europe), Fujitsu (Japan), and Ecodata of Brazil (South America) permitted the continued existence of the company. Although its marketing effort was reduced, the company strongly emphasizes that an unbroken continuity of engineering and systems work was maintained.

A great deal of confusion has surrounded the marketing of the Key-Edit systems. Trade press reports from time to time indicated that marketing was about to begin in the U.S. Whether a company statement about the desirability of such marketing was misinterpreted or the company was overly optimistic about lease financing is a moot point.

This smallest member of the Key-Edit family inherited much of the system and software architecture of the well known, but now retired, Key-Edit 100. The 50 should be welcomed by small to medium-volume users who need comprehensive data manipulation without extensive computation.

CHARACTERISTICS

MANUFACTURER: Consolidated Computer Inc., 50 Gervais Drive, Don Mills, Ontario, Canada M3C 1Z3. Telephone (416) 449-1120.

CONFIGURATION

There are two basic Key-Edit 50 configurations. Model 501 includes 4 to 8 CRT keystations and a 1.4-million-character disk unit. Model 502 includes 9 to 16 CRT keystations and a 2.8-million-character disk unit.

Both configurations are built around the same processor. Either configuration can include 1 to 4 magnetic tape units with a 7-track, 556/800-bpi; 9-track, 800-bpi; or 9-track, 1600-bpi format. Either configuration can be expanded to include a total of 5.6 million characters of disk storage. The basic processor includes 24K words (12 bits per word) of core memory; an 8K-word expansion module is required for large output tape blocks and/or data communications. Every configuration includes a KSR 33 teletypewriter for supervisory functions. A serial matrix printer or a 300-lpm line printer can be added. A bisync (BSC) communications interface can also be added.

A Key-Edit 50 system can include from 4 to 16 of the CRT keystations shown in the foreground. At rear are the central unit, which houses the processor, fixed-head disk unit, and magnetic tape drive, and an optional 165-cps matrix printer.

Consolidated Computer Key-Edit 50

Today, the Key-Edit systems are definitely available in the U.S. Sales and service are handled out of regional offices in Waltham, Massachusetts; Wayne, Pennsylvania; Worthington, Ohio; Silver Springs, Maryland; Cleveland, Ohio; Atlanta, Georgia; and San Francisco, California. Additional service offices are located in Hartford, Connecticut; Harrisburg, Pennsylvania; Akron, Ohio; Springfield, Illinois; and Macon, Georgia. Undoubtedly, the number will grow.

Re-entry into the end-user market in North America has been made possible by a line of credit (backed by the Canadian government) for financing leased systems, a vital necessity to successful penetration of the lease-oriented U.S. and Canadian user base.

The original Key-Edit Series 100 has been retired. It has been replaced by a family of key/disk systems that provide a graduated capability of up to 56 keystations per system. And Consolidated manufactures its own processors and disk units.

The Key-Edit 50 bears a strong family resemblance to the previous Series 100 systems, but the maximum number of keystations is limited to 16. The big brother of the family, the Key-Edit 1000, is just now being readied for official end-user marketing in the U.S., although a few systems have already been installed in the U.S. The 1000 is not program-compatible with the 50. An intermediate system, the Key-Edit 60, will be introduced in April 1975; it will permit the installation of up to 24 keystations. The Key-Edit 60 will be essentially an expanded 50, including software enhancements.

It is easy to underestimate the Key-Edit 50. With expansion limited to 16 keystations, it lacks the glamour of the larger key/disk systems. With per-station costs hovering above $200 per month (two-year lease) for typical small and expanded configurations, the Key-Edit 50 lacks the glamour of the cheap systems. With the deceptively simple programming concept used, it also lacks the glamour of the more complex systems. Well, then, where does it fit in?

The Key-Edit 50 seems to address the needs of the small-to-medium key entry environment where low volume does not mean reduced complexity of the data entry operations. While computational capabilities are limited to totaling and simple multiplication by repetitive addition, data movement and logical operations permit meeting complex data entry requirements. The capabilities are oriented specifically toward simplifying the task of converting human-generated documents into computer-readable records. The flexibility of the programming system would permit tasks such as report generation to be coded, but it would take a dedicated programmer to generate efficient programs. The capability to accommodate non-keyed entry operations is further limited by an inability to read blocked tapes into the system. If you wish to load data into the system, unblocked formats must be used. This is no handicap for data entry

COMPONENTS

KEYSTATIONS: The CRT monitor and nonseparable keyboard are integrated into a single package.

The CRT monitor displays 64 symbols using an 8-by-12 dot matrix arrangement in 11 lines of 40 characters each. A total of 422 characters can be displayed; the last 18 positions of the ninth line are not used. The top six lines display the data record being keyed or examined. The seventh line is used for display of batch and record status information. The eighth and ninth lines (62 characters maximum) are used to display control commands as they are entered. The tenth and eleventh lines display English-language error messages. Field delimiters when entering or verifying data are shown as a vertical bar between character positions. The cursor appears as an underscore.

The basic keyboard provides 49 keys arranged in data entry (keypunch) layout, including upper case alphabetics, numerics, special characters, and some control keys. An additional row of nine keys across the top of the keyboard provides additional control functions. Control keys include two levels of automatic dup/skip; character, field, record, and document forward or reverse advance; and character, field, or record correct. Some of the control keys, such as auto dup/skip and auto release, are switches that activate or deactivate a particular function.

The keystation can be separated from the processor by up to 500 feet.

DISK STORAGE: Fixed-head single disk unit with a capacity of 1.4 or 2.8 million characters. The disk rotates at 3600 rpm, giving a rotational time of 16.7 milliseconds and an average access time of 8.3 milliseconds. The maximum 5.6-million-character capacity is achieved by installing two 2.8-million-character units.

MAGNETIC TAPE DRIVES: Up to four tape drives of the same or intermixed recording formats can be attached to a Key-Edit 50 system. Available recording formats include 7-track, 556/800-bpi; 9-track, 800-bpi; and 9-track, 1600-bpi (phase encoded). All formats are industry-standard. All drives operate at 25 inches per second and can accommodate reels up to 10.5 inches in diameter (2400 feet). Rewind speed is 150 inches per second.

PRINTERS: Either of two printers can be attached. One is a 165-char/sec serial matrix printer, and the other is a 300-lpm line printer. Both units can print a 64-character set.

The matrix printer can accommodate sprocket-fed forms with up to 5 parts and up to 14.375 inches wide. Horizontal pitch is 10 characters per inch, and the maximum print line is 132 characters. Vertical pitch is 6 lines per inch. A two-channel vertical format control unit provides top-of-form and tabulation functions. Effective printing speed ranges between 60 and 150 lines per minute, depending on the number of characters printed per line.

The line printer operates at 300 lines per minute and is available with 80 or 132 print positions per line. It can accommodate up to 6-part forms from 4 to 14.875 inches wide. Vertical spacing is 6 or 8 lines per inch, and horizontal pitch is 10 characters per inch.

PROCESSOR: Manufactured by Consolidated Computer, the processor uses an architecture similar to that of the DEC PDP-8, which was used in the company's original Series 100 Key-Edit systems. It uses a 12-bit word. Main memory cycle time is 1.2 microseconds. Memory size is 24K words in the basic configuration, and can be expanded

Consolidated Computer Key-Edit 50

operations, or even occasional off-line jobs, but it does emphasize the orientation of the system.

Through the efforts of its OEM customers, Consolidated Computer has become a factor in the world data entry scene. Worldwide, more than 500 systems have been installed in 24 countries, representing about 7500 keystations. In the U.S., approximately 160 systems have been installed, of which about 100 are Series 100 systems. To date, about 50 Key-Edit 50 systems have been installed in the U.S. Consolidated Computer is currently shipping about 15 to 20 Key-Edit systems per month; typical system size is about 9 keystations.

USER REACTION

Datapro talked with six users of Consolidated Computer Key-Edit 50 systems. Five of these users were Canadian businesses and government agencies, and the other was a U.S. business. Altogether, these users had installed 11 Key-Edit 50 systems including a total of 122 CRT keystations. The most common configuration sizes were 16 stations (6 systems) and 4 stations (2 systems). Overall, the users were currently well pleased with their systems. This was reflected in both the ratings assigned, which are summarized below, and in the users' clarifying remarks.

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	2	4	0	0	3.3
Ease of operation, supervisor	2	4	0	0	3.3
Ease of operation, operator	5	1	0	0	3.8
Hardware reliability	3	3	0	0	3.5
Promptness of maintenance	3	3	0	0	3.5
Quality of maintenance	3	2	1	0	3.3
Software	2	2	2	0	3.0
Technical support	2	2	2	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

Almost all of the complaints had to do with the period during early installation rather than current operations. The problems included human engineering of the CRT which allowed the cooling fan to discharge a stream of hot air directly into the operator's face; a lip around the keyboard which formed a natural resting place for an operator's hands and which resulted in calluses; software bugs (minor and major); disk problems; long lead time between announcement and delivery of software features; supervisor procedures; and poorly informed field personnel.

In almost all cases, the problem was solved—a testimony to the attitude of Consolidated Computer toward its customers. Most of the customers remarked directly about the willingness of the company to work with its users; one user reported that preventive maintenance was performed at midnight so that his critical two-shift data entry operation was impacted as little as possible. In one case where the disk problem has not been completely solved, it has at least been made tolerable.

to 32K words to accommodate large tape blocks (up to 4,096 characters) and/or communications operations.

SUPERVISORY CONSOLE: A Teletype KSR 33 serves as the input station for entering supervisory commands and output for system error messages, statistics, program-generated data or messages, and operator-originated messages.

COMMUNICATIONS

Batch-oriented data communications hardware and software are optional. Transmission emulates the IBM 2780, using bisync (BSC) protocol at 2000 bps. External modems must be provided separately by the user. Leased lines or the public telephone network (DDD) can be used. Transmission between two Key-Edit systems (50 or 1000) is supported, as well as transmission between a Key-Edit system and a remote computer supporting batch communications for an IBM 2780 terminal. Data can be transmitted or received from/on disk or tape. Batch transmissions are initiated by the supervisor and can proceed concurrently with key entry and verification.

Remote keystations connected to the Key-Edit 50 processor via communications lines and modems are not supported.

SYSTEM OPERATION

OVERVIEW: All operations of the Key-Edit 50 system run under the MASTER control program. Data entry/verification/validation is initiated and controlled at the keystations. Data transfers between disk and tape, as well as to and from a communications line, are controlled from the supervisory station.

The central data group is the batch or output from one keystation. Subordinate data groupings include documents, records, fields, and characters. One super group, called Group, allows the supervisor to conveniently initiate operations on a sequence of related batches. The key to data flow is the batch name, an eight-character assignment made by the keystation operator the first time data is entered.

During key entry or verification, two levels of programming control operations. The Input program delimits fields and specifies data types; the Input Editor program controls data validation or computation. The operator specifies the Input program in control when a batch is opened. Any Input Editor programming is called from the Input program. After batches have been closed, output processing can be initiated by the supervisor by invoking an Output Editor program. All three levels can be composed of multiple sections or segments to handle varying requirements. A full range of data validation and reformatting procedures can be handled through the three software levels.

OPERATOR FUNCTIONS: The operator's primary responsibility is the key entry and verification of data. Supportive functions include corrections made in the entry or verify mode and the initiation of balance routines for documents or batches. The operator originally enters batch names, but the supervisor can rename a batch if desired. The operator can locate records by record number within a batch or by data content of one to four record segments. Specifications for segment contents can be linked by logical AND or OR conditions, but the two cannot be mixed in the same specification.

The operator names the controlling Input Program when opening or reopening a data batch for data entry or

Consolidated Computer Key-Edit 50

The two users who expressed less than complete satisfaction with the software felt that the facilities were not comprehensive enough for their needs, although they hastened to add that they were adequate for the cost involved.

Also clearly evidenced in the users' comments was the necessity of the standard 2.8-megabyte disk when the full complement of 16 keystations is implemented; one user feels that even this is not large enough.

On the favorable side, several users commented on the speed of installation. Two specifically stated that the system arrived one day and was up and running the next. (Their personnel had received prior training, of course.) A couple of users did report substantially longer installation times, however.

All but one of the users we talked to had replaced existing keypunch or paper tape data entry operations with Key-Edit 50 systems. The other user had a Key-Edit 100 system and keypunches. Two aspects—control of operations and quietness—were mentioned frequently by these users as the outstanding advantages over keypunches. The control aspects particularly impressed these former keypunch users because they permitted improvement in throughput and confidence in handling data. One user had implemented an audit section to monitor the accuracy of data entry. Previously, notes and card decks were returned to the data entry section to get corrections made. Now a keystation located in the audit section's offices permits corrections to be made directly without impacting key entry operations. □

verification. Both source editing programs and application data are treated as data batches and are keyed by the operator. During the course of keying operations, the operator can manually select a program section or can enter data free-form under no control other than a record length specification.

Batches can be suspended in either the entry or verify mode. Batches cannot be opened or reopened in either mode if the batch is open at another keystation. In the verify mode, records can be added or deleted from within a batch (i.e., not at the end). A group of records can be added to the end of a batch in the entry mode.

In general, the operator is guided as to the status of operations through the status line displayed on the CRT. Information displayed includes next column number to be keyed (location of cursor), the last keyed character, the mode of operation, current record number, batch name, current Input Program section number, data type, status of the two keyboard automatic dup/skip keyswitches, and a two-character error code. System error codes are provided for violations of data types in the Input Program and various illegal procedural steps. Failures to meet the validation checks in the Input Editor program can also generate error codes if programmed. The operator can use the Assist key to display a two-line English message explaining the error code. Provision is included in the Input Editor program to generate error messages for programmed error codes.

Prior to executing a balance program, the operator can input up to 40 data characters (typically a set of balance totals) for use by the program prior to reading the first record in a document or batch.

One special mode of operation permits the operator to key in a message of up to 60 characters that will be printed on the supervisor's console.

SUPERVISORY FUNCTIONS: The supervisor's responsibilities include start-up and system program loading; initiating translation of Input, Input Editor, and Output Editor programs and Look-Up tables; maintaining program libraries by linking Input Editor programs with Input programs and Look-Up tables with Output Editor programs; controlling batches through listing, grouping, force-closing, renaming, and releasing batches and initiating the execution of Output Editor programs; controlling data transfer between disk and tape and to and from the communications line; managing disk space; and monitoring system statistics. Data transfers to tape can be initiated individually by batch or group. In addition, batches can be transferred selectively if they meet certain specifications or automatically as soon as they meet certain specified conditions such as balanced, unbalanced, verified, and previously transferred to tape (peeled).

Disk space management operations include reorganizing the disk to compact data and free disk space, writing the contents of the disk to tape for system backup, and reading a system backup tape into disk storage.

OPERATING MODES

- Data Entry—Data is keyed into the system under control of an Input program that defines fields and data types. Automatic links to an Input Editor program provide data validation checks. Some data type specifications can be overridden, but in general the operator cannot force the acceptance of data not meeting type and validation checks. However, such action could be programmed in the Input Editor program if desired. Additional processing can be performed through an Output Editor program.
- Data Verification—Data is verified by rekeying. Selective verification is achieved by alternating use of the two automatic dup/skip switch-keys. Only closed batches can be verified. Visual verification is possible.
- Data Additions and Deletions—A data batch can be reopened in the Entry mode to add records at the end of a batch. In the Verify mode, records can be added or deleted in the middle of a batch.
- Search—In the Verify mode, a record within a batch can be located by record number or by the contents of up to four record segments, which can be linked by logical AND or OR operations. Data in a located record can be modified in the Verify mode, which may require reverification of modified fields if programmed.
- Background—Includes batch transfers to tape, Output Editor programs, and data transfers to and from the communications line. Background tasks and key entry/verification can proceed simultaneously if there is no conflict in device selection.

SYSTEM PROFILE

- Keystations—4 to 16 local CRT keystations plus supervisor teletypewriter.
- Record length—20 to 240 characters; up to 240 fields per record.

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- Formats–An Input program can include up to nine sections or individual formats. Each Input program can be linked to one Input Editor program which can have up to 99 data checking segments and 1 balance segment; branching between segments is not permitted. Output Editor programs are specified separately. The number of Input, Input Editor, and Output Editor programs permitted is a function of their length and the amount of disk space available.

- Output block length–Any blocking factor up to a maximum block size of 4096 characters.

- Data storage–The amount of space available for storing data records is dependent on the number and size of Input, Input Editor, and Output Editor programs. Allowing for system code and a modest number of editing programs, the 1.4-million-character disk should be adequate for a day's output from 8 operators, and the 2.8-million-character disk should handle a day's output from 16 operators. Extensive editing programs or leaving batches on disk for more than one day will decrease the data capacity.

SOFTWARE

The system runs under the overall control of the MASTER operating system. Facilities for user programming include the Input, Input Editor, and Output Editor program capabilities.

INPUT PROGRAM: Required for formatted data entry and checking. An input program consists of one to nine sections. Each section specifies a format. If an Input Editor program is used and the need arises, an Input program segment need not carry definitions for the entire record. Capabilities available in an Input program include data type specification, record length, duplication, skipping, check digit generation or checking, automatic linking to another section of the same Input program, and branching to a segment within the associated Input Editor program. A field can also carry a specification forcing a reverification if a change is made in the verify operation for this record.

A total of 12 different data types can be specified. They can be grouped into four cases (lower, upper, alphabetic, and numeric), operator override permitted or not, zero fill, and sign convention. Special types are permitted for sign overkey.

Automatic duplication and skipping are keyed to the status of the two Auto Dup/Skip keyswitches on the keyboard. Two levels permit different assignments for key entry and verification using the same Input program.

Several types of check digit calculations can be specified, including modulo 10, 11, or 7. Further, modulo 11 checking can be specified so that either a checking digit of 10 is not allowed or when a 10 is called for an "X" or "-" is used.

Automatic or manual record release is controlled by the status of a keyboard keyswitch. If automatic, release occurs only at the end of a record.

INPUT EDITOR: An Input Editor program consists of a group of up to 99 Check segments and 1 Balance segment. Each segment is in effect a closed subroutine with one entry point and the potential for one or multiple exits. An Input Editor program can be shared among several Input programs, i.e., multiple copies of the Input Editor programs need not be stored on disk.

A Check segment is entered from the Input program following the entry of a field. Exit from a Check segment can be to any defined position, including the beginning of a field that did not pass the check, in any of the up to nine sections (formats) of an Input program. Four 15-digit accumulators are available within a Check segment. The accumulators are automatically cleared when the segment is entered. Only literal constants can be introduced into the record being keyed. Therefore, no data can be passed from one segment to another except constants. While a direct branch cannot be made from one segment to another, an indirect branch can be arranged through the use of additional Input program sections containing the branch to the desired segment.

Only a few procedural statements are provided in the construction of the Input Editor language, but they are quite flexible. The central arithmetic and logical statements are add, subtract, conditional branch, and unconditional branch. The first operand of an arithmetic statement can be an accumulator, numeric literal, or an input field from the data record; the second operand is always an accumulator. Two types of conditional branch statements are provided: one for numeric operands and one for string (alphanumeric) operands. The statement is in the form of an If comparison, with a statement number serving as the destination of the branch if the comparison specified is true. The first operand of a string-oriented If statement is an input field; the second operand is an input field or constant. The numeric version adds the capability to specify an accumulator as the first and/or second operand. The same operators are provided for both versions of the statement and include equal, not equal, greater than, less than, greater than or equal, and less than or equal.

With these simple statements, coupled with the capability to branch back and forth among various Input program sections, virtually any type of data validation routine can be programmed, including conditional data entry. The simplicity of the statements, while convenient to understand, also means that complex validation routines will be rather lengthy.

The Balance segment includes all the capabilities of the Check segment plus a Read statement, a facility for setting a status flag, and the capability to accept up to 40 characters of data from the operator to be used in the execution of the Balance segment. The Balance segment is entered manually by the operator during data entry or verification. Execution causes the records contained in a batch (or document, if that organization is being used) to be reread on command, with the specified logical and numeric operations being performed on each record. The normal organization provides a loop for reading and calculating with a branch to a comparative operation when all the records have been read. Typically, a total or totals are first entered by the operator when the Balance segment is initiated. A flag indicating in or out of balance can be set as a result of the final comparison. This flag is available to the supervisor to use in conditional transfer of batches to tape.

The entire Input Editor program is limited to 2047 statements. Each segment can contain up to 300 labeled statements.

OUTPUT EDITOR: An Output Editor program bears no direct linkage with an Input or Input Editor program. Execution of an Output Editor program is initiated by the supervisor by program name for a named batch or the one group that can be formed.

The same arithmetic and logical operations are provided in the Output Editor language as in the Input Editor language, with an expansion to ten 19-digit accumulators and two

Consolidated Computer Key-Edit 50

special 19-digit accumulators that serve as record counters. The capabilities for data movement are greatly expanded.

In general, programming takes the form of manipulating data fields from an input record (the record keyed by the operator) and writing the results in an output record (the record that will end up on tape). The output records can be written selectively to two independent disk files, to the system console teletypewriter, or to a line printer. The disk files must be given new, unique batch names by the supervisor.

The data movement capabilities include moving the contents of an input field, literal, accumulator, or record counter to an output field; moving an output field back to an input field; and data substitution using an input field as the argument in a table look-up. Further control is provided through the capability to reread a batch or portion of a batch starting at the first record or at a program-set flag for additional processing. Coupled with the capability to write to disk at any time (to two independent files), this permits unlimited data record implosion or explosion; i.e., the number of output records generated from a given set of input records is a function of the programming. A special instruction permits the supervisor to enter up to 34 characters of data to be used by the Output Editor program.

A Look-Up table consists of up to 2047 entries. Each entry is a pair of alphanumeric values, and the maximum combined size of the pair is 80 characters. Up to 100 tables can be linked to a single Output Editor program. Look-Up tables can be shared among several Output Editor programs; i.e., multiple copies need not be stored on disk. A Move operation referencing a Look-Up table causes the first value of each entry to be compared with the input field; when a match is found, the second value is transferred to the output record. The capability is most frequently used to allow abbreviated or coded keyed input fields to generate longer output fields.

The maximum output record size is 240 characters. An Output Editor program can include up to 2047 statements, 300 of which can be labeled. Each of the two disk files is limited to 2047 records, but an automatic batch name assignment (with supervisor notification) is generated and a new file opened if the limit is exceeded.

PRICING

Key-Edit 50 systems are available on a one-, two-, three-, or five-year lease arrangement or for purchase. The rental prices listed below include maintenance. A separate maintenance agreement is available for purchased units.

	Monthly Rental			
	1-Year Lease*	3-Year Lease*	Purchase	Monthly Maint.
Model 501 system (includes 1.4-megabyte disk, 4 keystations, and controller for up to 8 keystations)	$ 750	$ 720	$27,100	$105
Model 502 system (includes 2.8-megabyte disk, 9 keystations, and controller for up to 16 keystations)	1,110	1,065	40,400	155
Additional keystations:				
For Model 501	67	64	2,360	11
For Model 502	111	106	4,000	16
Operator desk	7	7	175	–
Memory expansion (8K words)	111	106	4,000	16
Disk expansion:				
From 1.4 to 2.8 megabytes	272	259	9,820	42
From 2.8 to 5.6 megabytes	380	363	13,860	50
Peripherals				
Magnetic tape drives:				
7-track, 556/800-bpi or 9-track, 800 bpi	181	176	6,600	26
9-track, 1600-bpi	422	402	15,100	62
Printers:				
Matrix, 165 cps	292	279	10,380	42
Line printer, 300 lpm	437	417	16,160	52
Synchronous communications unit	136	131	4,840	21

*Includes maintenance. Monthly costs, excluding maintenance, for two-year leases are about 1.5 to 2.5 percent lower than one-year costs; monthly costs for five-year leases, excluding maintenance, are about 10 to 11 percent below one-year costs. ■

Consolidated Computer Key-Edit 1000

MANAGEMENT SUMMARY

The descending spiral of unit cost per instruction executed meshes with the ascending spiral of widening applications to create many crossover points in determining the number of central computers desirable in a data processing facility, where to locate them, and the division of tasks among them. The addition of a large-scale shared-processor data entry system with powerful software fits into these spirals to create still more decision points about what to do where.

Capable of supporting up to 55 data entry stations plus a supervisor's station, the Consolidated Computer Key-Edit 1000 provides sufficient power through flexible software to tempt system designers into unloading more than just data input validation from the mainframe. For data entry operations, the Key-Edit 1000 can control the data validation checking of complex record structures including conditional field entry. For output processing on data already keyed, the Key-Edit 1000 system can accommodate up to five input/output files to provide comprehensive data restructuring. Hardware can include up to four 29.2-million-byte disk pack drives, up to eight tape drives, up to 192K bytes of 900-nanosecond main memory, and a line printer. The outstanding characteristic of the software supporting this impressive array of hardware is its flexibility. The data entry operator can be drawn heavily into decision-making about entering data, or the decisions can be preprogrammed, depending on how predictable the data entry operations are. The system supervisor has the opportunity to closely regulate background functions or to catalog standard procedures which require minimum input, again depending on the predictability of the

The power of the Key-Edit 1000 shared-processor key/disk system is deceptive because many worthwhile data entry features, such as batch balancing, range checking, conditional field entry, etc., are built into the programming languages and do not appear as separate features with fancy names. The 1000 supports up to 56 data entry CRT keystations in grand style.

CHARACTERISTICS

MANUFACTURER: Consolidated Computer Inc., 50 Gervais Drive, Don Mills, Ontario, Canada M3C 1Z3. Telephone (416) 449-1120.

CONFIGURATION

The principal components of the Key-Edit 1000 system are 1 to 56 local CRT data entry stations (Data Terminals), a minicomputer central processor, 1 to 8 magnetic tape drives, 1 to 4 disk pack drives, and a 30-character-per-second printer. Any one of the CRT stations can be designated as the supervisory station. In addition, a 300- or 600-lpm line printer can be added. The central system can be equipped to operate as a remote batch terminal emulating an IBM 2780 terminal.

Data Terminals are connected through Data Terminal Concentrators. One local Concentrator can accommodate up to 8 Data Terminals. The Concentrator can be located up to 6000 feet from the processor, and the Data Terminals can be located up to 100 feet from the Concentrator. A remote Concentrator can accommodate up to 4 Data Terminals located up to 100 feet from the Concentrator. A maximum of seven local and remote Concentrators can be connected to the processor.

The processor includes three high-speed DAC (Direct Access Control) I/O channels. Each can accommodate one

The powerful Key-Edit 1000 system can accommodate as many as 56 of the CRT keystations shown here. The system's central components can be seen in the background at left.

Consolidated Computer Key-Edit 1000

situations. For data manipulation itself, strong emphasis has been placed on the capability for conditional execution of data checking instructions.

Although the Key-Edit 1000 shares a family name with the Key-Edit 50, there is no program compatibility between the two systems. Nor will there be any program compatibility between the brand new Key-Edit 60 and the 1000. Upgrading present Key-Edit 50 users eventually to Key-Edit 1000 systems will put Consolidated Computer on an equal footing with its competitors. But there is a significant gap between the capabilities of the two systems, and such upgrades are not really a marketing factor. Present Key-Edit 50 users, seeing the sophisticated features of the 1000 (such as remote keystations), are pressuring Consolidated Computer to upgrade the capabilities of the 50. (The Key-Edit 60 is one answer to these pressures.)

To date, Consolidated Computer has installed about 10 Key-Edit 1000 systems in the U.S. and about as many in Canada. Current predictions are that about 30 more systems will be installed during 1975.

USER REACTION

Datapro talked to four Canadian users of the Key-Edit 1000 system. They were using a total of 6 systems representing 136 keystations. System sizes ranged from 8 to 30 keystations. Each of the systems included one 29.2-megabyte disk drive and one 9-track, 1600-bpi tape drive; one system also included a 9-track, 800-bpi tape drive. The ratings given by the users are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	1	3	0	0	3.3
Ease of operation, supervisor	2	2	0	0	3.5
Ease of operation, operator	2	2	0	0	3.5
Hardware reliability	2	2	0	0	3.5
Promptness of maintenance	2	2	0	0	3.5
Quality of maintenance	3	1	0	0	3.8
Software	0	1	3	0	2.3
Technical support	0	3	1	0	2.8

*Weighted Average on a scale of 4.0 for Excellent.

The comments from all of these users were remarkably similar. They liked the product and they liked the company. Three of the four, however, felt that additional software development was required. A very strong feeling that the company was willing to work with the customers in solving problems as they arose surfaced here, as it did when Datapro talked with Key-Edit 50 users. All felt that they had just begun to use the full potential of the system, and that more data checking and other tasks would be implemented in the future.

All four users gave high praise to the hardware, even though one had had extensive problems in the early history of the installation. (Again, the willingness of the company to send in a team to solve the problems did

tape or disk controller. Each controller can accommodate four tape or disk drives. Presently, only one channel can be used for disk devices.

COMPONENTS

KEYSTATIONS: Each keystation (Data Terminal) consists of a CRT display and a keyboard.

The same basic display is used for both operator and supervisory functions. It displays 12 lines of 40 characters each. Characters are formed by an 8-by-12 dot matrix; a total of 64 symbols can be displayed, including space. At operator stations, the CRT displays operating mode, operator ID, batch name, current location, next location, status, etc., in the first several lines in a highly formatted arrangement; field descriptors as well as values are displayed. The next three lines are used to display keyed data by character (normal), field, or record (118 characters maximum display). The bottom two lines are used to display error codes and system messages or programmed error messages. Vertical and horizontal lines are displayed to provide separation of display areas.

The supervisory station utilizes a different organization for the display. The top line shows the station identification, percent of disk capacity in use, and time of day. The next five lines are used to display portions of data batches or system files. The next two lines are used to display system- or program-generated messages. The next three lines display up to three pending system requests for supervisor action or response. The bottom line displays supervisor-entered commands or answers to system requests.

Two keyboard styles are available: data entry (keypunch) or typewriter. The typewriter-style keyboard includes a 10-key, adding machine-style numeric keypad to the right of the main keyboard to facilitate entry of numeric data. The principal difference, other than the dissimilar location of particular special symbols and numerics, is the handling of the shift specification in input control programs. Upper/lower shift specification is not operative for the typewriter-style keyboard; all shifts are always performed manually. The two types of keyboards can be intermixed on the same system. A number of control keys are provided in a row at the top of the keyboard and in a dual column to the left of the keyboard for controlling functions.

DISK STORAGE: The disk pack drive uses IBM 2316-style disk packs. The 11 disks provide 20 recording surfaces. A total of 203 tracks are recorded per surface. Each track is divided into 24 sectors of 204 bytes each. The actual total storage capacity if 19.9 million bytes. (The maximum storage capacity for this type of disk pack is usually reported as 29.2 million bytes, which is based on one record per track without sectoring.) Up to four drives can be included in a Key-Edit 1000 system. The average positioning time is 35 milliseconds, the rotational time is 25 milliseconds per revolution, and the average access time is 47.5 milliseconds.

MAGNETIC TAPE: Up to eight drives can be attached to a Key-Edit 1000 system. Available formats include 7-track, 556/800 bpi; 9-track, 800 bpi; and 9-track, 1600 bpi (phase-encoded). Drives with different formats can be intermixed in the same system. All drives accommodate reels up to 10.5 inches in diameter (2400 feet) and operate at 25 or 37.5 inches per second. Rewind speed for all models is 150 inches per second. A variety of data codes can be implemented for domestic or foreign computers; data codes are specified when the system is ordered. Read-after-write error checking appropriate to the particular tape format is performed.

PRINTERS: The standard printer included with all systems is a 30-character-per-second serial character printer. The maximum print line is 132 positions. Effective speed ranges between 60 and 200 lines per minute, depending on the length of the printed lines. Horizontal pitch is 10 characters per inch, and vertical pitch is 6 lines per inch. Up to 5-part sprocket-fed forms as wide as 14.375 inches can be used.

One line printer can be added in addition to the character printer. If desired, the line printer can be shared between

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much to keep the good will of the customer.) A couple of these users were pioneers in implementing the Key-Edit 1000 system and experienced problems that will not recur on newly installed systems.

The software provided for the Key-Edit 1000 elicited much comment. There was a feeling that Consolidated Computer had not fully realized the systems implications of all the features provided, particularly for input editing. Three of the users—those who rated the software as only Fair—remarked that the degree of input editing they were trying to implement resulted in noticeable system-caused delays in keying; this interrupted the smooth keying of the operators. A new software release directed toward this problem is due about the first of May 1975. A temporary solution is to move the editing operations from the input side to the output side. While execution time is not improved, there will be no interference with the operator's keying. The disadvantage of this approach is that it eliminates the immediate correction of keying errors and forces a second handling of the source documents in order to make corrections.

Except for early bugs, which led to numerous patches in the operating software and may have contributed to performance limits, the users were delighted with the capabilities of the software. All four of the users had upgraded from Key-Edit 100 systems. Extended experience with a well-debugged system may have spoiled them somewhat and raised their expectations for the 1000.

Overall, the Key-Edit 1000 and Consolidated Computer received high praise from the users. As of this writing, the Key-Edit 1000 should be considered to be in the final stages of product shakedown. New software releases with smoothed code corrections will be distributed shortly. If you are looking for a large key/disk system with extensive capabilities for data validation and other processing, the Key-Edit 1000 should be in the group considered. □

two Key-Edit 1000 systems. Two models of line printers are available with similar specifications except for speed. One model operates at a nominal speed of 300 lines per minute; the other operates at a nominal speed of 600 lines per minute. Both printers print up to 136 positions and accept up to 6-part sprocket-fed forms from 4 to 14.875 inches wide. Horizontal pitch is 10 characters per inch; vertical pitch is 6 or 8 lines per inch.

PROCESSOR: The main processor is a 16-bit minicomputer. Basic memory size is 96K bytes. Memory cycle time is 900 nanoseconds. Memory can be expanded in 16K-byte increments to a maximum of 192K bytes. While the memory size required to support a given number of key entry stations is dependent on the number and size of programs used, Consolidated Computer makes the following general recommendations. The basic 96K-byte memory will handle up to 16 stations. For a configuration of 17 to 32 stations, 112K bytes of memory are recommended. A configuration of from 33 to 44 stations requires 128K bytes of memory. A configuration including between 45 and 56 stations would require at least 144K bytes of memory. The processor includes a real-time clock and incorporates a power-fail/restart capability.

COMMUNICATIONS

REMOTE KEYSTATION TO SYSTEM: Communication between a Key-Edit 1000 processor and a remote Data Terminal Concentrator is synchronous, full-duplex at up to 9600 bits per second. Timing for transmission is supplied by the modem. Standard RS-232C interfaces are provided to accommodate Bell System or independent data sets. Multipoint operation is not supported. Normal operation is via leased (private) lines, but full-duplex operation using two dialed connections and modem pairs at each end can be achieved. The remote cluster is limited to four Data Terminals per Concentrator. The communications interface is completely transparent to the supervisor and operators; remote key entry, verification, and data searching are performed identically with local operations.

SYSTEM TO SYSTEM: A utility program coupled with a binary synchronous communications interface enables a Key-Edit 1000 system to operate as a remote batch terminal emulating an IBM 2780. Point-to-point communication between a Key-Edit 1000 and a Key-Edit 50, 60, another 1000 system, and some 100 systems is supported, as well as batch communication with an IBM System/360 or 370 computer under HASP or the equivalent. Half duplex transmission at up to 9600 bps is supported; clocking is provided by the modem supplied by the user. The data source/destination for communications operations is magnetic tape. Multiple data batches can be combined for transmission. Establishment of the communications connection is performed manually by the supervisor, who also handles the hand-shaking protocol from the supervisor's station.

SYSTEM OPERATION

OVERVIEW: All operations of the Key-Edit 1000 run under a central operating system. Data entry/verification/validation is initiated and controlled at the keystations. Data transfers between disk and tape as well as batch transmissions are controlled from the supervisory station. The supervisory station can be any terminal, as designated when the system is started from a power-off condition. The central data group is the batch or output from one keystation. Subordinate data groups include documents, records, fields, and characters. Supergroups, composed of multiple batches, can be formed by the supervisor for convenience in building output files. The key to batch flow is the batch identifier, a 17-character assignment made by the keystation operator the first time data is entered. It can be any combination of job name, batch name, and date.

There are two levels of programming. One is operative during data entry and verification operations. It is referred to as UPL1 (Users' Programming Language One). It can be triggered automatically through a link based on the job name in the batch identifier or can be called manually by the keystation operator. The second programming level is UPL2. It operates on completed batches of data and is called by the supervisor. Both programming facilities provide comprehensive capabilities for setting up data validation checks. UPL2 is an expanded version of UPL1 and includes input/output facilities for reformatting, as well as facilities for table-oriented data handling operations. UPL2 allows handling of up to a combined total of five individual files (data batches), at least one of which must be an input file.

OPERATOR FUNCTIONS: The operator's primary responsibility is the key entry and verification of data. Errors can be corrected as made, or can be bypassed, if the UPL1 program permits, with an error flag inserted for later discovery and correction. The level of decision-making required of the operator is controlled through the UPL1 program and the system. The operator may have to select a controlling input program, choose the controlling format, initiate the execution of a special routine in the input program for handling conditions not recognizable by examining the data keyed, and/or react to a message displayed as a result of an error or condition identified in the data by the input program. Or the operator may only have to initialize the operation and key data. For occasional keying tasks, the operator may create a two-format input program at the keystation that delimits fields and controls data types but does not include any data validation checks other than check digits.

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A keystation can operate in one of four modes: Entry, Verify, Correct, and Examine. Correct is a special mode that permits searches to be made for records containing error flags. Examine is a special mode that allows multiple operators to search a data batch (file) for information retrieval purposes but prohibits data alteration; data is displayed by field. Within these modes, the operator has facilities for three important control operations: positioning, searching, and data insertion/deletion. In any mode, the operator can advance or backspace by character, field, record, or document (a collection of records entered from the same source document). Special provisions are made to inhibit nonmeaningful positioning operations, such as forward-spacing when in the Entry mode beyond the point where data has been entered. The positioning is activated by control keys on the keyboard. A special provision is made to permit positioning to skip from one field in a document to the corresponding field in the next document without having to skip over intervening fields manually.

Three Search modes are implemented. One is a search by document number (sequential position within the batch). A second is a masked search by field. The masked search can be qualified by format level, field number, or just the mask. A mask is limited to the first 16 character positions of a field. The masked search is not permitted in the Verify mode. The third mode is a search for records containing error flags; it is operative in the Correct mode only.

Data can be inserted or deleted by character, field, record, or document in any mode other than Examine. A data batch can be open for data entry at one keystation and open for verification or correction (Correct mode) at a second keystation. The system inhibits the key entry operator from backspacing into the verify/correct segment, and forces a suspension if the verify/correct operator catches up to the key entry operator.

While comprehensive status information is presented on the screen for the operator, data display capabilities are limited. Normally, only the current character keyed is displayed. Field display or record display (first 118 characters maximum) can be requested. Prompting information that describes the field cannot be displayed. Format and editing specifications other than the format level number are not displayed.

SUPERVISOR FUNCTIONS: The supervisor's responsibilities include: 1) system start-up and system program loading; 2) initiating translation of UPL1 and UPL2 programs; 3) maintaining system libraries; 4) controlling data batches through listing, grouping, and releasing batches and initiating the execution of UPL2 programs; 5) controlling transfers between disk and tape and to and from the communications line; and 6) monitoring system statistics. Data transfers to tape can be initiated individually by batch or by group. In addition, batches can be transferred automatically as soon as they meet certain specified conditions as determined by the setting of indicators. (A total of 60 indicators is available to each UPL1 and UPL2 program; the first 7 of these are retained in the information header for each batch.) UPL2 programs can also transmit a message to the supervisor's station as an advisory comment or with a request for a data response, such as the control total for a batch balance operation.

In general, the supervisor conducts a dialog with the system to initiate system commands, such as compile a UPL1 or UPL2 program, transfer a data batch to tape (peel), list a data batch, etc. Associated with each system command are a group of keywords and corresponding parameters. A command is initiated by name. The system will then display the keywords one by one, and the supervisor will key in the parameters or default to a system-defined value. In some cases, parameters are required, and the system will reprompt until the supervisor fills in the necessary parameter. Since some of the commands include a list of 25 or more keywords, this can be a time-consuming procedure. In addition, the supervisor will frequently wish to apply several system commands to the same data batch. Included in the Key-Edit software repertoire is a cataloguing facility for easing the supervisor's task. Basically, this facility permits the creation of new system commands which may include the specifications for the parameters and may be composed of several basic system commands. Initiation is started the same way, by keying in the command name. Only those parameters, if any, that need to be specified will be requested.

OPERATING MODES

- Data Entry–Data is keyed into the system under control of a UPL1 program that specifies fields, data types, and validation checks. Data type specifications cannot be overridden. Validation check violations are handled according to the UPL1 program specifications and may require rekeying, or an error flag may be inserted. Prompting with field names or descriptors is not included as a direct capability, but could be implemented through the use of the error message display capability; such usage, however, would extract a heavy performance penalty.

- Data Verification–Data is verified by rekeying. Selective verification using the same UPL1 program can be accomplished by programming and the use of the two automatic dup/skip keys. Visual verification is possible. Verification can be performed on a batch that is open for data entry. A special Correct mode is provided to search for fields containing an error flag.

- Data Additions and Deletions–Characters, fields, records, and documents can be inserted or deleted freely when entering or verifying data, subject to field length restrictions.

- Search–Data can be located by document number within batch or by field content (mask) within batch. Positioning operations can be performed freely within the Entry and Verify modes. In the Examine mode, multiple operators can access the same data batch (file) simultaneously. In the Correct mode, a search can be made for fields containing error flags.

- Background–Includes batch transfers between tape and disk, UPL2 programs, and batch communications to another Key-Edit data entry system or computer. Multiple background, data entry, and verification operations can proceed simultaneously subject to the rules for data entry/verification and the availability of system resources.

SYSTEM PROFILE

- Keystations–Up to 56 local CRT keystations, including the supervisor's station. A group of four remote keystations can replace a group of eight local keystations.

- Record length–1 to 4096 characters; up to 118 fields per record; up to 64 characters per field; up to 99 records per document; up to 9999 documents per batch. If output processing via UPL2 is used, maximum record length is between 842 and 948 characters.

- Formats–One format per record type; up to 32 record types (format levels) per document; multiple records of the same type in the same document are permitted.

- Output block length–Any blocking factor up to a maximum block length of 4096 characters.

- Data storage–The amount of space available for storing new data batches is dependent on the number and extent of UPL1 input and UPL2 output programs and the number and extent of data files retained for on-line inquiry in the Examine mode. The basic disk (29.2 million characters nominal, 19.9 million characters actual) could handle the output of the maximum complement of operators (55) if data batches were not retained for extended periods before peeling to tape.

SOFTWARE

The system runs under the overall control of the operating system. Facilities for user programming include UPL1 (Users Programming Language One) and UPL2.

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UPL1: The organization of a UPL1 program is based around a "document," a collection of data records usually keyed from the same source document. For example, the keying for an invoice could contain three record formats: header record with Bill To and Ship To information; detail records giving product, quantity, and cost; and totals record. Each of these three types of records would be assigned a format, or, as Consolidated Computer calls it, a level. The code for the three levels would comprise a UPL1 program. Changing from one level to another can be automatic, with or without conditional requirements, or manually by the operator. Automatic repetition of a single level can be programmed (e.g., the detail level in the example above) with manual escape when the last record of this type is keyed. Up to 32 different levels can be defined in one program.

Programming in UPL1 centers around fields. Two types of operations are specified for each field; format and edit procedure. Field names can be added for annotation purposes, but are not addressable. The basic field parameters are the number (for identification), length, and type. Permissible field types include variable length and fixed length with no end-of-field delimiter, and operator-entered end-of-field, or a system-entered end-of-field. All variable-length fields imply an operator-entered end-of-field indication. Variable-length fields require the specification of a maximum size. The variable-length capability can be used to simplify the handling of fields, such as name or address, known to be variable by eliminating the requirement for justification and space-filling. The main computer must be programmed to look for the end-of-field delimiter, or the spaces must be inserted by a UPL2 program. Other format parameters are indicated by a single letter in a column of the input coding form, including keyboard shift (upper, lower); data type; left fill character (zero or space); check digit type (modulo 10 or 11); skip/stop identification; sign convention; and control of automatic skipping and duplication.

Data types include alphabetic only, alphabetic plus a few punctuation marks and space, signed or unsigned numeric only, signed or unsigned numeric and a few punctuation marks and blanks, alphabetic and numeric only, alphanumeric and a few punctuation marks plus space, and all characters. The skip/stop identification permits a field to be identified by a single alphabetic character as the skip-to location for an operator-initiated selective skip.

The edit procedures are composed of four types of information: mode; indicator controls; commands with associated operands and parameters, if any; and error handling controls. The positional sequence of the edit procedure statements governs the time at which the command is executed; i.e., execution occurs following the entry of the field specified on the same line as the edit statement. Only that field and/or registers or indicators can be an operand in that edit procedure.

The edit mode specification simply identifies whether the error handling procedures, including message display, are to be performed in the Entry, Verify, or all modes.

A total of 60 two-condition indicators is available to each program. The conditions are set (on) and clear (off). Indicator control includes making the execution of the associated edit statement conditional on whether a specified indicator is on or off, as well as setting or clearing a specific indicator depending on the results of a comparison or test specified by the associated edit statement. The status of the first seven indicators is carried with other batch information and is usable by the supervisor in controlling data transfers to tape.

The commands available in UPL1 can be grouped into program flow and system control, including handling of message display, arithmetic/data handling, and comparing/testing.

For computation, data manipulation, and comparisons, a total of eight 14-digit numeric registers and one 32-character alphanumeric register is provided. The alphanumeric register and the current field can be partially addressed.

Add, subtract, multiply, and divide arithmetic operations are provided, as are string move, shift left, and shift right logical operations. A rich variety of comparison and test commands is implemented, including comparisons for equal, not equal, greater than, less than, greater than or equal, and less than or equal; and testing for the presence or absence of non-space characters (several variations); positive or negative; presence of a divide remainder; arithmetic overflow; if all of a specified set of indicators are set; if any one of a specified set of indicators is set; if all of a set of characters are present; if any of a set of characters is present; if within a range or group of ranges; and if not within a range or group of ranges. In general, the commands operate on the current field or a register. In addition, indicators can be cleared, and an error flag can be set.

Program flow control includes identifying the end of a record and batch, setting up subroutines, linking among levels, and limited branching capability. Special routines can be coded for end-of-record and end-of-batch situations. Subroutines can be identified and coded once; when the program is compiled, the subroutine code is inserted in place. Branching is limited to bypassing the remaining edit procedures on a field (usually conditional on presence or absence of a field) and skipping to the end of a record (all intervening edit routines are executed, with default values supplied as necessary). One special routine, called Sub-Batch, can be coded for calling by the operator when encountering a situation not recognizable by data edit procedures.

System control commands include copying batch identification information and inhibiting data insert or delete functions for individual format levels.

Error handling consists of specifying one of five types of control to be executed and whether or not an error flag is to be set when associated edit conditions are not met. The types of control include: must correct; correct at operator's option (acceptance of the error requires depressing the Acceptance key); two alternatives for correct at operator's option (correction requires depressing the Correct key); and none. Each of the five types generates a different prefix word for the error message displayed to the operator. User-generated messages can be displayed to further clarify the problem; the current field or any of the registers can be incorporated into the message. The maximum user message displayable is 57 characters. Message display is normally used in error situations, but is not limited to situations where an edit command is not satisfied.

UPL2: The structure of a UPL2 program basically consists of a series of up to 47 record format definitions identifying field number, length, type, and sign convention followed by a single block of code defining the manipulation, arithmetic computation, and validation checks to be performed. This contrasts with the style of a UPL1 program which sets up individual procedural blocks for each record type (format level). UPL2 is coded in free form, also in contrast to the rigid format of UPL1 program statements. UPL2 omits the data-type checking and other key-entry-oriented checking (no data is being keyed) and adds capabilities for reformatting, including combining and exploding data groupings.

Data flow control is principally achieved through up to 10 buffers which serve as storage for records read in, records to be written out, and working areas. Buffer size is limited to 999 characters, including from 51 to 157 bytes of non-data-control information such as UPL1 registers. Input and output devices are not named directly in a UPL2 program. A logical assignment is made by the supervisor when execution is performed. Record flow in and out is completely dictated by the program.

Each separate usage of the data, whether in the same format or different, requires the assignment of a file device. For example, reading a data batch from disk, performing some data manipulation and checks, then writing the batch out to tape and also printing the data batch would require the assignment of three files. Buffers can be reassigned dynamically as needed, but reassignment cannot be performed with retention of the data in the buffer.

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Program flow control is established through the use of conditional or unconditional GO TO constructions, conditional instruction execution, and indirect addressing. Program statements can include a one- or two-character label (tag) that can serve as the destination for a GO TO construction. All data-oriented instructions can be used to form compound conditional statements of the form IF...ELSE. Several test or comparison instructions can be chained to serve as the conditions for executing a particular instruction or set of instructions. The ELSE construction can be used to initiate the execution of an instruction or set if all the associated test and comparison conditions fail. If the ELSE construction is not used, and the specified comparisons and tests fail, execution passes to the next statement. While this compound statement structure provides no more programming power than a single instruction form, it is more convenient and less time-consuming. Indirect addressing permits the use of the contents of a register to specify fields to be used as operands rather than requiring an explicit identification in the instruction. This permits convenient programming of the processing of the sequential fields of a record as well as computed selection of operand fields.

A total of twelve 14-digit numeric registers is available to a UPL2 program. Buffers can be used for alphanumeric string operations.

Essentially the same arithmetic, data manipulation, comparison, and testing instructions are available in UPL2 as in UPL1, including a complement of 60 settable and testable indicators. Addressing of data fields used as operands is accomplished by naming the buffer and relative field number. Partial fields can be addressed by naming the first position and specifying the length; the contents of a register can be used for either or both of these specifications. One major enhancement added to UPL2 is table-oriented operations. Two types of tables can be created. One is a list of keys. The second is a list of pairs of keys and values. One type of table operation checks the operand to see if it is one included in the table. The second type of table operation implemented uses the operand as a key to access the table, with the corresponding value being transferred to the program. Tables are maintained in a separate system file and are linked to a UPL2 program through a name specification.

Several specialized instructions are included to simplify programming. For example, the maximum length of a field can be loaded into a register; a disk file can be backspaced one record at a time all the way back to the beginning of the data batch if desired; a message of up to 56 characters can be displayed on the supervisor's screen with or without a reply requested from the supervisor; data formats can be checked with one instruction; etc.

PRICING

A Key-Edit 50 system is available on a one-, two-, three-, or five-year lease arrangement or for purchase. Rental prices below include maintenance. A separate maintenance agreement is available for purchased units.

	Monthly Rental*			
	1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Key-Edit 1000 basic system (includes 8 Data Terminals, 30-cps printer, and one 29.2-megabyte disk)	$1,800	$1,725	$63,000	$300
Memory Module, 16K bytes	115	110	4,200	15
Data Terminal	95	91	3,360	15
Data Terminal Concentrator, local (accommodates 8 Data Terminals)	NC	NC	NC	NC
Data Terminal Concentrator, remote				
At remote end (accommodates 4 Data Terminals)	100	96	3,570	15
At system end	125	120	4,620	15
Additional 29.2-megabyte disk pack drive	610	585	22,100	85
Magnetic Tape Controller	NC	NC	NC	NC
Magnetic Tape Drives–				
9-track, 800 bpi, 25 ips	181	176	6,600	26
9-track, 800 bpi, 37.5 ips	198	190	7,100	28
9-track, 1600 bpi, 25 ips	422	402	15,100	62
9-track, 1600 bpi, 37.5 ips	470	450	16,800	70
Line Printers–				
300 lpm	437	417	16,160	52
600 lpm	625	600	23,100	75
Communications (remote batch)	136	131	4,840	21

*Includes maintenance. Monthly costs, excluding maintenance, for two-year leases are about 1.5 to 2.5 percent lower than one-year costs; five-year costs, excluding maintenance, are about 10 to 11 percent below one-year costs.

NC–no charge. ■

Control Data 200 User Terminal

Basically a CRT display terminal, the 200 UT can function effectively as a remote batch terminal when equipped with an optional card reader and/or printer. Transmission speeds up to 600 characters/second are available, and several terminals can share a common line.

MANAGEMENT SUMMARY

The 200 User Terminal is designed for use in a multiple-station party-line environment or for use over the public telephone network as a remote terminal for Control Data 3000 or 6000 Series computer systems. The terminal was configured from previously available CDC peripheral components such as the 217 Entry/Display Unit, 224 Card Reader, and 222 Line Printer.

Although the 200 User Terminal is no longer being manufactured, it is being actively marketed on an as-available basis; Control Data refers to this status as "Resale Product, Active."

Basically a conversational terminal with a CRT and keyboard as prime components, the User Terminal supports batch operation through the optional card reader and printer. The printer can be either a line printer or an IBM Selectric Typewriter.

Terminal operation is highly operator-oriented, with the display unit acting as an interface between remote computer and operator. Besides the interplay between operator and remote computer during conversational operation, the operator can also initiate batch transfers of card data or printed messages. Batch operations can be initiated via the CRT keyboard in the form of a request message, which is transmitted to the computer when the terminal is polled. Only one operation can be performed at a time.

The display unit provides split-screen operation; a partial or complete message can be transmitted. Partial messages begin with the first character position of the specified line. Insert and delete functions found on more sophisticated display units are not included.

Announced early in 1968 and initially delivered early in 1969, the 200 User Terminal made a significant impact within the remote processing environment. There may have been as many as 2000 units installed at one time, and the terminal is still being actively used by many installa- ▷

CHARACTERISTICS

MANUFACTURER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55440. Telephone (612) 853-8100.

CONFIGURATION: The basic terminal is composed of a controller and CRT display station. Optional I/O devices include a card reader, line printer, and typewriter (IBM Selectric). A terminal configuration can include the typewriter or line printer, but not both. Configurations using either BCD or ASCII code are available; the typewriter can be included in a BCD terminal only.

COMMUNICATIONS: Synchronous in the half-duplex mode at 2000, 2400, or 4800 bits/second (250, 300, or 600 char/second). BCD or ASCII transmission code can be specified; both are 8-level codes including parity. Synchronizing is performed by a sequence of four sync characters transmitted prior to each message.

The 200 User Terminal is designed to operate over a voice-band facility via a modem compatible with the Bell System 201 A or 201 B Data Set. The terminal can be used in a party-line arrangement where a number of terminals in different locations share a common line and are sequentially polled and addressed by the computer, or it can be used on the public telephone network.

CRT DISPLAY: Rectangular 14-inch (diagonal measurement) CRT produces an 8-inch-wide by 6-inch high viewing area. A character set of 63 characters, including upper-case alphabetics, numerics, and special symbols, is displayed in white against a gray background. Each character is formed by a 5-by-7 dot matrix. The display arrangement consists of 20 lines of 50 characters each or 13 lines of 80 characters each, as specified by the user.

DEVICE CONTROL: The 200 User Terminal is designed to operate in a polling/addressing environment; terminal operation is controlled by the stored program at the remote computer.

Off-line operation permits listing non-displayed data read from cards or printing displayed data entered from the keyboard. Listed data is printed in 12-card blocks.

Under command from the remote computer, the terminal transmits punched-card data or displayed messages entered from the keyboard and prints messages received from the remote computer. The terminal responds to Poll, Write, and Alert commands.

The Poll command causes the terminal to transmit a displayed message or a message containing data read from a batch of up to 12 cards. The terminal responds to a Poll command with a rejection message to indicate no-message status or with an Acknowledge to indicate an anticipated message. Rejection and Acknowledgement message responses are manually selectable at the keyboard.

The Write command contains a message to be displayed only or displayed and printed. The message accompanying a Write command is displayed beginning at the current cursor ▶

Control Data 200 User Terminal

tions. No small part of the terminal's popularity was due to Control Data supporting it for use on the company's own remote batch processing and conversational time-sharing networks. Along with the IBM 2780, the UNIVAC DCT 2000, and the IBM System/360 Model 20, the Control Data 200 User Terminal is in the group of batch terminals most frequently emulated by the independent manufacturers of intelligent terminals.

Control Data also announced a capability for interfacing the 200 User Terminal with an IBM System/360 computer by replacing IBM's BTAM or QTAM control coding with routines supplied by Control Data, but there is no indication that a significant number were sold to IBM computer users.□

location and can contain up to 1000 or 1039 characters, depending on the display format. Reset-Write and Clear-Write commands both position the cursor to the initial display position where the accompanying message is displayed; the Clear-Write command, in addition, erases the entire screen. The terminal responds to a Write command with a rejection message when the terminal is busy.

The Alert command is used as a prelude to a Write command; when received, the Alert command visually and audibly alerts the operator to a pending Write command.

The terminal operator can request a printer message as directed by a Write command or request a Poll command to transmit a batch of cards. These request messages, composed via the keyboard and displayed on the CRT, are transmitted to the remote computer in response to the following Poll command.

Message composition is performed by positioning the cursor and keying the data. The cursor is defined as a chain of underscore symbols called entry markers that extend the full width of a line. For each character keyed, an entry marker is erased. The chain of markers can be sequentially positioned to any display line.

A message can be transmitted in either Block or Line mode. When in Block mode, a complete message is transmitted. Line mode permits a portion of the displayed data to be transmitted, beginning at the first character position of the line identified by a special symbol called a line indicator and ending at the current cursor position. The line indicator is manually positioned prior to message transmission.

Printer format control, initiated via control codes in the print message, is limited to spacing a single or double line, space suppression (sustaining the current line), and advancing to the beginning of the next form. Format control is not provided for off-line operations such as listing card data or printing displayed data. Through the use of special control codes in a print message, print-line truncation or zero and space compression can be performed, but the two operations cannot be performed simultaneously. Where truncation is specified, the remaining print line is filled with blanks. Zero and space compression permits a number of spaces or zeros to be identified by a two-character control code sequence.

Card data can be compressed by reading only the columns identified by holes punched in a program disc; columns not read are automatically skipped.

ERROR CONTROL: Character and longitudinal parity are generated for all transmitted messages and checked for all received messages. A special error symbol is substituted for characters received in error. The terminal responds to a detected character or longitudinal parity error by transmitting an Error message in place of the Acknowledgement message. Data transfers to the printer or from the card reader are inhibited as a result of detected parity errors. Error-message transmission as a result of detected errors can be manually inhibited.

Other error conditions that are checked include unrecognized control codes, non-existent station address, absence of I/O function codes, and interrupted carrier signal from the telephone line. An Error message is transmitted as a result of any one of these error conditions.

KEYBOARD: 58-key typewriter style. Any of 63 characters, including upper-case alphabetics, numerics, and special characters, can be generated from the keyboard. Cursor and control keys are included. Repetitive entry of data or initiation of a function corresponding to a keytop symbol is performed by depressing the desired key in conjunction with the Repeat key.

TYPEWRITER: IBM Selectric Typewriter prints from a set of 64 characters at a rate of 15.5 characters/second; total message length cannot exceed 1000 characters. Forms are friction-fed; roll paper or fanfold forms up to 15.5 inches wide can be accommodated. Maximum writing width is 13 inches. Horizontal spacing is 10 char/inch, and vertical spacing is 6 lines/inch.

LINE PRINTER: The drum printer prints data received from the communication facility or lists data from the card reader via its 1000-character buffer. The printer provides 136 print positions and has a rated speed of 300 lines per minute. The character set contains 63 print symbols.

CARD READER: Reads standard IBM 80-column cards at a rated speed of 333 cards per minute. Hollerith code is translated to BCD or ASCII prior to translation. The card reader includes a 1000-character buffer that can be loaded with data from up to 12 cards. A 1200-card hopper is provided.

PRICING: The 200 User Terminal is available for purchase or through a variety of lease plans. The basic Control Data lease is for a period of one year and permits unlimited usage. Through Commercial Credit Corporation, a Control Data subsidiary, various long-term lease plans up to seven years in length are available. The lease prices below are for the standard one-year Control Data lease and the basic three-year Commerical Credit lease. The Commercial Credit lease is cancellable after 24 months (upon 90 days notice) and includes unlimited usage and liberal add-on and substitution provisions. Various discounts are available for extending the non-cancellable period and waiving the add-on and substitution privileges.

	Monthly Rental*			
	1-year	3-year	Purchase**	Monthly Maint.*
217 Remote Entry/Display Control	$294	$284	$4,200	$44
218 Typewriter Output Station	282	277	4,000	27
222 Terminal Line Printer	585	576	11,550	195
224 Terminal Card Reader	148	147	5,250	38

* Monthly rental figures include prime time (6 A.M. to 5 P.M.) maintenance charges shown in the last column. Increased maintenance coverage for extended periods and for weekends is available according to a fixed schedule.

** The purchase prices reflect the discounts for an "Active Resale" products, which in most cases are quite small.■

Control Data 730 Series Remote Batch Terminals

Control Data's new 730 Series intelligent batch terminals are available in three models designed to satisfy low, medium, and high-volume applications. Current operating software limits their usage to CDC computers, but IBM 2780 emulation is planned. The terminals feature high-performance peripherals and transmission speeds up to 50,000 bits/second.

MANAGEMENT SUMMARY

Early in 1972 Control Data Corporation introduced a new line of remote batch terminals designed to serve a broad spectrum of applications ranging from low-volume to high-volume usage. These new terminals, like many competitive terminals currently being marketed, are programmable. Programmability furnishes an added dimension to terminal operation to provide the kind of flexibility that cannot be derived from a hard-wired terminal.

The chief advantage offered by programmability is the capability to emulate other terminals with similar I/O configurations and communications capabilities by simply loading the emulation program for the particular terminal. This capability is advantageous to users and manufacturer alike. The user can operate on-line with several different computers; e.g., those provided by various time-sharing services with remote batch capabilities. The manufacturer can sell to other markets besides IBM users. However, to permit such flexibility the appropriate emulation software must be available. Current operating software provided by Control Data for the 730 Series Terminals does not include emulation programs for IBM terminals or any other manufacturer's; right now, the user is locked into CDC computers through CDC communications software, although the company does plan to furnish emulation software for the IBM 2780 toward the end of 1972.

Current CDC operating software is divided into two categories: an emulation package for the CDC 200 User Terminal, available only for low- and medium-speed 730 Series Terminals, and a communication program called Mode II that operates only in a full-duplex environment. ▷

CHARACTERISTICS

MANUFACTURER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-4656.

Models:

- 731–For low-speed, low-volume remote batch applications.
- 732–For medium-speed, medium-volume remote batch applications.
- 733–For high-speed, high-volume remote batch applications.

COMPATIBILITY: All three models are compatible with one another and can be used on the same communications facility.

CONFIGURATION:

- 731-10–Includes a microprocessor with 4K words (8K bytes) of 16-bit, 1.1-microsecond core memory, a 300-cpm 80-column card reader, a 300-lpm 136-column line printer, a control/status console, an operator keyboard, and a communications interface. Options include: a 4K-word memory expansion module, a CRT display (without keyboard), a combined 80-column card reader/punch which reads at 330 cpm and punches at 66 cpm (full card), a cyclic encoder, and one or two channel expansion modules (containing 4 additional I/O channels each).
- 731-12–Operates as a 200 User Terminal via emulation software. Model 731-12 includes all components basic to the 731-10 except that the 731-12 features an 8K-word (16K bytes) memory and a CRT display unit. The 731-12 is marketed as a complete package without options.
- 732-10–Includes a microprocessor with 4K words (8K bytes) of 16-bit, 1.1-microsecond core memory, a 500-cpm 80-column card reader, a 600-lpm 136-column line printer, a control/status console, an operator keyboard, and a communications interface. Options are the same as those available for the Model 731-10.
- 732-12–Operates as a 200 User Terminal via emulation software. Model 732-12 includes all components basic to the 732-10 except that the 732-12 features an 8K-word (16K bytes) memory and a CRT display unit. The 732-12 is marketed as a complete package without options.
- 733-10–Includes a microprocessor with 4K words (8K bytes) of 16-bit, 200-nanosecond core memory, a 1200-cpm 80-column card reader, and a 1200-lpm 136-column line printer. Options include a 250-cpm 80-column card punch, additional 1200-lpm 136- ➤

Control Data 730 Series
Remote Batch Terminals

Mode II operation permits concurrent transmission of input and output data between the 730 Series Terminal and a remote CDC 6000 or Cyber 70 Series computer. The emulator package supports communication with a CDC 3000 or 6000 Series computer under MASTER or SCOPE via the EXPORT/IMPORT communications software.

Control Data is not currently supporting off-line processing functions, although the terminals can be used off-line for functions such as listing, data transcription, and keypunching. Programs for on-line and off-line operation are stored in drum memory and are easily loaded via a bootstrap loader, which also resides on the drum.

First customer deliveries are scheduled for June and July 1972. □

➤ column line printers, an additional 1200-cpm 80-column card reader, a CRT keyboard/display unit, a communications interface, and a 4K-word (8K-byte) memory expansion module, which is required for I/O additions. Configurations are limited to a maximum of two card readers, one card punch, and four line printers.

COMMUNICATIONS: Synchronous in the full-duplex mode, using 8-level ASCII transmission code. The 730 Series Terminals (other than those operating as 200 User Terminals) employ CDC Mode II communications procedures, which require a full-duplex facility for simultaneous two-way operation. The 730 Series Terminals operate at the following transmission speeds:

- 731 – 1200 to 4800 bits/second.
- 732 – 2000 to 9600 bits/second.
- 733 – 19,600 to 50,000 bits/second.

Conventional clock rates for synchronous transmission over a voice-grade facility are 1200, 2000, 2400, 4800, 3600, 4800, 7200, and 9600 bits/second. All models provide an EIA Standard RS-232C interface, but require clocking from an external user-supplied modem. The communications interface for the Model 733 is compatible with the Bell System 300 Series modems. Communications compatibility other than transmission parameters is a function of terminal communications software, which defines the line discipline, transmission format, and control codes.

DEVICE CONTROL: Terminal control is provided by a programmable microprocessor, the nucleus of each of the 730 Series Terminals, under the direction of the operating software. Current operating software supports the use of the 730 Series Terminals only with Control Data computers and includes two program packages: an emulator for the 200 User Terminal and a program for full-duplex operation called Mode II.

The emulator, available only for Models 731 and 732, causes the terminal to operate exactly as a 200 User Terminal; i.e., the terminal performs all functions and responds to commands and communications discipline as a 200 User Terminal (Report 70D-263-01) and can operate on-line as a remote terminal to a Control Data 3000 or 6000 Series computer.

The Mode II software employs CDC communications discipline and is compatible only with the large-scale CDC Series 6000 and 7000 computers. A bootstrap loader which resides on the terminal's micro-drum (remote operation) or at the computer (local operation) automatically loads the program from punched cards into core memory prior to terminal operation. On-line operation can then proceed by establishing a communication link with the computer and by transmitting data from an input device or receiving data on an output device. The Mode II software supports concurrent operation of one input and one output device on Models 731-10 and 732-10 or up to four I/O devices on Model 733-10.

Off-line operations include keypunching (keyed input, punched card output), listing, and data transcription. These three functions are executed under the direction of off-line programs.

The processing unit employs its micro-drum memory for storage of the bootstrap loader, CRT refresh memory (Model 733 only), and operating programs. Average access time and data transfer rate are 8.4 milliseconds and 1.11 MHz, respectively.

CRT DISPLAY: A 15-inch (diagonal measurement) CRT with a viewing area 10 inches wide by 8 inches high. For Models 731 and 732, screen arrangement is 16 lines of 80 characters each (1280 character positions). Model 733 is available with either a screen arrangement of 18 lines of 64 characters (1152 character positions) or that of the other models.

A character set of 96 ASCII characters, including upper- and lower-case alphabetics, numerics, and special symbols, is displayed in white against a dark background. Characters are formed by a 5-by-7 dot matrix.

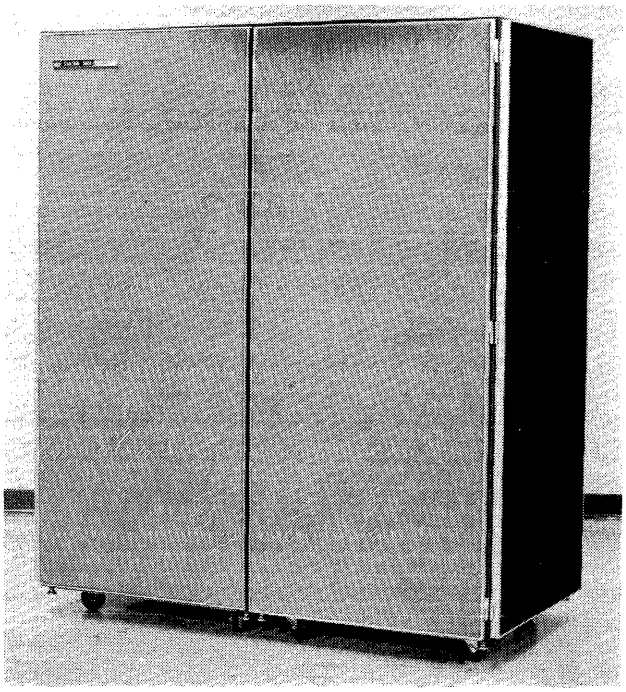
KEYBOARD: The 82-key, typewriter-style keyboard can generate any of 96 character codes; code interpretations are determined by the operating software and can vary with the application. The keyboard includes 8 or 10 function keys, cursor control keys, and operating mode switches.

PRICING: The Control Data 730 Series Terminals are available for purchase or lease; conversion from lease to purchase is available through a purchase-credit arrangement. Control Data offers lease contracts for one, three, four, and five years. Lease rates include prime-shift maintenance. A separate maintenance contract is available for purchased units.

Terminal	Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Model 731-10	$1,074	$1,038	$30,300	$244
Model 731-12	1,204	1,120	34,500	269
Model 732-10	1,612	1,560	45,820	359
Model 732-12	1,743	1,684	49,920	385
Model 733-10	2,980	2,860	96,800	650
Options				
Models 731-10 and 732-10:				
CRT Display Unit (without keyboard)	45	42	1,400	10
Reader/Punch Unit	406	392	13,000	81
4K Memory Expansion	85	80	2,800	15
Channel Expansion**	20	20	520	5
Cyclic Encoder	3	3	120	0
Model 733-10:				
250-cpm Card Punch	490	470	20,000	100
1200-lpm Line Printer	1,155	1,110	42,000	260
1200-cpm Card Reader	480	460	18,000	90
8K-byte Memory Expansion	422	402	16,200	32
Communications Adapter	15	14	600	0
CRT Display Unit (with Keyboard)	90	86	3,200	20

*Includes prime-shift maintenance.
**Adds four channels; two expansions permitted. ■

Control Data Main Memory for IBM System/360 and 370



This double-bay cabinet holds up to 2048K bytes of core memory for System/360 Model 65 systems. Other models of the CDC add-on memory are available in single-bay upright cabinets or desk-height consoles.

CDC offers semiconductor replacement memory for System/370 Models 135 through 165 and core replacement memory for System/360 Models 30, 40, 50, and 65. A processor speed-up feature provides 370/155 users with performance equivalent to that of a standard 370/158.

MANAGEMENT SUMMARY

Control Data, which continues to be the only mainframe manufacturer in the add-on and replacement memory market, is the second largest supplier (after Itel) of AMS semiconductor memory for the IBM System/370 computers; it also supplies Fabri-Tek core memory for the IBM System/360 computers. The company's current installation base includes over 130 million bytes of memory for System/370 computers and over 50 million bytes for System/360 computers.

CDC's MOS semiconductor memory is available for System/370 Models 135, 145, 155, 158, and 165 in IBM-standard capacities, as well as in enhanced capacities that provide up to 4096K bytes for Models 155 and 165. The semiconductor memories for Models 155 and 165 offer substantial reductions in floor space, power consumption, and heat dissipation over equivalent IBM core storage. Replacement memory for the 370/168 is scheduled to become available in the first quarter of 1976.

Error checking and correction (ECC) is featured on all members of the 370 family of memories. An error light notifies the operator that maintenance is required, while normal processing continues. Maintenance is facilitated by a fault location capability, which identifies the exact card that is failing. The memory is quickly serviced by replacing the faulty card.

CDC's core memory is available for System/360 Models 30, 40, 50, and 65 in IBM-standard capacities, as well as in ▷

CHARACTERISTICS

SUPPLIER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-7600.

MANUFACTURERS: System/360 memory–Fabri-Tek, Inc., Memory Products Division, 5901 South County Road 18, Minneapolis, Minnesota 55436; telephone (612) 935-8811. System/370 memory–Advanced Memory Systems Inc. (AMS), 1276 Hammerwood Avenue, Sunnyvale, California 94086; telephone (408) 734-4330.

370 MODELS: Five models are available: 33135, for IBM 370/135; 33145, for IBM 370/145; 33155, for IBM 370/155; 33165, for IBM 370/165; and 33158, for IBM 370/158. All models use MOS technology and are offered in IBM-standard incremental capacities; Models 33155 and 33165 are also available in enhanced capacities.

360 MODELS: Four models are available: 23030, for IBM 360/30; 23040, for IBM 360/40; 23050, for IBM 360/50; and 23065, for IBM 360/65. All models use core technology and are offered in IBM-standard incremental capacities and in enhanced capacities.

COMPATIBILITY: Control Data's 33000 and 23000 Series main memories are designed as plug-compatible add-on or replacement memory units for IBM System/370 and System/360 computers, respectively. CDC memory can be used to extend the storage capacity of an existing IBM System/370 or 360 processing unit and/or to replace all storage down to the minimum mainframe capacity as specified for the particular IBM processing unit. Operating speed of the CDC memory matches that of the corresponding IBM processing unit. The following table presents the range of IBM-standard and CDC-enhanced storage capacities available for each CDC memory model and its corresponding IBM processing unit.

CDC Memory Model	IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	CDC Enhanced Capacities, bytes
33135	3135	96K	96K to 512K	None
33145	3145	160K	160K to 2048K	None
33155*	3155	0	256K to 2048K	2560K, 3072K, or 4096K
33158	3158	512K	512K to 4096K	None
33165*	3165	0	512K to 3072K	4096K
23030	2030	8K or 16K	16K to 64K	96K or 128K
23040	2040	32K	64K to 256K	384K or 448K
23050	2050	128K	128K to 512K	768K or 1024K
23065*	2065	0	256K to 1024K	Up to 4096K

*All existing IBM memory can be replaced.

Physical specifications and maximum power requirements for the Control Data memory cabinets are as follows: ▷

Control Data Main Memory for IBM System/360 and 370

enhanced capacities that provide up to twice the IBM-imposed maximum storage capacity for Models 30, 40, and 50, and up to four times that for Model 65.

The CDC memories can be used to upgrade an existing IBM System/370 or 360 computer by adding onto the existing IBM memory or by replacing all IBM memory down to the minimum storage capacity as specified by IBM for the particular processing unit. Complete memory replacements can be made on the System/370 Models 155 and 165 and on the System/360 Model 65, where all main memory is external to the processing unit.

Control Data also offers an acceleration feature for the 370/155, in conjunction with its memory modules. This enhancement can particularly benefit the user of a purchased Model 155. Introduced in June 1973, the AMS-produced Processor Speed-Up (PSU) feature promises a 10 to 20 percent increase in performance, bringing the 370/155 up a level equivalent to that of the 370/158 (but not the new 370/158-3). The PSU feature does not include a dynamic address translation (DAT) capability, but it does provide complete compatibility with the IBM DAT feature, thus permitting its use with a 370/155-II. Read/write cycle times with the PSU are identical with those for the IBM 370/158. The PSU feature is included within the CDC memory cabinet. An integral Storage Adapter permits the CDC memory to bypass IBM's Storage Adapter, providing additional savings by precluding the need for a second IBM Storage Adapter when both ports of the primary SA are occupied.

CDC prices its System/360 memories an average of 65 to 70 percent below the rental prices of equivalent IBM memories, and its System/370 memories an average of 15 to 25 percent below IBM's rental prices.

Customer deliveries of CDC's 360 replacement memory began in June 1972 with the installation of replacement memory for the Model 50. Deliveries of the 370 replacement memory began in April 1973 with the installation of replacement memory for the Model 155. Service is provided by Control Data through its worldwide service organization.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 12 users reported on their experience with a total of 3 CDC replacement memories for System/360 Models 50 and 65, having an aggregate capacity of 768K bytes, and a total of 10 CDC replacement memories for System/370 Models 135, 145, and 155, having an aggregate capacity of 7,544K bytes. Their ratings are presented in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	6	5	1	0	3.4
Equipment reliability	6	5	0	1	3.3
Maintenance service	5	4	2	1	3.1
Ease of installation	4	7	1	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

The majority of these users reported only minor problems during installation and testing and in diagnosing malfunctions and obtaining service. The two Poor ratings came from one 370/145 user who cited many failures and poor service due to "untrained" CE's, but his experiences were

Model	Max. Storage, bytes	Depth, inches	Width, inches	Height, inches	Max. Weight, lbs.	Max. Power, Watts
33135	256K	25	25	55	450	600
33145	512K	32	62	60	1,250	1,200
33155	2048K	62	32	60	1,700	4,000
33165	2048K	62	32	72	2,300	4,000
23030*	32K	20	27	29	200	500
23030	120K	32	32	72	700	1,600
23040	256K	32	32	72	825	2,300
23050**	1024K	32	64	72	1,500	4,000
23065	1024K	32	32	72	1,500	6,000

* Low-boy (desk-height) cabinet; others are upright cabinets.

**Double-bay upright cabinet.

The CDC memories contain an integral power supply that satisfies the memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, provides an off-line diagnostic capability to facilitate the isolation of malfunctions within the unit.

PRICING: CDC memories are available for purchase and on a one, three, four, or five-year lease arrangement. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. Separate maintenance contracts are arranged for both leased and purchased equipment. Available arrangements range from prime-shift, 5 days per week, to full-time, 24 hours per day, 7 days per week. In the costs presented below, prime-shift maintenance has been included.

One-year leases are noncancellable. The basic three-year agreement, presented below, includes a 12-month noncancellable period. A two percent discount (not including maintenance) is applied for each year in the lease agreement beyond three and up to five years, and also for each one-year extension of the noncancellable period. The lease term may not exceed the noncancellable period by more than two years.

IBM Processor Conversion		Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
From 2030C	(8K) to:				
F	(64K)	$ 930	$ 802	$ 25,506	$ 75
FE	(96K)	1,171	1,011	31,512	113
G	(128K)	1,576	1,359	42,939	136
From 2030D	(16K) to:				
F	(64K)	798	688	21,723	69
FE	(96K)	1,065	920	28,587	106
G	(128K)	1,477	1,274	40,131	131
From 2030E	(32K) to:				
F	(64K)	658	567	17,979	55
FE	(96K)	1,071	923	29,074	94
G	(128K)	1,272	1,099	34,359	120
From 2030F	(64K) to:				
FE	(96K)	674	583	17,979	71
G	(128K)	1,071	923	29,094	94
From 2040E	(32K) to:				
F	(64K)	658	567	17,979	55
G	(128K)	1,241	1,068	34,359	89
GF	(192K)	1,798	1,547	49,491	137
H	(256K)	2,488	2,138	69,225	166
HG	(384K)	3,971	3,421	108,732	323
HGF	(448K)	4,676	4,027	128,544	365
From 2040F	(64K) to:				
G	(128K)	1,053	905	29,094	76
GF	(192K)	1,653	1,421	45,747	118
H	(256K)	2,148	1,848	59,280	159
HG	(384K)	3,623	3,123	98,865	306
HGF	(448K)	4,323	3,723	118,638	343
From 2040G	(128K) to:				
GF	(1982K)	1,053	905	29,094	76
H	(256K)	1,653	1,421	45,747	118
HG	(384K)	2,921	2,522	79,170	266
HGF	(448K)	3,623	3,123	98,865	306

Control Data Main Memory for IBM System/360 and 370

distinctly in the minority. Judging by the healthy overall scores given to the CDC memory and the general lack of comments about product disadvantages or serious problems, most users are well satisfied with the products and with CDC's support. □

IBM Processor Conversion	Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
From 2040GF (192K) to:				
H (256K)	1,053	905	29,094	76
HG (384K)	2,213	1,913	59,280	224
HGF (448K)	2,921	2,522	79,170	266
From 2040H (256K) to:				
HG (384K)	1,718	1,486	45,747	183
HGF (448K)	2,213	1,913	59,280	224
From 2050G (128K) to:				
H (256K)	1,753	1,507	48,555	124
HG (384K)	2,764	2,382	75,543	230
I (512K)	3,500	3,023	94,302	336
IH (768K)	5,444	4,708	145,548	561
J (1024K)	7,464	6,455	199,485	772
From 2050H (256K) to:				
HG (384K)	1,753	1,507	48,555	124
I (512K)	2,764	2,382	75,543	230
IH (768K)	4,511	3,899	121,290	443
J (1024K)	6,539	5,651	175,071	666
From 2050HG (384K) to:				
I (512K)	1,753	1,507	48,555	124
IH (768K)	3,410	3,023	94,302	336
J (1024K)	5,444	4,708	145,548	561
From 2050I (512K) to:				
IH (768K)	2,764	2,382	75,543	230
J (1024K)	4,511	3,899	121,290	443
From 2065 (any 256K-byte increment, 0 to 1024K) to any 256K-byte increment	2,719	2,360	74,530	338
From 2065 (any 512K-byte increment, 0 to 1024K) to any 512K-byte increment	4,588	3,982	119,925	565
From 2065 (any 768K-byte increment, 0 to 1024K) to any 768K-byte increment	6,723	5,830	176,826	792
From 2065 (any 1024K-byte increment, 0 to 1024K) to any 1024K-byte increment	8,430	7,314	220,974	1,018
From 2065 (any 256K-byte increment, 0 to 1024K) to any 1280K-byte increment	10,776	9,341	284,154	1,245
From 2065 (any 256K-byte increment, 0 to 1024K) to any 1536K-byte increment	$12,907	$11,184	$340,899	$1,472
From 2065 (any 256K-byte increment, 0 to 1024K) to any 1792K-byte increment	15,042	13,032	397,800	1,699
From 2065 (any 256K-byte increment, 0 to 1024K) to any 2048K-byte increment	16,750	14,517	441,909	1,927
From 2065 (any 256K-byte increment, 0 to 1024K) to any 2304K-byte increment	19,358	16,766	512,859	2,154
From 2065 (any 256K-byte increment, 0 to 1024K) to any 2560K-byte increment	21,226	18,388	561,873	2,380
From 2065 (any 256K-byte increment, 0 to 1024K) to any 2816K-byte increment	23,361	20,235	618,735	2,607
From 2065 (any 256K-byte increment, 0 to 1024K) to any 3072K-byte increment	25,069	4,720	662,883	2,834
From 2065 (any 256K-byte increment, 0 to 768K) to any 3328K-byte increment	27,415	23,747	726,063	3,061
From 2065 (any 256K-byte increment, 0 to 512K) to any 3584K-byte increment	29,546	25,590	782,808	3,288
From 2065 (0 or 256K) to 3840K or 4096K bytes	31,680	27,437	837,709	3,514
From 2065 (0 bytes) to 4096K bytes	33,388	28,923	883,857	3,742

IBM Processor Conversion	Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
From 3135FE (96K) to:				
GF (192K)	1,760	1,592	67,350	89
DH (240K)	2,492	2,256	101,025	124
H (256K)	2,771	2,507	102,300	183
HF (320K)	3,350	3,033	125,250	230
HG (384K)	3,910	3,543	148,200	301
HGF (480K)	4,752	4,307	182,625	136
From 3135 GD (144K) to:				
DH (240K)	1,760	1,592	67,350	89
HG (384K)	3,079	2,791	114,525	194
I (512K)	4,201	3,810	160,425	289
From 3135 GF (192K) to:				
HF (320K)	1,789	1,621	64,910	112
HG (384K)	2,383	2,160	86,727	160
I (512K)	3,371	3,060	126,750	255
From 3135 DH (240K) to:				
HG (384K)	NA	NA	80,850	124
I (512K)	NA	NA	126,750	218
From 3135 H (256K) to:				
I (512K)	NA	NA	102,182	207
From 3145 H/H2(256K) to:				
HG/HG2 (384K)	1,829	1,644	54,200	179
I/I2 (512K)	2,942	2,032	73,800	187
IH/IH2 (768K)	5,352	3,572	130,000	322
J/J2 (1024K)	7,764	5,574	203,600	484
From 3145 HG/HG2(384K) to:				
I/I2 (512K)	2,379	1,924	62,800	224
IH/IH2 (768K)	3,620	3,090	112,600	275
J/J2 (1024K)	4,998	4,373	159,400	388
From 3145 I/I2 (512K) to:				
IH/IH2 (768K)	2,647	2,377	79,300	232
J/J2 (1024K)	4,822	3,562	129,600	322
From 3158I (512K) to:				
JI (1536K)	4,840	4,404	175,600	480
K (2048K)	7,264	6,603	263,475	653
KJ (3072K)	13,028	11,825	476,550	999
From 3158J (1024K) to:				
K (2048K)	4,840	4,404	175,600	480
KJ (3072K)	10,607	9,630	388,725	829
L (4096K)	15,452	14,024	564,375	1,173
From 3158JI (1536K) to:				
KJ (3072K)	8,182	7,429	300,900	653
L (4096K)	13,028	11,825	476,550	999
From 3158K (2048K) to:				
KJ (3072K)	5,758	5,230	213,075	480
L (4096K)	10,607	9,630	388,725	829
IBM 370/155 and 165 Memory and Enhancements				
512K-byte increment	$3,322	$3,046	$105,018	$ 567
768K-byte increment (155 only)	5,102	4,667	134,094	757
1024K-byte increment	6,047	5,537	158,862	946
1536K-byte increment	8,803	8,055	223,821	1,326
2048K-byte increment	11,757	10,752	295,804	1,706
2560K-byte increment (155 only)	15,932	14,547	380,296	2,085
3072K-byte increment	16,972	15,521	429,381	2,466
3584K-byte increment (155 only)	19,925	18,217	497,632	2,845
4096K-byte increment	21,790	19,933	556,291	3,225
Storage Address Unit Enhancement (permits addressing 2048K bytes of CDC memory on one port of an IBM 370/155)	245	221	11,000	NC
Out-of-Bounds-Expansion (permits addressing up to 4096K bytes of CDC memory on an IBM 370/155)	490	441	22,000	NC

Control Data Main Memory for IBM System/360 and 370

IBM 370/155 and 165 Memory and Enhancements	Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
Storage Control Unit (SCU) Enhancement (permits addressing 3072K bytes of CDC memory on one port of an IBM 370/165	245	221	11,000	NC
SCU Added Port (adds one port to a one- or two-port IBM 370/165; permits addressing up to 3072K bytes of CDC memory	333	300	15,000	NC
Out-of-Bounds Expansion (permits addressing up to 4096K bytes of CDC memory on an IBM 370/165)	490	441	22,000	NC

IBM 370/155 Memory with Processor Speed-Up	Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
1024K-byte increment	NA	NA	242,862	1,300***
1536K-byte increment	NA	NA	307,821	1,680***
2048K-byte increment	NA	NA	379,804	2,138***
3072K-byte increment	NA	NA	597,381	2,820***
4096K-byte increment	NA	NA	724,291	3,579***

*Includes prime-shift maintenance.

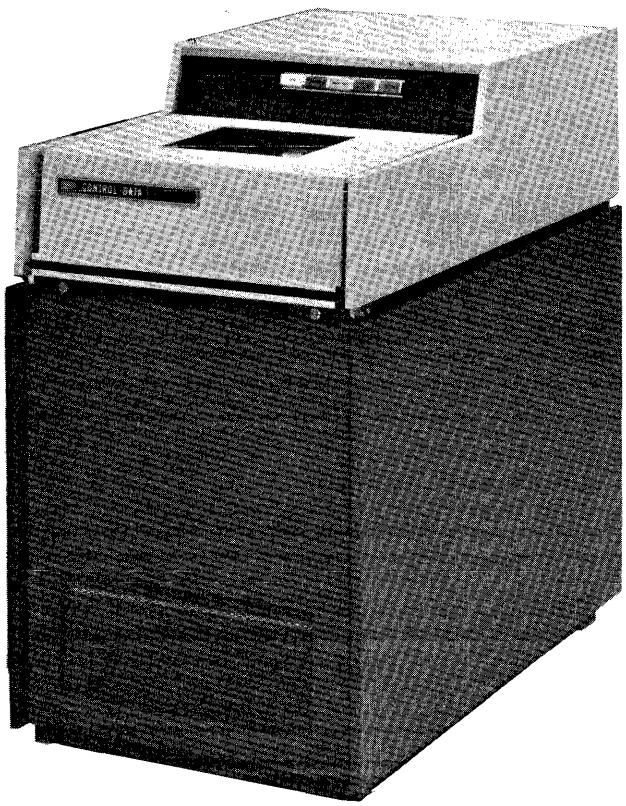
**Prime-shift maintenance.

***Maintenance prices apply to cities in which Comma Corp. has service locations. Maintenance prices for areas other than those with Comma service centers are available on request to CDC.

NA–Not available for lease; purchase only.

NC–No charge. ■

Control Data 33301 Multiple Disk System



The CDC 33301 system, a plug-to-plug replacement for IBM's initial 8-spindle, channel-attached 3330 Disk Storage Facility, matches the 3330's performance and is priced substantially lower.

MANAGEMENT SUMMARY

Control Data Corporation has entered the IBM 3330 replacement market with its 33301 Multiple Disk System, which is plug-to-plug compatible with the IBM 3330 Disk Storage Facility. The CDC subsystem offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and operating characteristics. No hardware or software modifications to existing IBM equipment are required. Disk packs recorded by CDC drives can be read by the equivalent IBM drives, and the converse.

CDC is offering its users a direct replacement for the original eight-spindle, channel-attached IBM 3330 subsystem. The 33301 subsystem does not boast any new features that are not present in the IBM 3330. Its performance characteristics are the same as those of IBM's 3330, and the CDC subsystem is priced substantially below its IBM counterpart.

CDC prices its Model 33301 drives 15 percent below IBM's lease and purchase prices for the 3330 drives. The CDC 38301 controller leases and sells for 25 and 35 percent, respectively, below IBM's 3830 Model 1 Controller.

CHARACTERISTICS

MANUFACTURER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-8100.

DISK DRIVE: Model 33301 Disk Storage Unit.

DISK CONTROLLER: Model 38301 Storage Control Unit.

CONFIGURATION: The CDC 33301 Multiple Disk System includes a 38301 Storage Control Unit and one to eight 33301 Disk Storage Units; all drives can remain on-line and immediately accessible to the computer.

The optional Two-Channel Switch feature provides two channel interfaces, which serve as alternate data paths to the controller and its attached disk drives.

COMPATIBILITY: The 33301 subsystem is designed for connection to an IBM System/360 computer, Model 85 or 195, or to an IBM System/370 computer, Models 135 through 195 (via a Block Multiplexer Channel), as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 33301 provides complete compatibility with the IBM 3330 command structure and requires no changes to the existing software.

STORAGE CAPACITY: The data storage capacity of each CDC 33301 Disk Unit is identical with that of one spindle of the two-spindle IBM 3330 Disk Storage module: 100.018 million bytes. Total on-line storage capacity of an 8-drive subsystem is 800.146 million bytes.

ACCESS ARRANGEMENT: Each CDC 33301 Disk Unit provides access to 404 recording cylinders (19 tracks/cylinder) via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

DISK PACK: Each CDC 33301 Disk Unit accommodates one IBM 3336 or CDC 879 Disk Pack or an equivalent pack. The IBM 3336 and CDC 879 each contain 12 disks and provide 19 recording surfaces.

FILE ORGANIZATION: Identical with that of IBM; each disk pack corresponds to one logical file. Module Select (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

PERFORMANCE: The performance characteristics of the CDC 33301 drives are compared with those of the IBM 3330 drives in the following table.

Control Data 33301
Multiple Disk System

The CDC 38301 Storage Control Unit is equipped with microprogrammed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive while it is off-line.

Like its IBM counterpart, the 33301 system features Rotational Position Sensing (RPS), Multiple Requesting, and Command Chaining. The CDC 33301 drives are capable of fully overlapped seek operations on any combination of up to 16 on-line drives and of multi-track searching through a cylinder without loss of any disk revolutions.

Two-channel selection is also available for the CDC disk subsystem. The Two-Channel Switch feature permits the 38301 controller to be attached to two computers for shared operation or between two controller positions on the same computer. Switching is performed under program control.

Control Data is purchasing a limited number of its controllers for the 33301 System from Century Data Systems; however, CDC plans to manufacture its own controllers and to incorporate enhancements comparable to those offered by other independents.

The CDC 33301 System was announced in February 1973. Customer deliveries are scheduled to begin in June 1973.

What does CDC hope to gain by introducing a somewhat dated 3330-type replacement subsystem that is not functionally competitive with the current IBM 3330 equipment? Most of the other independents now offer extended capabilities for their own 3330-type subsystems to match or counter the improvements introduced by IBM in August 1972 and February 1973. Our guess is that CDC hopes to grab a thin slice of the remaining vintage 3330 market and hang on until its own controller is ready for marketing. Hopefully, for the sake of CDC, its new controller will match the extended capabilities of the current IBM 3330 subsystem. □

Head Positioning Time, Milliseconds

Disk Drive	Track to Track	Average (400 cyl.)	Maximum (400 cyl.)	Tracks per Inch
CDC 33301	10	30	55	192
IBM 3330	10	30	55	192

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are also identical with those of the IBM 3330. Head positioning is controlled electromagnetically by both the CDC and IBM drives.

PHYSICAL CHARACTERISTICS: The physical arrangement of the CDC 33301 subsystem is quite different from that of the IBM 3330. Unlike the 3330, the CDC subsystem consists of discrete components with the following cabinet dimensions:

Device	Width, inches	Depth inches	Height, inches	Weight, pounds
33301 Drive	22	45	39	650
38301 Controller	32	34	60	600

Compared with a full-blown (8 spindles), channel-connected IBM 3330 Facility, which stacks its drives two-high, the CDC 33301 subsystem requires somewhat more floor space, including the required service area.

The CDC 33301 subsystem operates in the same physical environment as the IBM 3330, with slightly lower power requirements.

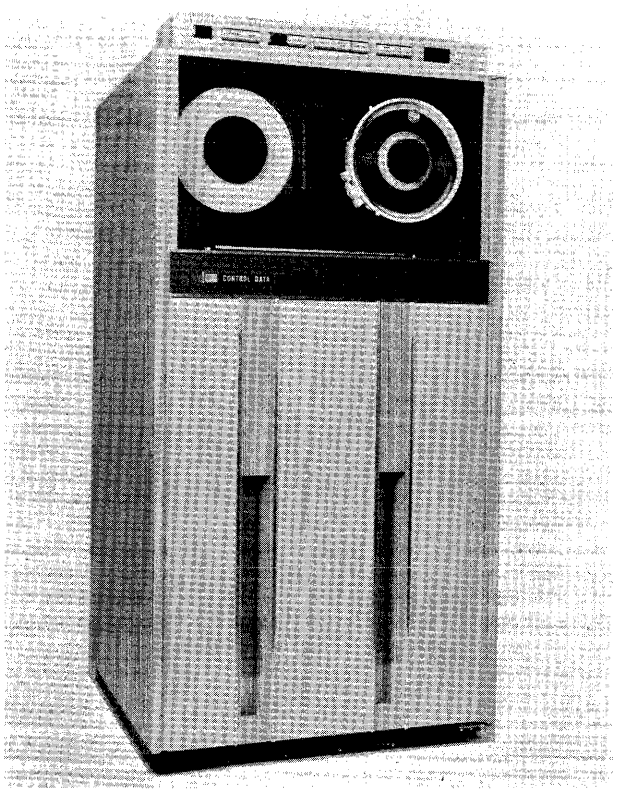
PRICING: The CDC 33301 Disk Storage Facility is available for purchase or lease. Leases are available for one to five years. Lease rates include complete maintenance, installation, all cables, diagnostic performance checks, and unlimited usage. A separate maintenance contract is available for purchased units.

Monthly Rental*

Device	1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
33301 Drive	$ 500	$ 463	$22,000	$128
38301 Controller	1,650	1,502	62,000	172
Two-Channel Switch	150	135	4,500	NC

* Includes maintenance for 24 hours/day, 7 days/week. ■

Control Data 38031/34201 Magnetic Tape Subsystem



This subsystem is a plug-compatible replacement for IBM's 800/1600-bpi 3420/3803-1 tape subsystem, but does not currently provide compatibility with IBM's new 6250-bpi 3420 drives and 3803-2 controller. The CDC subsystem offers price/performance advantages over its IBM counterpart, as well as additional model choices.

MANAGEMENT SUMMARY

Control Data's 38031/34201 Magnetic Tape Subsystem, unveiled at the National Computer Conference in June 1973, is a plug-to-plug replacement for IBM's 800/1600-bpi 3420/3803-1 Magnetic Tape Subsystem, introduced in November 1970. However, the CDC subsystem does not currently provide compatibility with IBM's new high-performance 3420/3803-2 Magnetic Tape Subsystem, introduced in March 1973, which records at 6250 bpi via the Group Coded Recording (GCR) technique.

The CDC 38031/34201 subsystem offers a family of tape drives consisting of five members. The performance characteristics of three models of the CDC 34201 drives correspond to those of the IBM 3420 Models 3, 5, and 7. The performance characteristics of the other two models fall above and below those of the IBM 3420 Model 5 drive. These added drives allow the user to configure his subsystem from a broad range of tape speeds and corresponding data transfer rates.

The CDC subsystem also employs the radial attachment technique conceived by IBM and initially employed in its 3803/3420 subsystem. With this technique, each tape drive is connected independently to the control unit instead of in the conventional "daisy-chain" or series arrangement where all drives are connected in sequence ▷

CHARACTERISTICS

MANUFACTURER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-8100.

TAPE DRIVES: Five models, compatible with the IBM 3420 Series Magnetic Tape Units: CDC 34201 Models 3, 4, 5, 6, and 7.

TAPE CONTROLLER: CDC Model 38031 Tape Controller.

COMPATIBILITY: The CDC 34201 Series Magnetic Tape Drives are designed as plug-compatible replacements for the IBM 3420 Series Magnetic Tape Units, Models 3, 5, and 7. CDC has introduced two additions to this series with characteristics that fall between IBM Models 3 and 5 and between Models 5 and 7. The CDC models are listed below with the equivalent IBM 3420 models and their characteristics. The CDC 34201 tape drives, however, are not compatible with IBM's newer 3420 Model 4, 6, and 8 tape drives (rated at 6250 bpi).

IBM 3420 Model	IBM 34201 Model	Tape Format, tracks*	Tape Speed, ips	Tape Density bits/inch*	Transfer Rate, K bytes/sec.
3	3	9	75	800/1600	60/120
3	3	7	75	556/800	41.7/60
–	4	9	100	800/1600	80/160
–	4	7	100	556/800	55.6/80
5	5	9	125	800/1600	100/200
5	5	7	125	556/800	69.5/100
–	6	9	150	800/1600	120/240
–	6	7	150	556/800	83.4/120
7	7	9	200	800/1600	160/320
7	7	7	200	556/800	111.2/160

* Seven Track and Dual Mode features are optional; see text below.

The CDC 34201 Series drives can be used with IBM System/360 computers, Models 30 through 195, and with IBM System/370 computers, Models 135 through 195, via the CDC 38031 Tape Controller.

The standard CDC 34201 Series drives, like their IBM counterparts, are 9-track, phase-encoded drives that read and write at a single density of 1600 bits/inch. Single-density operation at 800 bits/inch using NRZI encoding can ➤

Control Data 38031/34201 Magnetic Tape Subsystem

beginning at the controller and ending with the last drive. The radial technique is superior to daisy-chaining because it permits a drive to be switched off-line and exercised by diagnostic routines without interrupting or affecting the operation of the remaining drives.

The CDC 38031 Controller employs integrated-circuit technology and is equipped with microprogrammed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive in the off-line mode.

The CDC 38031/34201 subsystem is priced about 20 percent below its IBM counterpart on both a purchase and lease basis (under a one- or two-year lease). Further savings can be realized through extended lease periods up to five years.

Control Data provides worldwide service through its own service organization, which includes an international network of field offices and spart-parts depots.

Customer deliveries of the 38031/34201 subsystem are scheduled for the first quarter of 1974. □

also be specified. The Dual Mode feature, available for all 34201 Series models, also permits reading and writing at a density of 800 bits/inch using NRZI encoding. The Seven Track feature, also available for all 34201 Series models, permits reading and writing in the 7-track, NRZI-encoded mode at selectable densities of 556 or 800 bits/inch.

Standard features include single-capstan operation, automatic reel latch, automatic threading, power window, cartridge-handling capability, visual load-point indicator, and read-backward capability.

The CDC 38031 Tape Controller is designed as a plug-compatible replacement for the IBM 3803 Model 1 Tape Control and as a controller for the CDC 34201 Series Magnetic Tape Drives. Like its single-channel IBM counterpart, each CDC 38031 and its tape drives operate as a tape subsystem for System/360 Models 30 through 195 or System/370 Models 135 through 195. The basic 38031 Controller provides control and data-handling capability for up to eight 9-track, phase-encoded tape drives.

Dual Mode and Seven Track features are required for the controller when operating with drives incorporating these features. The Seven Track feature also includes translation and data conversion functions. When selected, the translator function writes 8-bit, EBCDIC-coded bytes as 6-bit, BCD-coded equivalents on 7-track tape; the converse translation is performed when reading. When selected, the data conversion function writes three 8-bit bytes as four 6-bit characters on 7-track tape; the converse function is performed when reading.

The Two-Channel Switch feature provides a second channel interface as an alternative path to the controller and attached tape drives.

Pooling options permit up to 16 tape drives to be switched among two, three, or four 38031 Controllers to allow simultaneous operation of two, three, or four tape drives over as many Selector Channels.

The physical characteristics of the CDC tape drives and controller are virtually the same as those of their IBM counterparts. The CDC drives and controller operate in the same environment as the equivalent IBM equipment, with essentially the same power requirements. Physical characteristics are as follows:

	Width, inches	Depth, inches	Height, inches	Weight, pounds
34201 Drive	30.5	30	67	800
38031 Controller	30	30	60	–

PRICING: The CDC 38031/34201 Magnetic Tape Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Control Data offers lease terms of one, two, three, four, and five years. Its one-year lease arrangement permits leasing on a month-to-month basis following the initial 12-month period. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and maintenance.

Either of two separate maintenance contracts is available for leased or purchased units: Basic Maintenance (9 hours/day, 5 days/week) or Extended Maintenance (24 hours/day, 7 days/week).

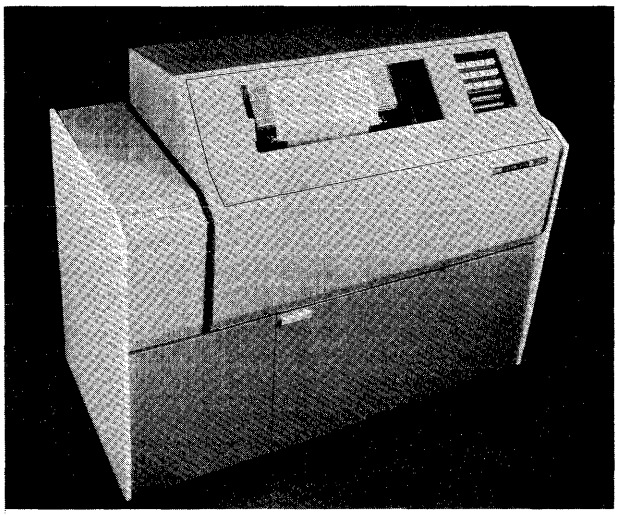
	Monthly Rental*			
	1-Yr. Lease	2-Yr. Lease	Purchase	Monthly Maint. (Basic)
34201 Tape Drives:				
Model 3	$263	$242	$11,000	$50
Model 4	208	283	12,000	50
Model 5	358	328	14,000	55
Model 6	394	360	16,000	55
Model 7	440	402	18,000	65
38031 Controller	499	459	21,000	95
Drive Features				
Seven Track	57	54	2,500	25
Dual Mode	77	72	3,500	25
Single Density**	62	57	2,500	15
Controller Features				
Seven Track	60	54	2,500	3
Dual Mode	60	54	2,000	3
Single Density**	0	0	0	0
Controller Switch***				
Two controllers	157	142	6,000	10
Three controllers	200	181	7,500	15
Four controllers	236	214	9,000	15
Two-Channel Switch	119	108	5,000	5

* Monthly rental prices under a one- or two-year lease include Basic Maintenance. Monthly rental charges under a five-year lease are about 23 percent below those under a one-year lease.

** Single Density is available as 800 bpi (NRZI) or 1600 bpi (PE).

*** Switches up to 16 tape drives among two, three, or four controllers. ■

Control Data 28211/14031 Printer System



This printer subsystem is a plug-to-plug replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit. The CDC subsystem offers substantial savings in cost over the equivalent IBM configuration while providing a number of new features.

MANAGEMENT SUMMARY

Control Data Corporation has heretofore supplied original equipment manufacturers with train printers, train cartridges, and other printer components. Now the company has marshalled its experience in printer technology to design the CDC 28211/14031 Printer System, which combines the 14031 train printer with an appropriate model of the 28211 controller series, and it is marketing this product to end users as a functional, plug-to-plug replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit. The CDC printer system was announced in June 1973, and the first production model is scheduled for delivery in late December 1973.

Compared to the IBM 1403/2821, the CDC system provides several features that are either lacking or optional in the IBM unit. What's more, the CDC system can be obtained under a number of procurement plans at a distinctly lower cost than that of the IBM printer, long-term leasing arrangements or outright purchase offering the best advantage.

Outstanding features of the CDC system are as follows:

- *Universal Character Buffer* – Provides buffering for two user-specified character sets that correspond in sequence to the graphics on the train cartridge. Buffer capacity is 288 characters, compared with 240 in the IBM printer system. In effect, the greater capacity is tantamount to an extra character set on the basic 48-character train; an advantage is improved operational reliability. The stored character sets are selectable by the operator at the computer. These sets can be loaded from the computer or from an IBM 2540 Card Read Punch. The feature is standard in the 28211/14031, but optional in the IBM counterpart.

- *Format Tape Buffer* – Stores the contents of a 12-channel format tape for vertical format control; hence, interruptions caused by tape loop severance are eliminated.

CHARACTERISTICS

MANUFACTURER: Control Data Corporation, 8100 34th Avenue South, Minneapolis, Minnesota 55420. Telephone (612) 853-8100.

PRINTER: Control Data Model 14031.

PRINTER CONTROLLERS: There are six models of the 28211 Controller, which are compatible with all but one of the IBM 2821 series Control Units; see the table below.

COMPATIBILITY: The CDC 28211/14031 Printer System, which consists of a 14031 Train Printer and a 28211 Controller, is a plug-compatible replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit, Models 1, 2, 3, and 5. CDC offers no replacement for the IBM 2821 Model 4 – which is a controller for the IBM 1404 Printer – but does offer controller models that correspond to IBM 2821 Models 3 and 5 equipped with the Third Printer Control feature. Three of the CDC models are like their IBM counterparts in allowing attachment of an IBM 2540 Card Read Punch.

The CDC controller models are listed below with the equivalent IBM models and their characteristics.

IBM 2821 Model	CDC 28211 Model	Peripheral Devices Controlled
1	10	Printer and IBM 2540
2	21	Printer only
3	30	Two printers
4	–	IBM 1404 and 2540
3*	40	Three printers
5	50	Two printers and IBM 2540
5*	60	Three printers and IBM 2540

* IBM model with Third Printer Control feature.

CDC Controller Model 28211-21 is actually integrated within the CDC 14031 Printer housing; hence, the printer and controller in this instance consists of a single unit rather than two separate units.

Because of its plug-to-plug compatibility with the IBM 1403 Printer subsystem, the CDC 28211/14031 Printer System can be used with IBM System/360 Models 25 through 195 and with IBM System/370 Models 135 through 195.

CDC and IBM train cartridges are not interchangeable. The CDC cartridge has a capacity of 288 characters, compared with the smaller 240-character array of the IBM 1416 Interchangeable Train Cartridge.

The Universal Character Set feature, which is optional on the IBM 1403 Printer, is standard in the CDC system.

Buffering in the CDC system accommodates two 288-character train images, and the operator can select either buffer section by a switch. IBM buffering allows for only 240 characters. The characters can be entered into the computer by an IBM 2540 Card Read Punch and loaded into the CDC printer system from the computer.

Control Data 28211/14031 Printer System

- *Stepped-up Print Speed* – Operates at 1200 lines/minute with a standard 48-character set, compared with 1100 lines/minute for the IBM printer. When a 36-character set is used, the printing rate increases to 1500 lines/minute. Using a 16-character set, the 14031 can attain a speed of 2500 lines/minute for several minutes under automatic control in burst mode. CDC makes the interesting claim that the throughput of the 14031 will be about 8 percent greater than that of the IBM 1403. This improvement results from starting the high-speed skip rate at the fourth skip line instead of the eighth, as the 1403 does, and from superior paper handling.
- *Automatic Power Stacking* – Provides improved forms stacking capability by means of an enclosed, powered platform, which can service a full box of paper (approximately 15 inches high). This is a standard feature of the 14031, but optional in the 1403. Users of comparable IBM replacement print systems have repeatedly called attention to this feature as particularly useful.

A convenience of the 28211/14031 system is full-opening, 180-degree tractors that allow front-access loading and forms positioning. Other useful facilities are push-button operator controls and a display panel that includes a printer-operability signal, an indicator for top-of-forms, and another for unlatched train gate. The controls permit verification printout of type array and of contents, as well as forms alignment checking.

Service downtime for fault isolation and diagnosis is reduced by an off-line maintenance panel that facilitates diagnosis without affecting mainframe operation. A comprehensive diagnostic software package microprogrammed in the controller enables service engineers to trace errors quickly, whether their source is in the printer or elsewhere.

Circuitry consists of MSI and LSI semiconductors for compactness and reliability. The controller is a 16-bit microprogrammed minicomputer. Format tape reading employs optical rather than brush techniques. The cabinetry utilizes sound-attenuating materials so that the printer will not disturb nearby personnel.

Although completely compatible with the IBM 1403 Printer, the CDC 14031 does not currently include the Selective Tape Listing Feature available with IBM printers.

The Control Data service organization is one of the most respected in the industry. It has offices in all principal cities and provides service in many secondary population regions as well. □

The CDC printer system also includes a vertical format tape buffer. This buffer is loaded with format information that is either read from a 12-channel tape loop or loaded via a computer equipped with an IBM 2540 Card Read Punch. In the former case, the format tape reader can be removed once the buffer is loaded. Alternatively, the vertical format can be controlled directly from the tape reader. The IBM 1403 Printer does not have a vertical format buffer.

Other standard features include the capability to print all elements of the type array, transient error recovery via an automatic print retry capability, 36- and 16-character print subsets, and high-speed skipping by means of servo paper-advance system.

If a transient impulse causes an error condition, the print retry function automatically brings about reprinting of the line.

The rated printing speed of the 14031 is 1200 lines/minute when a 48-character subset is employed. Use of a 32-character set increases the continuous printing rate to 1500 lines/minute. When a 16-character set is used, a burst speed of 2500 lines/minute can be attained and held for several minutes. The system can be programmed to utilize all 288 characters of the print train cartridge.

The high-speed slewing capability of the 14031 printer effects a skipping rate of 70 inches/second, commencing with the fourth skip line and continuing until the second line from the end of the skip. The slow-speed skipping rate is 30 inches/second. In comparison, the peak skipping speed of the IBM 1403 is 75 inches/second, but this rate is achieved only on skips of 8 lines or more, and shorter skips are performed at 33 inches/second. CDC's Automatic Power Stacker greatly facilitates paper handling during lengthy skipping runs.

Printer forms can be from 4 to 18-3/4 inches wide, including margins. Length can be from 7 to 14 inches fold-to-fold (14 to 22 inches with the front and stacker doors open). The maximum stacking height is 15 inches.

PRICING: The CDC 28211/14031 Printer System can be obtained either by lease or purchase. Conversion from lease to purchase is possible through a purchase-credit arrangement.

CDC offers two leasing plans. One is a simple, noncancellable 12-month lease, and the other is the company's more flexible Commercial Term Plan. In one form, the latter plan specifies a base price for three years with termination rights and a termination fee amounting to 15 percent of the rental due in the unexpired period. Another form offers credits not only for extension of the contract term, but also for extension of a noncancellable period. Both forms provide for add-ons and substitutions.

Various maintenance contracts are available. The prime-shift contract covers a nine-hour day for five days a week; prices for this arrangement are given in the table below. Other arrangements, up to 24-hour service for 7 days a week, are available at higher prices. Monthly rentals include maintenance charges.

CDC does not quote prices for the printer alone, but only for printer/controller combinations. These prices exclude the print trains, which must be ordered separately.

	Monthly Rental*	Purchase	Monthly Maint.
14031 Printer and Controller Model:			
28211-10	$1,262	$60,752	$225
28211-21	915	41,537	215
28211-30	2,300	94,015	425
28211-40	3,224	130,977	515
28211-50	2,350	97,715	435
28211-60	3,274	134,677	625
Standard Print Trains (each)	81	2,627	Time & Matl.
Punch Read Feature	37	2,500	No charge
Column Binary Read Feature	68	4,000	No charge

* Commercial Term Plan, 3-year lease.

Note: Nonstandard print trains are also available. ■

Courier Executerm I

The Executerm I is a low-priced interactive terminal that offers Teletype compatibility, selectable transmission speeds up to 1200 bits/second, and editing capabilities. Options include a parallel interface and an impact printer.

MANAGEMENT SUMMARY

The Courier Executerm I is a noteworthy entry in the low-priced, Teletype-replacement, interactive display market that usually relates to time-sharing applications. Inside its glamorous casework, the Executerm I features an MOS refresh memory, Teletype typewriter compatibility, a limited editing capability, limited horizontal tabulation, automatic page rolling, optional lower-case display, and optional Format-mode operation.

Its editing capability consists of character replacement, insertion, and deletion. The insertion and deletion functions affect all lines that follow the inserted or deleted character, up to the end of the screen. Line insertion and deletion, however, are not provided.

Horizontal tabulation is a very useful feature for constructing formats and arranging information in tabular form. Ideally, horizontal tabulation should allow setting tabs in any column, as on conventional typewriters. Courier, however, has elected to implement a limited version of tabulation in which tabs can be set only in four fixed columns, as specified by the user. This tab feature is not restricted to a single line, but allows the operator to tab through subsequent lines.

The optional Format mode extends the Executerm's usefulness by adding a format handling capability. In this mode, the operator can key data into the "blank" spaces of a fixed format that has been generated via keyboard or computer. Field descriptors are protected from inadvertent typeover. Character replacement, insertion, and ▷

CHARACTERISTICS

MANUFACTURER: Courier Terminal Systems, Inc. (a subsidiary of Boothe Computer Corporation), 2202 E. University Drive, Phoenix, Arizona 85034.

COMMUNICATIONS: Transmits and receives asynchronously in the half- or full-duplex mode at switch-selectable speeds of 110, 150, and 300 bits/second. Switch-selectable speeds of 600 and 1200 bits/second are optional. The 8-level (including parity) ASCII transmission code is used; the unit code structure is 11 bits/character (including one start and two stop bits) at 110 bits/second and 10 bits/character (including one start and one stop bit) at all other speeds.

Connection to a voice-band communications facility is established via a modem. Courier provides an asynchronous integral modem (one circuit board) that operates at speeds up to 300 bits/second.

DIRECT CONNECTION: The General Parallel Interface option provides parallel data transmission using the 8-level ASCII code at 800 bits/second.

CRT DISPLAY: Via a 9-inch (diagonal measurement) CRT with a viewing area 6.4 inches wide by 4.8 inches high. The screen is arranged in 15 lines of 40 characters each to total 600 display positions.

A character set of 64 or 96 (optional) ASCII characters, including upper- and (optionally) lower-case alphabetics, numerics, and special symbols, is displayed in white against a dark background. Characters are generated via a 7-by-8 dot matrix.

DEVICE CONTROL: Executerm I operates in a contention environment, where communication between computer and terminals is controlled by the terminal. Three transmission modes are provided: Conversation, Echo, and Edit. In the Conversation and Echo modes, data is transmitted as it is keyed. The Conversation mode displays data as it is keyed, while the Echo mode displays data only when it is returned or "echoed" from the remote computer. In the Edit mode, a complete message is composed and edited prior to transmission.

A message can consist of up to 512 characters, the capacity of the display buffer. Transmission modes can be controlled by the program residing in the remote computer when the Executerm I contains the optional Program Mode. Besides selection of any of the three transmission modes, the Program Mode feature includes selection of the Format mode when this option is incorporated. The Extended Transmission Format feature, available with the Program Mode option, adds a carriage return and DCI code to the end of each message sequence.

Cursor controls position the cursor one character space to the left or right or reset the cursor to the initial display position (home). Cursor left and right controls are repetitive; the cursor moves from the left margin of a line to the right margin of the previous line and the converse. Wrap-around capability is provided. ▶

deletion can be performed within the variable fields. Upon completing the entry of a variable field, the operator simply tabs to begin entry in the next. Clearing or transmitting the completed page clears or transmits only the entered data and not the format.

The Executerm's page-rolling feature is useful for receiving and displaying a relatively large volume of information analogous to several pages of a report. The feature requires operator alertness to read each displayed "page" or to recognize a certain key. When receiving at 110 bits per second, the screen fills in one minute, but at 1200 bits per second, the screen fills in just five seconds. The page-rolling feature complements the Executerm's small screen capacity of 600 characters, about one-third the size of other competitive display terminals.

Though it is marketed as a teletypewriter replacement, the Executerm I provides only half as many character positions per line as a teletypewriter. To compensate for this, the terminal automatically initiates a carriage return after the last entry on a line. This technique may resolve the problems for some applications, but the user may find it inconvenient or awkward for others.

Switch-selectable transmission speeds allow the user to select the speed of a particular time-sharing service or to match the transmission characteristics of his computer facility. Courier, as an option, provides an integral modem that is compatible with the Bell System 103F Data Set and priced considerably lower.

First deliveries of the Executerm I and the Execuprint I were made in January and July 1970, respectively. Lead time on orders is currently quoted at 90 days for Executerm I and Execuprint I.

Installation and service are provided by the RCA Service Company on a nationwide basis and by Courier on a local basis. Courier provides support through Eastern and Western regional offices located in New York and Phoenix, respectively. □

Edit functions include character insertion and deletion, character replacement, and erasure. Insert and delete functions affect all displayed lines that follow the character insertion or deletion–not just the edited line. Two erasure functions are provided to erase the entire screen or the portion of the screen following the current cursor position.

Standard features also include Horizontal Tabulation, Page Roll, Automatic Line Advance, and Selective Blinking.

Horizontal Tabulation provides four fixed tab stops at columns 8, 16, 24, and 32; any four columns can be specified. Tab characters generated by the keyboard or received within the computer message index the cursor to the next tab position; the data that follows is displayed beginning at the indexed cursor. Tabbing is not confined to a single line; subsequent tab characters index the cursor from line to line.

Page Roll, when selected, enables an automatic roll feature that is initiated when received data exceeds buffer or screen capacity. When initiated, displayed data rolls toward the top of the screen until a carriage-return character is encountered on the first line; data displayed up to the carriage-return is lost.

Automatic Line Advance automatically executes a carriage return after the 40th character on a line is displayed.

Selective Blinking flashes selected characters or groups of characters within a displayed message. A blink-control character precedes the character or characters; blinking is terminated with a space or carriage-return character.

Optional features include Answer-Back and Format mode. Answer-Back responds to a received computer inquiry with a 23-character terminal identification sequence. When operating in the Format mode, entry is restricted to variable fields; field descriptors are protected.

ERROR CONTROL: Even parity is generated, accompanies each transmitted character, and is checked for each received character. Characters received in error are replaced with a special symbol, which is displayed on the screen in place of the error character.

KEYBOARD: 61-key typewriter-style, with a column of five function keys to the right of the main keygroup. The keyboard can generate any of 128 ASCII characters, including upper- and lower-case alphabetics, numerics, special symbols, and control characters. Repetitive entry of data or initiation of a function is performed by holding down the appropriate key.

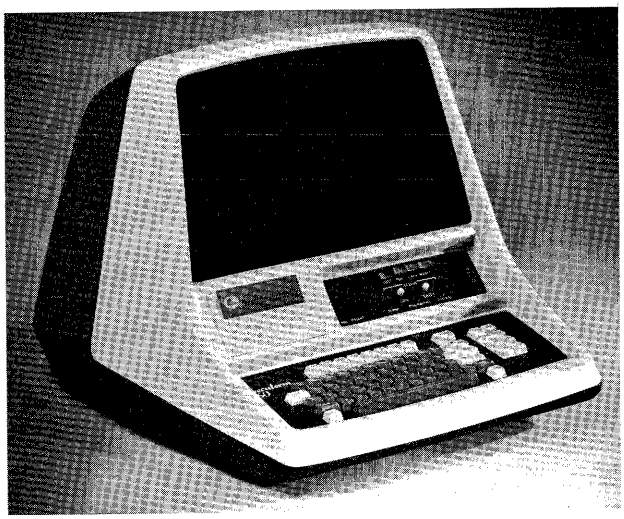
PRINTER: A low-profile, desk-top, impact printer that prints up to an 80-character line composed of any of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols, at speeds up to 10 characters/second. Horizontal spacing is 10.8 characters/inch, and vertical spacing is 6 lines/inch.

PRICING: The Executerm I and Execuprint I are available for purchase or on a 90-day, 1-year, 3-year, or 5-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased equipment.

	Monthly Rental* 1-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.
Executerm I (Without Program Mode)	$137	$111	$2,950	$25
Executerm I (With Program Mode)	150	120	3,350	27
Execuprint I	78	65	2,150	15
Executerm Options:				
Format Mode	5	4	200	1
Lower Case Alphabetics	5	4	150	1
Answer-Back	10	8	200	1
Parallel Interface	9	7	250	2
1200 bps Transmission Speed	3	3	100	1
Integral Modem	8	6	225	2
Dual Port Interface (EIA Standard RS 232C)	3	3	20	1

*Includes prime-shift maintenance. ■

Courier IBM-Compatible Communications Terminals



The Executerm 260 replaces the IBM 2260 Display Station and has a display capacity of either 960 or 1920 characters. The Executerm 60, 65, and 265 terminals are quite similar in appearance.

Courier offers these terminals as direct replacements for the IBM 2260/2848 and 2265/2845 Display Stations. The Executerm display terminals offer a wider range of screen capacities and several significant capabilities not provided by the IBM displays. The Execuprint printers can be used as communications terminals or as local printers to provide hard copy.

MANAGEMENT SUMMARY

The Courier Executerm display terminals, Models 60 and 260 and Models 65 and 265, are designed as replacements for the IBM 2260/2848 and 2265/2845 Display Stations, respectively, for use as remote terminals with IBM System/360 or System/370 computers. The Courier terminals provide both hardware and software compatibility with the IBM terminals. Operation is controlled by the program residing in the remote computer. Like their IBM counterparts, the Courier terminals are supported by standard IBM software as remote terminals operating under the full Operating System (OS) or the Disk Operating System (DOS) via either BTAM or QTAM telecommunication programs. The Courier terminals are also compatible with RCA Spectra 70 computers operating under TDOS/COS.

The Courier display terminals provide all the features that are offered with their counterpart IBM terminals plus some important features not provided by IBM, such as character insert and delete functions, page roll, and Format mode (a more sophisticated formatting technique than that provided by the IBM 2260 and 2265). Line Addressing is a standard feature on the Courier terminals. As an option, Courier provides a set of eight function keys for its display terminals that enter unique codes within the address portion of a message. This feature adds considerable flexibility to terminal usage and accommodates such applications as calling up display formats, tagging records for special handling, etc.; however, the feature requires manipulation of the communications program.

CHARACTERISTICS

MANUFACTURER: Courier Terminal Systems, Inc. (a subsidiary of Boothe Computer Corporation), 2202 E. University Drive, Phoenix, Arizona 85034.

MODELS: Executerm 60 and 260, both multi-station display terminals with different screen sizes; Executerm 65 and 265, both stand-alone display terminals with different screen sizes; and Execuprint 60, 65, 260, 261, and 265 printers. These display terminals are compatible with the IBM 2260/2848 and 2265/2845 Display Stations.

CONFIGURATION:

MULTISTATION: The Multi-Station Adapter (MSA) accommodates up to 16 terminals that can include any combination of Executerm 60 and 260 display terminals and Execuprint 60 and 260 communications printers. The MSA also provides a local printer interface to provide printed output of a message displayed on any of the attached display terminals. Either printer model can be used as a local printer. A printer can perform both communications and local print functions via switch-selectable modes. The MSA is connected to a communications facility via a modem.

SINGLE STATION: The Executerm 65 and 265 display terminals and Execuprint 65 and 265 printers are stand-alone, buffered devices that contain a controller and interface a communications facility via a modem. These devices can also be used in a multi-station environment when used with the Multi-Terminal Adapter (MTA), a multiplexer that can accommodate any combination of up to four devices including the Executerm 65 and 265 display terminals and Execuprint 65 and 265 communications printers. The MTA is connected to a communications facility via a modem. The Executerm 265 can accommodate an Execuprint 60, 260, or 261 (unbuffered) printer to provide a printed copy of a displayed message.

COMMUNICATIONS: Asynchronous in the half-duplex mode at 1200, 2400, or 4800 (optional) bits/second.

The 8-level ASCII transmission code is used; the unit code structure is 10 bits per character, including single start and stop bits.

Transmission compatibility is established with the IBM 2701 Data Adapter Unit equipped with an IBM Terminal Adapter, Type III. Connection with a voice-band facility is established via a modem. The following table shows the relationship between transmission speed and modem type;

Courier IBM-Compatible Communications Terminals

The Courier terminals offer four screen capacities – one more than IBM. Three of the four screen capacities match those of IBM: 240, 480, and 960 characters; the fourth is double that of IBM's largest screen capacity, or 1920 characters. Screen capacities of 240 or 480 characters are provided by the Executerm 60 and 65, while the larger screen capacities of 960 or 1920 characters are provided by the newer Executerm 260 and 265 display terminals. Courier offers either screen size for the same price.

The Courier terminals provide an even greater advantage over their counterpart IBM displays when operating in a multi-station environment: screen capacity of the Executerm displays is not limited or affected by the number of devices attached to a common controller as in the case of IBM's 2260 Display Station. Courier's Multi-Station Adapter can support up to 16 Executerm 260 terminals, each with a full 1920-character display. Although the IBM 2848 Display Control can support up to 24 of the 2260 Display Stations, each is limited to a 240-character display. Even with 16 IBM 2260 displays, each is limited to a 480-character display.

Courier has also enhanced the communications interface. The standard terminals have transmission rates that correspond with those of the counterpart IBM terminals, but Courier also offers a 4800-bps capability as an option.

The Courier terminals also provide a more flexible print capability than the counterpart IBM terminals. In a cluster, printers can be used in place of display terminals to operate as communications terminals. A printer can also be shared by all display terminals within a cluster to provide hard copy for displayed messages. Courier uses Centronic printers for its 260 series Execuprint printers.

Strikingly absent from any Courier installation is a controller the size of IBM's 2848 Display Control. Courier's Multi-Station Adapter, equivalent to the IBM 2848 measures 22 by 24 by 11 inches high and sits on any desk or table that can support 80 pounds. The unit supports up to 16 devices (display terminals and printers operating in the communications mode) plus a local connection for printed output of displayed messages.

The Executerm 65 and 265 display terminals incorporate their controllers within the casework instead of using a separate controller as in the IBM 2265/2845 arrangement. Courier also provides a multiplexer called the Multi-Terminal Adapter that can handle up to four devices consisting of printers and display terminals. The Executerm 265 can also support a printer for hard-copy output.

First deliveries of the Executerm 65 and 60 were made in July 1970, and deliveries of the Execuprint 60 and 65 printers began in September 1970. Deliveries of the

although Bell System modems are shown, equivalent modems from independent manufacturers can be used.

Transmission Rate, bits/second	Bell System Modem	Line Conditioning
1200	202D	C1
2400	201B/203A	C2
4800	203A	C2

An EIA Standard RS-232C or contact-closure equipment interface is available.

CRT DISPLAY: The display characteristics of the four Executerm display terminals are presented in the following table.

Executerm Terminal Model	Viewing Area Width, inches	Viewing Area Height, Inches	Display Format Char/ Line	Display Format Lines/ Display	Screen Capacity, Chars.*
60	6.4	4.8	40	12/6	480/240
65	6.4	4.8	40	12/6	480/240
260	11	6	80	24/12	1920/960
265	11	6	80	24/12	1920/960

*Not affected by number of display terminals in a multi-station environment.

A character set of 65 ASCII characters, including upper-case alphabetics, numerics, and special symbols, is displayed in white against a dark background. Each character is formed by a 7-by-8 dot matrix.

DEVICE CONTROL: The Executerm terminals are designed to operate in an addressing and polling environment under control of the program stored in the remote computer. Operation is compatible with IBM telecommunications software: BTAM and QTAM under OS/360 or DOS/360. The Executerm and Execuprint terminals are compatible with the IBM four-byte addressing sequence, command code structure, and line discipline employed by the IBM 2260/2848 and 2265/2845 Display Stations.

The terminals respond to the IBM addressing sequence by executing any of the six associated commands. These commands interrogate the status of an addressed printer or display terminal and read an awaiting message in the display buffer (Specific Poll); interrogate the status of all devices common to the addressed controller, sequentially reading each pending message and the corresponding display buffer address (General Poll); read the entire contents of an addressed display buffer (Read Addressed Full Buffer); or write a computer message to the addressed display terminal or printer. Write commands directed to a display terminal include two types. The Erase/Write command erases the contents of the display buffer and writes the message beginning with the first display position; messages that follow are written beginning at the current cursor position. The Write Line Address command writes the first message following the command beginning at the initial character position of the addressed line. A write command can also direct (broadcast) a computer message to all devices common to the addressed controller.

All commands and messages are acknowledged, and acknowledgment of computer-directed messages is anticipated.

Courier IBM-Compatible Communications Terminals

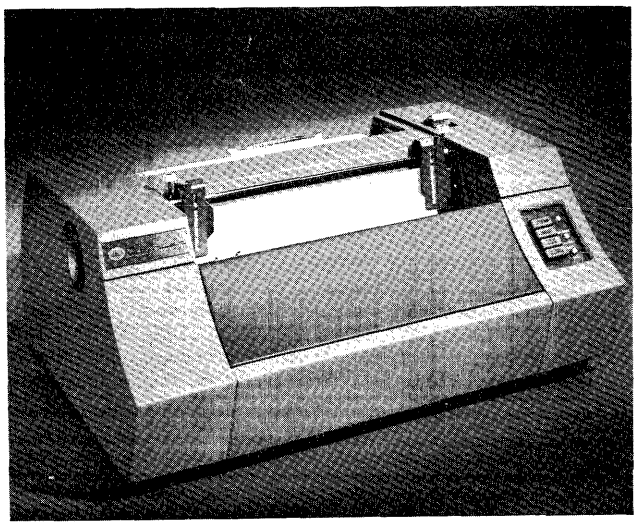
Executerm 260 and 265 began in April 1971, and deliveries of the Execuprint 260 series printers began in September 1971. Lead time on orders is currently quoted as 90 days.

Disney World, Florida, is a showcase installation for Courier. Operational in October 1971, the ever-expanding installation currently boasts some 40 Courier display terminals ranging in screen size from 480 to 1920 characters and 12 Courier-supplied printers that include 10 A.B. Dick Videojet Printers (used in quiet areas) and 2 Centronic line printers. This network of terminals communicates via six private lines with a central processing site in Burbank, California, the headquarters of Walt Disney Productions, which employs two RCA Spectra 70 Model 45 computers. Line economy, an important consideration for any communications environment (especially for the distances involved here) is achieved through multiplexing; each of the six private lines is operated at 4800 bps to accommodate four terminals operating at 1200 bps. The installation uses three of the six lines on a 24-hour basis for "real-time" activity; the remaining three are dedicated to batch operations in addition to providing a back-up capability. Disney World uses its remote processing capability as a hotel reservation system besides handling job functions relevant to general operations.

DATAPRO 70 found the Disney World people quite pleased with the overall system performance as well as with that of the individual Courier terminals. Down-time has been minimal and service, supplied by Courier, has been excellent. The Disney facility did, however, report some difficulty with the forms-feed mechanism on the Videojet Printers, which it says has since been corrected.

Courier became a subsidiary of Boothe Computer Corporation in November 1970. Boothe has been listed on both the American and Pacific Coast Stock Exchanges since April 15, 1971.

Installation and service are provided by the RCA Service Company on a nationwide basis. Courier also provides local support from its Eastern and Western regional offices located in New York and Phoenix, respectively. □



The Execuprint 260 is a Centronics-built unit that provides hard-copy output at speeds up to 165 characters per second. Courier also offers the slower Execuprint 60 and 65 printers at considerably lower prices.

The cursor, displayed as an underscore, is nondestructive. Cursor control keys move the cursor right, left, up, or down by one position, and to the initial display position (home). Repetitive cursor movement results when key pressure is sustained. The cursor moves from the last display position to the first, and the converse, and from the last character position of a line to the first character position of the next line, and the converse (wraparound).

Character insert and delete functions allow the insertion or deletion of characters into or from a displayed line of text. The text expands or contracts to accommodate the inserted or deleted data. Insertions or deletions affect a line of text up to the New Line symbol; text expanded beyond this symbol is lost. Repetitive operation results when key pressure on the Insert or Delete key is sustained.

The Tab function moves the cursor to the character position following a tab stop character (colon) with each depression of the Tab key. Tabbing can continue line by line until the cursor moves from the last display position to the first, an automatic tab stop.

Three erasure keys permit erasure of displayed data from the cursor to the end of a line or from the cursor to the end of the screen, or the erasure of the complete screen. Erasure does not effect cursor movement.

The Page Roll function causes all lines of displayed data to move up by one line after entry into the last display position is completed; data displayed on the first line is lost as the following line is rolled up. Subsequent entry of data is displayed on the last line and is rolled up when the last display position is filled.

Three additional special symbols are displayed besides the cursor: Start of Message, End of Message, and New Line. The control codes corresponding to the symbols can be keyed or received within a computer message and are stored in the display buffer. The Start of Message symbol identifies the beginning of a message to be transmitted following a General or Specific Poll; the End of Message symbol identifies the end of the message. These control codes are not transmitted. The New Line symbol positions the cursor to the beginning of the next line whenever the cursor encounters the position occupied by the symbol. When transmitting a message to the remote computer, New Line codes are transmitted as line feed codes; data to the right of a New Line symbol on the same line is not transmitted.

The New Line code can be used by the Executerm 60 and 65 display terminals to construct a fixed format; New Line symbols can be used to separate variable and fixed data fields. Fixed fields contain format descriptors, immediately

Courier IBM-Compatible Communications Terminals

follow the New Line symbol, and appear to the right of the screen. Only the variable data to the left of the New Line symbol is transmitted; the fixed data remains displayed for the next data entry operation.

The Format mode, provided only by the Executerm 260 and 265 display terminals, is program-generated and can be initiated by a keyed request. The format, received from the remote computer, contains fixed and variable fields. Fixed fields are protected from inadvertent key entry and contain format descriptors. Variable fields, bracketed by displayed Start of Field (colon) and End of Field (New Line symbol) characters, are used for data entry. Only variable fields are transmitted; fixed data remains displayed for the next data entry operation. Tabbing is used to skip to the beginning of the next variable field after partial entry into a variable field.

The Blink feature, provided only by the Executerm 260 and 265 terminals, blinks all data between a blink control code and an End of Field code or the end of the screen. Blink codes cannot be keyed.

Following message composition and any necessary editing, a keyed End of Message symbol is inserted. A received Specific Poll or General Poll command will initiate transmission of all displayed data between Start of Message and End of Message symbols, or from the initial display position (home) if the Start of Message symbol is absent. Protected fields or data to the right of New Line symbols are not transmitted. Keyboard entry is inhibited once the End of Message symbol is keyed and remains inhibited until a successful transmission is completed.

A keyed message is erased and replaced by a computer message when any of the write commands is received prior to a poll command. A Read Full Buffer command received prior to a poll command will initiate the transmission of the complete display buffer contents, but a pending message will remain displayed until a poll command is received and successfully executed.

The Local Print function initiates the execution of a printed copy of a displayed page by a printer operating in the local mode. The display terminal is placed in the local mode when this function is initiated and remains in this mode until printing is completed; all computer commands are ignored but alert the operator via a lighted indicator.

ERROR CONTROL: Character and longitudinal parity generation is performed on all commands and messages transmitted to and received from the remote computer. A message is automatically retransmitted from a terminal when a negative acknowledge to a just-transmitted message is received. An error symbol is displayed in place of a character received in error. The Executerm and Execuprint terminals respond to detected errors by transmitting a negative acknowledgement. Cancel characters, used by the IBM 2260/2848 and 2265/2845 Display Stations to identify detected parity errors prior to transmission, are not used by the Executerm terminals.

KEYBOARD: A choice of three keyboards is available: an ASCII typewriter keyboard, an alphanumeric inquiry keyboard, or a data entry keyboard, which employs a keypunch format. A set of eight transaction keys, positioned over the main keygroup, is optional. An audible tone with adjustable loudness can be used to indicate key depression. The keyboards can generate any of 64 characters including upper-case alphabetics, numerics, and special symbols.

EXECUPRINT 60 and 65: Low-profile, desk-top, impact printers that print up to an 80-character line composed of any of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols, at speeds up to 11 characters/second. Horizontal spacing is 10.8 char/inch; vertical spacing is 6 lines/inch. The printers accommodate pin-fed single or multiple-copy forms from 5 to 8.5 inches wide and store roll paper up to 5.25 inches in diameter. Both printers include a 1024-character message buffer and a line buffer.

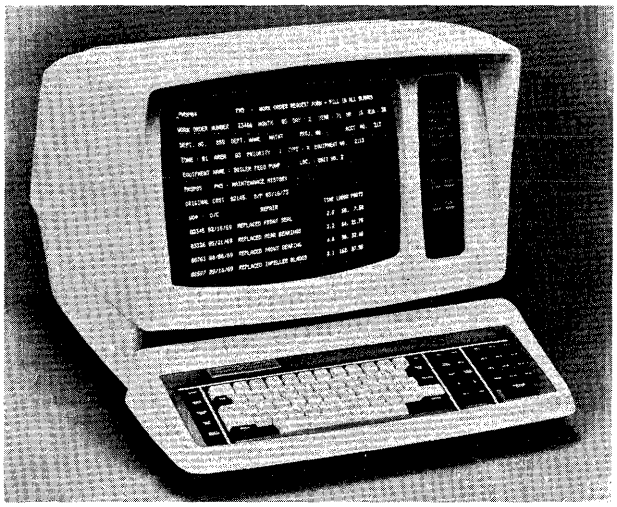
EXECUPRINT 260, 261, and 265: Table-top, impact printers that print up to a 132-character line composed of any of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols, at speeds up to 165 characters/second. Each character is formed by a 5-by-7 dot matrix equivalent to 10-point type. Horizontal spacing is 10 char/inch; vertical spacing is 6 lines/inch. The printers accommodate pin-fed continuous forms up to 14 inches wide. Features include vertical form control and horizontal tab. Except for the Execuprint 261, these include a 1024-character message buffer and a 132-character print buffer.

PRICING: The Executerm and Execuprint terminals are available for purchase or on a 90-day, one-year, three-year, or five-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased equipment.

	Monthly Rental*			
Device	1-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.
Executerm 60	$ 95	$ 76	$4,200	$21
Executerm 65	122	98	4,450	25
Executerm 260	128	103	5,200	26
Executerm 265	144	116	5,350	37
Multi-Station Adapter (MSA)	110	90	4,300	21
Multi-Terminal Adapter (MTA)	48	40	720	10
Execuprint 60	95	76	3,300	24
Execuprint 65	98	79	3,600	25
Execuprint 260 or 265	275	220	7,800	50
Execuprint 261	225	180	5,250	45
Executerm Options:				
Transaction Keys	10	8	250	3
Audible Alarm	2	2	100	N/C
4800 bps Transmission Speed (Exec. 65 & 265)	4	4	100	N/C
MSA Options:				
Dual Channel	N/C	N/C	450	N/C
Local Print	7	6	330	2
4800 bps Transmission Speed	4	4	100	N/C

*Includes prime-shift maintenance.
N/C – No charge. ■

Courier 270
IBM 3270-Compatible Display Systems



These direct replacements for the IBM 3270 Information Display System are available as remote stand-alone terminals or as clustered arrangements with up to 160 local or up to 32 remote displays and printers. Enhancements include extended display and printer capabilities, a remote master station arrangement, and transmission rates of up to 9600 bps.

MANAGEMENT SUMMARY

Courier, a leading supplier of replacement CRT terminals for the IBM 2260/2848 and 2265/2845 Display Stations, entered the IBM 3270 replacement market in November 1973 with the introduction of its 270 Display System.

The Courier 270 is available for local or remote applications as clustered terminals; as many as 64 or 160 display units and printers, can be clustered in a local environment, and as many as 32 display units and printers in a communications environment. A stand-alone version of the 270, the 275, is designed for remote applications and provides printed copy via a single printer. In addition to these conventional display arrangements, Courier also offers a master station arrangement for remote applications that consists of a CRT "master" terminal and up to four "slave" devices including CRT terminals, a printer, and an 8K- or 16K-byte auxiliary memory for the storage of fixed formats. The auxiliary memory can also be used for remote cluster arrangements.

The Courier 270 provides complete compatibility with the IBM 3270 with respect to line discipline, commands and command-code structure, and addressing sequence. The Courier terminals also provide all features and functions that are currently available with the IBM 3270, as well as some worthwhile enhancements.

The salient features of the 270 system as compared with those of the IBM 3270 system include:

- Display capacity – The C270 and C275 offer a choice of three screen sizes: 480, 960, and 1920 characters. IBM provides two screen sizes: 480 and 1920 characters.

- System configuration – The clustered C270 systems are available in both local and remote configurations.

CHARACTERISTICS

MANUFACTURER: Courier Terminal Systems, Inc., 2202 East University Drive, Phoenix, Arizona 85034. Telephone (602) 244-1392.

MODELS: The C270, a local or remote cluster display system; the C275, a remote stand-alone display terminal; and the C275 MS, a remote master station display terminal.

MULTISTATION CONFIGURATION: The C270 display unit is designed for use in a local or remote cluster arrangement that includes a separate controller. Local and remote cluster applications are implemented by separate controllers designated as Local Terminal Controllers (LTC) and Remote Terminal Controllers (RTC).

The basic Local Terminal Controller can accommodate up to 16 devices including any mix of display units and printers. Three additional device adapters can be added to provide accommodation for the full complement of 64 devices. Different printer models and screen sizes can be mixed on the same controller.

An expanded version of the local cluster arrangement uses the Local Terminal Controller to provide accommodation for up to 160 devices via one to five Extended Channel Controllers (ECC). Each ECC can accommodate any mix of up to 32 display units and printers. Different printer models and screen sizes can be mixed on the same ECC; each device is buffered and can be located up to 2,000 cable-feet from the ECC. The ECC can be located up to 2,000 cable-feet from the LTC.

The basic Remote Terminal Controller can accommodate up to 8 devices including any mix of display units and printers. Three additional device adapters can be added to provide accommodation for the full complement of 32 devices. Different printer models and display screen sizes can be mixed on the same controller. Each device is buffered and can be located up to 2,000 cable-feet from the controller.

The RTC can also accommodate an auxiliary memory unit and/or magnetic tape cassette; each device requires one position on a device adapter.

Each display unit in a local or remote cluster arrangement can support a light pen and a badge reader.

The Local Terminal Controller contains a channel interface for the direct connection (via up to 200 cable-feet) to an IBM System/360 computer, Models 25 through 195, or an IBM System/370 computer, Models 115 through 195, via a Selector, Multiplexer, or Block Multiplexer channel. The maximum data transfer rate for transfers from LTC to channel is 483,000 bytes/second; that for transfers from channel to LTC is 535,000 bytes/second.

The Remote Terminal Controller is connected to a modem via a 50-foot cable.

Courier 270
IBM 3270-Compatible Display Systems

An expanded configuration is available for local configurations that require a large number of terminals. The remote configuration can accommodate up to 32 devices, including any mix of display and printer models in increments of up to 8 devices. The local configuration can accommodate up to 64 devices, including any mix of display and printer models in increments of up to 16 devices. The expanded local configuration can accommodate up to 160 devices in increments of up to 32 devices.

System redundancy is provided for both local and remote cluster arrangements and is implemented via two controllers, where the second controller is used as a backup unit for the first. The second controller is a standard feature for remote operation, but is an added-cost option for local operation.

IBM's 3270, by contrast, can accommodate any mix of up to 32 devices including CRT display units and printers for both local and remote cluster arrangements; however, display and printer models cannot be mixed. As many as 31 printers can be attached.

- Printed output – Courier offers a choice of two serial impact printer models rated at 100 cps (Centronics 306) or 165 cps (Centronics 101AL) with 80 or 132 print positions, respectively. The printers are available with or without a 2048-character buffer for use with the C275 stand-alone display terminal, and are equipped with the buffer when used in a cluster arrangement. The printers are also available as stand-alone units, in which case they are equipped with a 2048-character buffer and an RS-232 modem interface for use as remote terminals. The two printer models can be combined in any mix in a cluster arrangement.

  By comparison, IBM offers two printers rated at 40 cps and 66 cps and providing 120, 126, or 132 print positions. Each printer attached to the IBM 3270 is buffered and operates essentially as an on-line device; however, the two printer models cannot be mixed on the same controller. The stand-alone printer, however, is unbuffered; printing is performed from the CRT terminal buffer.

- Displayed output – The C270 and C275 feature a standard displayable character set of 64 symbols; 96 symbols (including lower case alphabetics) are available as an option. Display resolution is enhanced via the use of a 7-by-10 dot matrix to form each character. By contrast, the IBM 3270 has a standard 64-character set of upper case alphabetics (lower case alphabetics are available via an RPQ), which are formed by a 7-by-9 dot matrix. Like their IBM counterpart, the 270 systems feature two beam intensity levels and a beam blanking level; individual characters

I/O devices such as printers produced by other vendors can be attached to the 270 system via the Peripheral Device Controller. Use of this unit requires one device position on the LTC or RTC controller.

SINGLE-STATION CONFIGURATION: The C275 is designed for use in a stand-alone arrangment and contains its own controller. The C275 can support either model of buffered or unbuffered printer. An unbuffered printer prints from the C275's display buffer. The C275 display unit can also support a light pen and a badge reader.

Connection to a communications facility is established via a modem, which can be located up to 50 cable-feet from the C275 display unit.

MASTER-STATION CONFIGURATION: The C275 MS display unit is designed for use in a master station arrangement and contains its own controller. The C275 MS can support up to four C270 display units; a buffered printer, an auxiliary memory unit, and a magnetic tape cassette unit can be attached to the C275 MS, but each device displaces one display unit. Different screen sizes can be mixed and either printer model can be used, but the screen capacities of the slave units must be equal to or smaller than the screen capacity of the master station. Each display unit can support a light pen and badge reader. Connection to the communications facility is established via a modem, which can be located up to 50 cable-feet from the C275 MS.

COMMUNICATIONS: Transmission is half duplex synchronous at 9600, 7200, 4800, 2400, or 1200 bits/second, using 8-level EBCDIC or ASCII (with parity) transmission code. The C270 series terminals employ the IBM Binary Synchronous Communications (BSC) technique and are transmission-compatible with the IBM 3270 Information Display System.

The 270 provides an EIA Standard RS-232C interface and connects to a voice-grade communications facility via a modem. The following table shows the relationship between the transmission speed and modem type; although Bell System modems are shown, equivalent modems from independent manufacturers can be used.

Transmission Rate	Bell System Modem
1200 bps	202C/D/E/R
2400 bps	201 B/C
4800 bps	208 A/B
7200 bps	203A
9600 bps	203A

CRT DISPLAY: Via a 14-inch (diagonal measurement) CRT with a viewing area 8 inches high by 11 inches wide. The display screen arrangement is dependent on the model, as shown below.

C270 or C275 model:	I	II	III
Characters/display:	480	960	1920
Lines/display:	12	12	24
Characters/line:	40	80	80

A character set of 64 or 96 (optional) ASCII characters, including upper and lower (optional) case alphabetics, numerics, and special symbols is displayed in green against a dark background. Each character is formed by a standard matrix of 7 by 10 dots.

Beam intensity, via program control, can be switched between normal and bright intensity levels, or the beam can be turned off (blanked).

SOFTWARE SUPPORT: The 270 is supported under existing IBM software support for the IBM 3270, which includes the following IBM access methods: BTAM under DOS, DOS/VS, OS, or OS/VS2; TCAM under OS; and VTAM under DOS/VS, OS/VS1 or OS/VS2. The 270 is also supported for use with the following IBM Program

Courier 270
IBM 3270-Compatible Display Systems

or fields can be displayed at a brighter-than-normal intensity to contrast with data displayed at a normal level of brightness, or the data can be blanked (not displayed) for security purposes. As an added touch, the Courier terminals provide blink and underscore functions as standard features. When incorporated into the user's application programs, these non-IBM features allow underscoring variable data fields within a fixed format to define the exact number of characters to be entered and blinking fields that require correction. The cursor, an underscore, can be easily located by blinking the character (or non-character) at its current location.

- Key entry – Three keyboard styles are available with the Courier terminals, which essentially duplicate those offered with the IBM 3270. A 10-key numeric pad is available with the typewriter arrangement. The keyboards are designed to produce an audible "click" in response to a key depression.
- Communications – Transmission speeds for the 270 series terminals range from 1200 to 9600 bits per second, compared with 1200 to 4800 bits per second for the IBM 3270.
- Software support – the 270 system is compatible with and can utilize all existing IBM software for the 3270.

Initial customer deliveries of the local cluster version of the 270 system were made in November 1973. Deliveries of the remote cluster version began in January 1974, to be followed by the stand-alone version during the second quarter of 1974 and the master station version during the third quarter of 1974.

Installation and service is provided by Courier through its nationwide service organization, which currently consists of 40 customer engineers and service locations in 30 major cities throughout the U.S., including Hartford, New York, Cleveland, Atlanta, Chicago, Kansas City, Washington, D.C., Phoenix, Seattle, San Francisco, and Los Angeles. Service support is also provided by RCA Service Company and by Honeywell. Courier is seeking additional service support and plans to contract with another service organization by the end of 1974.

Last year's Datapro user survey of CRT display terminals found users to be well pleased with the overall performance, ease of operation, and hardware reliability of Courier's family of IBM 2260- and 2265-compatible display terminals. Maintenance service and technical support, however, received somewhat lower ratings. Early returns of Datapro's 1974 user survey follow the same general pattern so far. Direct user experience with the new 270 system is not available at this writing. Support for the substantially more sophisticated 270 system presents an even greater challenge to Courier and its service representatives and should be a key consideration for potential customers.

Products: VIDEO/370, DATA/360, IMS, IQF, CICS, and TSO.

DEVICE CONTROL: The 270 operates under the control of the program stored at the host computer and provides complete compatibility with the addressing sequence, command code structure, and line discipline employed by the IBM 3270 Information Display System.

The 270 responds to and executes the full repertoire of IBM 3270 commands via a microprocessor with read-only memory. In addition, the 270 features some enhancements that are supported under the existing framework of IBM software and can be user-implemented through slight modification to individual application programs.

Cursor control is functionally the same as in the IBM 3270, with the addition of a Home position. The cursor can be moved up, down, left, or right, step-by-step or repetitively (if the key remains depressed), backspaced one character position, moved to the beginning of the next line, tabbed to the beginning of the next unprotected data field, back-tabbed to the beginning of the previous unprotected data field, or returned to the first unprotected character position on the screen (Home). Like the IBM 3270, the 270 features cursor wraparound.

Program Function and Program Attention keys (designated PFn and PAn, respectively), a standard feature of the IBM 3270, are also a standard feature of the 270. Each of these keys generates a unique code recognized by the controlling software as a specific program request or data identifier. The two key functions differ in that the Program Function code accompanies the displayed data as it is transmitted to the computer, while the Program Attention code is transmitted separately.

A light pen is available as an option and functionally corresponds to IBM's Selector Pen, a 3270 option. Any one or several alphanumeric or numeric fields of fixed or variable format can be selected by the pen, which transmits the address of the selected entry to the computer to initiate the programmed function.

Features include all those provided by the IBM 3270 plus a few extra features including display functions. The display functions include blink and underscore features, which are implemented via the use of attribute codes. The blink and underscore features permit one or more characters to blink or to be underscored via program control. Double buffering, an optional feature, provides buffering for two pages of data per display. A page of edited data can be transferred from the display buffer to a second buffer to await a polling sequence so that the next page of data can be keyed without interruption. The Page Swap feature, used in conjunction with double buffering, allows returned error pages to be interchanged with the completed page in the display buffer so that corrections can be performed while the next page awaits a polling sequence.

KEYBOARD: Any of three keyboard arrangements can be specified, including two typewriter-style and one data entry arrangement. The keyboards are similar in layout and key arrangement to the equivalent IBM 3270 keyboards. One of the typewriter arrangements provides 12 Program Function keys clustered to the right of the main key group; the other provides a 10-key numeric pad at the right and 12 Program Function keys located in a row above the main key group. The Data Entry keyboard provides six Program Function keys interspersed within the main key group. All three keyboard arrangements are available in ASCII or EBCDIC.

PRINTED OUTPUT: Two impact serial printers are available, the Execuprint 170 series and 270 series. Both printers form printed characters within a 7-by-9 dot matrix using the wire matrix technique, and are available in the following models:

Courier 270
IBM 3270-Compatible Display Systems

Courier has become a substantial factor in the display terminal industry, having delivered between 5,000 and 6,000 displays since January 1970. Current deliveries are estimated at about 200 units per month, and Courier is presently negotiating several large OEM contracts. Courier has yet to show a profit operationally, but expects to do so in 1974. This is not an unusually good or bad performance. In a lease-oriented environment, recovery of capital invested in product development and production is slow. However, Courier is a 90-percent-owned subsidiary of Boothe Computer Corporation, and the parent company is experiencing serious financial problems of its own.

Boothe has been heavily involved in leasing IBM System/360 equipment, a market that is eroding rapidly. Substantial writedowns of inventories were a major factor in Boothe's $37.7 million loss for 1972 and $12.3 million loss for the first 9 months of 1973. While Courier is a separate entity from Boothe, and in fact has been operating autonomously for the past 18 months, Boothe's fortunes will have a definite effect on Courier's future. Although Courier has not received any recent financial aid from Boothe, as of January 1, 1974, all new Courier leases are financed by Boothe Credit Corporation, a subsidiary of Boothe Computer. One distinct future possibility would be the acquisition of Courier by another company. Such a move could naturally affect Courier's management policies and future directions. □

Printer Model	Print Rate	Print Positions	Use*	Buffering**
EP 170:				
Model I	100 cps	80	C/SA	Buffered
Model II	100 cps	80	SA	Unbuffered
EP 175	100 cps	80	Comm.	Buffered
EP 270:				
Model I	165 cps	132	C/SA	Buffered
Model II	165 cps	132	SA	Unbuffered
EP 275	165 cps	132	Comm.	Buffered

* C–cluster; SA–stand-alone; Comm.–Communications printer with EIA RS-232 modem interface.

** Buffer capacity is 2048 characters.

The printers are equipped with a 64-character set of ASCII symbols including upper case alphabetics, numerics, and specials. Horizontal and vertical spacing are 10 characters/inch and 6 lines/inch, respectively. The printers accommodate pin-fed, continuous, 5-part forms up to 9-1/2 (170 Series) or 14-7/8 (270 Series) inches wide. The Execuprint printers are produced by Centronics as the 306 (170 Series) and 101AL (270 Series).

AUXILIARY MEMORY: Provides storage for fixed formats in a remote environment. The MOS memory is available in 8K-byte or 16K-byte storage capacities and operates as a random-access auxiliary memory for remote cluster and master station arrangements. Formats are stored in a compressed state for maximum utilization of storage.

MAGNETIC TAPE CASSETTE: Available as a single- or dual-drive unit with respective storage capacities of 144,000 and 288,000 bytes.

PERIPHERAL DEVICE CONTROLLER: Provides control and interface logic to accommodate a variety of devices produced by other vendors. Devices currently supported include the GE TermiNet 300 and 1200, NCR 260, and A. B. Dick Videojet printers.

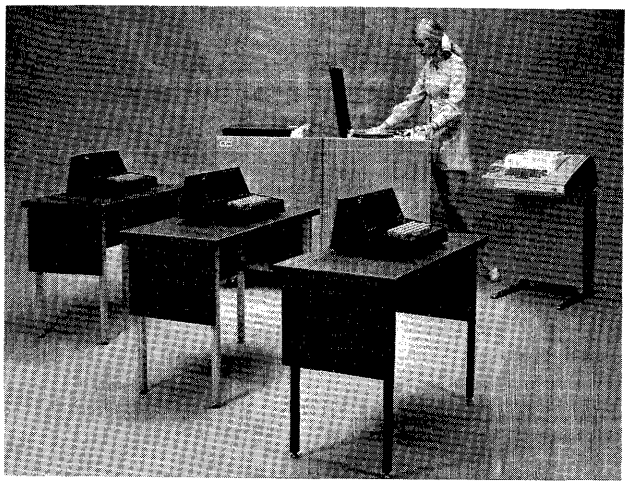
PRICING: The 270 system is available for purchase or on a 2- through 5-year lease, including maintenance and installation. A separate maintenance contract is available for purchased units. Courier was unwilling to provide complete pricing information, but offered the following representative 2-year lease and purchase prices for typical terminal arrangements:

	Screen Size, Chars.	Monthly Cost per Display*	Total Monthly Rental*	Purchase
Remote Cluster				
C270 displays –				
8	480/960	$123	$ 984	$ 36,000
16	480/960	116	1,854	66,900
24	480/960	114	2,724	97,800
32	480/960	112	3,594	128,700
8	1920	135	1,080	39,200
16	1920	128	2,046	73,300
24	1920	126	3,012	107,400
32	1920	124	3,978	141,500
Local Cluster				
C270 displays –				
16	480/960	120	1,924	68,500
24	480/960	117	2,808	98,500
32	480/960	114	3,632	130,250
48	480/960	111	5,340	192,000
64	480/960	110	7,048	253,750
16	1920	132	2,116	74,900
24	1920	129	3,096	108,100
32	1920	126	4,016	143,050
48	1920	123	5,916	211,200
64	1920	122	7,816	279,350
Stand-Alone				
C275 display	480/960	–	133	4,700
C275 display	1920	–	147	5,050
Master Station				
C275 MS**	480/960	–	639	22,750
C275 MS**	1920	–	689	24,300
Printers				
Execuprint 170/175 –				
Buffered		–	157	5,200
Unbuffered		–	127	4,220
Communications		–	162	5,400
Execuprint 270/275 –				
Buffered		–	211	6,600
Unbuffered		–	177	5,780
Communications			216	6,800
Auxiliary Memory –				
8K bytes		–	85	3,175
16K bytes		–	100	3,900
Peripheral Device Ctlr.		–	65	2,500
Magnetic Tape Cassette		–	NA	NA

* Monthly rental prices are for a two-year lease and include prime-shift maintenance.

** Includes Master Station Display, three slave displays (any screen size), and a 100-cps buffered printer. ■

C3 AU-150 Data Entry System



Three AU-150 Entry Units, which combine a keypunch-style keyboard with an alphanumeric display panel, are shown in the foreground. The central control unit is at rear, and the supervisor's teletypewriter is at the right.

This shared-processor keyed data entry system incorporates up to 20 keystations and is reasonably cost-effective at 8 stations or more. Output consists of IBM-compatible 7- or 9-track magnetic tape. Many useful editing and validation features, both standard and optional, are available. Marketing is currently limited to the Washington and Boston areas.

MANAGEMENT SUMMARY

C3, Inc., was founded in May 1968 as a software house. The AU-100 Data Entry System, which was the forerunner of the AU-150, reached the marketplace in the latter part of 1969. Production and marketing of the new system was assigned to Applications Unlimited until the latter part of 1970, when it became evident that this organization could not fulfill its obligations as a separate entity. Reluctantly, C3 absorbed it as a subsidiary and assumed full responsibility for the product. The role played by the second company accounts for the AU designation in the C3 systems. The more advanced AU-150, which features intermediate disk storage, was introduced in 1972.

Analysis of the AU-150 system and interviews with users show that it is an effective, attractive data entry system. Unfortunately, it is not enough to state that the system is competitive both in performance and price with similar systems; it is also necessary to ask whether a good product of a little company can really compete against a good product of a large company.

Many users have a bias against small companies and feel that there is a major advantage in the greater resources of a large company. Other users are biased against a large company, believing that largeness breeds indifference to an individual user's needs and that a small organization will be more responsive. Still other users do not really care about the size of an organization as long as they can be assured that the company that is here today will also be here tomorrow.

Therefore, the financial condition of C3 and the manner in which it markets and supports the AU-150 system are as important to a prospective user as the merits of the system itself. With the economic downturn of 1970 and ▷

CHARACTERISTICS

MANUFACTURER: C3, Inc., 2820 Dorr Avenue, Fairfax, Virginia 22030. Telephone (703) 573-4600.

CONFIGURATION

The AU-150 Data Entry System is composed essentially of 8 keystations in a basic configuration or up to 20 keystations in an expanded installation, a supervisor's console, a minicomputer processor, a magnetic disk drive and associated controller, and a magnetic tape drive and associated controller. In addition, there is an Entry Unit (keystation) controller housed in a cabinet along with the processor, disk drive, tape drive, and their controllers to make up a group known as the Control Unit. It requires no special air-conditioning or ventilation. A table-top work surface can be attached to the right-hand side of the cabinet for the convenience of the operator. Optional I/O devices consist of an on-line printer, a card reader, and a paper tape reader and punch. Alternative disk drives and tape drives are also available.

AU-150 ENTRY UNIT: Combines an IBM 29 Card Punch style keyboard with an alphanumeric display panel situated directly behind it. The keyboard consists of 50 symbol and function keys and a space bar, which implement a set of 64 alphanumeric characters and control various system functions, such as duplication, skipping, operating-mode selection, etc. Keyboard operation is almost totally silent except for an audible click that signifies normal keystroke operation.

The display panel is composed of nine lettered indicator lights and four display windows. The windows present the last character keyed to the left, the field number, and the character position within the field. Indicator lights to the right illuminate to announce system status and error conditions. In addition, indicator lights signify the keyboard shift, the keystation status, the operating mode, and the program state.

CENTRAL PROCESSOR: System operations are controlled by a Data General Nova 1200, a 16-bit, multi-accumulator minicomputer with a memory cycle time of 1.2 microseconds and a 1.35 microsecond execution time for most arithmetic and logical instructions. Storage capacity is 24K words in the basic system, expandable in 4K increments to a maximum of 32K words. In the AU-150 this minicomputer includes a real-time clock for computing elapsed time for individual operational steps.

SUPERVISORY STATION: This unit is a Teletype Model 33 ASR, which consists of a keyboard, print mechanism, paper tape reader and punch. It has the dual ability to transmit messages to the central processor and to print or punch control and statistical information received from the processor. Supervisory messages can be handled only by the teletypewriter.

DISK DRIVE: A Diablo Model 31, a 1.25-million-byte movable-head disk unit, provides intermediate storage for ▶

C3 AU-150 Data Entry System

the expense of the AU-100, its first hardware product, the company lapsed into a loss situation. As recently as the fiscal year ended March 31, 1973, C3 reported total revenues of $900,000 and a loss of $200,000. A management change made in July 1972 apparently began producing results in the quarter that ended in June 1973, when the company reported gross revenues of $288,000 and a profit of $39,000. C3 states that it is projecting a profit of roughly the same proportions for the second quarter, which ends September 30, 1973. The company also says that its present financing is adequate to support all phases of the AU-150 program.

The ability of C3 to survive in the face of adverse circumstances over the past several years is attributable in part to its marketing strategy. Company officers acknowledge that C3 cannot compete against the larger concerns in the data entry field on equal terms everywhere, and therefore it has decided to compete with them on even terms selectively. Accordingly, C3 currently markets its system only in the Washington and Boston geographical areas. It services installed equipment from these centers, and will not install equipment too distant from the centers. The company also plans to direct a broad marketing approach without geographical restrictions to the insurance industry. It hopes to make enough installations in a given new area to justify the opening of a new service center.

What does all of this mean to someone who is attracted to the AU-150 system? Negatively, it means that if he is located anywhere but in the Washington or Boston area, C3 for the moment has opted against accommodating him. The positive side is that if C3 is willing to make an installation, the user can expect attentiveness to his requirements. Moreover, users interviewed by Datapro expressed complete confidence in C3 as a company and reflected no anxiety over its future ability to provide service.

The basic AU-150 should be considered a relatively small system with minimal disk capacity and a limited number of allowable keystations. Preferably, the minimum number is 8, and up to 12 can be added without control unit changes. Among questioned users, the range seemed to lie between 6 and 15. Nevertheless, the programming of the AU-150 is such that it can perform many functions that are often associated with larger systems. Examples of functions that the users consider especially valuable are discussed in the following paragraphs.

The Batch Balance and Check Digit option provides up to four accumulators for crossfooting (intra-record), subtotaling (inter-record), and batch totaling (inter-record). This last check can be performed only at the conclusion of batch entry; hence, it is carried out in the background partition and does not affect keying. Several check digit routines with various modules are available for use with account numbers, check numbers, invoice numbers, etc.

The Operator Job Report presents performance statistics by operator number, job number, and batch number. Mode of operation, record and keystroke counts, elapsed time, production rates in keystroke/minutes, and error strokes are stated.

systems programs and record formats as well as for data keyed by the operators into the system. The data transfer rate is 1.56 million bits/second. This single-disk unit is organized into 203 cylinders of 2 tracks/cylinder; each track is divided into 24 sectors of 128 usable words/sector. Average, maximum and track-to-track positioning times are 67, 135, and 15 milliseconds, respectively. Average rotational delay is 20 milliseconds.

MAGNETIC TAPE DRIVE: Can be either a 7- or 9-track unit for recording data in industry-compatible NRZI formats at densities of 200, 556, or 800 bits/inch. The standard drive is a Pertec Model 6840, which operates at 37.5 inches/second, rewinds at 150 inches/second, and has a 30,000 byte/second transfer rate. It records on 9-track tape at 800 bits/inch. An optional 1600-bpi tape drive employing phase encoding is available. All AU-150 tape drives operate at 37.5 inches/second. Each tape reel contains 2400 feet of 1/2-inch tape.

ON-LINE PRINTER: Operates up to 600 lines/minute and prints, upon supervisory command, any data stored on the disk, whether keyed by an operator or entered into the system from another source.

CARD READER: Can read up to 400 cards/minute, and permits transfer of card data to magnetic tape while normal keying proceeds.

PAPER TAPE READER: Reads up to 300 characters/second and permits the transfer of data from sources utilizing paper tape to magnetic tape during keying procedure.

PAPER TAPE PUNCH: Punches up to 100 characters/second, enabling formatted records to be recorded on paper tape as well as on magnetic tape.

OPERATING MODES

- Data Entry (consists of calling up a job format, which is composed of four record format levels in standard operation and eight optionally, followed either by keying of data or by insertion or deletion of data if a storage batch has been reopened or if error correction is in progress).
- Verification (subsequent rekeying of data by the same or a different operator for comparison with the original data entries; characters, fields, and records may be inserted or deleted in place).
- Alternate Entry-Verify (permits an operator to enter a record and then verify the same record before proceeding to the next one; an expert operator can thus enter and verify the data with a single handling of documents).
- Search (permits recovering a particular record in a previously completed batch by specifying the number of records to be bypassed, by specifying the number of records keyed under control of a particular program state to be bypassed, or by keying a unique identifier located somewhere within the record itself).
- Format Entry (permits job formats to be entered at the supervisor's teletypewriter).

SYSTEM OUTPUT

- IBM-compatible tape, as described under Magnetic Tape Drive, above. (Optionally, data can also be recorded on paper tape.)

SYSTEM PROFILE

Some of the specifications that follow depend on the manner in which disk storage is allocated and should therefore be regarded as illustrative of AU-150 operation rather than as rigid specifications. Enlarging disk capacity, of course, will alter these specifications proportionately. A

C3 AU-150 Data Entry System

The Foreign Data Feature was mentioned repeatedly. It enables data tapes created externally to the AU-150 to be read into the system while keying operations proceed. Once stored on the disk, this data can be accessed by the processor and transmitted to a keystation, where it can be treated in exactly the same manner as data that was originally keyed into the system. Hence, a tape prepared by a computer but subject to updating can be entered into the AU-150 for this purpose.

These features mean that the AU-150 is much more than just a keypunch or key-to-tape replacement. The system enables data entry operations to be formatted and organized in a manner conducive to maximum throughput.

USER REACTION

All users interviewed regarded the AU-150 system as reliable, with negligible interruptions in its operation. When needed, service was provided within a half hour to one hour of the request call. Instructions could often be given on the telephone that resulted in the immediate restoration of system operation. Users expressed their satisfaction with both the product and the company. These opinions help to explain why even early users of the AU-100 have remained with C3 and why some have not even upgraded to the AU-150, which all acknowledge is much more versatile and more powerful.

Conversations with some supervisors reveal that they regard the system as an easy one for operators to use. Format flexibility also drew favorable comment.

One user brought out an interesting point. During the summer electric power companies often reduce the voltage of their delivered power, and these reductions can disturb the operation of the system. Dump tapes and power-failure safeguards are therefore advisable. □

1.2-million-byte disk capacity, which suffices for most installations, is assumed.

- Record length – can be any multiple of 80 characters up to 320 characters without options, or optionally can be any multiple of 250 characters up to 2000 characters; record blocks on output tapes, however, are normally 500 characters and can optionally be 1000 characters.
- Record format – 50 to 100 job formats, each consisting of 4 record format levels.
- Data record storage – 12,000 80-character records or 3000 320-character records.
- System management storage – about 35,000 words, comprising programs for such system functions as compiling record formats, governing keyboard activities, presenting system display information at the keystation panels, effecting accumulation totals, carrying out edit and validation routines, performing check digit routines, etc.

SOFTWARE

All system operations, including keystation operations, supervisory functions, I/O device control, data transfer between system components, and data output reformatting, are under software control. The foreground, or Entry Unit, operations include the basic functions of skipping, duplication, character insert and delete, left zero fill, and such basic editing as alpha check, numeric check, and alphanumeric check. Minimum and maximum size checks are examples of more advanced capabilities. A description of other software capabilities follows.

BATCH SUSPEND: This feature enables an incomplete batch to be stored indefinitely and recalled to a keystation later; work then commences with the next record to be keyed, as if no time had elapsed.

GROUP SKIP: This feature enables an operator to pass through a number of contiguous fields in a record without striking the Skip key for each individual field.

DATA INPUT DESCRIPTION (DID): Usually consists of four program levels and up to 48 fields, but can incorporate fewer levels according to job requirements. Each level may consist of 1 to 80 characters, and four such levels can be combined to structure input records of up to 320 characters. An option called Expanded Data Handling can increase a job format to a maximum of 8 levels, allows a level to consist of up to 250 characters, increases the number of allowable fields to 396, and permits an output tape block to consist of 1000 characters.

CODE COMPARE: This feature requires that a character keyed into a specified field be one of a prescribed set of allowable characters. An excluded character is rejected by the system.

RANGE CHECK: This feature compares the contents keyed into a field with a specified algebraic range of values. If the contents lie outside this range, a system error is announced at the display panel.

CONSTANT INSERTION: This feature causes the system to insert stored constants into a record as specified by the DID (Data Input Description).

AUTOMATIC SKIPPING: This feature effects automatic skipping of designated areas of a record during the keying operations.

FOREIGN FIELD: This is a specially designated field that may be entered optionally by the operator during the Verify process. Data unavailable during the original keying operations can be added or inserted at this time. This feature is primarily used to key data to a file that was originally entered through the Foreign Data facility.

AUTOMATIC PROGRAM STATE SWITCHING: The DID can be formatted to switch automatically to another program level at the conclusion of keying while under a particular program level. This process is often called chaining. During Verify the same automatic changes are made.

SELECTIVE VERIFY: The DID can designate fields that must be verified and fields that are to be bypassed during verification.

DATA OUTPUT DESCRIPTION (DOD): Provides the necessary information to bring about the assembly and writing of output records to magnetic tapes. It can simultaneously structure up to four different fixed-length records from a single input record. A single record can consist of 500 character positions. One capability is field rearrangement, which allows a field from an input record to be shifted to any location in the output record area. Constant data can be inserted into the output record, and automatic duplication of data from one record to another can take place during output formatting rather than during keying.

DISK MANAGEMENT: This routine is used to determine the percentage of disk area available for data storage, to delete formats or data from the disk, and to generate a disk backup tape.

C3 AU-150 Data Entry System

BATCH BALANCE AND CHECK DIGIT: Totals can be accumulated and eventually compared with a keyed reference value. This feature is also used in conjunction with controlled numbers incorporating a check digit.

OPERATORS STATISTICS: Statistical reports ordered by operator number, job number, and batch number can be printed upon supervisory command. The report includes mode of operation, record number, keystroke count, elapsed time, production rate, and error strokes. Another capability is the generation of a statistical summary tape that can be used to generate overall performance reports.

PROGRAMMED OUTPUT: This option adds the following features: Conditional processing, which makes execution of output operations dependent on certain specified conditions; Output Arithmetic, which performs totaling during output data generation; Variable Length Records, which enables records within a block to be of different character lengths; Expanded Field Rearrangement, which enables the contents of input fields to be transferred to output fields or to internal accumulators (results in shifting of data by stipulated amounts in either direction); Record Padding, which allows creation of tapes having fixed-length data blocks; left and right justify with any fill symbol (for example, "check protect"); and Leading Space Suppress.

FOREIGN DATA: Allows data on tapes that were originated elsewhere to be entered into the AU-150 system and then treated in exactly the same manner as data keyed into the system.

SYSTEM OPERATION

In the AU-150 system, the responsibility of the supervisor is control and the obligation of the keystation operators is data entry. Owing to the formatting, keystroke-saving, editing and validation procedures, and output reformatting capabilities of the system, the operator is in a position to key data from the source documents in the manner most convenient to her. The supervisor, on the other hand, controls the operator staff and the data coming into and leaving the data entry facilities. All documents are specified by job number and by batch number within job. This control information is retained until processing of output data is completed.

ERROR CONTROL: All validation procedures, including check digit validation, batch balancing, range checks, etc., eliminate the need for standard verification of certain fields. Module 7, 10, or 11 can be specified for the check digit routines.

Parity generation and checking is performed on data transferred between the computer and disk and between disk and tape or other output devices. Longitudinal and cyclic redundancy check characters are produced and written on disk and tape. A read-after-write check is performed on tape.

COMMUNICATIONS: An AU-150 system can emulate a communications terminal and communicate with an IBM System/360 or 370 computer installation. Individual keystations, however, cannot be linked via a communications lines to the controlling processor.

PRICING

The AU-150 system can be either purchased or leased. Figures appearing below assume a 12-month lease period. Maintenance is included in the lease charges, and is arranged separately for purchased items. Quoted maintenance rates are for the user's prime shift. Additional service is rendered for a premium. C3, Inc. currently performs service from centers in Boston and Washington only.

Total system cost depends on the configuration. The following table lists charges for basic AU-150 installations; namely, the keystations, the processor, one disk drive with a 1.25-million-byte capacity for 8 and 12 stations and a 2.5 million-byte capacity for 15 and 20 stations, and one tape drive. Additions of core memory to the processor, as required by additional stations and options, must be taken into consideration by the user.

Data Stations	Cost per Data Station	Monthly Rental	Purchase	Monthly Maint.
8	$175/mo.	$1,400	$57,000	$220
12	142/mo.	1,700	70,000	240
15	142/mo.	2,125	89,250	265
20	125/mo.	2,500	105,500	290

Each keystation leases for $75/month, including maintenance, and sell for $3,250; separate maintenance for a purchased station costs $5/month. The basic Control Unit, which comprises a supervisor's console, a Nova control processor, a real-time clock, a 1.25-million-byte disk, a disk controller, a tape drive (7- or 9-track), and a tape controller, leases for $800/month and sells for $31,000; separate maintenance costs $180/month. Storage capacity of the minicomputer for these prices is 24K, and up to 8K more can be added. Pricing for other system components is given in the following table.

Device	Monthly Rental (1-yr. lease)	Purchase	Monthly Maint.
Work Station	5	100	0
Disk Storage (2.5 megabytes)	200	9,500	10
Disk Storage (5 megabytes)	500	24,000	20
Tape Controller (9-track)	160	7,500	10
Tape Controller (7-track)	160	7,500	10
Tape Controller (1600 bpi)	320	15,000	20
Tape Unit (9-track)	125	5,000	25
Tape Unit (7-track)	125	5,000	25
Tape Unit (1600 bpi)	250	10,000	50
Additional 4,096-Word Memory Increment	132	6,000	12
Card Reader and Controller	165	6,750	30
Communications Interface	200	9,000	20
600-lpm Printer and Controller	600	25,000	100
Paper Tape Reader and Controller	155	6,750	20
Paper Tape Punch and Controller	140	5,250	15
OPTIONAL FEATURES			
Batch Balance and Check Digit	100	4,750	5
Operator Statistics and Statistical Summary	75	3,750	5
Extended Record Length	100	4,750	5
Save Tape Re-Entry	50	2,250	5
Programmed Output	200	9,500	10
Foreign Data	50	2,250	5
Expanded Data Handling	400	20,000	50

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MANAGEMENT SUMMARY

Cummins-Allison has installed more scanners than any other company, if you include the small Dennison ticket scanners widely used in the retail industry. This is a surprising statement in view of the company's rather low public profile. Its impressive position was attained in the retail industry, banking industry, insurance industry, and other applications areas that make use of bar code, mark scan, perforated character scan, and optical character scan turnaround documents. In 1972, Cummins-Allison surprised the EDP community by announcing an entry in the glamorous key/disk marketplace. True, it started out as an effort to broaden the marketability of the company's proven line of scanner/sorter devices, but it has blossomed into a major factor in the key/disk industry, with many key-entry-only installations. Altogether, there are currently about 120 KeyScan installations, most of which are in the U.S.

Traditionally, equipment buyers respond to two factors: price and flexibility. Equipment procurements can be justified either on the basis of lowest cost or on the number of different things that the equipment can do. While the KeyScan system's price structure is not as attractive as when first announced, it remains competitive. And in terms of flexibility, KeyScan is one of the leaders.

On the basis of data inputs accepted, the KeyScan system can accommodate keyed input, punched cards, magnetic tape, and a wide variety of scannable media. On the basis of programmability, a comprehensive array of software is provided, including highly formatted data entry; scanner input, manipulation, and document sorting; remote batch communications; comprehensive data retrieval (searching);

This multimedia data entry system accepts input from optical character scanners, ticket scanners, mark scanners, and MICR scanners in addition to or instead of input from up to 32 CRT key entry stations. All input stations function independently under the control of a shared processor; data is stored on disk.

CHARACTERISTICS

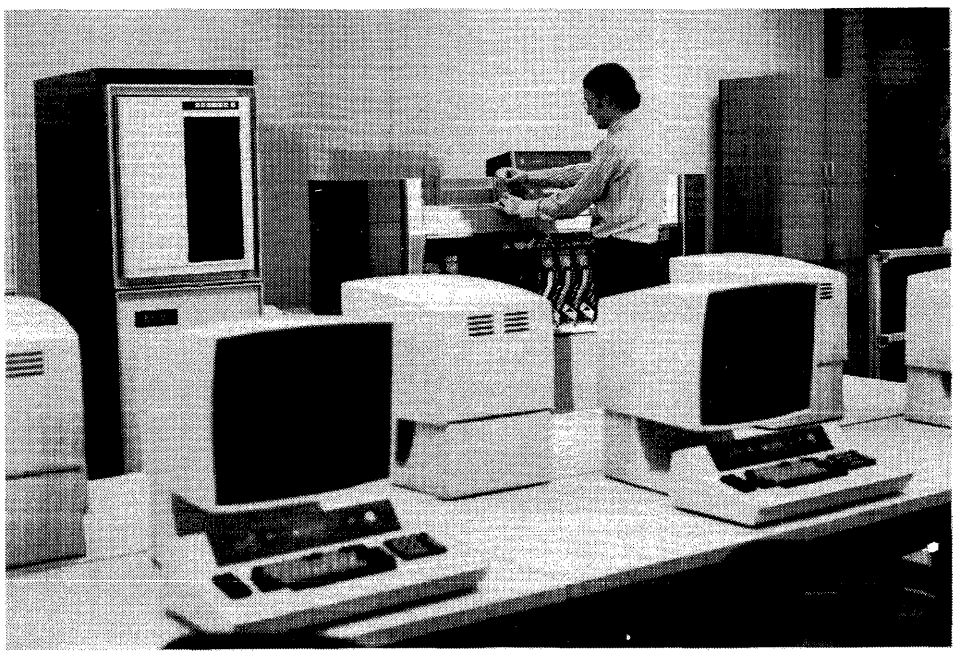
MANUFACTURER: Cummins-Allison Corporation, 800 Waukegan Road, Glenview, Illinois 60025. Telephone (312) 724-8000.

CONFIGURATION

A Cummins 4400 KeyScan system incorporates a mix of up to 32 CRT keystations with a variety of OCR, MICR, OMR, and ODP scanning stations, all of which are supported by a shared processor and disk storage units. Output is to up to eight magnetic tape drives, available in a variety of recording formats. Two printers are available with rated speeds of 100 characters per second and 600 lines per minute. A 300-cpm card reader can also be attached. Batch communications can be supported at up to 9600 bits per second.

COMPONENTS

CRT KEYSTATION: Consists of a movable keyboard and a CRT console resting on a table that provides convenient working space. A left-to-right pivot for adjusting the position of the CRT, a special nonglare screen, and a contrast control improve operating convenience. Normally, the station is located within 200 feet of the processor, but with optional cabling it can be as far as 2000 feet away.



The 4400 KeyScan is an unusually versatile data entry system. Up to 32 of the CRT keystations shown in the foreground can be supported, and the Model 4216 Scanner/Sorter in the background can be equipped to read perforated characters, marks, or a variety of printed character fonts.

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extensive security provisions; and an RPG II facility for users who need to program conventional file processing applications. On the basis of reject re-entry of nonreadable scanned data, several choices are available to the user. On the basis of reading MICR-encoded documents, the user can sort and read both optically and magnetically, with comparison.

To implement the capabilities outlined here, Cummins has continuously expanded upon the original hardware announcements. For example, the original upper limit on control processor memory was 64K bytes; that is now the basic memory size, with the upper limit stretched to 128K bytes. To implement MICR reject re-entry with complex transit routing, a microprocessor was added to the scanner to facilitate decision-making. In this manner, the Cummins-Allison 4400 KeyScan System has grown into a mature product line.

Two factors stand out when considering the KeyScan system: format coding and reject re-entry. Record formats are composed at the CRT keystation by the operator. Parameters are filled in for each field of a record in response to displayed questions about field type and validation checks to be made. Coded parameters are displayed for each question; not keying any parameter for a question automatically causes a default to the first displayed parameter, a convenience. Three different screen displays must be keyed for each field to handle all the possibilities. While this method of tutorial programming is very convenient for keying single programs, it is somewhat awkward for complex formats with extensive data validation and logical relationships that need to be established. In effect, it is like having the coding sheet displayed for you. It is expecting a lot for an operator to be skilled at both key entry and coding. Complex formats are no doubt normally coded on paper by analysts and then keyed into the system. Typically, format entry is a small part of the overall number of keystrokes initiated in a system, so the slight awkwardness in inputting complex programs is only a minor annoyance.

Typical scanner performance across the industry today results in non-scannable characters amounting to no more than a few percent of the total characters, even with numeric handprinting. Yet this small group of characters has caused difficulties far beyond its percentage of occurrence. The difficulty in handling these detectable errors lies in trying to relate the correct character, discovered when an operator looks at the document, to its position in the already recorded medium containing all of the scannable characters.

Two traditional approaches have been employed to deal with this reject re-entry problem. One involves rejecting *all* of the characters on any document containing unreadable characters. Later, these documents are hand keyed in their entirety. The corrected batch must then be married to the primary batch. If batch totals (and sub-batch totals in some cases) are maintained for control purposes, rejecting a document affects the totals, and special

Two different keyboard arrangements are available. One is equivalent to that of the IBM 29 and 129 keypunches, and the other follows the pattern of the Selectric typewriter. Keys are square and feature a non-glare surface; each section is color-coded for convenient recognition. Both arrangements have a 10-key adding machine cluster to the right of the main keyboard to expedite pure numeric keying. CRT cursor control and system control keys are always to the left.

The CRT display of 480 characters is organized into 12 lines, each containing 40 characters in a 5-by-7-inch display region. Error messages and system status statements appear in the bottom two lines; keyed data or previously recorded data recalled from the disc for verification is presented in the top 10 lines. Field tags (names) can be displayed or suppressed. Any station can act as a supervisory or production control console provided that a designated code is keyed.

DISK DRIVES: Available in three models, made by Caelus Memories. The smallest model provides a capacity of 2.45 million bytes and incorporates a single, sealed, non-removable disk (platter). The other two models provide 4.9 million and 9.8 million bytes of storage and incorporate one removable and one non-removable platter. Each disk controller can accommodate up to four drives of any model. Two controllers can be used in a system.

The two smaller disk drives provide a track-to-track head positioning time of 20 milliseconds and an average positioning time of 75 milliseconds. Corresponding figures for the large model are 9 milliseconds track-to-track and 35 milliseconds average. Rotational speed is 1500 rpm, giving an average rotational delay of 20 milliseconds for all models.

MAGNETIC TAPE DRIVES: A number of models are available that differ primarily in recording formats. Available formats include 7-track, 200/556, 556/800, or 200/800 bpi and 9-track, 800, 1600, or 800/1600 bpi. All models accommodate 10.5-inch reels (2400 feet) and operate at 37.5 inches per second. Individual controllers that accommodate four drives are available for each format; mixing formats, other than in specified combinations, is not permitted on the same controller. Two controllers can be attached.

PRINTERS: Either a 100 char/sec or a 600-lpm printer can be attached. The low-speed unit prints 132 positions at 6 lines per inch using a 64-character set. The line printer also produces 132-character lines. Some of the special symbols in the standard 64-character set can be replaced with the OCR-A Size 1 numeric subset. Horizontal pitch is 10 characters per line. Vertical pitch is six or eight lines per inch. Form widths of 3.5 to 19.5 inches can be accommodated. A vertical format unit with 12 channels is standard.

CARD READER: Reads 80- or 51-column cards at up to 300 cards per minute. The hopper and stacker hold 550 cards each.

MODEL 4216 SCANNER: This multicode document scanner is available in various models that can read optically, magnetically, or both during the same pass. The scanner has previously been used in off-line operation as the Cummins Scanak 216, but its efficiency increases greatly when used on-line with the 4400 Processor. Since it can read several different codes on the same document pass, document preparation requirements are appreciably simplified.

The 4216 scanner can transport documents at 100 inches/second. The document processing rate depends, of course,

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procedures must be used in order to be able to use totals for control. The second approach is to reject the document, halt the scanning process, display the scannable characters, and have an operator key in the correct character from the document. This is a workable solution for dealing with occasional occurrences in optical character scanning. It does not work for MICR documents when sorting is taking place. If the document is halted in the feed path to await operator action before a sort decision is made, the operator cannot look at the document. If the document is rejected, it must be refed to get a sort allocation.

Cummins provides two techniques for handling reject re-entry. One records all scannable data on disk, with non-scannable characters flagged, and sends documents with non-scannable characters to a reject stacker. A regular key entry operator, working from the stack of rejected documents, accesses the data batches in a conventional manner to fill in just the non-scannable characters. A record is displayed with the cursor positioned at the non-scannable characters, which are displayed as intensified, blinking question marks. This technique does not slow scanning and enables corrected data to be placed in the proper positions. It is the recommended technique if the occurrence of non-scannable characters is high. The disadvantage is that it requires manual rehandling of documents and extra care on the part of the operator to match the displayed record with the physical record in front of her.

The second method is on-line correction. A special CRT station displays a video image of the non-scannable character while the document is at a wait station in the transport. The operator looks at the image, keys the correct character, and scanning resumes. The advantage of this method is that no rehandling of documents is required and balancing can be performed immediately on the batch. Since a video image is presented, the operator will be able to recognize just about any character she could recognize by looking at the document itself. If the character is totally obliterated, special handling is required, of course. The disadvantage of this Video Correct technique is that scanning is halted while the correction is made. For a high rate of occurrence, productivity will suffer severely.

The above discussion still has by no means exhausted the potential of the Cummins KeyScan system. One final data input method should be mentioned: Video Capture. In this mode, a video image of a handwritten field is displayed and the keystation operator keys the appropriate characters. The difference between this and Video Correct is one of intent. In Video Correct, non-readable characters are handled, but the characters were originally intended to be read. In Video Capture, a deliberate non-scan situation is created, with the original intent being for the key station operator to insert the information. It is an interesting alternative to scanning of handprinted fields, but overdoing it could result in poor throughput.

on document width. For example, documents that are 6 inches wide or less are processed at a rate of 650/minute, and those that are 8¾ inches wide (the largest acceptable) are processed at a rate of 450/minute. Other examples are 7-inch documents, 563/minute, and 8-inch documents, 489/minute. The scanner can be equipped with a variable thickness feeder so that documents ranging in thickness from 0.004 to 0.007 inch can be accommodated. The feeder, which holds up to 1500 documents, employs a counter-rotating separating wheel. A fixed-thickness knife feeder can be used when the documents are all of the same paper weight. An adjustment can quickly adapt the feeder to a different thickness. Tension on the follower block is also adjustable.

According to the scanner model in operation, document height can vary from a minimum of 2¼ inches to a maximum of 4 inches, and a document width from a minimum of 4¼ inches to a maximum of 8¾ inches. Small tickets can vary from 1 inch to 2½ inches in height and from 2-7/8 inches to 5¾ inches in width.

Depending on the model, the 4216 can accommodate multiple reading systems. The available reading systems are summarized below.

PERFORATED ARABIC CHARACTERS (ODP): In this mode the scanner simply detects the presence or absence of a hole in a designated area of the document. Since readability is unaffected by smudges on the paper, this technique is inherently more accurate and reliable than other procedures. It is referred to as original document processing (ODP).

OPTICAL MARK READ (OMR): This method determines the presence or absence of marks on the document in certain detection positions. Interpretation of reflected light leads to appropriate decisions. Possible codes are the bar code, which is unusually imprinted from acredit card with or without variable amount information; a manually marked code, which is usually intended to specify exceptions; and the 1's code, which is imprinted by a computer line printer. Scanners equipped with OMR heads can read all three codes in a single pass of a document when this option is installed.

OPTICAL CHARACTER RECOGNITION (OCR): Conventional methods are employed to identify characters in accordance with interpretation of shapes in specified segments of the character area. The following numeric fonts can be recognized: OCR-A Size 1, OCR-B, IBM 407-1 (1403), IBM 1428, Farrington 7-B, and handprint. Recognition of the OCR-A alphanumeric font is also available, as is optical recognition of Font E-13B.

MAGNETIC INK CHARACTER RECOGNITION (MICR): This recognition method requires both a charging head and a reading head. These enable the scanning unit to respond to the magnetic strength and polarization of seven horizontal "time zones" into which each MICR character is divided. It should be noted that some models equipped with both MICR and OCR sensors can read the E-13B font both optically and magnetically in the same pass and thus assure almost perfect identification.

4229 SCANNER: A separate unit for reading Dennison Print/Punch tickets at speeds of 300 or 500 tickets per minute, depending on the model.

CONTROL PROCESSOR: Includes a minimum of 64K bytes of main memory, which can be expanded to 128K bytes; cycle time is 720 nanoseconds. Peripheral data transfer rates of up to 1.4 million bytes per second can be supported. The processor is a General Automation SPC-16/45.

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USER REACTION

Datapro talked to five users of the Cummins 4400 KeyScan System, representing a wide cross-section of applications. Altogether, 7 systems were represented, including a total of 41 keystations and 2 scanners. Typical record lengths ranged from 40 to 300 characters per second. The disk capacity implemented was either 4.9 or 2.45 megabytes in all cases, with no particular relationship between number of keystations and disk capacity. System sizes ranged from 2 keystations plus a scanner up to 12 keystations with no scanner. All of the processors utilized a 64K-byte memory. A summary of the ratings given by these users appears below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	2	2	1	0	3.2
Ease of operation–					
Supervisor	2	3	0	0	3.4
Operator	2	3	0	0	3.4
Hardware reliability	0	4	1	0	2.8
Maintenance–					
Promptness	2	3	0	0	3.4
Quality	0	4	1	0	2.8
Software	1	3	1	0	3.0
Technical support	0	3	2	0	2.6

*Weighted Average on a scale of 4.0 for Excellent.

As you can see, the users were generally pleased with the system, although most had experienced difficulties in implementing their data entry applications from both hardware and software aspects. Most of the hardware difficulties were resolved satisfactorily in a relatively short period of time. Software bugs, generally called minor by the users, were also quickly resolved. A more serious software difficulty has to do with the amount of main memory. Each of the users we talked to employed a 64K-byte processor memory. In some cases, this led to problems when trying to implement the sophisticated capabilities offered by the Cummins software package with more than half a dozen keystations operating simultaneously.

Memory limitations are not unusual in key/disk systems–or, for that matter, in full-blown computer systems with a half million or more bytes of main memory. The reason is simple: it is much easier to compile a list of specifications for desirable processing capabilities than it is to shoehorn them into a small memory. Lots of tasks performed simultaneously means lots of memory–if you want to keep processing speeds respectable. A couple of users indicated that they had memory expansion modules on order. The users of scanner-oriented systems with just a few keystations were happy enough with the system. The larger key-entry-oriented users were the ones who felt the constraints of memory capacity the most.

This reflects the development history of the KeyScan system. The company's original intent was to provide an enhancement for its many scanner installations. The key/disk capability was an outgrowth of providing a

COMMUNICATIONS

The communications controller can operate at up to 9600 bits/second synchronously. It interfaces Bell System 201/208/209 series modems or their equivalents; clocking, and therefore operating speed, is derived from the modem. Operation can be either half or full duplex. An automatic answer feature is optional. Through supporting software, the interface can be used to permit operation of the KeyScan system as an RJE terminal to an IBM System/360 or 370 central computer running under HASP or an equivalent RJE facility; line protocol is the same as that of an IBM 2780 batch terminal.

SYSTEM OPERATION

Two modes of data input activity proceed concurrently in the 4400 KeyScan system: keyed data entry at the CRT keystations and document and ticket scanning by suitable optical reading devices. Each class of input stations operates under special executive software installed in the control processor. Thus, scanner software in the processor defines the field locations (format) of the documents to be scanned and the nature of sorting (selection of document output tray) to be performed. If desired, data released to the processor can be subjected to validation and balancing procedures commonly applied to keyed data. When scanned data is written on tape, furthermore, it is reformatted according to its particular requirements in the same manner that keyed data is. The comprehensive software developed to control keying at the CRT stations is described later under the "Software" heading.

The 4400 system software makes several methods of dealing with the scanner reject problem possible, but essentially all entail keying of unidentified characters only. Upon entry of the rejected characters, batches are immediately rebalanced.

Operation of the key entry section of the KeyScan system is analogous to that of other key/disk systems. The supervisor assigns job and batch numbers, allocates them to the CRT station operators, enters new formats at her station (or assigns the task to an operator) transfers data files from the disc to tape, purges outdated records from the disc, and causes various printouts to be made, such as statistical reports on operator performance, system error and status reports, audit trails, program coding for diagnostic purposes, etc. The supervisor can also assign formats to the individual operators, or an operator can call up an applicable set of up to 99 formats consistent with her job requirements. Any number of operators can use any or all of these formats at a given time. As mentioned previously, formats can be chained, conditionally or unconditionally.

A security provision of the 4400 system enables the supervisor to impose blanking of confidential information from a keystation CRT display while its operator is keying or verifying. Under this restriction, only incorrect data keyed by the operator is displayed.

OPERATING MODES

- Data entry (keying of source data at the CRT keystations).
- Verification (subsequent rekeying of data previously stored on the disk for the purpose of character by character comparison).
- Display and correct (a data record stored on disk is searched by account name or number, batch number, date, error flag, etc., and displayed on the screen; it can

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smooth means for inserting data characters not recognizable by the scanner. The support of larger key/disk-only systems was not really envisioned at first, even though the software capabilities included features admirably suited for such applications. Support for larger systems is being delivered now, according to the company.□

be scanned forward or backward and corrected character by character as desired).

- Format entry (can be entered character by character at any keyboard in response to questions displayed on the screen by the 4400 system).
- Scanner entry (allows automatic entry of data into the processor by various scanners).

SYSTEM PROFILE

- Keystations–up to 32 CRT keystations.
- Record length–up to 490 characters; 99 fields per record maximum.
- Formats–limited only by disk storage capacity available.
- Output block length–user set; practical maximum is 4096 characters.
- Data storage–one 2.45-million-byte disk platter can hold 25,000 80-character records or 18,000 120-character records.

SOFTWARE

The capabilities of the 4400 system, keystation and scanner operation alike, are attributable to the system software. I/O device control, data transfer between system components, reformatting and blocking of output records written on tape, check-digit verification, editing, balancing, searching of records, communications, and innumerable other functions are all under software control. Some outstanding system characteristics are described below.

- Ability to request scanner input data without affecting keystation activity.
- Ability of the supervisor to specify field sequence numbers for both keyboard and scanner input data.
- Ability to perform 20 accumulations for each job entered at a keystation.
- Statistical reports on operator performance and job status.
- A user code for specifying certain operations to be performed on data during entry; instructions include all arithmetic operations, conditional comparisons, and format change.
- Use of a CRT keystation, in conjunction with its adding machine keyboard, as an adding machine, with totals storable for later use in balancing operations.
- Multiple levels of data and job security (certain jobs may be accessed only by the supervisor, and certain data files can be accessed only by stations designated by the supervisor).
- Ability to create two or more data files from a set of data records.
- Ability to display a record that is a composite of data from two or more input files (such as a payment notice and a corresponding check).

An RPG II compiler can be installed in the 4400 system for users who want to customize programs for special applications, such as payroll, inventory control, customer accounts, etc. The compiler also converts existing RPG II programs into forms that can be executed by the 4400 system.

CUMMINS OPERATING SYSTEM (COS): This real-time multiprogramming operating system controls the scheduling, loading, and execution of all system programs. Included in COS is a special "sub-executive" (SUBEX) package that provides conversational operator-machine interaction via the on-line CRT and keyboard. As system and application jobs are requested in such operation, SUBEX will effect the scheduling and control of the requested function. In addition, SUBEX will record the throughput and system statistics and will update the system data files for use by the Supervisory Statistics Package (SUSTAT).

SCANNER AND KEYED INPUT LANGUAGE (SKIL): This is a conversational method of specifying record formats for a key entry or scanner entry application. The SKIL program guides the operator through the specification of a job by asking questions (via the CRT display) and allowing the operator to key the answers on the terminal's keyboard. The format is then stored on the disk.

KEYED INPUT LANGUAGE (KIL): Enables the following system characteristics to be specified: columnar or line prompter fields; up to 99 conditionally or unconditionally linked formats per job; extended field operations on a pre-record basis (add, subtract, multiply, divide, and conditional comparison); availability of batch summary records at end of batch; alpha, numeric, alphanumeric, integer, or hexadecimal fields; must enter or must not enter fields; right and/or left justification with any fill character; fields that require verification; high or low limit checks for a field; range checks for a field; various table look-up options (i.e., is value in table or not in table); multi-code capability; and check digits (modulo 7, 9, 10, or 11).

SCANNER INPUT LANGUAGE (SIL): This is a conversational program to set up scanner input applications, including editing and validating procedures. The following are some of its capabilities:

- Input data fields can be reformatted into different locations of the output records.
- Data fields can be duplicated from a control document (header) into all other following (detail) document data fields.
- Total can be accumulated by pocket or by batch from a specified field on the document.
- The scanner can be programmed to stop when an out-of-balance condition arises.
- The batch number can be assigned from a header, from the operator via CRT, or automatically (sequentially) by the system.
- A user application can intermix up to 99 different document types (formats) per job.
- The scanner application can be linked to a KIL-generated job block for subsequent operator intervention (for example, reject re-entry or jam recovery).

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OUTPUT TAPE RECORDING: Includes record reformatting and record blocking in addition to the basic recording operations. The user can select any block length that he needs (4096 is a practical maximum). Records on the disk can be sequenced in a specified order when transferred to tape. These features enable the operator to record source data in any convenient order and let the system put it into its final form. Writing of DOS and OS tape labels is a standard feature.

PRICING

The Cummins KeyScan system is available for purchase or on an 18-, 36-, or 60-month lease arrangement. The monthly cost figures below include prime-shift maintenance for locations within 50 miles of a Cummins service office. Separate arrangements for purchsed equipment are available. Extended period and distance maintenance arrangements are available at extra cost.

	Monthly Rental*	Purchase	Monthly Maint.
KeyScan System (includes processor with 64K bytes of memory, disk drive and controller, tape drive and controller, and CRT key terminal controller)**–			
With 2.45-megabyte disk (permits key entry or scanning, but not simultaneously):			
With dual-density 7-track or 9-track, 800 bpi tape drive	$1,335	$55,200	$200
With 9-track, 1600 bpi tape drive	1,385	58,600	200
With 9-track, 800/1600 bpi tape drive	1,485	63,400	210
With 4.9-megabyte disk (permits simultaneous key entry and scanning):			
With dual-density 7-track or 9-track, 800 bpi tape drive	1,485	61,200	222
With 9-track, 1600 bpi tape drive	1,535	64,600	232
With 9-track, 800/1600 bpi tape drive	1,635	69,400	232
Memory module, 16,384 bytes	145	4,800	20
CRT Expansion Memory (4K bytes; 1 required for each group of 4 CRT's)	50	2,000	7
Data Entry/Display Terminal (without table)	50	2,000	8
Data Entry/Display Terminal (with table)	58	2,300	8
Scanner Adapter	100	4,800	20
RPG II Compiler	60***	3,500	–
System Peripherals			
Disk Storage–			
Controller (accommodates 4 drives)	100	4,200	15
Disk drive, 2.45 million bytes	150	6,000	23
Disk drive, 4.9 million bytes	300	12,000	45
Disk drive, 9.8 million bytes	430	16,800	55
Magnetic Tape–			
9-track, 800 bpi format:			
Controller (accommodates 4 drives)	90	3,600	15
Drive	200	8,000	40
9-track, 1600 bpi format:			
Controller (accommodates 4 drives)	125	5,000	20
Drive	240	10,000	40
9-track, 800/1600 bpi format:			
Controller (accommodates 4 drives)	200	7,800	30
Drive	290	12,000	40
7-track, 200/556, 556/800, or 200/800 bpi format:			
Controller (accommodates 4 drives)	90	3,600	15
Drive	200	8,000	40
Printers–			
100 cps	200	8,400	50
600 lpm	590	27,800	120
600 lpm (with OCR-A numerics)	640	28,900	125
Communications Controllers (9600 bps, sync.)–			
Half-duplex controller	75	3,600	11
Full-duplex controller	90	4,200	13
Automatic answer feature	10	480	2
Card Reader, 300 cpm	225	9,000	35
Scanners			
4216 Scanner (without any reading system)–			
With knife feeder:			
4216-60 Scanner (3 large pockets; accepts ODP, OMR, and OCR read systems)	1,380	51,500	240
4216-63 Scanner/Sorter (11 large and 2 small pockets; accepts ODP, OMR, and OCR read systems)	1,625	60,000	300
4216-64 Scanner (3 large and 3 small pockets; accepts ODP, OMR, and OCR read systems)	1,630	58,200	340
With variable-thickness feeder:			
4216-65 Sorter/Scanner (13 large pockets; accepts ODP, OMR, OCR, and MICR read systems; MICR/OCR compare not implemented)	1,675	60,000	350
4216-66 Sorter/Scanner (13 large pockets; accepts ODP, OMR, OCR, and MICR read systems; MICR/OCR compare implemented)	1,950	70,000	400
4216-67 Sorter/Scanner (13 large pockets; accepts ODP, OMR, and OCR read systems)	1,575	57,000	300
4216-68 Scanner (3 large pockets; accepts ODP, OMR, and OCR read systems)	1,450	54,000	250
Read Systems:			
ODP	25	1,200	4
OMR	50	2,400	8
OCR (without font detection; 5 fonts max.)	325	13,300	50
Font detection:			
OCR-A Size 1, numeric	40	1,700	5
OCR-A Size 1, alphanumeric	230	8,800	35
IBM 407-1 (1403), numeric	40	1,700	5
IBM 1428, numeric	40	1,700	5
Farrington 7-B	40	1,700	5
E-13B (optical reading)	40	1,700	5
OCR-B, numeric	40	1,700	5
Numeric handprint	335	16,200	50
MICR (magnetic reading of E-13B)	185	7,000	30
Video Insert Terminal	225	8,500	35
4229 Scanner (for Dennison tickets)–			
300 tickets per minute	767	34,800	145
500 tickets per minute	1,003	34,800	173

* 18-month rental agreement; includes prime-shift, local monthly maintenance. The monthly lease costs for a 36- or 60-month arrangement are 7.5% or 15% less, excluding maintenance costs.

** Several packaged systems are available as introductory offers for current Cummins scanner users at substantial discounts on a 30-month contract.

***Plus $1,000 one-time-charge. ■

Cyber-Comm CODE I Key Encoder System

The CODE I Key Encoder. Note the program card at left, and the tape cassette which the operator is inserting into the recorder.

The CODE I System is designed for free-standing key-to-tape applications. Emphasis is on simplicity of operation. Cassettes recorded at individual keystations are converted to computer-compatible magnetic tape by a common converter. A communications link can be used to transmit data from keystations to converter.

MANAGEMENT SUMMARY

Cyber-Comm, a pioneer in the key-to-cassette approach to data entry, is now five years old. Its CODE I Key Encoder System incorporates independent keystations that record data on interchangeable cassettes and a common translator unit that converts the cassette data to a computer-compatible format on ½-inch magnetic tape. (CODE stands for Cassette Oriented Data Entry.)

Designed with emphasis on simplicity, the Key Encoder resembles a large electronic calculator. Programs are entered by means of a hand-punched program card (shades of Dr. Hollerith) that the operator slips into the photoelectric read station prior to a data entry operation. As the card is read, the program is entered into core memory, which provides storage for two programs. Once the program has been entered, the operator uses the punched card to reference each character keyed with the current location within the record. To do this, the operator must ensure that the card is aligned with respect to column and row indicator lamps located within the display panel; two sets of row indicators, each a different color, are used to identify the active program.

A recorded cassette is removed from the Key Encoder and inserted into the Cassette Pooler (translator) for conversion to a computer-compatible format on ½-inch tape. A full cassette requires about five minutes for conversion. When communications are employed, the operator does not remove the recorded cassette, but dials the number of the remote Cassette Pooler, which automatically answers the call and records the cassette data.

All displayed data can be read directly. Errors are displayed as operator messages and, when required, remedial action is included in the message. Although program codes are not displayed, the operator can easily look at the current entry location and pick the code right off the card. (A code list can be taped to the desk for convenient translation.)

CHARACTERISTICS

MANUFACTURER: Cyber-Comm, 516 Aldo Avenue, Santa Clara, California 95050. Telephone (408) 247-1992.

CONFIGURATION: The CODE I System includes one or more Key Encoders and a Cassette Pooler (translator). The Key Encoder is a free-standing key-to-tape unit that contains a program-card read station and a magnetic tape cassette recorder. The Cassette Pooler, also a free-standing unit, contains a magnetic tape cassette reader and a computer-compatible magnetic tape drive. One pooler will support up to 15 Key Encoders in typical applications.

CARTRIDGE TAPE OUTPUT: Each Cyber-Comm cartridge contains 230 feet of 0.25-inch magnetic tape. Recorded at the Key Encoder, the cartridge data is translated to computer-compatible form by the pooler. Record length is fixed at 80 or 120 characters; approximately 650 full-length records can be recorded per cartridge.

COMPUTER TAPE OUTPUT: 7-track, 200/556/800 bits/inch; 9-track, 800 bits/inch; or 9-track, 1600 bits/inch, in IBM-compatible tape formats. Tape movement is reel-to-reel. The Cassette Pooler accommodates an 8.5-inch reel (1200 feet) of 0.5-inch magnetic tape that can store data contained on 15 tape cartridges when the 800 bpi density is used.

DEVICE CONTROL: Programs are entered into core storage via a punched program card that the operator inserts in the photoelectric read station prior to keying data. Provision is made for storing two programs simultaneously, with manual switching between the programs. The program controls the format of data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or right justification (left-zero fill).

The pre-scored program card, prepared with a Porta-Punch and stylus, contains 120 character positions arranged in three rows of 40 characters each. A three-bit binary program code is punched into each character position. Because the card is used for operator reference when keying in entry or verify modes, vertical lines should be drawn to separate the fields, and field titles should be hand lettered.

After the program is read from the card, the operator aligns it so that the card's 40 character positions match a row of 40 indicator lamps contained in the display panel. These lamps, in conjunction with two groups of three lamps (adjacent to the left edge of the card) that identify the card row and the active program, indicate the addressed character position within core memory.

Operating modes include Data Entry, Verify, and Search. In the Entry mode, all data for a complete record is accumulated in core memory prior to releasing it to tape. In the Verify mode, a complete record is read from tape into core memory and compared character for character with the data keyed by the operator from the source document. Verification can be performed after a number

Cyber-Comm CODE I Key Encoder System

The CODE I System in essentially its present form was first delivered in December 1969. Prototypes had been delivered in May 1969, but several changes were incorporated between the two dates. Current lead time on orders is 15 days. Cyber-Comm says that it now has over 150 units installed domestically and overseas. Units are marketed in Japan through Communications Science Corporation on an OEM basis.

USER REACTION

Conversations with users disclosed a consistent pattern. The common incentive for trying the Cyber-Comm Key Encoder was a desire for a more economical and efficient data entry method than keypunching. In some cases users were influenced by free trial offers. Generally speaking, users appeared satisfied that throughput had been improved by the encoder. Credit was given to the elimination of card handling, ability to accumulate about 650 records on a cassette without handling, machine pooling of cassette tape onto standard IBM-compatible tape, and transfer of data to a central site over communications lines. Economy of operation was also regarded as improved.

As long as large volumes of data are involved, the encoder is deemed as having an advantage over keypunching. In contrast, low-volume applications are better served, in the opinion of users, by card punching because they prefer to deal with small quantities of cards rather than a number of partially filled cassettes.

COMPANY INFORMATION

In its brief existence since 1968, Cyber-Comm has careered from early affluence in the form of lavish equity funding to the limbo of Chapter XI reorganization in June 1971 and back to respectability in January 1973 following disposition of all outstanding claims. The company's restoration was accomplished through a reorganization plan that allotted preferred stock in lieu of cash to three major creditors—Lockheed Electronics, the Union Bank of California, and Econtech, a subsidiary of Seagrams Distillery. The remaining debts were settled to the satisfaction of other creditors, most of whom received payment in full.

The company asserts that early service problems with its equipment have been overcome and that its leasing income, in conjunction with other revenue, is sufficient to assure stable operations and to support technical improvements, such as the new capability to transfer data directly to an IBM System/3. The company also states that it is now operating at a profit.

Service is provided by Cyber-Comm in San Francisco and Los Angeles and by Anderson Jacobsen in Chicago and New York. □

of records have been entered or immediately after keying each record. The Search mode allows a record to be found with the same identifier as one keyed in by the operator; any portion of a record can be used as an identifier. Upon completion of a successful Search operation, the identified record is read from tape to core memory. An unsuccessful Search will audibly and visually alert the operator.

Display of current location within a record, data characters, record counter, and error status is provided by a rear-projection display panel. All information except the currently addressed location (indicated by individual column and row lamps) can be read directly from the display without code translation. Error status includes remedial instructions.

ERROR CONTROL: Character parity is produced along with character generation for each key depression. When a record is released to tape from core memory, a conventional read-after-write check is performed on each character to ensure correct parity. Character parity is also checked when reading from tape to core memory in Verify or Search mode. Detected parity errors halt device operation; the error status is displayed along with the proper remedial action. which advises the operator to initiate a tape rewrite through key depression. The rewrite operation is performed automatically from the core memory.

The Cassette Pooler checks the parity of the cartridge data as it is read from tape to core memory. Detected errors require operator intervention. Parity is checked prior to recording data on tape, and longitudinal parity or cyclic redundancy check characters are recorded at the end of each block. Record counters are provided for both input and output as an aid in logging recorded data and error records. The Cassette Pooler also performs an audit check to ensure that each record read from the tape cartridge has been verified; this check looks for a duplicate recording on a second track, which is erased during the verification process. Mod 7, 10, or 11 check digit generation and validation is available as an option.

KEYBOARD: 4-row keypunch style; the keyboard can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters including space. All keys are repetitive. A multiple code function, available with 9-track systems, provides the capability to generate an additional 64 characters.

Up to 14 control keys provide for initiating functions such as manual duplication, skipping, left-zero fill, Program One or Two selection (as an alternate to that selected), alpha or numeric mode initiation, error correction, etc.

COMMUNICATIONS: Transmission is half-duplex asynchronous, at 1200 or 2400 bits/second. The communications interface is compatible with the Bell System 200 Series Data Sets.

A special interface, scheduled to become available in July 1973, allows direct transfer of data from the encoder to core storage of an IBM System/3, Model 6 or 10. If desired, the data can then be transferred to disc. The transfer rate of records that are 80 characters long is 220/minute and of records 96 characters long, 200/minute. Transfer of output data from the System 3 to the encoder is also possible. In this reverse operation, the information is decoded and stored on cassettes prior to entry into the encoder for modification.

PRICING: The CODE I System is available for purchase or rental. Rental prices include maintenance; a separate maintenance contract is available for purchased equipment. Price ranges for the CODE I equipment are listed below; the higher prices include a communications capability.

Device	Monthly Rental	Purchase	Monthly Maint.*
Key Encoder	$145-200	$2,500-3,500	$20-35
Cassette Pooler	200	3,500	25
Check Digits (7, 10, or 11)	20	500	5
Key Encoder Transmission	37	900	10
Pooler Receiver	25	1,000	8

*Included at no charge if a minimum of 10 Key Encoder units are rented or purchased. ■

Data Action 150 Series Magnetic Data Inscribers

The 150 Series Inscribers, now produced and marketed by Data Input, Inc., provide an alternative to input preparation via the IBM Model 50 Inscriber. Attractive features include a lower price tag and the availability of a pooler to transcribe data from cartridges to high-density computer tape off-line.

MANAGEMENT SUMMARY

The Data Action Magnetic Data Inscribers are key-to-tape devices designed for data preparation and are functionally identical with the IBM Model 50 Magnetic Data Inscriber. The Data Action units record data on IBM magnetic tape cartridges in the same format as the IBM Model 50. Except for tape speed, all parameters of the Data Action units are identical with those of their counterparts.

The Model 150 Magnetic Data Inscriber, an obvious copy of IBM's Model 50, was the initial product of the now-defunct Data Action Corporation, which was founded in 1968 by three former Control Data executives. Data Action was dedicated to the development and production of computer input equipment for such applications as data preparation, source data entry, text editing, and word processing. Other products developed and manufactured by Data Action include the Model 500 and 510 Tape Poolers, the Model 220 Typescribe, and the Model 1500 Editor System. In May 1972, the assets of Data Action were acquired by Data Input, Inc., a newly-formed organization. Data Input will continue to manufacture and market the existing product line under the Data Action nameplate.

Besides their noticeably enhanced casework, the 150 Series Inscribers feature a direct character-readout matrix that displays current data in "English" as it is read from tape. This is a refinement over IBM's "xy" coordinate readout. A significant upgrade in performance is provided by the Model 152, a later version of the 151, which is also equipped for pooling. The 152 pooler performs "dup", skip, search, and pooling operations at 1200 characters per second, ten times the speed of Models 150 and 151.

Data can be transcribed from the IBM magnetic tape cartridge to industry-compatible magnetic tape for direct computer input. Two tape poolers are available that ▷

CHARACTERISTICS

MANUFACTURER: Data Input, Inc., 4445 West 77th Street, Minneapolis, Minnesota 55435. Telephone (612) 920-9200.

MODELS: Models 150, 151, and 152. Models 151 and 152 are equipped for pooling; the two differ in pooling speeds. All models are identical in appearance and, except for pooling, all perform the same functions.

TAPE OUTPUT: IBM magnetic tape cartridge; contains 100 feet of sprocketed, 16-mm magnetic tape. Tape code is 8-level EBCDIC plus odd character parity. The IBM magnetic tape cartridge is compatible with the Data Action Model 500 and 510 Tape Poolers, the IBM 2495 Tape Cartridge Reader, and the IBM Model 50 Magnetic Data Inscriber.

Recording density is 20 characters per inch; record length is variable from 1 to 720 characters. The tape capacity per cartridge is rated at 23,000 characters (equivalent to about 290 punched cards).

The magnetic tape handler is designed for ease of loading and unloading a tape cartridge. Once mounted on its tape-drive spindle, the magnetic tape is automatically threaded and wound on an internal take-up reel.

The incremental tape drive moves the magnetic tape at 120 (Models 150 and 151) or 1200 (Model 152) characters per second when performing "dup," skip, or search operations. Rewinding the complete tape requires about 30 seconds.

DEVICE CONTROL: Programs are punched into a program card. The card can identify up to 50 data fields; field size can vary up to 15 positions per field. Fields can be linked together by program to any desired length up to the 720-position maximum capacity.

Up to eight discrete programs, limited to a total of 50 fields, can be punched into the card; programs can be automatically repeated or sequenced. Alternatively, the operator can manually select the sequence of programs to follow.

The program controls format of the data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or right justification (left zero fill). Left-zero fields cannot be linked and are thus limited to 15 digits. Program chaining and verification bypass can also be indicated by punches in the card.

Because the Data Inscriber lacks a buffer, data to be duplicated from record to record cannot be stored. The problem is resolved by recording special "dup" and skip codes in each character position of a duplicate or skip field. The input utility program of the System/360 or 370 processor or the 500 or 510 Pooler must replace these codes with correct data from a previous record. In addition, each record written on tape contains a program level code, to identify the program used to format the record, ➤

Data Action 150 Series
Magnetic Data Inscribers

pool from a Model 151 or 152 Inscriber and transcribe the data into 7- or 9-track tape at densities of 556, 800, or 1600 bits per inch. An important feature of the poolers is that they preclude the need for a special input utility program to duplicate fields; duplicate data is automatically inserted by the pooler when "dup" codes in the input tape are read. Both models of tape poolers include a 1024-character buffer to provide for full utilization of the 720-character record length of the Inscribers.

The Data Action Inscribers constitute an important alternative to the IBM Model 50. They offer (1) direct compatibility with the IBM Model 50 Inscriber and the 2495 Tape Cartridge Reader, (2) off-line pooling of data recorded on magnetic tape cartridges onto 7- or 9-track computer-compatible tape, and (3) a lower price tag than IBM's.

First deliveries of the Model 150 and 151 Inscribers were made in November 1969, and the Model 152 was initially delivered in July 1971. First deliveries of the Tape Poolers were made in 1970 (Model 500) and in July 1971 (Model 510). Over 750 Data Action Inscribers have been installed among over 100 users.

Service is provided by Data Input through its own service organization, which currently includes 25 customer engineers. When necessary, Data Input supplements its service with support from Control Data Corporation. Data Input quotes a service response time of 2 hours or less and claims that it is typically 1 hour. □

and an end-of-record code. These codes are automatically written at the beginning and end of each record.

Modes of operation include Write, Read, Verify, and Search.

The Write mode is synonymous with the data entry mode of most keyboard-to-tape devices. With each keystroke, a character is recorded directly on magnetic tape. The program drum is automatically advanced at the end of a field.

The Read mode allows data written on tape at the current position to be displayed via the character readout matrix. Subsequent characters are read and displayed via spacebar depression. The operator can advance to the beginning of the next record or the end of a skipped field or can backspace to the beginning of a field or record. When entering the Verify mode, the first character of the record to be verified is read; i.e., the program level code. The program is then advanced to the beginning of the proper program and the verify operation is initiated. Data rekeyed from the source document is compared character for character with the data written on magnetic tape.

The Search mode advances the tape until a group separator or end-of-data (last complete record) is encountered. Tape motion is halted, Read mode is entered, and the special code is displayed. The Search mode can be entered any number of times until the end of tape is reached. Models 150 and 151 search at 120 char/second; Model 152 searches at 1200 char/second.

Display of current location within a field is not provided, since the Data Inscriber is unbuffered. The graphic representation of each character read from tape is directly identified in "English" by a character readout matrix.

Handwritten or typed information on the program card relating to the active program is visible through a window on the indicator panel. Status conditions such as error, rewrite character, end-of-media, character check, and first character are directly displayed via indicator lamps.

ERROR CONTROL: Character parity is produced along with character generation for each data key depression. Character parity is checked when in the Read mode, during a search operation, and during a record backspace or field backspace operation in the Write or Verify modes. A parity error detected during any of these operations halts the Data Inscriber, inhibits the keyboard, and visually alerts the operator.

Keying errors detected by the operator can be corrected by backspacing and rekeying.

POOLING: Consolidates data contained on IBM magnetic tape cartridges onto one or more 10.5-inch computer tape reels in an industry-compatible format. Two tape poolers are available: Model 500 accepts data from a Model 151 Data Inscriber only at 120 char/second, while Model 510 accepts data from either a Model 151 or 152 Data Inscriber at 120 or 1200 char/second, respectively. The 500 and 510 Poolers both include 1024-character buffers. Tape parameters for the Model 500 and 510 Tape Poolers are presented below. Rewind speed is 150 inches/second for both models.

Pooler Model	Tape Tracks	Recording Density, bpi
500	7	556/800*
500	9	800
510	7	556/800*
510	9	800/1600*

*Switch selection provided.

KEYBOARD: 49-key keypunch style; keyboard can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters. Any character code can be produced with the Special Code Function. The key arrangement of the Microswitch keyboard is identical with that of the IBM Model 50.

The keyboard can also be used as a 48-character keyboard by manually disabling 16 special characters on the uppercase shift. Up to 12 control keys provide for initiating functions such as alpha and numeric shift, program select, left zero, field and record backspace, skip, etc.

PRICING: The Data Inscribers and Tape Poolers are available on a purchase basis or on a one-year lease that allows unlimited usage. A separate maintenance contract is provided for purchased units. Unit purchase prices are available on request to Data Input. The following monthly lease prices include prime-shift maintenance:

Model 150 Data Inscriber:	$155
Model 152 Data Inscriber:	155
Model 152 Data Inscriber:	165
Model 500 Tape Pooler: (7- or 9-track)	60
Model 510 Tape Pooler: (7- or 9-track, 556/800 bpi)	195
Model 510 Tape Pooler: (9-track, 1600 bpi)	295

Data Input also offers two "package" configurations it calls System 1 and System 2. System 1 includes one Model 500 Tape Pooler, two Model 151 Data Inscribers, and one Model 150 Data Inscriber and leases for $525/month, including maintenance. System 2 includes one Model 500 Tape Pooler, two Model 151 Inscribers and three Model 150 Inscribers and leases for $800/month, including maintenance.

Program cards and magnetic tape cartridges are supplied by Data Input. ■

Data Instruments Dataplex System

The Dataplex Recording Typewriter, shown here in a savings and loan application, records typed data on cassettes that can be hand-carried or transmitted to the Dataplex Processor.

The Dataplex System produces typed documents and records the typed data on cassettes. The cassettes are then read into the Dataplex Processor, and the data is formatted, edited, and written on computer-compatible magnetic tape. The result is an elimination of manual data transcription steps.

MANAGEMENT SUMMARY

Key-to-tape systems are designed to replace keypunches with as little change in the existing data preparation procedures as possible. The Dataplex System, on the other hand, is designed to allow implementation of a computer data preparation function with as little impact on existing business procedures as possible.

Essentially, data is recorded on small tape cassettes just as it is typed. In a separate operation, a small computer reads the cassette, makes format conversions, and writes the data on computer-compatible magnetic tape. Provisions are made to accommodate code translations so that tape can be prepared for almost any current commercial computer.

The key to the operation of the system is FORMOL, a proprietary program developed by Data Instruments and included with each system. This program, operating from implicit instructions identified by format definitions or explicit instructions entered by the typist, converts the data to a format acceptable by a computer.

As in most of the current data entry systems that include a minicomputer, the processor in the Dataplex system is not intended to serve as a free-standing computer for general data processing in addition to its primary formatting function. The current FORMOL program does allow an output data field to be subroutine-generated, but currently this facility is intended mainly for handling control-total generation and checking. ▷

CHARACTERISTICS

MANUFACTURER: Data Instruments Company, 16611 Roscoe Place, Sepulveda, California 91343. Telephone (213) 893-6464.

CONFIGURATION: The Dataplex System includes free-standing units called Recording Typewriters, which record data on cassette tape, and a Dataplex Processor that is made up of a small computer, an IBM Selectric I/O typewriter, one to four computer-compatible magnetic tape units, and a tape cassette reader. Several models of the computer are available with different memory cycle times and sizes. One model of the recording typewriter (T30) is equipped with a communications interface for transmission to the Dataplex Processor. Other peripheral devices can be added to the Processor, including a line printer, paper tape reader, or paper tape punch.

SYSTEM CONTROL: Dataplex functions as a complete system. Recording Typewriters are employed for local and/or remote operation; each produces a recorded cassette tape identical to the typed copy. Data entered into the computer from recorded cassettes is manipulated by the FORMOL program, following commands in the typed copy, to produce a computer-compatible tape ready for processing by a computer system.

Typewriter operation is manually controlled; operation is dependent on mode selection. The R30 operates in one of two modes: Type-Only or Record. The T30 operates in one of three modes: Type-Only, Record, or Transmit.

The Type-Only mode allows the unit to function as a normal office typewriter.

With the Dataplex tape cassette inserted and the unit switched to the Record mode, data entered at the keyboard is typed on the inserted sheet and simultaneously recorded on magnetic tape.

The user has the option of hand-carrying the recorded tape cassettes to the processing facility or transmitting the recorded data via the Model T30.

Messages are transmitted from a T30 Typewriter via the public telephone network to a Dataplex Processor at the central facility. The Dataplex cassette containing the message to be transmitted is inserted in the T30, the Transmit mode is selected, and a call to the processing facility is established in the conventional manner by dialing. Once established, the connection is confirmed by a tone from the processing facility. The typewriter operator then transmits the recorded data.

At the receiving end, the data is recorded on another Dataplex tape cassette or on 1/2-inch tape. Having been ▶

Data Instruments Dataplex System

At present, the FORMOL program seems well adapted to handling almost any type of "fill-in-the-blanks" form. For each field in the form, a field format designation is carried in computer memory. A format statement is a collection of field format definitions and is identified by a calling mnemonic. The program is also flexible enough to allow text composition, with provisions for insertions, corrections, and deletions.

Data Instruments is currently concentrating its marketing efforts upon trust, savings, and loan operations in banking and upon text editing functions in other industries.

The advantage of the Dataplex way is the elimination of one or more manual data transcription steps and the resulting cost savings. The disadvantage lies in this very same element: making data preparation more transparent—i.e., moving toward source data automation—increases the discipline required to ensure that errors, whether they arise from miskeying or mistaken original data, can be rectified.

The centralization of functions always brings about the need for proper communication between different elements of the operation. In the case of the Dataplex system, the chief communications problem is in the coordination of changes to previously recorded data. Adequate audit trails are provided, if supplemented by good manual controls and records, to minimize this problem.

If the user wants to, he can intermix record types on the recording cassettes. At the Dataplex processor, records can be selectively written onto computer tape by record type, thus separating the data files; additional tape drives expedite this operation.

An operator at the Dataplex I/O typewriter can selectively retrieve specific fields from each record in a file—in effect, yielding a miniature information retrieval system. This capability is currently limited to generating a tape holding the selected information; the data can then be output on an optional line printer.

First deliveries were made in February 1970, complete with software. Between then and January 1972, the company's financial road was rocky. The company spread itself too thin in marketing and applications development. Severe cash problems developed. The company was completely reorganized in January 1972, and a substantial amount of new capital was injected. Total employment at present is about 60.

The company recently acquired Information Resources Corporation, which added a new item to the Data Instruments product line. This product, called Dart, is a small, 16-key portable data recorder for walk-around data recorded, the data is then reformatted by the FORMOL program and recorded on computer-compatible tape.

The FORMOL program provides the mechanism for translating between the visually-oriented typing format and the position-oriented computer format. A single format definition identifies the format of the input data read in and the output data written out. Special provisions are made for skipping input data or for adding output data.

FORMOL provides five modes of operation: Format, Process, Special, Halt, and Search. These modes are established by manipulating processor console switches to force the computer to the beginning point of each mode program.

The Format mode is the normal working mode in which data is transferred from the cassette to the computer-compatible tape. For most routine jobs, the typist need only identify the format to be used, the cassette identification, and the beginning and end of the job. Field definition is done by the FORMOL program based on the prestored format. Fields can be identified as numeric or alphanumeric, left or right justified, and zero or space filled. Not all combinations of these field definitions are permitted. If desired, a numeric field can be identified as a tally check; a processor subroutine generates an arithmetic tally on the specified field and compares the result with a value entered by the typist.

Additional provisions are made for interpreting ditto marks in columnar entries and correctly filling in the actual entry. Data can be duplicated from a format heading or from a previous record.

In general, fields are delimited by multiple spaces, tabs, or carriage returns while the data is being typed, thus posing no special problems for the typist. For special situations, almost any character can be used to end a field.

The input and output data codes are also specified in the format for each field, and translations can be performed between ASCII, EBCDIC, binary, or special codes set up by the user.

Typing errors require special procedures to correct because the cassette tape recorder does not backspace. The backspace key causes a character to be recorded which is interpreted by the standard software as a character delete function. Exact procedure depends on the type of correction technique used (e.g., correction tape or fluid, overtyping, mechanical erasure, etc.). A string of backspace symbols is interpreted as a reverse string of character deletes. Simple repositioning of the carriage and overtyping will not work because the tape does not backspace. The half-space key is non-recording, which can help the typist position copy. A second non-recording character, "Obliterate", is useful in "x'ing" out copy. A recording character, a circumflex, is interpreted as a word erase function. Special procedures must be followed if a correction is required in a previous line; the Carriage Return character functions as an end-of-record symbol.

In the Format mode, the typist can also type instructions for using special formats, correcting single or multiple fields, erasing an entire file, and inserting comments. If these instructions are not wanted on the form, the typist can tab over and type them to one side, or she can insert a scratch sheet if carbons are not being prepared. Fields are identified by number, so the typist should have some sort of format guide handy.

Data Instruments Dataplex System

recording, as in inventory counting. It includes an acoustic coupler for transmission of data to a Dataplex Processor for formatting and conversion to computer-compatible tape.

Datapro talked to a couple of Dataplex users, and both seemed pleased with the equipment. They mentioned no outstanding problems with either the equipment or software. One user has been using the equipment for about two years, and the other for about six months. Both sites are maintained by Data Instruments service personnel. One user gathers data for a computer application program. This installation was converted from an existing keypunch setup. The only significant conversion problem reported was in training the typists; once they became aware that all carriage movements must be performed by tab, carriage return, backspace, and space keys so that the codes would be recorded, things were all right. The other user employs the Dataplex System for text preparation for composition; he reported no difficulty in training the typists.

Currently, there are about 15 to 20 Dataplex systems installed, representing about 200 Recording Typewriters. Data Instruments provides its own service in Southern California, where most of its installations are, and in New York, the company's second marketing front. Systems in other locations are maintained by independent service reps.□

The Search mode allows the computer operator to access and modify a previously recorded tape. Individual or sequential groups of records can be located and typed out on the I/O typewriter. New formats can be keyed in from the I/O typewriter, and old formats can be deleted. This mode also allows programs to be loaded from cassette or computer tape and to be written onto computer tape.

The Process and Special modes are for loading format specifications (called Macroforms) previously recorded on cassettes or computer tape.

The I/O typewriter is also used to output a log identifying the reel of tape, data, cassette, format, file number, and number of records for each file. This information is necessary to provide an audit trail whereby the source data can be reconstructed for each computer tape file—if the cassettes are saved. Manual procedures are necessary to permanently identify the contents of a cassette and provide the historic correlation between the computer tape files and the source documents prepared on the typewriters.

About 25 numeric diagnostic codes can be printed by the I/O typewriter to identify errors detected in the cassette recording (parity or format), format definitions, or identification or instruction forms.

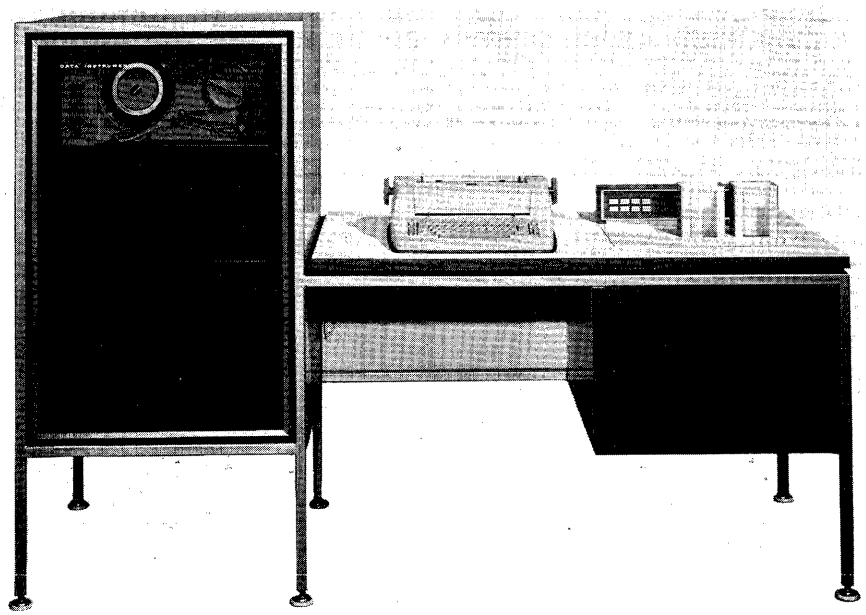
Other operations can be performed within the FORMOL program. A sort routine is provided that uses three or four tape drives. A utility routine for listing data from tape onto the line printer is also provided.

ERROR CONTROL: Character parity accompanies each character recorded on the cassette tape and is transmitted along with the data. Odd parity is employed for cassette recordings.

Errors detected when operating over a communications line are corrected by automatic retransmission; an error count can be maintained, with automatic disconnect if it exceeds a preset figure.

DATAPLEX RECORDING TYPEWRITERS: The R30 is a standard Olympia office typewriter modified to include an integral tape cassette recorder. In addition to the typed copy produced from keyed data, the data is recorded on magnetic tape contained in the inserted tape cassette.

The Dataplex Cassette, a standard "Philips-type" cassette, contains 300 feet of 0.150-inch magnetic tape. Data is recorded incrementally at 20 char/inch. The recorded



The Dataplex Processor combines a minicomputer, automatic cassette changer, magnetic tape drive, and Selectric I/O typewriter. It reads data from cassettes, reformats it, and writes it on computer-compatible magnetic tape.

Data Instruments Dataplex System

cassette is compatible with other Dataplex equipment only. Character parity is recorded.

The T30 Typewriter is identical except that it includes a communications interface compatible with a Bell System 202E9 or 202C Data Set. Transmission speed is 50 char/second.

The keyboard is a 44-key conventional typewriter-style keyboard. It can produce any of 86 character codes that include upper and lower case alphabetics, numerics, punctuation, and special characters. Both full- and half-space keys are provided.

DATAPLEX PROCESSOR: The processing facility includes a basic 2.66-microsecond, 8192-byte minicomputer. Memory capacity can be expanded to 16K bytes. An older version using an 8-microsecond memory is being phased out.

Input to the processor is via the Automatic Cassette Reader, which reads cassettes recorded by the Dataplex Typewriters. The reader will handle up to 10 cassettes, loading, reading, rewinding, and rejecting each cassette automatically. The data transfer rate is approximately 400 char/second.

Output from the processor is provided by a computer-compatible magnetic tape unit, which is used to record data read from Dataplex cassettes and reformatted under control of the FORMOL program.

An IBM Selectric I/O Typewriter provides direct communication with the computer and is dedicated to activities such as listing operations performed on data, listing error diagnostics, listing performance data, and performing edit operations such as instructing the computer in the Search mode as to the identification of a file or record to be manipulated.

A 4K version of the processor, the C50, with the automatic cassette reader and computer-compatible tape drive but without the I/O typewriter, is available for media conversion.

COMPUTER TAPE OUTPUT: One to four tape drives can be included in a Dataplex system. Two models are available. One model records 7-track tape at 556 bpi; tape speed is 10 inches/sec. The second model records 9-track tape at 1600 bpi with a tape speed of 25 inches per second; this model is also available for recording at 800 bpi. Submodels are available to handle either 7-inch (600 feet) or 10.5-inch (2400 feet) reels. The first drive is mounted in the same cabinet as the computer; additional drives are housed in auxiliary cabinets.

OTHER PERIPHERAL DEVICES: A line printer can be attached. It operates at 245 lpm when equipped with a 64-character set or at 173 lpm with a 96-character set. Line width can be 80 or 132 columns.

Punched tape units can also be used. A 200, 300, or 400 character-per-second reader can be added that reads 5- or 6-level or 7- and 8-level tape. A 60 character-per-second tape punch can be added that accommodates 5- to 8-level tape.

PRICING: The Dataplex System is available for purchase or for lease on a two- or three-year term. The lease prices shown include maintenance; a separate maintenance contract is available for purchased equipment.

Maintenance charges included in the lease prices and shown for purchased units cover single-shift operations only; routine or special after-hours maintenance is available at additional cost. There is no increase in monthly charges for additional usage other than for Dataplex maintenance, if wanted.

Component	Monthly Rental 2-Year Lease	Monthly Rental 3-Year Lease	Purchase	Monthly Maint.
Dataplex Processor (8K, 2.66-microsecond memory, 1 tape)	$1,077	$1,001	$34,000	$123
Options for Processor:				
8K Additional Bytes of Memory	170	158	5,400	20
Additional Tape Unit–				
7-track, 556-bpi or 9-track 800-bpi:				
7-inch reel	187	174	5,950	22
10.5-inch reel	192	178	6,050	22
9-track 1600-bpi	NA	NA	NA	NA
Recording Typewriters:				
R30 (record only)	98	91	2,850	14
T30 (record and transmit)	115	107	3,375	16
Other Peripheral Units:				
Line Printer–				
245 lpm, 64 characters, 132 columns	690	646	18,900	135
173 lpm, 96 characters, 132 columns	765	716	20,900	150
Paper Tape Reader–				
200 char/sec	NA	NA	NA	NA
300 char/sec	215	200	6,400	30
400 char/sec	NA	NA	NA	NA
Paper Tape Punch, 60 char/sec	205	191	6,300	30
C50 Cassette/Computer Tape Converter (4K memory)	495	459	18,500	50

DATA 100 Model 70 Remote Batch Terminal

MANAGEMENT SUMMARY

When DATA 100 was delivering the first production units of its Model 70 Terminal in February 1970, the terminal was available in only two Model configurations that correspond to IBM's 2780 Models 1 and 3. Since then, DATA 100 has plugged the gap with three additional models. The Model 70 family of hard-wired terminals now includes members that correspond with all models of IBM's 2780 plus an additional member that provides punched card input only.

DATA 100's marketing thrust is, of course, the IBM 2780 replacement market, which according to industry sources currently includes about 8000 terminals; however, DATA 100's vigorous marketing effort has resulted in more new installations then actual IBM 2780 replacements. The Model 70 Terminal has had a significant impact upon the remote batch processing market, with over 500 units delivered to date. Current lead time on orders is 30 days.

The Model 70 offers extensions beyond the IBM 2780 in the following areas: buffering, data compression, independent card reader and punch units, reading and printing speeds, and transmission speed. These extensions lead to increased communication line efficiency, but the buffer and data-compression extensions require modifications to the System/360 or 370 I/O handler, which DATA 100 says take about one man-week of programming effort. DATA 100 furnishes the necessary information and guidance, but the user must do his own programming. ➢

The Model 70 Terminal, designed as a replacement for the IBM 2780 Data Transmission Terminal, Models 1 through 4, offers the user increased performance through extended capabilities at substantial savings in cost.

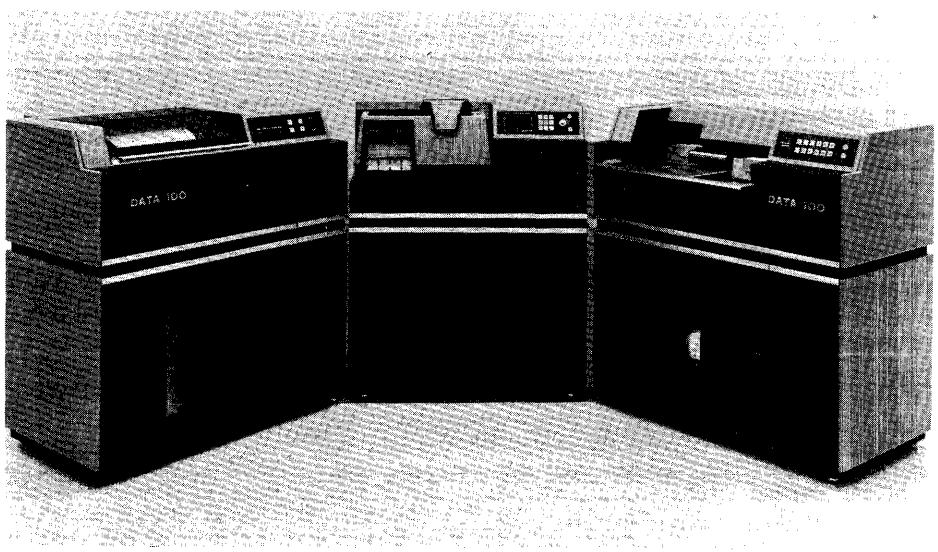
CHARACTERISTICS

MANUFACTURER: DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

MODELS: Five models are offered, with the following I/O capabilities:

- 70-1 – Punched card input and printed output.
- 70-2 – Punched card input/output and printed output.
- 70-3 – Printed output.
- 70-4 – Punched card input/output.
- 70-5 – Punched card input.

COMMUNICATIONS: Transmission is in half-duplex, synchronous mode at 9600, 4800, 3600, 2400, or 2000 bits/second. One of three transmission codes can be specified: 8-level EBCDIC, 8-level ASCII (with parity), or SBT (Six-Bit Transcode). All models employ the IBM Binary Synchronous Communications technique. Common-carrier or independent modems can be used to interface the Model 70 with a voice-band communications facility. ➤



The Model 70-2, one of five available equipment configurations and DATA 100's best seller, includes (left to right) a printer, card reader with operator panel; and card punch.

DATA 100 Model 70 Remote Batch Terminal

The basic terminals can block up to seven records of 400 characters (with no software manipulation required). By comparison, the basic IBM 2780 blocks two records, with seven-record blocking available as an added-cost option. Optional features enable Model 70 users to block up to 15 records (600 characters) or up to 31 records (1000 characters).

Data compression further extends the terminal's capabilities by compressing a string of spaces or identical characters into two or three coded characters, respectively. This capability lends itself well to applications such as transmitting blanks, zeros, or asterisks. The IBM 2780 also has a compression feature (RPQ), but only spaces can be compressed and IBM charges seven times the price charged by DATA 100 for the capability.

Terminal efficiency is further enhanced by the use of a drum printer (with printer mechanism supplied by Control Data) in place of the IBM 2780's bar printer. This substitution increases the rated printing speed from 240 to 300, 400, or 600 lines per minute.

Most users now operating in a remote batch environment require the capability to transmit data from cards and to print data received from the remote computer on a high-speed printer; many just need the printing capability. The capability to punch received data into cards is required by only a small percentage of users. Because IBM's 2780 combines both card read and punch functions in a single unit, installations that require the card input capability but not card output must pay for the punching capability when dealing with IBM. DATA 100 offers separate reader and punch units to cut the cost of terminal configurations that provide card input capability without card output. However, this approach results in higher terminal costs when the card output capability is included, since the cost of a complete punch unit is involved.

This line of reasoning is reflected in DATA 100's pricing for the Model 70 terminals. Models 70-1 and 70-3 are priced substantially below the equivalent models of the IBM 2780. Lease prices for the two terminals, on a three-year basis, fall about 12 to 15 percent below IBM's prices for the corresponding IBM 2780 models; purchase prices are about 24 percent below those of IBM. Slim or no savings are provided for Model 70 configurations that incorporate a card punch or reader only. Of course, in sizeable installations where only a few terminals require the punch, quantity discounts will probably result in favorable per-terminal savings over the cost of an equivalent IBM installation.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major U.S. cities. DATA 100 maintains a staff of 40 customer engineers

Transmission characteristics (at 4800, 2400, and 2000 bps only) are compatible with the IBM 2701 Data Adapter Unit, 2703 Transmission Control, and Integrated Communications Attachment (ICA), each equipped for Binary Synchronous Transmission.

The Model 70 is designed for communicating with the System/360 Model 25 via the ICA, with the System/360 Models 25 through 195 and System/370 Models 135 through 165 via the 2701 or 2703 controllers, or with the IBM 1800 computer via a communications adapter. When communicating with the System/360 Model 25 via the ICA or with the IBM 1800, only EBCDIC or ASCII codes can be specified.

The terminal can operate in a point-to-point or multipoint arrangement with other Model 70 Terminals or other IBM Binary Synchronous devices such as the IBM 2780 Data Transmission Terminal and the IBM 2770 Data Communication System. All devices operating on the same line must use the same transmission code. Automatic answering and disconnection is provided as a no-cost option.

DEVICE CONTROL: Control is provided via an integral control unit and through switches on the operator panel.

Four standard operating modes include Off-Line, Receive, Transmit, and Transmit Transparent (which requires using the EBCDIC transmission code). The Off-Line mode lists punched card data (one single-spaced line per card) and/or reproduces cards read by the card reader. The terminal is capable of concurrent punch and print operations (on- or off-line) when equipped with the Simultaneous Print & Punch feature. The Receive and Transmit modes print and/or punch received data and transmit data read from cards. The Transmit Transparent mode performs the same operation as the Transmit mode, but with control-character recognition disabled to allow the transmission of all EBCDIC code combinations.

Record length is variable up to 80 text characters for the reader and basic printer. With the extended print line, record length can vary up to the 120- or 132-character limit. Fixed-length records are required with the Transparency feature.

Two data compression/decompression options are available that transmit a string of three or more consecutive spaces or identical (Extended Compression) characters as a two- or three-character sequence, respectively. The space compression options are operable with SBT or EBCDIC nontransparent transmissions. The Extended Compression option is operable only with EBCDIC nontransparent transmissions.

With the optional Multipoint Line Control feature, the terminal can operate in a multipoint arrangement in which communication is performed by polling and selection initiated by the remote program.

Horizontal formatting is optional and is implemented via a stored horizontal-format record composed of space characters interspersed with horizontal tab characters. Vertical formatting is handled by a 12-channel punched tape loop.

ERROR CONTROL: Cyclic redundancy check characters (two) are generated and checked for EBCDIC- or SBT-coded transmissions, and both odd-character and longitudinal parity are generated and checked for ASCII-coded transmissions. A negative acknowledgement is transmitted

DATA 100 Model 70 Remote Batch Terminal

that assist about 130 DATA 100-trained Honeywell CE's.

DATA 100 finances its customer leases through banks and non-affiliated leasing companies.

A DATAPRO 70 survey of installations using the Model 70 found its users to be quite satisfied with its operation and performance. Little or no down-time was reported, though some users complained that the 300-cpm reader goes out of adjustment easily. Users were generally pleased with the performance, reliability, and service–both DATA 100's and Honeywell's. □

in response to successive negative acknowledgements; then the terminal halts and the operator is alerted, both audibly and visually, that human intervention is required. An odd/even block check is performed to ensure that message blocks are not lost or duplicated.

CARD PUNCH: Punches 80-column cards in Hollerith code at a rated speed of 59 to 200 cards/minute. (The 200-cpm speed is attained when punching is confined to the first 11 columns of each card.) Single hopper and stacker capacities are 1500 cards each.

CARD READER: Reads 80-column, Hollerith-coded cards at 300 or 600 (optional) cards/minute. Single hopper and stacker capacities are 600 cards each for the 300-cpm unit and 1000 cards each for the 600-cpm unit. Reader logic translates card data from Hollerith code to the specified transmission code.

PRINTER: Drum printer; prints at a rated speed of 300 lines/minute or, optionally, at 400 or 600 lines/minute. The standard printer has 80 print positions, with 120 or 132 positions available as options. The printer accommodates ASCII, EBCDIC, or SBT character sets, as specified by the user. ASCII provides 63 print symbols; EBCDIC, 52 (39 or 63 optional); and SBT, 47 (39 optional). Horizontal spacing is 10 char/inch; vertical spacing is 6 or 8 lines/inch. The printer accommodates pin-fed continuous six-part forms from 3.5 to 20.6 inches wide and up to 22 inches long.

PRICING: The DATA 100 Model 70 Terminal is available for purchase or on a one- or three-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units.

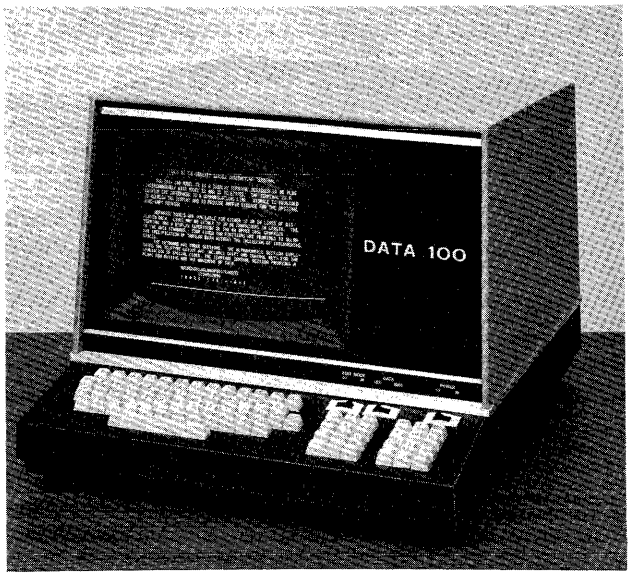
Device	Monthly Rental* 1-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
Model 70-1	810	750	29,000	180
Model 70-2	1,080	996	42,000	205
Model 70-3	690	640	24,400	160
Model 70-4	720	660	27,600	120
Model 70-5	450	414	16,330	95
Options–				
600-Char. Buffer	50	46	1,800	11
1000-Char. Buffer	90	82	3,500	15
Multipoint Line Control	0	0	0	0
Data Compress/Decompress–				
Space compression, EBCDIC	50	45	2,300	0
Space Compression, SBT	50	45	2,300	0
Extended Compression, EBCDIC	25	25	1,150	0
Simultaneous print & punch	25	25	1,150	0
Card Reader, 600 cpm	50	46	2,070	5
400-lpm Printer Option	60	55	2,500	6
120 Column Option	50	45	2,150	4
132 Column Option	70	65	3,000	5
Horizontal Tabulation	25	25	1,150	0
Static Eliminator	6	6	280	0
Printer, 600 lpm, 132 col.	330	284	14,520	20
High-Speed Transmission**	25	25	1,150	0
4800 bps Transmission (EBCDIC only)	10	10	460	0
203 Modem Compatibility	4	4	185	0
Dual Modem Switch	46	42	1,850	6
Modem Pair Simulator***	120	110	4,930	15

*Includes prime-shift maintenance.

**Required for transmission speeds above 4800 bps up to 9600 bps (EBCDIC) and up to 7200 bps (SBT).

***Limited-distance modem for rates up to 9600 bps; uses twisted-pair line. ■

DATA 100 Model 73 Interactive Terminal



The Model 73 Interactive Terminal, a low-priced replacement for the Teletype 33 and 35 teletypewriters, offers a wide range of selectable speeds in two display arrangements.

MANAGEMENT SUMMARY

Are you searching for an interactive CRT terminal to replace that Teletype 33 or 35 teletypewriter you now use, but find inadequate for your future requirements? If so, take a look at DATA 100's new Model 73 Interactive Terminal, the first member of a planned family of CRT terminals.

The Model 73 Terminal is directly compatible with the Teletype Model 33 and 35 teletypewriters, is priced about the same as an IBM 2741 Communication Terminal, and features an adding-machine-style keygroup and MOS display and read-only memories. Two display arrangements are offered: 12 and 24 lines. Each arrangement is available with 72 or 80 characters per line. The number of characters per line is a field-interchangeable feature.

Cursor controls provide conventional cursor manipulation, and a tab facility provides tabs at four fixed locations.

Besides its speed compatibility with the teletypewriter, the Model 73 allows the user to manually select other transmission speeds up to 1200 bits per second. With the added speed flexibility, the terminal can be used for additional applications.

A printer adapter for hard-copy output is available, but the user must procure his own printer from among those recommended by DATA 100.

The Model 73 Interactive Terminal was announced, and a working prototype was displayed, at the 1970 Spring Joint Computer Conference. First deliveries were made in ▷

CHARACTERISTICS

MANUFACTURER: DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode. Transmission rates of 110, 150, 300, 600, or 1200 bits/second can be switch selected. The communications interface is designed to EIA Standard RS-232B.

The 8-level (including parity) ASCII transmission code is used; the unit code structure is 11 bits/character (including one start and two stop bits) at 110 bits/second and 10 bits/character (including one start and one stop bit) at all other speeds.

The Model 73 Interactive Terminal is completely compatible with the Teletype Model 33 and 35 teletypewriters. Connection to a voice-band communications facility is established via a modem.

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT with a viewing area 9 inches wide by 6 inches high. The display arrangement can be specified as 12 or 24 lines of 72 or 80 characters each. The number of characters per line, but not the number of lines per display, can be field-interchanged.

A character set of 64 ASCII characters, including uppercase alphabetics, numerics, and special symbols, is displayed in white against a dark background. Each character is formed by a 5-by-7 dot matrix.

DEVICE CONTROL: Provided by 13 control codes. Control codes can be interspersed with data to control operations such as cursor positioning, horizontal tab, line feed, bell, etc. Control codes are not stored in display memory.

One of two on-line operating modes can be manually selected: character or block. In the character mode, each character is transmitted as it is keyed and displayed only when returned from the remote computer (full-duplex mode) or from the terminal's interface (half-duplex, non-edit mode). In the block mode (half-duplex, edit mode), a complete message is composed on the screen prior to transmission. Transmission in this mode is controlled by the Send Page or Send Line functions. The Send Page function positions the cursor to the beginning of the screen and transmits all displayed data. The Send Line function transmits all displayed data between the cursor and the end of the line occupied by the cursor.

A local off-line operating mode permits message composition without computer interruption. ►

DATA 100 Model 73 Interactive Terminal

September 1970. DATA 100 is currently quoting a 30-day lead time on orders.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major U.S. cities. DATA 100 says it has about 70 customer engineers that assist about 130 DATA 100-trained Honeywell CE's.

DATA 100 is also marketing its terminals in Europe and has a manufacturing facility at Chichester, England, which it acquired from Scientific Furnishing, Ltd., a peripherals supplier to ICL and other European computer manufacturers.

DATA 100 sells its Model 73 to both OEM and end-user markets, and says its OEM market is the larger of the two at present. □

The cursor can be positioned in any of four directions: up, down, left, and right. Repetitive operation is provided for these functions, but no wrap-around capability is provided. The Up and Down cursor controls move the cursor up or down one line until it stops on the first or last displayed line. The Left and Right cursor controls advance or backspace the cursor by one character position. The cursor moves from the left margin of a line to the right margin of the previous line, and from the right margin of a line to the left margin of the next line.

The cursor can be returned to the first character position of a line (Return) or the first character position of the display (Home). The Line Feed control moves the cursor down one line; at the bottom line, the displayed text will roll up one line for each Line Feed, erasing the first displayed line. The screen is erased and the cursor is positioned at the home location when the Clear function is initiated.

Page roll-up is a standard feature. Model 73-1 provides full-page roll-up, while Model 73-2 provides either full- or half-page roll-up, as specified. The roll-up feature moves all lines of data displayed on the screen (full-page) or the bottom half of the screen (half-page) upward by one line, replacing the top line, which is lost, and vacating the bottom line to make ready for the next entry. The roll-up feature is initiated when a line feed code is keyed or received after the cursor has moved to the bottom line. "Pad" characters (ASCII control codes) are required for consecutive roll-up functions when operating at transmission speeds above 300 bits/second. A minimum of one or two pad characters are required at 600 or 1200 bits/second, respectively.

Four fixed tab stops are located at columns 17, 33, 49, and 65. The Tab function moves the cursor to the next tab stop until the cursor tabs to column 65; the cursor will not tab to the next line.

ERROR CONTROL: When selected, character parity is generated for each character keyed and accompanies the transmitted character. When selected, a parity check is performed on received data; characters received in error are replaced with a special symbol (*) which is displayed on the screen in place of the incorrect character.

The display facilitates operator recognition and correction of keying errors.

KEYBOARD: 53-key typewriter-style. Two keygroups to the right of the main keygroup include an 11-key numeric inset (optional) and a 12-key cursor and control key inset. The keyboard can generate any of 77 ASCII characters: upper-case alphabetics, numerics, punctuation, and 13 control codes, which include Teletype-compatible functions. Repetitive entry of data or initiation of control functions is performed by holding down a key while simultaneously depressing the Repeat function key.

PRINTER: The optional printer adapter accommodates a user-procured, serial character printer with operating speeds of from 10 to 60 char/second. The adapter provides either an EIA standard RS–232C or a contact-closure interface.

PRICING: The Model 73 Interactive Terminal is available for purchase or on a one- or three-year lease. Lease prices include prime-shift maintenance. A separate maintenance contract is available for purchased units. Prices are as follows:

Terminal	Monthly 1-Year Lease	Rental 3-Year Lease	Purchase	Monthly Maint.
73-1 (12 lines)	$105	$ 97	$3,750	$22
73-2 (24 lines)	115	105	3,950	25
Printer Adapter	6	6	240	0

■

DATA 100 Model 78 Programmed Terminal

MANAGEMENT SUMMARY

Switch it on, load the cards (or tape), press the button – SHAZAM! Your Model 78 terminal has just turned into an IBM 2780, or an IBM System/360 Model 20 or 30 operating as a HASP multileaving terminal, or a Control Data 200 User Terminal, or any of several other terminals that the Model 78 can emulate. DATA 100's programmable terminal belongs to the new breed of intelligent terminals that employ a minicomputer for control. This new approach to terminal operation offers the user far greater operating flexibility than with hard-wired terminals, besides providing the sophisticated user with the opportunity to generate his own application programs. DATA 100 emphasizes the use of its Model 78 terminal for remote batch applications and does not encourage nor promote off-line data processing activities; however, it does provide an assembler and a program debugging package to satisfy users that insist on doing their own programming.

Flexibility is the key factor in the selection of a programmable terminal. The Model 78 and its competitors permit the user to operate on-line with almost any computer system provided the emulation software is available to adapt the terminal to the communications discipline and command structure of the particular computer system. The inherent flexibility of the programmable terminal is particularly important to companies using several commercial time-sharing services that support remote batch processing for different batch terminals produced by different manufacturers. The basic concept of a programmable terminal translates into extensive operating flexibility–provided the manufacturer supports these capabilities by offering a variety of software packages or the user does his own pro- ➢

DATA 100's Model 78 can serve as a replacement for various remote batch terminals produced by leading computer manufacturers. The Model 78 is programmable, emulates other terminals via DATA 100-supplied software, and offers a variety of I/O devices and a wide range of transmission speeds. DATA 100 also provides an assembler and a debug package.

CHARACTERISTICS

MANUFACTURER: DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

MODELS: DATA 100 offers five distinct models, each designed as a turnkey system to emulate one of five prominent remote batch terminals marketed by the leading computer manufacturers. All models are based on an 8-bit minicomputer with a basic 8K bytes of core memory (expandable to 32K bytes) and can accommodate up to 12 I/O devices, including a single-line communications controller, a Teletype Model 33 KSR teleprinter or a DATA 100 Model 73 display unit, multiple card readers, card punches, line printers, magnetic tape units (up to four), and paper tape punches and readers.

The five models are defined as follows:

- **Model 78-1 – Provides software and hardware compatibility with the IBM 2780 Data Transmission Terminal and accommodates a card reader, line printer, and a synchronous communications capability.**
- **Model 78-3 – Provides software and hardware compatibility with the IBM System/360 Models 20 or 30** ➤

DATA 100's Model 78 Terminal is programmable and can include up to 12 I/O devices. This configuration includes (left to right) a printer, card reader, punch, operator console (CRT display), and computer-compatible magnetic tape unit containing two drives.

DATA 100 Model 78 Programmed Terminal

gramming. To the manufacturer, a programmable terminal translates into a market extension, in that it allows him to sell his terminal as a replacement for terminals operating with several different computers under a variety of operating systems.

Besides offering emulation software for terminals that are currently in extensive use, DATA 100's Model 78 terminal is available with a wide variety of I/O devices: low- and medium-speed card readers and drum printers, a card punch, computer-compatible magnetic tape units, and punched tape equipment. With the existing I/O capability, the Model 78 terminal can be configured according to the user's needs. DATA 100 produces its own minicomputer, a modified Micro 810, and its own I/O controllers, but buys the I/O devices from leading OEM manufacturers such as Data Products and Documation (card readers), Control Data (printer mechanisms), Wang Computer Products (magnetic tape drives), and Digitronics and Facit for (paper tape equipment). DATA 100 also offers a plotter capability, using a customer-supplied CalComp or Houston Instrument plotter, and says it has received about a half-dozen orders for this capability. A disk storage capability using a single-disk cartridge drive is planned for the third quarter of 1972.

The Model 78 with its wide range of peripheral devices including magnetic tape presents a powerful batch capability that should satisfy high-volume applications. Pricing is not conducive to terminal replacement on a single-terminal, parallel-capability basis, but is attractive to users who want to emulate more than one terminal, users who want extended capabilities, and users who are operating with an IBM System/360 Model 20 or 30 as a multileaving terminal in a HASP environment.

DATA 100 announced the Model 78 terminal at the November 1970 FJCC, although deliveries actually began a month earlier. To date, DATA 100 has delivered over 130 terminals.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major cities. DATA 100 says it has about 40 customer engineers that assist about 130 DATA 100-trained Honeywell CE's.

Lease financing is provided through banks and non-affiliated leasing companies.

A DATAPRO 70 survey of Model 78 installations found its users to be satisfied with its performance and reliability. The 300-cpm card reader seems to present some adjustment problems, but otherwise little or no down-time was reported. Installation and service by both DATA 100 and Honeywell were rated as excellent. □

for communication with IBM System/360 or System/370 computers as a HASP or ASP multileaving terminal. This configuration accommodates one or more card readers, card punches, line printers, magnetic tape units, punched tape readers and punches, plotters, a teleprinter or display unit used as a control console, and a synchronous communications capability.

- Model 78-4 – Provides software and hardware compatibility with the UNIVAC DCT 2000 and accommodates a card reader, line printer, and communications capability.
- Model 78-5 – Provides software and hardware compatibility with the Control Data 200 User Terminal and accommodates one or more card readers, line printers, and magnetic tape units in addition to communications capability.
- Model 78-7 – Provides software and hardware compatibility with the UNIVAC 1004 Terminal and accommodates a card reader, line printer, and communications capability; this configuration can also accommodate a display unit.

Memory capacity of any model can be expanded in increments of 4K bytes up to the maximum addressing capability of 32K bytes.

COMMUNICATIONS: Synchronous or asynchronous in the half- or full-duplex mode via either of two communication interfaces. Synchronous speeds range from 2000 to 9600 bits/second; asynchronous speeds are available for 110, 150, 300, 1200, 1800, 2000, and 2400 bits/second. Both interfaces are designed to EIA Standard RS-232 B/C. The transmission parameters such as code level, control signals, line discipline, blocking-deblocking, etc., are a function of the communications software. Hardware capability is provided for 6- through 8-level codes (synchronous interface) and 5- through 8-level codes (asynchronous interface). Asynchronous transmissions add one start bit and one or two stop bits to each character transmitted. The Model 78 also provides an automatic answer feature.

DEVICE CONTROL: The nucleus of the Model 78 Terminal is a general-purpose minicomputer that executes all terminal operations under program control. For applications that use the Model 78 exclusively as a communications terminal, the minicomputer serves as a terminal controller and, for all practical purposes, is transparent to the user; i.e., he is not cognizant of its computing capability. DATA 100 furnishes operating software it calls Terminal Control Programs; each of these programs is designed to emulate the operation of a specific batch terminal produced by a leading mainframe manufacturer and currently supported by the manufacturer's communications software. Prior to on-line terminal operation, the operator loads the Terminal Control Program from cards or from magnetic tape if his installation provides this capability. On-line operation can then proceed by establishing a communications link with the remote computer and by transmitting data from an input device or receiving data on an output device. The terminal can be transformed to emulate the functions of a different terminal by loading the Terminal Control Program for that terminal.

Off-line operation includes listing and data transcription functions and is initiated by loading the off-line program

DATA 100 Model 78 Programmed Terminal

from cards or magnetic tape. All data transcription and listing functions are performed on a one-to-one basis. e.g., one 80-column card per print line. The standard software does not provide for editing. Input and output devices are selected via the operator panel.

For those users who insist on exploiting the terminal's computing capability, DATA 100 provides a two-pass cross-assembler called the TAS-F Assembler and a debugging program called the TDS-A Debug System. The TAS-F Assembler accepts symbolic-language coding and is designed to run on an IBM System/360 or System/370 under OS or DOS. TAS-F source programs can be entered into the IBM computer locally, or remotely via a Model 78 Terminal that includes a card reader, card punch, and line printer. Support for the FORTRAN G procedural library and a minimum region of 100K are prerequisites for the IBM computer system.

DATA 100's Minicomputer is a Modified Micro 810, which it acquired from Microdata Corporation and equipped with its own instruction repertoire. The Micro 810 has a memory cycle time of 1.1 microseconds and a word length of 8 bits (one byte). Its minimum and maximum storage capacities are 4,096 and 32,768 words, respectively. (See DATAPRO 70 Report 70F-400-01 for further information about the Micro 810.) Terminal control is implemented via firmware programs, which are stored in a 220-nanosecond ROS memory. The firmware, a compilation of microprograms, is composed from a set of 22 commands to produce an instruction repertoire of over 80 instructions.

CARD READERS: Low- and medium-speed 80-column card readers are available. The low-speed unit reads cards at 300 cards/minute and has input hopper and output stacker capacities of 600 cards each. The medium-speed unit reads cards at 600 cards/minute and has hopper and stacker capacities of 1000 cards each.

CARD PUNCH: Punches 80-column cards at 60 to 200 cards/minute. Hopper and stacker capacity is 1500 cards.

PRINTERS: Low- and medium-speed drum printers are available. The basic low-speed printer has 80 print positions and a maximum speed of 300 lines/minute. Options provide 120 or 132 print positions and a speed of 400 lines/minute. The medium-speed printer has 132 print positions and a maximum speed of 600 lines/minute.

Both printers are available with ASCII, EBCDIC, or Six-Bit Transcode character sets at no extra cost. Both provide vertical format control via a 12-channel tape loop. Horizontal and vertical spacing are 10 char/inch and 6 or 8 lines/inch, respectively. Horizontal tabulation is optional. Both printers accommodate multipart, continuous, pin-fed forms from 3.5 to 20.6 inches wide and with up to 6 parts.

MAGNETIC TAPE INPUT/OUTPUT: Records in 7- or 9-track industry-compatible format at 556 or 800 bits/inch (7-track units) and 800 or 1600 bits/inch (9-track units). Tape speed is 25 inches/second; reel size is 10.5 inches.

PUNCHED TAPE INPUT/OUTPUT: Two discrete units; read or punch 5- through 8-channel paper, Mylar, or plastic tape. Tape is read at 300 char/second and punched at 60 char/second.

CRT DISPLAY: The DATA 100 Model 73 Interactive Terminal is available as an option. See DATAPRO 70 Report 70D-311-02 for detailed information.

PRICING: The Model 78 Programmed Terminal is available for puchase or on a one- or three-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units.

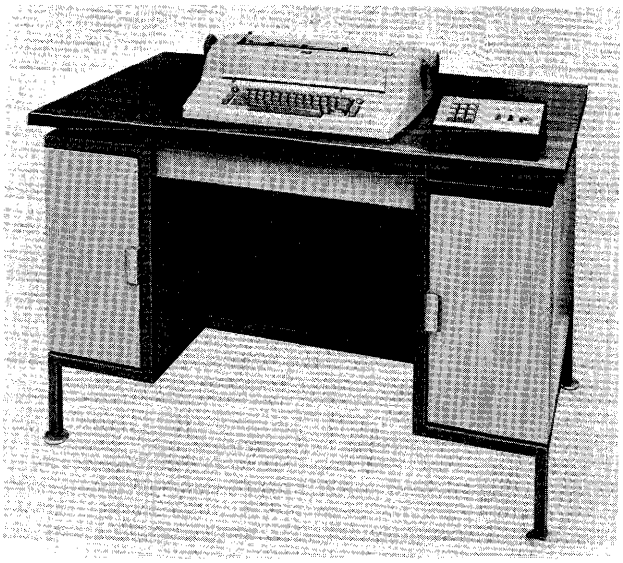
Emulation software to emulate any one terminal is provided at no charge; additional emulation packages are priced at a one-time charge of $100 each.

Device	Monthly Rental (1) 1-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
Terminal Controller	$316	$291	$11,600	$64
Operator Station (2)	85	79	2,760	25
Peripheral Expansion (3)	95	87	3,920	10
4K-Byte Core Module	112	102	4,500	14
Magnetic Tape Unit, 7-/9-track with control	200	183	7,820	30
Magnetic Tape Unit, 7-/9-track w/o control	180	165	7,130	25
Card Reader–				
300-cpm	127	116	4,950	20
600-cpm	177	162	7,020	25
Card Punch	270	246	13,000	25
300-lpm Printer	460	422	17,480	80
600-lpm Printer	790	722	32,000	100
Options–				
400-lpm operation	60	55	2,500	6
120 Print Columns	50	45	2,150	4
132 Print Columns	70	65	3,000	5
Horizontal Tab	25	25	1,150	0
Static Eliminator	6	6	280	0
Modem Controller–	790	722	32,000	100
Synchronous	22	20	860	4
Asynchronous	22	20	860	4
Dual Modem Switch	46	42	1,850	6
Modem Pair Simulator	120	110	4,930	15
203A Data Set Feature	4	4	185	0
9600 Baud Modem Adapter	35	32	1,350	6

(1) Monthly rental includes prime-shift maintenance.
(2) Model 73 display unit or Teletype Model 33 KSR.
(3) Required for seven or more peripherals.

Emulation software to emulate any one terminal is provided at no charge; additional emulation packages are priced at a one-time charge of $100 each. ■

DATA 100 Model 88-23 Terminal System



The DATA 100 Model 88-23 Terminal System is shown in its basic form. This unit, which was formerly marketed under the Compat name, includes a minicomputer in the right pedestal and a random-access storage unit built around a continuous tape loop in the left pedestal.

Using a minicomputer and appropriate software to permit convenient specification and preparation of business forms, the Model 88-23 stores key-entered data on a proprietary random-access device for later transmission to a central computer site.

MANAGEMENT SUMMARY

The DATA 100 Model 88-23 was known as the Compat 88-23 prior to a recent merger. Now Compat goes under the name DATA 100 (Westbury), Inc., a subsidiary of DATA 100 Corporation. Marketing and support functions have been taken over by DATA 100. What was Compat Corporation is now essentially one of the manufacturing arms of DATA 100.

Compat developed its own proprietary minicomputer and low-capacity random-access device to automate the preparation of business documents (forms) and simultaneously collect the information for transmission to a central processing site. Operation of the unit during the data entry and collection phase is completely independent from the central site. Under normal operating conditions, all data collected during the day is transmitted at the end of the day.

The operation of the Model 88-23 Terminal System revolves around the COMFILE unit. This component incorporates the 30-inch tape loop and functions logically like a fixed-head disk. A total of over 73,000 characters of storage are available. Unlike a disk, the tape loop does not move continuously, but stops after each operation. The equivalent "rev time" is 700 milliseconds, with a data transfer rate of 11,700 characters per second. These specifications are not very ➢

CHARACTERISTICS

MANUFACTURER: DATA 100 (Westbury), Inc., subsidiary of DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

CONFIGURATION: The basic Model 88-23 Terminal System includes a minicomputer with 4K 16-bit words of memory (8K bytes), input/output typewriter, auxiliary keyboard, COMFILE random-access memory (72K bytes), and a communications interface. To this can be added another 4K core memory module, an industry-compatible magnetic tape drive, a line printer, a card reader, a paper tape reader, and a second COMFILE unit. The basic terminal is a complete operating unit, requiring only a modem for connection to a communications line.

COMMUNICATIONS: Duplicates IBM Binary Synchronous discipline. Transmission can be at 1200, 2000, 2400, or 4800 bits per second. The interface provided is the standard EAI RS-232C. Transmission is half-duplex, synchronous. The data code can be EBCDIC, ASCII, or IBM's 6-bit Transcode. (EBCDIC is used internally and is considered standard.) Transmission is compatible with IBM Binary Synchronous terminals, such as the 2780, but may require a little programming to accommodate special features such as the 2780 Multiple Record Transmission and Multipoint Line Control (party line). An internal clock is provided for 1200-bps transmission so Bell System 202 or equivalent modems can be employed. Normally, Bell System 201 or equivalent modems are used for transmission at 2000 or 2400 bps.

DEVICE CONTROL: Control of all operations is exercised by the built-in minicomputer through software. In general, operations are initiated by loading a program from a COMFILE magazine as directed via the I/O typewriter. A bootstrap routine hardwired into the Read Only Memory gets things going.

The minicomputer includes a single-address, binary processor that operates on 16-bit words. Direct and indirect addressing are both implemented. (Indirect addressing can be used in place of the missing index registers, but is quite a bit slower.) Instruction execution requires from one to three memory cycles (2 to 6 microseconds). Memory size is 4,096 or 8,192 16-bit words (8K or 16K 8-bit bytes).

The standard software can be divided into three groups: keyboard data entry/communications, batch transmission, and own programming/utility.

DATA ENTRY: COMENT is a collection of eight programs devoted to data entry and related communications.

Data entry is performed under control of the Data Entry Program, which uses the field identifiers previously recorded on the COMFILE unit as a result of executing the Forms Definition Program. Forms definition is synonomous with record format or layout. Format definition is accomplished on a field-by-field basis using the I/O typewriter. ➤

DATA 100 Model 88-23 Terminal System

impressive in terms of raw power. But the COMFILE unit uses interchangable magazines, which expand the amount of storage. The performance is more than adequate for the environment in which the terminal is intended to work – that of keyboard-oriented data entry and processing. The capacity of the COMFILE unit is sufficient for the output of one operator, and the speed is more than sufficient to keep up with the operator.

The 88-23 shines when there is a need to prepare long and/or complicated forms. Extensive editing and checking provisions can be included to catch many errors.

For data entry applications, a forms description is first generated on a field-by-field basis. This is recorded on a COMFILE magazine, which can carry descriptions for multiple forms. This magazine is also used to hold the keyed-in data. Standard software accesses the forms descriptors, positions the typing element (the familiar IBM Selectric), and checks the data keyed in by the operator. Forms can be preprinted or free-form. In the free-form mode, a fill-in-the-blanks approach can be used by having the computer print out the captions for each entry.

Communications software for the basic terminal provides for unattended transmission of the day's data to the central site when called, and also for receiving a reply. A conversational mode is not implemented.

Software is available for expanded configurations, including a magnetic tape drive to collect data from several remote terminals and pool it on industry-compatible magnetic tape. The addition of a card reader, line printer, or paper tape reader greatly expands the capability for a Model 88-23 terminal to handle data from sources other than its own keyboard.

Data transmission is structured to duplicate the IBM Binary Synchronous technique, allowing direct transmission to an appropriately equipped IBM System/360 or 370 computer. Transmission speeds of 1200, 2000, 2400 or 4800 bps can be specified. Any of the three data codes used by IBM (EBCDIC, ASCII, or Transcode) can be used.

There are at least three elements in any business data processing operation: data entry, computation, and file handling. (Creation and maintenance of files is required so that information can be handled in an orderly manner, whether sequentially or randomly.) The Model 88-23 Terminal System is oriented toward data entry and limited computation. Its specific orientation is toward handling the needs of a branch office that relies on a central site for major processing. Its primary strength is the flexibility in setting up a controlled data entry operation. This strength comes from the software

The Forms Definition Program is loaded from the systems COMFILE magazine. After loading is completed, a new magazine is substituted. As the form definition progresses, the appropriate identifiers are recorded on the first track of the COMFILE tape loop. The other eight tracks are reserved for data. A library of format definitions can be built up on the magazine, each identified by a four-character name. In general, the typed form is the permanent copy of the data recorded, and the data on the COMFILE magazine is not saved after it has been transmitted.

All conventional keypunch (and key-to-tape) field types can be specified, including check digit. In addition, a number of arithmetic and edit operations can be specified, including range checks, variable-length fields, mandatory/optional entry, summing two or more fields, left or right zero or space fill, decrementation of a field from form to form, etc. Full format capabilities are provided to automatically position the typewriter to the correct location for the next entry. In all, more than 30 different field types can be identified.

A very useful feature for repetitive formats is also included. Two levels of repetition are permitted. A particular line or group of lines (paragraph) can be specified to be repeated a fixed number of times or until halted by the data entry operator. This feature simplifies formatting a form with multiple entries that have the same format, such as multi-item orders.

For non-preprinted forms, a text identifier can be recorded with the forms definition and printed during data entry. This allows you to print your forms as you go. The company calls this "prompting." It should be of great value for occasionally-used forms because it eliminates the requirement for stocking the forms. The extra time used to print the prompting information will not be significant if the use of the feature is confined to seldom-used forms.

All descriptors are typed as they are entered, forming a hard copy of the forms description. A utility program is available to print just the names or selected forms description from the master magazine. This gives the directory necessary for reference. Once entered, forms descriptions can later be modified in place on the master magazine. However, no provision is included for copying all or portions of one description to make a new description.

Typically, field definition and positioning information can be done in under six characters. To this must be added range check values and prompting information. About 8,000 characters of COMFILE storage is available to hold the forms descriptions. The number of forms definitions that can be stored depends on the extent of the form. However, the kinds of forms used by typical Model 88-23 users are complex. Forms having over 100 fields are not unusual. If you run out of space, another master magazine can be used, giving essentially unlimited storage for forms descriptions.

Data entry is accomplished by loading the Data Entry program from the system COMFILE magazine and then replacing the system magazine with the master magazine containing the forms descriptions. Selection of a particular form description to follow is accomplished by typing in the four-character name of the form. After that, control is entirely exercised by the Data Entry program and the field descriptors previously recorded. Positioning to the beginning of a field is automatic. Any spacing done to change position is recorded as data. If the data keyed by the operator fails to pass the checks associated with that field, the keyboard is locked and the typing element repositioned to the beginning of the field. The keyboard is unlocked by using the auxiliary keypad.

Typing errors caught by the typist can be corrected by backspacing and overtyping.

DATA 100 Model 88-23 Terminal System

that is available for use, rather than from the hardware components themselves.

Concepts that compete with the 88-23's arrangement include all the data entry techniques from key-punches/card transmission terminals to intelligent CRT terminals and key-disk systems. Compat offers a substantial amount of computational capability in addition to controlled key entry, but it does not replace a small computer. Conceptually, the closest competitor of the Model 88-23 Terminal System is the IBM 3735, announced in mid-1971. The chief differences are the Model 88-23's capabilities for independent operation and changeable-cartridge storage.

The areas of best application for the 88-23 terminal can be identified through the following questions:

- Are hard-copy documents required?
- Are the documents long and complex?
- Is a one- or two-day turnaround sufficient for the task?
- Are the data entries of such form that they can be conveniently checked by machine?

A series of positive replies to these questions indicates a potential application for the Model 88-23.

Discussion of the Model 88-23 terminal would be incomplete without some mention of price. The cost will seem high, if you have been accustomed to looking at typewriter or CRT terminals or at key-to-tape recorders with data transmission capabilities. It is in line with other terminals built around minicomputers – but most of those are marketed only for batch transmission applications. Cost justification lies in the reduction of errors through field checking and the elimination of communications and central processor costs in entering data off-line.

The first Model 88-23 was delivered in January 1970, and to date over 200 have been installed, including many expanded configurations with a magnetic tape drive and/or line printer.

Chatting with several Model 88-23 users revealed general satisfaction with the equipment and service, although several problems did crop up in the early models. Building a service organization is difficult for a young, small company. In December 1971, Compat was acquired by DATA 100, a larger but still-young builder of communications terminals. It is too early to assess all the effects of this move, but the DATA 100 service personnel are being trained to maintain the Compat

As the data is keyed it is stored in a buffer in core memory. Two buffers are used. When one is filled, its contents are written onto the COMFILE unit while keyed data is being entered into the other buffer. This technique prevents any delay when keying data.

Eight tracks of COMFILE storage are available for data. This represents about 65,000 characters, or about the limit of a full day's work for an average typist. If for some reason, such as extended working hours before transmission or a delay in transmission, data entry exceeds the capacity of the COMFILE magazine, a second magazine can be used, but it will have to be initialized with the forms descriptions.

One program in the COMENT package permits duplication of a COMFILE magazine onto another. In the basic terminal (i.e., one without magnetic tape or other auxiliary peripherals), this can be a time-consuming operation because only a portion of one track can be stored in core memory before magazines must be swapped to record that portion on the new magazine. With a magnetic tape drive attached, it can be accomplished in one operation. Duplication of magazines is, however, only an occasional task in most installations, so the difficulties of copying a magazine with a basic terminal are just a minor annoyance. Then too, most duplication would be just the forms description portion of a master magazine, which would reduce to a maximum of three the number of swaps needed.

The other four programs in the COMENT package are oriented toward different data communications operations. The basic Remote Communications Program permits unattended transmission of data from a Model 88-23 terminal and reception of replies. Received data is stored on the COMFILE unit and can be automatically printed out if desired. The slow speed of the I/O printer makes it desirable to do this during off hours. Another program allows use of the line printer to print received data at an unattended terminal. The Magnetic Tape Central Program permits use of the magnetic tape drive to collect data from several unattended terminals; this configuration is called a Data Central. The Data Central must be attended; no standard provision is made for automatic dialing or multi-drop operation.

Another program included in the COMENT package permits a basic terminal to receive data from several terminals and collect it on the COMFILE unit. Thus, it allows a basic terminal to function as a limited-capacity Data Central.

The basic Remote program, then, is oriented toward operating a terminal in an unattended mode. When called, the terminal transmits data and then receives any reply. Operated in this mode, the terminal must wait until it is called. Either of the Central programs is oriented toward initiating, under operator control, communications with other terminals.

The final program in the COMENT package provides the compability for using the Model 88-23 terminal as an automatic typewriter for editing or updating free text data such as letters. Access to the data for editing is by address (line number) or contextual; i.e., you can go directly to an individual word by using the word itself as the input. In the context mode, individual occurrences of words can be modified or all occurrences can be automatically modified.

BATCH TRANSMISSION: This series of programs permits data transmission to or from the various available peripherals directly, without requiring transcription to the COMFILE unit. Specific configurations supported include punched card input and line printer output; magnetic tape input and output; and multi-media Data Central, which allows a magnetic tape-equipped terminal to receive and pool data from remote Model 88-23 terminals of any configuration. Other combinations of peripherals can be

DATA 100 Model 88-23 Terminal System

equipment. Supplemented by DATA 100 and Honeywell service personnel, the maintenance outlook for the Model 88-23 should be significantly improved. □

accommodated by using utility routines to transcribe data from a source such as punched paper tape to the COMFILE unit.

OWN PROGRAMMING: A number of facilities are provided to help you implement your own adaptation of the standard software or create your own applications. Heading this list are an assembler and a set of I/O routines. With these, you can fully exercise the processor and peripheral functions. Closely coupled with these facilities are a Selectric Debug program that gives full access to core storage locations for examination or modification, and a program for modifying programs recorded on the systems COMFILE magazine without loading the whole program into memory. Also included are floating-point arithmetic routines; the 14-digit precision is sufficient to handle almost any routine application. Other programs in this package are various transcription routines, including paper tape to COMFILE, COMFILE to magnetic tape, COMFILE to typewriter or line printer (directory listing or complete dump), COMFILE magazine duplication and printout, and direct transmission of COMFILE magazine without translation to another terminal.

Notably absent are any facilities for sorting, a virtual necessity for any kind of file processing. Local processing applications are likely to be confined to those which do not require updating of an existing master file unless you are willing to program (or can talk DATA 100 into programming) a sort or random-access routine. Even so, there remain a number of applications within the typical office that could be profitably automated, particularly those that require computation and or table lookup for determination of rates or other factors.

COMFILE MEMORY UNIT: The COMFILE unit is an integral part of every Model 88-23 terminal. It incorporates a continuous 30-inch loop of half-inch computer tape. Nine tracks are recorded, each by its own read/write head. Tape speed is 43 inches per second, and the tape requires 700 milliseconds to make one complete loop. Data is recorded serially by bit on each track at a density of 3000 bits per inch. Each track is divided into 64 sectors, each 128 bytes long, yielding storage capacity of 8,192 bytes per track. Total storage capacity is 73,728 bytes. An additional COMFILE unit can be included in a terminal, but few have been delivered.

Address identification for the beginning of each sector is recorded on the ninth track. Under the standard data entry program, format descriptions are also stored on the ninth track and cannot be accessed. Particular care must be exercised in using this track to prevent loss of the sector identifiers.

The tape loop does not move continuously; it stops after each read or write instruction unless another instruction is executed in time to keep the tape going. Start or stop time is approximately 200 milliseconds.

Stopping the tape apparently adds to the life of the tape loop and does not affect performance in the normal modes of operation. A rough estimate indicates that a series of sequential write operations, such as when forms (records) are being entered, involves a delay of about 700 milliseconds for the tape to come up to speed and get around to the point following the previous record. This compares with an inter-card delay of about 250 milliseconds on a conventional keypunch. However, double buffering of records in main memory means that the operator's rhythm is not interrupted at all. Data reading or writing progresses at about 11,700 characters per second. For any key-entry type of data processing, the performance of the COMFILE unit is more than adequate. For processing data from punched cards or magnetic tape, the relatively slow access times of the COMFILE unit will probably be the controlling factor in throughput.

I/O TYPEWRITER: This unit is an IBM Selectric I/O typewriter. Typing pitch is normally 10 characters per inch; a 12 pitch version is available on special order. The typewriter has a 15-inch carriage, and pin-feed and forms tractor mechanisms are optionally available.

AUXILIARY CONTROL KEYBOARD: This component sits on the basic desk unit and provides a 10-key pad plus a few basic control switches and indicators. The function of each key is defined by software; the keys are typically used for convenient numeric entry and special functions.

MAGNETIC TAPE: Either 7-track (556/800 bpi) or 9-track (800/1600 bpi) models are available. Tape speed is 25 inches per second, giving a peak transfer rate of 13,900 bytes per second (556 bpi), 20,000 bytes per second (800 bpi), or 40,000 bytes per second (1600 bpi). The drive can accept a full 10.5-inch reel.

LINE PRINTER: The high-speed line printer operates at a peak rate of 600 lines per minute and is fully buffered. It prints a 64-character set and has 132 print positions. Vertical forms control is via a paper tape loop containing 8 or 12 channels. Fan-fold forms from 3.5 to 19.5 inches wide can be handled, and up to 6 copies can be produced. Vertical line spacing is 6 lines per inch.

CARD READER: This unit operates at up to 300 cards per minute and reads cards photoelectrically, using a single lamp and fiber optics for the light source. A 500-card input hopper and a 600-card output stacker are provided.

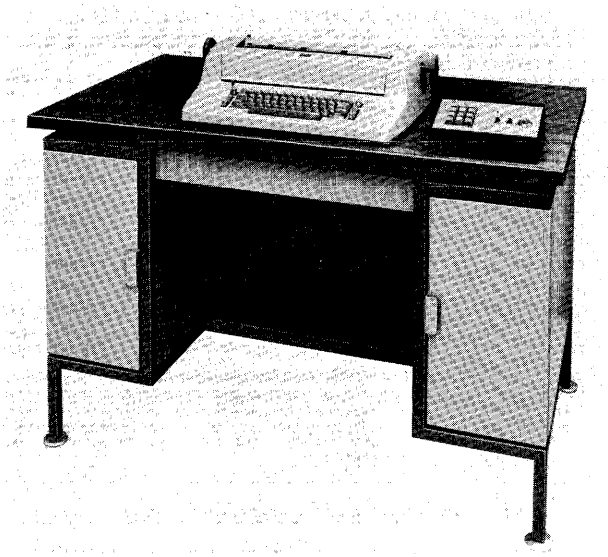
PAPER TAPE READER: This unit is available with or without a spooler. It reads up to 300 characters per second from 5- to 8-level tapes.

PRICING: The Model 88-23 terminal and its options are available for purchase or on a 1- or 3-year lease basis. Maintenance for prime-shift operation (8 hours a day, 5 days a week) is included in the monthly rental prices shown below.

	Monthly Rental 1-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
Basic Terminal	$485	$427	$18,400	$85
Pin-Feed Platen	5	5	230	-
Tractor Feed	10	9	368	2
Service Panel	20	17	828	2
COMFILE Magazine	-	-	75	2
Magnetic Tape Drive (7- or 9-track)	200	183	7,820	30
Line Printer	520	454	20,240	80
Card Reader	150	131	5,750	25
Paper Tape Reader	97	86	3,450	22
Paper Tape Reader with Spooler	164	144	6,210	29

Extended maintenance arrangements are available for periods of 16 or 24 hours per day and for 5, 6, or 7 days per week. Premiums for extended service run about 40% for one extra shift (8 hrs.), 100% for two extra shifts (16 hrs.), and 20% per extra day. The maximum premium for full coverage is 140% over the basic maintenance charge. ■

DATA 100 Model 88-21 and 88-22 Keyboard Terminals



These new members of DATA 100's 88 Series family are specialized terminals intended as keypunch replacements for low-volume applications where communications and printed-copy capabilities are desirable.

MANAGEMENT SUMMARY

DATA 100, with the introduction of its 88-21 and 88-22 Terminals, has created a family of "intelligent" typewriter terminals, of which the 88-23 is the initial member (see Report 70D-311-04). Although the new terminals have the same physical appearance and configuration as the 88-23 (except for the 88-22's added printer), their applications are quite different. Models 88-21 and 88-22 are marketed as specialized keypunch replacements for low-volume environments. The terminals produce printed copy and communicate with a remote computer or another terminal of the same kind. Both terminals are turnkey systems that, under software support, provide conventional keypunch functions (excluding verification) and emulate the communications capability of an IBM 2780.

When operating as keypunches, the terminals are placed off-line. Data is keyed into the Selectric typewriter keyboard or the auxiliary numeric keypad under the direction of a control program. As records are created, they are accumulated on the COMFILE, a continuous magnetic tape loop. A batch of records, accumulated during the course of a day, can be automatically transmitted to the remote computer after normal working hours, since both terminals are equipped with an automatic-answer and disconnect capability.

The terminals do not incorporate a conventional keypunch verification capability, but do provide visual verification of keyed data as it is keyed.

Capabilities are provided to: generate and store for immediate access up to 25 control programs (record formats); list any of the stored control programs; list any number of recorded records, from one to all; add records to the end of a file; edit, including record insertion, deletion, and replacement; search for and list records ▷

CHARACTERISTICS

MANUFACTURER: DATA 100 (Westbury), Inc., subsidiary of DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

CONFIGURATION: The Model 88-21 and 88-22 Terminal Systems each include a minicomputer with 4K 16-bit words of memory (8K bytes), input/output typewriter, auxiliary keyboard, COMFILE random-access memory (72K bytes), and a communications interface. Model 88-22 also includes a 165-cps character printer for off- or on-line printing. The terminal is a complete operating unit, requiring only a modem for connection to a communications line.

COMMUNICATIONS: Duplicates IBM Binary Synchronous discipline. Transmission can be at 1200, 2000, or 2400 bits per second. The interface provided is the standard EAI RS-232C. Transmission is half-duplex, synchronous, employs the EBCDIC code, and is compatible with IBM Binary Synchronous terminals, such as the 2780. An internal clock is provided for 1200-bps transmission so Bell System 202 or equivalent modems can be employed. Normally, Bell System 201 or equivalent modems are used for transmission at 2000 or 2400 bps.

DEVICE CONTROL: Control of all operations is exercised by the built-in minicomputer through software. In general, operations are initiated by loading a program from a COMFILE magazine as directed via the I/O typewriter. A bootstrap routine hardwired into the Read Only Memory gets things going.

The minicomputer includes a single-address, binary processor that operates on 16-bit words. Direct and indirect addressing are both implemented. (Indirect addressing can be used in place of the missing index registers, but is quite a bit slower.) Instruction execution requires from one to three memory cycles (2 to 6 microseconds). Memory size is 4,096 or 8,192 16-bit words (8K or 16K 8-bit bytes).

The standard software for Models 88-21 and 88-22 includes a keypunch emulation program for off-line data preparation and a communications program that provides compatibility with the IBM 2780 communications discipline. COMENT, standard with Model 88-23, is optional for Models 88-21 and 88-22; COMENT is a collection of eight programs devoted to data entry and related communications (see Report 70D-311-04).

DATA ENTRY MODE: Performed under control of the Data Entry program, which simulates standard keypunch functions in an 80-column card format.

Data is entered in an off-line mode under the direction of a control program, similar to that stored on a keypunch control card. The Data Entry program permits up to 25 control programs (record formats) to be keyed and stored on the COMFILE magazine. The programs control the format of the data recorded by delineating alphabetic, numeric, and alphanumeric fields and by initiating automatic field skipping, duplicating, and right justification (left zero fill). Other program-controlled functions include check digit verification (modulo 10 or 11) and gang punching. Control programs can be keyed for temporary use or stored within the file as new or replacement programs. The ▶

DATA 100 Model 88-21 and 88-22
Keyboard Terminals

containing specified parameters; establish printer parameters; transmit or receive a batch of records; and transmit or receive control programs.

In addition to all the features provided by the 88-21, the 88-22 offers an on- or off-line print capability. Received data can be immediately printed or recorded on the COMFILE magazine for printing at a later time. The printer, a Centronics Model 101A, is rated at 165 characters per second and is one of the leading printers in current use for terminal applications.

For applications that include a combination of keypunching and data entry, such as entering data into a prepared format, DATA 100 provides its COMENT application software as an option (see Report 70D-311-04).

The 88-21 and 88-22 Terminals should not be considered as keypunch replacements on a generalized basis, but as specialized devices that provide a limited keypunch capability enhanced with communications and on-line printing.

First customer deliveries of the 88-21 Terminal were made in September 1972; the 88-22 is scheduled for delivery in November. Lead time on orders is 30 days.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major cities. □

programs are identified by a unique file-location number and can be quickly accessed and placed in the active program area for a data entry operation, or printed for visual verification via a keyed command. A specific control program or all programs residing in the file can be printed.

Records can be added to or deleted from an existing file, inserted before a specific record in an existing file, or inserted in place of existing records within the file. An end-of-job mark is used to identify the last record of each job within the file; the mark is appended to the last record within the job file.

Records residing on the COMFILE can be listed with or without sequence identification. Selected records are listed sequentially; the selection is defined by keyed initial and terminal record sequence numbers.

A search function locates and lists all records residing on the COMFILE defined by the search parameters.

Printer parameters, including lines per page and skips between the last printed line on a form and the first line or the next, are established in the Data Entry mode but control printing in the Communications mode.

COMMUNICATIONS MODE: The Communications mode permits communications between the 88-21 or 88-22 Terminal and a remote computer or another terminal. On the 88-21 Terminal, the communications facility interfaces the COMFILE unit via a 400-character buffer; the 88-22 Terminal operates in the same manner, but allows communications to be manually switched between the COMFILE unit and the 165-cps printer. Standard features include automatic answer and communications transparency or non-transparency.

The Communications mode supports the transmission and reception of data files and control programs. Transmit and receive functions initiate a batch transfer of files between the communications facility and the COMFILE unit; when transmitting, all recorded data is transmitted. Special functions initiate the transmission of a specific control program within the file and, following the transmission, can switch the terminal to receive data on the COMFILE.

COMFILE MEMORY UNIT: The COMFILE unit is an integral part of every terminal. It incorporates a continuous 30-inch loop of half-inch computer tape. Nine tracks are recorded, each by its own read/write head. Tape speed is 43 inches per second, and the tape requires 700 milliseconds to make one complete loop. Data is recorded serially by bit on each track at a density of 3000 bits per inch. Each track is divided into 64 sectors, each 128 bytes long, yielding a storage capacity of 8,192 bytes per track. Total storage capacity is 73,728 bytes.

I/O TYPEWRITER: This unit is an IBM Selectric I/O typewriter. Typing pitch is normally 10 characters per inch; a 12-pitch version is available on special order. The typewriter has a 15-inch carriage, and pin-feed and forms tractor mechanisms are optionally available. The I/O typewriter operates only in the off-line mode. Keyed data is recorded on the COMFILE, and data to be printed is received from the COMFILE.

AUXILIARY CONTROL KEYBOARD: This component sits on the basic desk unit and provides a 10-key pad plus a few basic control switches and indicators. The function of each key is defined by software; the keys are typically used for convenient numeric entry and special functions.

PRINTER: The printer, a Centronics Model 101A, is rated at 165 chars/second (60 132-character lines per minute) and provides 132 print columns. A set of 64 symbols is formed within a 7-by-9 dot matrix equivalent to 10-point type. The printer can accommodate continuous forms up to 14 inches wide. Vertical line spacing is 6 lines/inch. The printer can print data received directly from the communications facility or recorded on the COMFILE unit, as specified by manual selection.

PRICING: The Model 88-21 and 88-22 Terminals and their options are available for purchase or on a 1- or 3-year lease basis. Maintenance for prime-shift operation (8 hours a day, 5 days a week) is included in the monthly rental prices shown below.

	Monthly Rental*			
Terminal	1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Model 88-21	$395	$364	$14,260	$185
Model 88-22	595	547	22,310	110
Options				
COMENT feature	90	63	4,140	0
COMFILE Magazine	—	—	75	—
Pin-Feed Platen**	5	5	230	0
Tractor Feed**	10	9	368	2

*Includes prime-shift maintenance.
**For IBM Selectric I/O Typewriter.

Extended maintenance arrangements are available for periods of 16 or 24 hours per day and for 5, 6, or 7 days per week. Premiums for extended service run about 40% for one extra shift (8 hours), 100% for two extra shifts (16 hours), and 20% per extra day. The maximum premium for full coverage is 140% over the basic maintenance charge. ■

DATA 100 Model 74 Programmed Terminal

MANAGEMENT SUMMARY

DATA 100's Model 74 Programmed Terminal is the latest member of its 70 Series family of remote batch terminals. Essentially an "intelligent" Model 70, the 74 is a turnkey system with a fixed I/O configuration that provides punched card input and printed output. Its integral minicomputer, with supporting software, permits the terminal to emulate any of several prominent batch terminals produced by leading mainframe manufacturers. Currently, DATA 100 supports the Model 74 as an IBM HASP multileaving terminal, an IBM 2780, a CDC 200 User Terminal, and a UNIVAC 1004 under EXEC 8 and EXEC 2. Software emulation for any one of these terminals is included within the cost of the Model 74, and additional emulators are priced at $100 each.

The Model 74 is intended as a logical upgrade from a Model 70 for users who do not require the sophistication of a Model 78. All operating software is provided by DATA 100, which does not encourage the user to generate his own applications software and does not even provide an assembler. Operating software for the Model 74 is not compatible with the Model 78, although both models can emulate the same brands of remote terminals.

Flexibility is the key factor in the selection of a programmable terminal. The Model 74 and its competitors permit the user to operate on-line with almost any computer system provided the emulation software is available to adapt the terminal to the communications discipline and command structure of the particular computer system. The inherent flexibility of the programmable terminal is particularly important to companies using several com- ▷

The Model 74 Terminal, the latest member of DATA 100's expanding family of batch terminals, is essentially an intelligent Model 70 with the capability to emulate other terminals via DATA 100-supplied software, but without the sophistication of the Model 78.

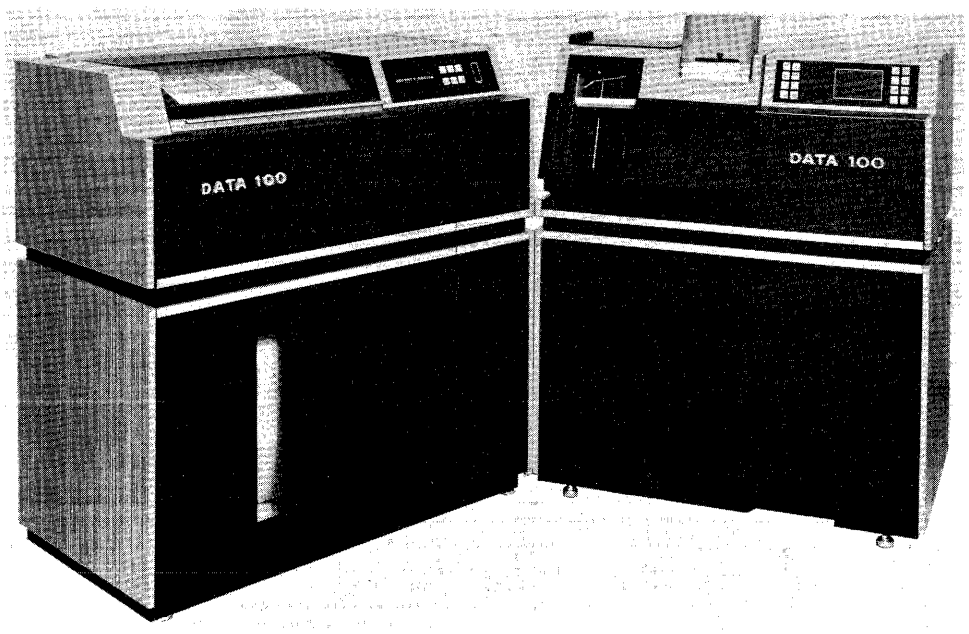
CHARACTERISTICS

MANUFACTURER: DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

MODELS: DATA 100 offers four distinct versions of the Model 74, each designed as a turnkey system to emulate one of four prominent remote batch terminals marketed by the leading computer manufacturers. All models are based on an 8-bit minicomputer with 8K bytes of core memory and include a 300-cpm or 450-cpm (optional) 80-column card reader with single hopper and stacker capacities of 1000 cards each, a 300-lpm or 400-lpm (optional) 80-column line printer (expandable to 120 or 132 print columns), and a communications controller. Most configurations accommodate an operator console, which can be specified as either a DATA 100 Model 73 Display Station (Report 70D-311-02) or a Teletype Model 33 KSR teleprinter.

The four models are defined as follows:

- Model 74-1–Provides software and hardware compatibility with the IBM 2780 Data Transmission Terminal.
- Model 74-3–Provides software and hardware compatibility with the IBM System/360 Model 20 or 30 for communication with IBM System/360 or System/ ▶



The "intelligent" DATA 100 Model 74 includes a printer (left) and card reader. The terminal's minicomputer is housed in the cabinet of the card reader.

DATA 100 Model 74 Programmed Terminal

merical time-sharing services that support remote batch processing for batch terminals produced by different manufacturers. The basic concept of a programmable terminal translates into extensive operating flexibility—provided the manufacturer supports these capabilities by offering a variety of software packages or the user does his own programming. To the manufacturer, a programmable terminal translates into a market extension, in that it allows him to sell his terminal as a replacement for terminals operating with several different computers under a variety of operating systems.

The Model 74's minicomputer is designed and built by DATA 100. Its limited storage capacity of 8192 words is strictly a marketing limitation, not a physical one.

DATA 100 announced the Model 74 in July 1972, and customer deliveries began in September. Current lead time on orders is 30 to 60 days.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major cities. DATA 100 says it has about 40 customer engineers that assist about 130 DATA 100-trained Honeywell CE's. □

370 computers as a HASP multileaving terminal. This configuration accommodates an optional operator console. Available with both non-transparent and transparent HASP features.

- **Model 74-5—Provides software and hardware compatibility with the Control Date 200 User Terminal and includes an operator console (DATA 100 Model 73 display unit).**
- **Model 74-7—Provides software and hardware compatibility with the UNIVAC 1004 Terminal and accommodates an optional operator console. Operates under UNIVAC EXEC's 8 or EXEC II Operating System.**

COMMUNICATIONS: Synchronous in the half-duplex or full-duplex mode at data rates ranging from 2000 to 4800 bits/second. The interface is designed to EIA Standard RS-232B/C. Transmission parameters such as code level, control signals, line discipline, blocking-deblocking, etc., are a function of the communications software. Hardware capability is provided for 6- through 8-level codes. The Model 74 also provides an automatic answer feature.

DEVICE CONTROL: The nucleus of the Model 74 Terminal is a general-purpose minicomputer that executes all terminal operations under program control. The minicomputer serves as a terminal controller and, for all practical purposes, is transparent to the user; i.e., he is not cognizant of its computing capability. DATA 100 furnishes operating software it calls Terminal Control Programs; each of these programs is designed to emulate the operation of a specific batch terminal produced by a leading mainframe manufacturer and currently supported by the manufacturer's communications software. Prior to on-line terminal operation, the operator loads the Terminal Control Program from cards. On-line operation can then proceed by establishing a communications link with the remote computer and by transmitting data from an input device or receiving data on an output device. The terminal can be transformed to emulate the functions of a different terminal by simply loading the Terminal Control Program for that terminal. Terminal Control Programs for the Model 74 Terminal are not interchangeable with those for the Model 78.
The terminal can be used off-line to perform listing, which is performed on a one-to-one basis (i.e., one 80-column card per print line). The standard software does not provide for editing. Input and output devices are selected via the operator panel.

PRICING The Model 74 Programmed Terminal is available for purchase or on a one- or two-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units.

Emulation software to emulate any one terminal is provided at no charge; additional emulation packages are priced at a one-time charge of $100 each.

	Monthly Rental*			
	1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
Model 74 Batch Terminal**	$965	$926	$35,880	$185
I/O Replacements:				
400-lpm, 80-col Printer	80	76	3,404	6
450-cpm Reader	20	19	736	4
Printer Options:				
120 Print Columns	40	38	1,656	4
132 Print Columns	70	67	3,000	5
Horizontal Tab	0	0	0	0
Suppress Line Advance	10	10	450	0
Static Eliminator	6	6	280	0
Operator Console (TTY or CRT)	85	82	2,760	25

*Includes maintenance.
**Includes 300-cpm reader and 300-lpm, 80-column printer. ■

DATA 100 Model 75 Print Utility Station

MANAGEMENT SUMMARY

DATA 100's new Model 75 Print Utility Station is an intelligent off-line print station composed of components from the firm's popular Model 78 product line. Operating software is provided by DATA 100 and currently supports only 9-track tapes produced under IBM 360/370 OS and DOS; however, DATA 100 plans to provide software support for tape formats produced by other major computers. The operating software for the Model 75, called Print Station Utility, is compatible with the Model 78 and will benefit Model 78 users who also have a need for off-line printing. For these users, the off-line software package is priced at $100 (a one-time charge).

The operating software provides two printing modes: a direct listing of all magnetic tape data without regard to formatting, or a formatted listing of selected records within a file. A wide range of tape parameters is acceptable. Tapes can contain standard labels or no labels; data can be blocked or unblocked; record length can be fixed or variable. Operating parameters are entered in the form of control statements, expressed in a simple job control language that can be keyed directly or loaded from punched cards or magnetic tape.

The operator's console, a DATA 100 Model 73 display unit or Teletype Model 33 teleprinter, alerts the operator to error conditions through displayed or printed messages and provides a means for entering commands and operating parameters. The display also provides a means for a visual search through tape files.

Most of the Model 75 peripheral units are obtained from outside sources. The print mechanisms are produced by ➢

Constructed from Model 78 components and supported by DATA 100 software as an off-line tape-to-print station, the Model 75 features 132 print positions, rated print speeds of 600 to 1250 lpm, and 9-track tape input at 800 or 1600 bpi via one to four tape drives. Card input is optional.

CHARACTERISTICS

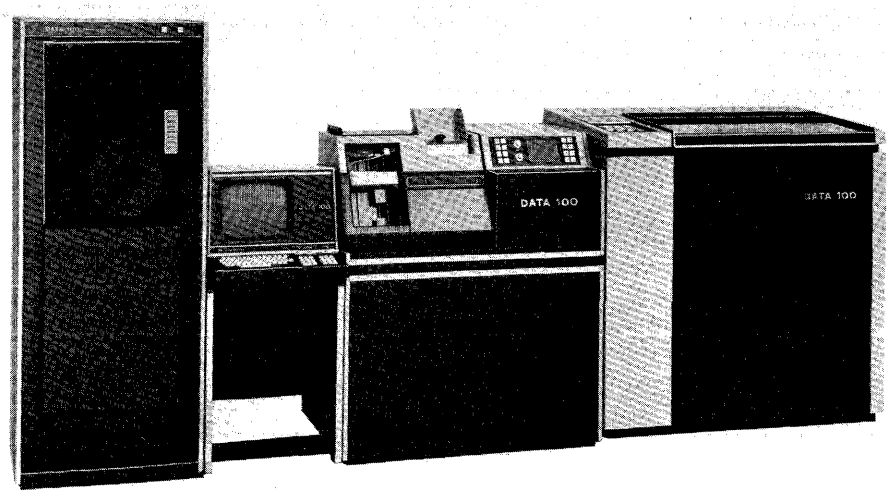
MANUFACTURER: DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

CONFIGURATION: The Model 75 Print Utility Station is composed of a programmable controller with 12,288 bytes of memory, one or more read-only 9-track tape drives, a 600-, 1000-, or 1250-lpm, 132-column line printer, and a CRT display operator console; as an alternative, a Teletype Model 33 teleprinter can be used in place of the CRT display. An 80-column punched card reader is optional. The Model 75 can support up to four 9-track magnetic tape drives–two 800-bpi and two 1600-bpi drives.

MAGNETIC TAPE INPUT: A read-only tape drive reads tape recorded in 9-track industry-compatible format at 800 or 1600 bits/inch. Dual density is not available. Tape speed is 12.5 inches/second for the 1600-bpi drive and 25 inches/second for the 800-bpi drive. Reel size is 10.5 inches.

PRINTED OUTPUT: Printing is performed by a 132-column drum printer. Three models are available, rated at 600, 1000, or 1250 lines/minute. The character set is composed of 64 EBCDIC characters, including upper-case alphabetics, numerics, and specials.

Vertical format control and horizontal tabulation are standard. Vertical formatting is implemented via a 12-channel tape loop. ➤



Configured from Model 78 components, the Model 75 includes (from left) a 9-track tape drive (up to four can be supported), an operator's console, a 300-cpm card reader, and a line printer. Any of three printer models can be specified, ranging from 600 to 1250 lpm.

DATA 100 Model 75 Print Utility Station

Control Data and the tape drives by Wang Computer Products. The card reader, however, is produced by DATA 100. Each of these products has earned a good reputation for reliability.

DATA 100 plans to enhance the flexibility of the Model 75 through the introduction of a media conversion package and the addition of other peripheral equipment.

First customer deliveries are scheduled for June 1973.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major cities. □

Horizontal and vertical spacing are 10 char/inch and 6 or 8 lines/inch, respectively. The printers accommodate continuous pin-fed forms from 3.5 inches to 20.6 inches wide.

DEVICE CONTROL: The nucleus of the Model 75 Print Station is a general-purpose minicomputer that executes all operations under program control. However, the minicomputer serves as a terminal controller only; the user cannot generate his own application programs. Operating software, furnished by DATA 100, is called the Print Station Utility (PSU), a magnetic-tape-to-line-printer utility program that currently accepts only 9-track, 800- or 1600-bpi tapes formatted under IBM System/360/370 OS or DOS.

The PSU accepts blocked or unblocked tape formats having fixed- or variable-length records and standard labels or no labels. (Standard labels are defined as 80-character records recorded in EBCDIC and having odd parity.)

Two print modes are provided: Data Display and Data List. The Data Display mode, intended primarily for program preparation and debugging, prints 120-character lines in hexadecimal or EBCDIC. Spacing between records is fixed. Logical records are single-spaced, and physical records are double-spaced. In the Data List mode, printed data is formatted according to user-defined parameters. Printed output is restricted to one line per logical record. Maximum line length is either 120 or 132 characters.

The PSU features the capability to transfer selected records to be printed, as specified by the operating parameters, while skipping those that are unwanted. The selection function, called Field Selection, can be executed only in the Data List mode. A maximum of 32,767 physical records between selected records can be skipped.

Vertical formatting is defined by any of three sets of vertical format commands: System/360 Command Code, 1401 Carriage Control, or ANS Fortran. Each command set uses all 12 format tape channels.

Jobs are described and job parameters defined via control statements, which can be read from punched cards or magnetic tape or keyed via the operator console.

CARD READER: Reads 80-column cards at 300 cards/minute; input hopper and output stacker capacities are 1000 cards each.

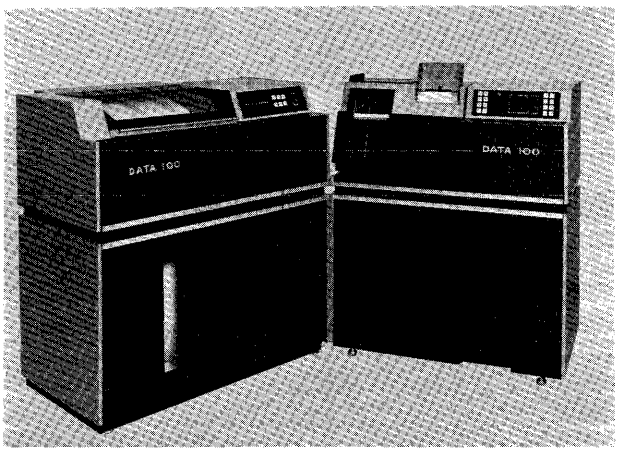
CRT DISPLAY: The DATA 100 Model 73 Interactive Terminal is used as an operator's console; see Report 70D-311-02 for detailed information.

PRICING: The Model 75 Print Utility Station is available for purchase or on a one- or three-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental (1)			
	1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Terminal Controller (2)	$ 575	$ 480	$ 19,530	$ 110
Printer:				
1250 lines/minute	1,060	970	37,380	170
1000 lines/minute	920	840	32,760	140
600 lines/minute	790	722	32,000	100
Tape Drive:				
With controller (3)	200	183	7,140	30
Without controller (3)	180	165	6,510	25
Operator Console	85	79	2,520	25
Card Reader, 300 cpm	137	125	4,914	20

(1) Includes prime-shift maintenance.
(2) Includes 12K bytes of memory.
(3) 9 track, 800 bpi or 1600 bpi; the controller includes one drive and accommodates a second with the same density. ■

DATA 100 Model 71 Remote Batch Terminal



Model 71, a specialized version of Data 100's popular Model 78, is an intelligent replacement for the IBM 3780. Available with an 80-column punch, it also offers a wide range of card reader and printer speeds. Transmission speed ranges from 2000 to 9600 bps.

MANAGEMENT SUMMARY

Designed as a replacement for the IBM 3780 Data Communications Terminal, the Model 71 Remote Batch Terminal is a new member of DATA 100's proliferous 70 Series family of remote batch terminals. Model 71 is essentially a specialized version of the Model 78 Programmed Terminal, which was introduced in late 1970. Both are intelligent turnkey terminals, but the Model 71 can be thought of as a subset of the Model 78 that is dedicated to operate as an IBM 3780. The Model 71 is controlled by operating software that is supplied by DATA 100 and loaded from cards prior to terminal operation. Software compatibility between the Model 71 and other Data 100 terminals, however, is not provided.

The Model 71's comparatively low price and flexible I/O configuration make it an attractive alternative to the IBM 3780. Its salient features, as compared with those of the IBM 3780, follow.

- Card input – a 300-cpm reader with a 1000-card hopper and stacker capacity is standard on the Model 71. Optional readers rated at 450 cpm and 600 cpm are available as substitutes. By contrast, IBM offers only a 600-cpm reader with a 1200-card hopper and 1300-card stacker.

- Card output – a 59-cpm (full card) punch with a 1500-card hopper and stacker capacity is optional. IBM offers a 120-cpm (full card) punch with a 1200-card hopper and 1300-card stacker.

- Printed output – a 300-lpm, 80-column drum printer is standard. Optional print speeds of 400 lpm and 600 lpm and line lengths of 120 and 132 columns are available. Character sets of 52 or 63 EBCDIC or 63 ASCII symbols are available for print speeds of 300 lpm and 400 lpm; only the 63-character EBCDIC set is available for 600 lpm. By contrast, IBM's bar printer is rated at 300 to 425 lpm, provides standard and optional line lengths of 120 and 144 columns, respectively, and is available with interchangeable type-bars each containing one of four character sets: ▷

CHARACTERISTICS

MANUFACTURER: DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

CONFIGURATION: The Model 71 Remote Batch Terminal, a replacement for the IBM 3780-1 Data Transmission Terminal, employs a minicomputer as a terminal controller and consists of a 300-cpm card reader, a 300-lpm, 80-column line printer and a communications interface. DATA 100 offers optional card readers rated at 450 or 600 cpm and line printers rated at 400 or 600 lpm as substitutes for the standard peripherals. A card punch with a rated punching speed of 59 to 200 cpm is also available as an option.

COMMUNICATIONS: Synchronous, half-duplex at fixed speeds of 2000, 2400, 3600, 4800, 7200, or 9600 (optional) bits/second using IBM's BSC (binary synchronous) communications technique.

The 8-level EBCDIC transmission code is used; ASCII transmission code is available only on a special order basis. Transparency transmission and reception is a standard feature.

The Model 71 is transmission-compatible with the IBM 3780 Data Communications Terminal. The modem interface is designed to EIA Standard RS-232B/C. The choice of modem is dependent on transmission speed.

Communications-related options include automatic answering for use on the switched network, a dual modem switch, and modem simulators (limited-distance modems for private-line use at distances up to 5 miles).

DEVICE CONTROL: Model 71 is designed to emulate the IBM 3780 as a turnkey system. The nucleus of the terminal is a general-purpose minicomputer that executes all terminal operations under program control. The minicomputer serves as a terminal controller and, for all practical purposes, is transparent to the user; i.e., he is not cognizant of its computing capability.

DATA 100 furnishes operating software it calls Terminal Control Programs; each of these programs is designed to emulate the operation of a specific batch terminal produced by a leading mainframe manufacturer and currently supported by the manufacturer's communications software. Prior to on-line terminal operation, the operator loads the Terminal Control Program from cards. On-line operation can then proceed by establishing a communications link with the remote computer and by transmitting data from an input device or receiving data on an output device. Software compatibility between the Model 71 and other DATA 100 terminals is not supported.

Model 71 duplicates the control structure of the IBM 3780. Basic to this structure is a pair of 512-character buffers which serve the card reader/printer and the communications line alternately to minimize delays. When receiving, if the buffer serving the printer is not empty by the time the next block has been fully transmitted, acknowledgement of the block is delayed until the buffer becomes available. In a similar fashion, if the card reader fills a buffer before the ➤

DATA 100 Model 71 Remote Batch Terminal

39-, 52-, or 63-character EBCDIC or 63-character ASCII. Horizontal tabulation, a standard IBM 3780 feature, is a no-charge option for Model 71.

- Transmission – Model 71 is transmission-compatible with the IBM 3780 on a point-to-point basis only, at transmission speeds of 2000 to 7200 bps over a leased line or 2000 to 3600 bps over the switched network using EBCDIC transmission code. Multipoint operation is not available for the Model 71, nor is ASCII transmission code, except on a special order basis. Component Selection and EBCDIC Transparency, optional features for the IBM 3780, are standard features for the Model 71; however, Auto Restart, a standard IBM 3780 feature is a no-charge option for the Model 71. Transmission at 9600 bps, not available for the IBM 3780, is optional for the Model 71. Like its IBM counterpart, the Model 71 features space compression/expansion and an automatic answer and disconnect option for operation over the switched network.

First customer deliveries of the Model 71 were made during July 1973 on a limited basis. Full production deliveries are scheduled for September 1973. Deliveries of the 80-column punch are scheduled to begin during the fourth quarter of 1973.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major cities. DATA 100 says it has about 120 customer engineers who assist about 150 DATA 100-trained Honeywell CE's. □

previous block has been fully transmitted, the reader is delayed until the buffer becomes available. Variable record length is a standard feature. Spaces at the end of a card are automatically eliminated to conserve transmission. Incoming print records can be split across two blocks. Space compression and expansion is also a standard feature, but cannot be used in conjunction with EBCDIC Transparency. When active, this feature replaces a consecutive string of spaces with a two-character sequence identifying a string of up to 63 spaces. For longer strings, multiple control sequences are used. When receiving, such control sequences are decoded and the appropriate number of spaces inserted.

Conversational mode, a standard IBM 3780 feature designed to improve line efficiency, is not provided by Model 71. The feature recognizes a received computer message as the positive response to the last transmitted message block and automatically switches the terminal from transmit to receive, provided the printer is ready.

Auto Restart, another standard IBM 3780 feature, is available as an option on Model 71. The feature provides for the automatic resumption of a computer-interrupted terminal message following receipt of the computer message. Operator intervention to restart the terminal is required without the automatic feature.

Model 71 can be used off-line (Home mode) to perform listing or duplication. Listing is performed on a one-to-one basis; i.e., one 80-column card per print line.

Component Selection is a standard feature.

CARD READERS: The standard 80-column card reader is rated at 300 cards/minute. Two optional readers are available on a substitute basis and are rated at 450 or 600 cards/minute. Hopper and stacker capacities are rated at 1000 cards each for all readers. The 600-cpm reader is produced by Documation, and the other readers are produced by Bridge Data Products.

CARD PUNCH: The optional 80-column card punch (Bull-GE) is rated at 59 to 200 cards/minute, depending on the number of columns punched per card. Hopper and stacker capacity are each rated at 1500 cards. The punch performs an invalid-character check for each character punched.

PRINTERS: The standard printer is an 80-column drum printer (Control Data printer mechanism) rated at 300 lines/minute. Options provide rated speeds of 400 or 600 lines/minute and printed line lengths of 120 or 132 columns. The 300-lpm and 400-lpm print speeds are available with either the 52-character set common to EBCDIC terminals or the 63-character set common to ASCII terminals. The 600-lpm printing speed is available with the 63-character set only.

Horizontal spacing is 10 char/inch; vertical spacing is 6 or 8 lines/inch. Pin-fed, continuous forms with up to 6 parts and from 3.6 to 20.6 inches wide are accommodated.

Vertical formatting, implemented via a 12-channel tape loop, is standard. Horizontal tabulation, implemented via a stored horizontal format record composed of space characters interspersed with horizontal tab characters, is a no-charge option.

PRICING: The Model 71 Batch Terminal is available for purchase or on a one- or two-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units. Operating software is included in the price of the terminal.

	Monthly Rental* 1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
Model 71 Batch Terminal**	$810	$685	$26,460	$180
80-Column Punch	340	320	13,230	25
80-Column Printer Replacements:				
400-lpm 52-char. Printer	0	0	0	0
400-lpm 63-char. Printer	80	76	3,108	6
600-lpm 63-char. Printer	280	267	11,088	16
Printer Options:				
120 Print Columns	40	38	1,512	4
132 Print Columns	76	67	2,730	5
Static Eliminator	15	15	630	0
Horizontal Tab	0	0	0	0
Card Reader Replacements:				
450-cpm Reader	20	19	672	4
600-cpm Reader	40	28	1,470	5
Terminal Options:				
9600-bps Transmission	25	25	1,050	0
Auto Answer	0	0	0	0
Auto Restart	0	0	0	0
Dual Modem Switch	46	42	1,680	6
Modem Simulators	120	110	4,410	15

*Includes maintenance.

**Includes 300-cpm reader and 300-lpm, 80-column printer. ■

DATA 100 Model 88-6 Remote Batch Terminal

MANAGEMENT SUMMARY

DATA 100 has introduced another member of its growing 88 Series family of intelligent terminals. The Model 88-6 is designed to serve as an inexpensive replacement for the IBM 2780-1 in low-speed, low-volume remote batch applications. Like the other family members, the 88-6 incorporates a minicomputer as a terminal controller, but the 88-6 is a complete turnkey system that emulates the IBM 2780-1 via emulation software loaded from punched cards.

The 88-6 is restricted to point-to-point communications with another 88-6 or with an IBM 2780 terminal, an IBM 1130 or 1800 computer, or an IBM System/360 or 370 computer. DATA 100 does not support the 88-6 for use in a multipoint environment. Automatic answering is provided as a standard feature for operation over the switched network (DDD).

The basic 88-6 terminal includes a 150-cpm Data Products card reader and a 165-cps, 132-column Centronics Model 101A printer, which prints from 60 to 200 lines per minute depending on the line length. The printer is a stand-alone unit and is typically separated from the operator console, a desk-like unit that houses the minicomputer and supports the table-top Data Products card reader and operator control panels. As an option, DATA 100 offers a faster printer as a substitute; the Centronics Model 102A is rated at 330 cps (125 lpm) and also prints up to 132 columns. Both printers are serial impact printers that form each character within a dot ▷

The 88-6, another member of DATA 100's 88 Series family, is intended as a replacement for the IBM 2780 in low-volume, low-speed, remote batch applications.

CHARACTERISTICS

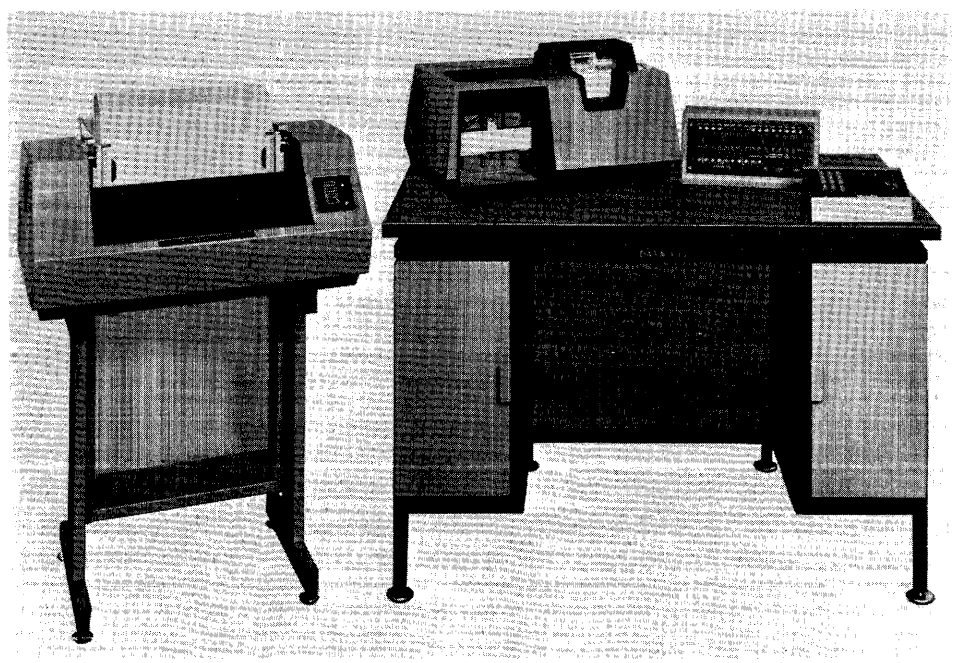
MANUFACTURER: DATA 100 (Westbury), Inc., subsidiary of DATA 100 Corporation, 7725 Washington Avenue South, Minneapolis, Minnesota 55435. Telephone (612) 941-6500.

CONFIGURATION: The Model 88-6 Remote Batch Terminal includes a minicomputer with 4K 16-bit words of memory (8K bytes), a 150-cpm card reader, a 165-cps printer, and a communications interface; a 330-cps printer is optional. The terminal is a complete operating unit, requiring only a modem for connection to a communications line.

COMMUNICATIONS: Duplicates IBM binary synchronous (BSC) discipline. Transmission can be at 1200, 2000, or 2400 bits/second. The interface provided is the standard EIA RS-232C. Transmission is half-duplex synchronous, employs the EBCDIC code, and is compatible with IBM Binary Synchronous terminals such as the IBM 2780.

DEVICE CONTROL: The nucleus of the Model 88-6 terminal is a general-purpose minicomputer that executes all terminal operations under program control. The minicomputer serves as a terminal controller and, for all practical purposes, is transparent to the user; i.e., he is not cognizant of its computing capability.

DATA 100 furnishes operating software it calls Terminal Control Programs. The Terminal Control Program for the ▶



The stand-alone Centronics printer is shown to the left of the Model 88-6 operator console, which houses the controlling minicomputer and supports the card reader and control panel.

DATA 100 Model 88-6 Remote Batch Terminal

matrix. Vertical format control, implemented via a 12-channel tape loop, is a standard feature of both printers. The printers offer the EBCDIC character set only.

The COMFILE memory unit, a continuous-loop magnetic tape storage device featured in the other members of the 88 Series family of terminals, is not available for the 88-6.

Transmission speed is program-selectable at 1200, 2000, or 2400 bits per second. Transmission code is restricted to EBCDIC; ASCII and SBT transmission codes are not available. EBCDIC transparency is provided as a standard feature. Multi-record transmission, an optional feature for the IBM 2780, is a standard feature of the 88-6, which, like its IBM counterpart, will accept up to 7 records or up to 400 characters per block.

First customer deliveries of the 88-6 Terminal were made in May 1973. By July 1, 24 units had been delivered. Lead time on orders is 30 days.

Service is provided by DATA 100 and by Honeywell through over 100 service locations in major cities. DATA 100 says it has about 120 customer engineers that assist about 150 DATA 100-trained Honeywell CE's.□

88-6 terminal is designed to emulate the communications and control functions of an IBM 2780-1 Data Transmission Terminal. Prior to terminal operation, the operator loads the Terminal Control Program from cards. Operation can then proceed by establishing a communications link with the remote computer or another terminal and by transmitting data from the card reader or receiving data on the printer.

The terminal can be used off-line to perform listing, which is performed on a one-to-one basis (i.e., one 80-column card per print line). The standard software does not provide for editing.

The terminal features a transparent mode, which permits all 256 EBCDIC code permutations to be transmitted without control-code recognition.

CARD READER: Reads 80-column punched cards photoelectrically at 150 cards/minute using a single lamp and fiber optics for the light source. Input hopper and output stacker card capacities are 600 cards each.

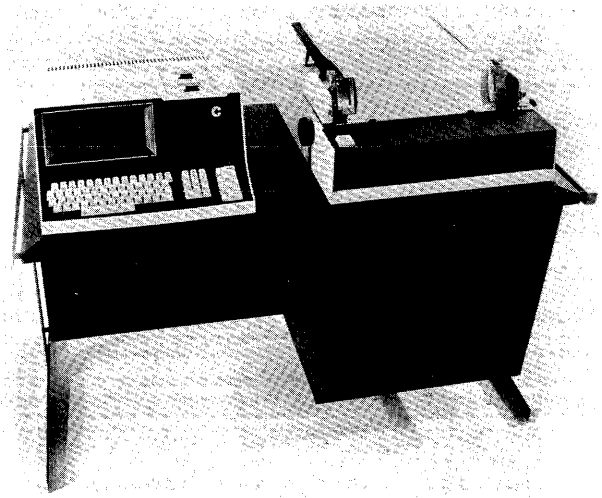
PRINTER: Two printers feature rated speeds of 165 char/second (Centronics Model 101A) or 125 lines/minute (330 char/second – Centronics Model 102A). Both are serial impact printers with 132 print positions that print any of 63 EBCDIC characters, including upper case alphabetics, numerics, and specials. Each character is formed within a 9-by-7 dot matrix equivalent to 10-point type. The printers accommodate pin-fed, continuous five-part forms from 4 to 14-7/8 inches wide. Horizontal and vertical spacings are 10 char/inch and 6 lines/inch, respectively. Vertical format control is implemented via a 12-channel tape loop. Horizontal tabulation is available as an option.

PRICING: The Model 88-6 Remote Batch Terminal is available for purchase or on a one-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

Model 88-6 Batch Terminal	Monthly Rental*	Purchase	Monthly Maint.
With 165-cps printer	$545	$13,500	$85
With 125-lpm printer	595	14,500	90

*Includes maintenance. ■

Datapoint 2200
Intelligent Display Terminal



The Datapoint 2200 is shown here with the Diablo 30-cps impact printer, newest of the four printers that can be used to provide hard-copy output capabilities for the system.

This intelligent terminal exhibits impressive processing power and can support a variety of peripherals, including card readers, printers, and disk and tape drives. Extensive software support includes tape and disk operating systems, business-oriented languages and several terminal emulators. Datapoint introduced a more powerful Version II processor in 1972.

MANAGEMENT SUMMARY

The growing demand for more sophisticated computer terminals designed to operate in general business environments has prompted the data processing industry to produce a new generation of so-called "intelligent" terminals, which incorporate minicomputers and can be programmed. The Datapoint 2200 is one of the most versatile and popular of these terminals.

The Datapoint 2200 is not a specialized terminal intended for a specific application, but a general-purpose device designed to meet the needs of a broad range of applications. Basically, the Datapoint 2200 provides a useful amount of processing power in a stand-alone environment. The unit looks like a conventional CRT display unit, with essentially the same physical dimensions: however, its casework embodies two cassette tape recorders that accommodate "Philips-type" cassettes, a byte-oriented minicomputer, and a memory that ranges from a basic 2K bytes to 16K bytes. A communications interface is optional, and the user can select one of four interface types that can include an integral modem compatible with Bell System modems. The communication capability can accommodate transmission rates ranging up to 9600 bits per second. An 8-channel multiplexer is also available for asynchronous operation.

A host of I/O devices is available for the 2200, including four printers ranging from 30 to 330 characters per second, an industry-compatible 7- or 9- track magnetic tape unit, an 80-column card reader, and up to 20 million bytes of on-line cartridge disk storage.

In early 1972, Datapoint introduced a more powerful version of the Datapoint 2200 called Version II. Basically, Version II provides twice the memory capacity of Version I (the original Datapoint 2200), and its processor virtually combines two Version I processors, each of ➢

CHARACTERISTICS

MANUFACTURER: Datapoint Corporation (formerly Computer Terminal Corporation), 9725 Datapoint Drive, San Antonio, Texas 78284. Telephone (512) 696-4520.

MODELS: The Datapoint 2200 is available in two models, Version I and Version II. The latter is a more powerful, upward-compatible version of the first with up to twice the memory capacity.

CONFIGURATION: The Datapoint 2200 is a stand-alone display terminal that contains a byte-oriented minicomputer, MOS read/write memory, an alphanumeric keyboard that also includes a separate numeric keygroup, a CRT display screen, twin magnetic tape cassette recorders, and 14 I/O channels to accommodate external devices including communications lines. Version I contains a 2048-byte memory, expandable to 8192 bytes in 2048-byte increments. Version II contains a 4096-byte memory, expandable to 16,384 bytes in 4096-byte increments.

I/O device options include four models of printers, an 80-column, 600-cpm card reader, industry-compatible 7- or 9- track magnetic tape units, and a 2.5-million-byte cartridge disk unit. Separate printer interfaces are available for a user-supplied IBM Selectric typewriter and for Centronics printers, Models 101A and 102A. A parallel interface permits the transfer of data on an 8-level parallel basis.

Communications interfaces are available for synchronous and asynchronous communications facilities and can include an integral modem for asynchronous operation. A communications multiplexer is also available for asynchronous operation; it can accommodate up to eight lines.

CASSETTE TAPE INPUT/OUTPUT: The twin magnetic tape cassette recorders each use a "Philips-type" cassette which contains 300 feet of 0.15-inch-wide magnetic tape. Data is recorded serially at 47 char/inch. The data transfer rate is 352.5 char/second. Read/write and rewind speeds are 7.5 and 90 inches/second, respectively. Start/stop time is 280 milliseconds. Inter-record gap is 2 inches. The cassette storage capacity is modestly rated at 130,000 characters.

Conversion from cassette tape to computer-compatible magnetic tape requires the optional magnetic tape unit. Conversion is performed under program control.

CRT DISPLAY: An 11-inch (diagonal measurement) CRT with a viewing area 7 inches wide by 3.5 inches high is standard. The screen is arranged in 12 lines of 80 characters each, a total of 960 character positions. A character set of 94 ASCII characters, including upper- and lowercase alphabetics, numerics, and special symbols, is displayed in green against a dark background. Characters are formed by a 5-by-7 dot matrix. The cursor is a solid formed by the dot matrix and blinks repetitively.

DEVICE CONTROL: The nucleus of the Datapoint 2200 is a general-purpose minicomputer that executes all opera- ➢

Datapoint 2200
Intelligent Display Terminal

which operates in a separate program-selectable mode. This capability lends itself well to applications that combine data entry and communications. The dual-processor architecture eliminates loading and restoring the contents of registers between tasks and, therefore, speeds processing time. Version II also includes a hardware interrupt feature not provided in Version I. Additionally, Version II features a random-access memory (RAM) that can be accessed in 3.2 microseconds, compared with Version I's minimum of 16 microseconds for sequential accesses and 520 microseconds for random accesses.

Datapoint provides strong solftware support for the 2200 and continues to strengthen its existing support through the introduction of additional software with expanded capabilities. In January 1973, Datapoint introduced a Disk Operating System (DOS) for use with Datapoint 2200 systems that incorporate the 2.5-million-byte disk cartridge drive. DOS is a random-access facility that can create or maintain logical or independent files without regard to overrunning existing files; it features linking, overlaying, interrupt handling, a library of subroutines, and diagnostics. DOS complements CTOS, Datapoint's initial cassette-based operating system that has been upgraded to accommodate Version II, and MTOS, an enhanced version of CTOS designed to operate with the industry-compatible 9-track tape unit. MTOS provides programs for transcribing data between cassette tape and reel tape and general-purpose tape-drive subroutines. It has the additional capability to catalog up to 37 application programs.

Datapoint 2200 software also includes a two-pass assembler and a family of business-oriented languages called Databus. Databus is a "COBOL-like" language with expanded facilities for record selection and data computation. It includes the capability to search a tape for a particular file and record. Databus application programs are composed of Databus statements which are converted to object code by an interpreter each time the programs are run. Each application program contains its own loader and interpreter; the interpreting process is transparent to the user. Databus 7, the latest member of the Databus family, introduced in May 1972, has been modified to run with DOS.

Datapoint recently introduced three important new software packages for the 2200: Basic Language, Dataform, and Datashare. Basic Language is a "Dartmouth-type" assembly language. Dataform is a form-driven compiler that is used to create user formats from user-supplied parameters. Datashare is a time-shared version of Databus that permits any combination of up to eight Teletypewriters and/or Datapoint 3000 series display terminals to operate on-line simultaneously with a disk-oriented Datapoint 2200.

Datapoint has strengthened its communications-oriented software with terminal emulators that provide software emulation for the IBM 2770, IBM 2780, IBM 2741, IBM 2265, CDC 200 User Terminal, UNIVAC DCT 2000, Teletype Model 33 ASR, and Datapoint 3300. Automatic dialing and call answering features are included in the Datapoint 3300 emulator.

tions under program control. Operating software for the Datapoint 2200 currently includes three operating systems, an assembler, a family of business-oriented languages called Databus, a family of utility programs, terminal emulators, a work processing program, and system diagnostics.

Operating systems include the initial Cassette Tape Operating System (CTOS); the Magnetic Tape Operating System (MTOS), a virtual copy of CTOS that resides on 9-track magnetic tape; and the recently introduced Disk Operating System (DOS).

CTOS resides on a single cassette that also includes a loader, assembler, assembler source code editor, and a family of utility routines (loaded with the operating system) that support keyboard, display, tape functions, etc. The cassette containing operating software is mounted on, and loaded into memory from, the rear tape deck. CTOS fills 6K bytes of a required 8K memory and provides a convenient conversational command linkage between the operator and the application programs. CTOS is generally overlayed when user programs are called from tape (unless they are less than 2K bytes in length and properly located). Keyed commands are displayed as they are composed, and the operating system responds to the operator via displayed messages.

CTOS commands allow the operator to: (1) list (by name) up to 20 application programs that also reside on the CTOS cassette, (2) change the name of any specific program, (3) run a named program, (4) enter (catalog) a new program at the end of the library of programs residing on the CTOS cassette, (5) delete a named program from the library, (6) replace a named program within the library with another, (7) tag a named program within the library for an automatic run whenever the operating system is restarted, (8) delete a named program from the automatic run mode, (9) copy a named program from the library to a second tape (on the front tape deck), (10) prepare the tape on the front tape deck for reuse by erasing and rewinding the tape, (11) load programs written in a hexadecimal format, and (12) transfer control to a debugging subroutine, a programming aid that allows the operator to manipulate and visually examine data stored in the Datapoint 2200's memory.

DOS adds substantial power to the 2200. It provides a random-access disk file capability. Logical or independent files can be opened, modified, deleted, and expanded. DOS supports 8 foregrouped tasks having various priorities and includes 30 utility commands.

New programs are generated by keying in the statements under control of the Assembly Source Code Editor, a program that allows the user to prepare and edit his source program in an assembler-compatible format prior to the assembly operation. Having loaded the Editor from tape, the user keys each line of source code in an assembly-language statement, which consists of four fields: label, instruction, operand, and comment.

During composition, the user can view up to 12 displayed lines of coding; as each code line is keyed, it appears as the bottom line of the CRT display and is moved up one line for each new line entry. After the first 12 lines have been keyed, the next line entry initiates transfer of the top line to create the source tape (as all lines are moved up one line). Having created a source tape, the user, under direction of the Editor, can then edit the tape prior to assembly. Edit commands are provided that initiate search, copy, insert, and delete functions on source tapes. Source tapes can be duplicated to produce any number of copies.

Assembly can begin once a final source tape has been generated. The Datapoint Assembler, when loaded in memory, generates a block of absolute object code from the symbolic source code. The assembled program can then be loaded by the operating system loader and

Datapoint 2200
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Datapoint also offers a somewhat limited word processing package, Scribe, designed to arrange unformatted text into structured copy. A more powerful disk version is planned.

In summary, the introduction of the Version II processor and its RAM offers the user a broad range of processing power, ranging from a Version I system with limited memory size and processing capability to a Version II system with a 16K-byte memory and disk storage operating under DOS. Add to this Datapoint's variety of peripherals and its extensive software, and the Datapoint 2200 is quite an attractive package that can be tailored to meet the needs of a wide range of users. On the other hand, Datapoint offers few application programs. Users who do not want to produce their own programs may take a negative view of this situation, while others may feel that the flexibility of Datapoint's variety of programming languages and other software aids more than offsets this handicap.

The Datapoint 2200 was announced in late 1970, and first deliveries were made in April 1971. Deliveries of Version II began in April 1972. To date, over 2000 units have been delivered. Lead time on orders is currently quoted at 6 to 8 weeks. Service is provided by Datapoint Corporation through 30 service locations nationwide.

Datapro has received glowing reports about the Datapoint 2200 from its users. They are especially impressed with its rugged construction, excellent overall performance, and strong software support. One exuberant user told Datapro that his own terminal had been flown around the U.S. as common luggage for eight weeks without any lapse in performance. In one case, he related, it was dropped three feet by the airline baggage handlers without ill effects. □

cataloged via the Operating System. Assembly is performed in two passes. The first pass generates a symbol table from the labels in the source code and checks for error conditions, primarily in syntax and form. The second pass generates the program listing and the object code on tape.

Utility routines provided with the Operating System are a set of in-line subroutines used to implement I/O operations and transfer data between the processor and I/O devices (including the keyboard and CRT display). All Datapoint 2200 I/O devices operate alike and have the same general I/O structure. The I/O devices are interrogated and operations are initiated via status and command words. Status words (received from the addressed device) indicate the state of the device, while command words are used to instruct the device to execute specific I/O functions.

Keyboard commands, besides transferring a keyed character to the processor, can initiate a beep or click or light an indicator lamp (as an audible or visual alert to the operator).

Display commands, besides transferring a character of data to the CRT, include: (1) erase from cursor to end of line or (2) end of frame, (3) roll up one line, (4) display or erase cursor (although the cursor remains active), (5) position the cursor to a given character address on the line currently occupied by the cursor, (6) position the cursor to a given line address without changing its horizontal character position, and (7) light indicator lamp(s) as an operator alert. Manually operated cursor controls, such as those found on conventional CRT display terminals, are not provided.

Tape commands are provided for deck selection (deck 1–rear or deck 2–front), read forward or backward, write forward, stop, and rewind. Detection, via a status word, is provided for an invalid sync code (which appears after each tape character and is composed of three bits), inter-record gap, end-of-file mark, end-of-tape, deck ready, cassette in place, and a read or write ready condition.

KEYBOARD: Includes a 41-key alphanumeric (typewriter-style) key-group and an 11-key numeric (adding-machine-style) keygroup. The alphanumeric keygroup can produce any of 128 ASCII characters including upper- and lower-case alphabetics, numerics, control codes, and special characters. Five keyes grouped to the right of the keyboard provide system control functions. Audible "clicks" or "beeps" for operator attention can be generated by programming.

PROCESSOR: Version I and Version II processors are both byte-oriented (8 bits/byte) minicomputers. Except for minor differences, both employ the same internal architecture, including 7 addressable registers, 4 control flipflops, and parallel I/O transfer. However, the Version II processor contains a second set of 7 addressable registers and control flipflops, which are functionally identical with the first, and includes a hardware interrupt feature. Both sets of registers and flipflops are active in mutually exclusive modes, Alpha and Beta.

Both processors also contain a 16-level push-down stack for instruction addressing and subroutine calling. The push-down stack is a group of registers interconnected in a "last-in/first-out" arrangement. The flexibility of the push-down stack has been enhanced in the Version II processor, which provides "pop" and "push" instructions to transfer a memory address between the stack and a pair of addressable registers.

The instruction repertoire, except for a few instructions unique to the Version II processor, is the same for both processors. Instructions include test, branch, arithmetic, logic, and I/O. Version I provides 28 instructions; Version II, 31. Execution of an instruction requires a minimum of 16 microseconds in the Version I processor and 3.2 microseconds in the Version II processor.

Main memory employs MOS construction, but operates differently for the two processor versions. Version I's memory (2K to 8K bytes in 2K increments) is composed of shift registers, each with a capacity of 512 bits (64 bytes). Each 2K-byte module contains 32 individual shift registers. Reading is performed serially and requires 16 microseconds per byte when reading sequentially; random accessing requires 520 microseconds to complete. Version II's memory (4K to 16K bytes in 4K increments) is a random-access memory with an access time of 500 nanoseconds. Memory is refreshed (contents rewritten) once every 40 memory cycles, resulting in a 2.5 percent degradation of processor performance.

PARALLEL INTERFACE: Provides an 8-level interface for transferring data between the Datapoint 2200 and an external device (e.g., instrumentation, a minicomputer, or a parallel I/O device). Besides a read/write bus, the interface provides the capability to sense device status and to issue commands from the Datapoint 2200.

PRINTER: Four printers are available.

The non-impact thermal page printer (NCR) prints up to 80 columns at 30 char/second on an 8.5-inch-wide, 150-foot roll of special paper. Any of 64 characters are formed within a 5-by-7 dot matrix.

The impact page printer, a Diablo HyType unit, is rated at 30 char/second. It prints up to 132 columns/line, can

Datapoint 2200
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be positioned across blank spaces at up to 30 inches/second, and is capable of incremental spacing as small as 1/60 of an inch. Paper can be fed via either friction or sprocket feed. The interchangeable, rosette-shaped typewheel is available in a variety of upper and lower case fonts.

Two matrix printers (Centronics) each print up to 132 columns/line at rated speeds of 165 char/second (Model 101A) and 330 char/second (Model 102A). Both models print any of 64 ASCII symbols; each is formed via a 9-by-7 dot matrix and is equivalent in size to 10-point type. The units accommodate pin-fed, continuous, 6-part forms up to 14-7/8 inches wide via an adjustable tractor. Horizontal pitch is 10 char/inch, and vertical spacing is 6 lines/inch. Vertical format control is implemented via a paper tape loop.

DISK STORAGE: The basic unit consists of a controller with a 1024-byte buffer memory (divided into four pages of 256 bytes each) and one or two removable-cartridge disk drives (Diablo Model 31) rated at 2.5 million bytes each. One controller can accommodate up to four drives, available as single- or dual-drive units. The 2200 can accommodate two disk controllers and up to eight disk drives. The parameters for the cartridge disk drive are as follows:

Drive capacity, bytes:	2.5 million
Transfer rate, bytes/second:	184,000
Cylinders/drive:	203
Tracks/cylinder:	2
Positioning time–	
Average:	70 msec
Track-to-track:	15 msec
Average rotational delay:	20 msec

TAPE INPUT/OUTPUT: 7-or 9-track, industry-compatible magnetic tape drive (Ampex TMX-500). Recording density is 556 or 800 bits/inch for the 7-track unit and 800 bits/inch for the 9-track unit; both employ the NRZI recording technique. The desk-mounted unit accommodates an 8.5-inch reel. Read/write and rewind tape speeds are 12.5 and 80 inches/second, respectively. The data transfer rate is 6,950 (556 bpi) or 10,000 (800 bpi) char/second. Tape tension is applied through servo-controlled "dancer" arms.

COMMUNICATIONS: The Datapoint 2200 can be equipped to operate as a remote terminal in a data communications environment when either of two external communications adapters is specified.

The Synchronous Communications Adapter provides compatibility with IBM's Binary Synchronous Communications (BSC) technique using either 8-level ASCII or EBCDIC transmission codes. Transparent operation is included. Operation is synchronous in the half- or full-duplex mode. The transmission rate is limited by the choice of modem; the I/O bus data transfer rate is 60,000 bits/second. User-supplied modems that provide clocking can be used for transmission speeds up to 9600 bits/second over leased or private voice-band lines.

The Asynchronous Communications Adapter operates asynchronously in the half-duplex mode using ASCII code. One of four interfaces can be specified: an EIA Standard RS-232 interface, a telegraph loop interface or an integral modem compatible with the Bell System 103 or 202 modems. The 103-type modem operates at speeds up to 300 bits/second; the 202-type operates at speeds up to 1200 bps (public network) or 1800 bps (leased or private line). Both modems provide automatic answering and dialing capabilities.

The Multiple Port Communications Adapter operates asynchronously in the half-duplex mode using ASCII code and multiplexes up to 8 communications lines to a single I/O channel. An EIA Standard RS-232 interface is provided for each line.

PRICING: The Datapoint 2200 is available for purchase, on a short-term lease, or on a one- or two-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental*			
Datapoint 2200	1-Yr. Lease	2-Yr. Lease	Purchase	Monthly Maint.
Version I:				
2K-byte memory	$197	$181	$6,040	$30
4K-byte memory	213	196	6,630	30
6K-byte memory	228	210	7,210	30
8K-byte memory	245	225	7,800	30
Version II:				
4K-byte memory	275	230	8,571	35
8K-byte memory	315	262	10,003	35
12K-byte memory	362	302	11,650	42
16K-byte memory	402	334	13,297	42
I/O Devices				
Magnetic Tape Unit (7 or 9 tk.)	280	248	8,500	35
Single Disk Unit**	317	280	9,800	35
Dual Disk Unit**	443	392	13,600	52
Additional Single Drive	280	248	8,500	35
Additional Dual Drive	424	375	12,900	52
Printer:				
Thermal, 30 cps	95	–	2,860	10
Impact, 30 cps	170	147	4,480	35
Matrix, 165 cps***	270	242	6,678	50
Matrix, 330 cps***	295	263	8,388	50
Card Reader	147	131	4,210	25
Communications Adapters				
Asynchronous	38	33	910	10
Asynchronous (includes modem)	56	48	1,500	10
Synchronous	38	33	910	10
Multiple Port (up to 8 asynch. lines)	57	51	1,250	15
Special Interfaces				
Parallel Data Adapter	34	29	750	10
IBM Selectric Interface	34	29	750	10
Centronics Printer Interface (for user-acquired printers)	–	–	1,088	–
Media				
Disk Cartridge	–	–	150	–
Tape Cassette (lots of 1 to 15)	–	–	6.25	–

* Includes on-call maintenance.
** Includes controller and one (Single Disk Unit) or two (Dual Disk Unit) drives; one controller can accommodate a maximum of four 2.5-million-byte drives.
*** Includes the Centronics Printer Interface. ■

Datapoint 1100, 2200, & 5500
New Product Announcement

On November 15, 1973, Datapoint Corporation announced a double blessed event in its family of dispersed data processing systems. The first-born family member, the Datapoint 2200, was joined by two new siblings, the Datapoint 1100 and Datapoint 5500 terminals. Customer deliveries of the 1100 will begin in January 1974, while the Datapoint 5500 has been earmarked for delivery in the third quarter of 1974.

The Datapoint 2200 is now the middle member of the family in terms of performance and price. The application area of the Datapoint 1100 is somewhat narrower than that of the 2200, and its prices are lower, as shown by the price list on the next page. The Datapoint 5500 has the most advanced capabilities and the highest prices of the three terminals, but no specific price information has been released to date. The original Datapoint 2200, meanwhile, has kept in step with the family growth through enhancement of its cassette facility and elimination of its lower-grade processor, Version I.

DATAPOINT 1100: The new Datapoint 1100 is an integrated system composed of a processor that incorporates either 4K or 8K bytes of RAM memory, dual cassette drives, a CRT display that presents 12 lines of 80 characters each, a full 94-character ASCII set, a solid, blinking, non-destructive cursor, and a keyboard composed of a basic 41-key alphanumeric group and an 11-key numeric group, with 5 system control keys. It is upward-compatible to the 2200.

The processor memory is structured into 8-bit words. This random-access memory, which is formed from MOS components, has an access time of 3.2 microseconds. Each processor cycle requires 1.6 microseconds, and instructions take from 2 to 4 cycles to execute. There are 50 different instruction types and a hardware interrupt. The interrupt signal occurs at a 1-millisecond rate. Two sets of 7 addressable registers each operate in independent alpha and beta modes. The processor also includes a 16-deep pushdown stack. Up to 14 external peripheral devices can be connected to the parallel I/O bus. The cassette tape decks, keyboard, and CRT display are connected internally. Both cassette drives record at 47 characters/inch and provide forward-reverse operation.

The Datapoint 1100 has only one operating system, CTOS. It can be programmed by means of Datapoint's Assembler and Dataform languages. The Dataform editor and forms generator make possible adaptation of the terminal to a variety of data entry applications.

With the modems supplied by Datapoint, transmission rates are 300, 1200, or 1800 bits/second (with the use of a leased or private line). Automatic answering and dialing capabilities are provided. Other communications characteristics conform with the discussion in the preceding report. The terminal incorporates emulators for the IBM 2780, UNIVAC DCT 2000, and CDC 200 terminals.

The card reader in current use with the 2200 terminal can also be used with the 1100; this provision, however, is subject to change. There are two printers: a Centronics matrix printer and a servo impact printer.

DATAPOINT 2200 CHANGES: The principal enhancements of the Datapoint 2200 are the introduction of two ECMA standard cassette drives and the elimination of the relatively slow Version I processor. The ECMA type drives have a 750 character/second data transfer rate, record at a density of 100 characters/inch, and can search records at 8,000 characters/second. A hardware-controlled read-after-write check is performed. Datapoint will continue to support present users of Version I processors, but in the future the old Version I functions will be performed more effectively by the Datapoint 1100.

DATAPOINT 5500: This new processor employs memory segmentation, hardware relocation, double-precision arithmetic, and string instructions, resulting in a processing speed three or four times that of the 2200. This speed-up is achieved even though the memory cycle time is only nominally faster than that of the 2200. Another feature is an I/O bus that operates at twice the speed of the 2200 bus. Up to 64K bytes of memory can be installed. The operating system can be the same as the 8K operating system of the 2200, or it can be expanded. The 5500 also has additional registers beyond those of the 2200 and various hardware features that modify its architecture to some extent. Nevertheless, the new processor is designed so that all 2200 programs ▷

Datapoint 1100, 2200, & 5500
New Product Announcement

can be run without modification on the 5500. Furthermore, the 5500 employs the same ECMA-standard dual cassette drives, CRT display, and keyboard as the 2200.

Datapoint states that an outstanding feature of the 5500 terminal is a sophisticated multi-programming operating system called the "Djikstra System," which enables multiple simultaneous operations. Exact pricing for the 5500 has not yet been disclosed, but it will cost approximately two or three times as much as the 2200.

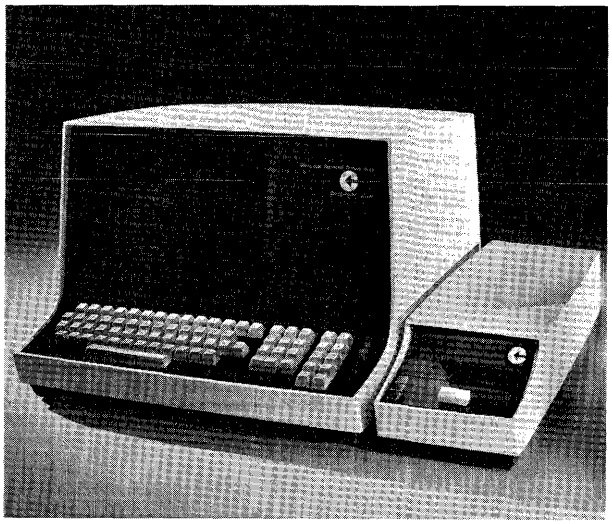
THE DATAPOINT PRODUCT LINE: Datapoint reveals an interesting market philosophy with this expansion of its product line. It attacks the low-order intelligent terminal market with the 1100, which omits disk or tape options and offers only 4K or 8K bytes of memory. Data entry and formatting are possible, but no local data processing. The 1100 also aims at the remote batch terminal market; the main peripheral devices are a printer and card reader, but again no local processing is provided. At an intermediate level of remote operation is the 2200 terminal. It possesses data processing power and in addition can control a multi-station intelligent terminal installation of up to eight stations. Remote data entry and remote job processing are widely used capabilities of this popular terminal. Finally, more detailed processing and more complex multi-station operations will be implemented by the 5500. Datapoint's clear intention here is to perform many complex operations that presently are considered a monopoly of the central computer.

A schedule of prices for the 1100 follows. All lease charges include on-call maintenance. The quantity discounts quoted by Datapoint are worthy of notice. □

	Monthly Rental				
Datapoint 1100	**1-Year Lease**	**2-Year Lease**	**3-Year Lease**	**Purchase**	**Monthly Maint.**
With 4K-byte memory	$213	$195	$168	$7,200 (1) 5,495 (2) 5,215 (3) 4,670 (4)	$30
With 8K-byte memory	245	224	192	8,040 (1) 6,450 (2) 6,130 (3) 5,485 (4)	30
I/O Devices					
Servo impact printer (30-70 cps)	191	184	171	6,300 (1) 5,430 (2) 5,160 (3) 4,615 (4)	35
Centronics matrix printer (65-125 lpm)	(5)	(5)	(5)	(5)	(5)
Communications Adapters					
Asynchronous (without modem)	38	36	31	910 (1) 840 (2) 798 (3) 715 (4)	10
Asynchronous (with Bell 103 or 202 modem)	56	52	45	1,500 (1) 1,380 (2) 1,310 (3) 1,175 (4)	10
Synchronous	38	36	31	910 (1) 840 (2) 798 (3) 715 (4)	10
Multiple Port (up to 8 asynchronous lines)	57	53	47	1,250 (1) 1,225 (2) 1,197 (3) 1,070 (4)	15

(1) Cost of single terminal.
(2) Cost per terminal for quantities of 3 to 24.
(3) Cost per terminal for quantities of 25 to 49.
(4) Cost per terminal for quantities of 50 or more.
(5) Prices not yet available.

Datapoint 3300 and 3000 Display Terminals



These low-priced CRT terminals offer Teletype compatibility, selectable transmission speeds up to 2400 or 300 bits/second, and an alphanumeric/numeric keyboard. Options include a tape cassette recorder and a non-impact printer.

MANAGEMENT SUMMARY

Would a low-priced interactive CRT terminal designed to be completely compatible with a Teletype 33 or 35 teletypewriter and including features such as alphanumeric/numeric keyboard, a wide range of manually-selectable transmission rates, hard-copy capability, and a cassette tape recorder satisfy your needs? If so, take a good look at the Datapoint 3300 or the Datapoint 3000.

The Datapoint 3300 and 3000 are completely hardware- and software-compatible with the Teletype 33 and 35 teletypewriters. Although they were designed specifically for time-sharing applications, they can serve in other application areas as well. Attractively styled, the units feature a glare-reducing tinted shield over the CRT screen, MOS read-only (character generator) and refresh (display) memories, and a simplified keyboard layout that includes an adding-machine keygroup located to the right of the main typewriter-style key group.

An optional tape cassette recorder, contained in a separate unit, adds power and flexibility to the Datapoint 3300. Received data such as formats can be recorded on the cassette tape and then read, displayed, and edited upon demand. Roll Up and Down controls move the tape forward or backward, causing the displayed text to move toward the top or bottom of the CRT screen, analogous to a moving scroll.

An optional non-impact printer, made by NCR, provides hard-copy output for either model. The complete contents of display memory are printed at 30 characters per second when a print function is initiated. (A full screen of 1,800 characters takes about a minute to print.) The printer uses special electrothermal paper available from Datapoint in 150-foot rolls.

CHARACTERISTICS

MANUFACTURER: Datapoint Corporation (formerly Computer Terminal Corporation), 9725 Datapoint Drive, San Antonio, Texas 78284. Telephone (512) 696-4520.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode. Switch-selectable transmission rates up to 300 bits/second are standard for the Datapoint 3000. Switch-selectable rates up to 2400 bits/second are standard for the Datapoint 3300. The available rates in bits/second are: 110, 220, 440, 880, 1760, 150, 300, 600, 1200, and 2400.

The 8-level (including parity) ASCII transmission code is used. The code structure at 110 bits/second is 11 bits/character and includes one start and two stop bits. At all other rates, the code structure is 10 bits/character including one start and one stop bit.

The Datapoint 3300 and 3000 are completely compatible with the Teletype Model 33 and 35 teletypewriters.

Connection to a voice-band communications facility is established via a modem. Datapoint supplies its own acoustic coupler for operation over the public telephone network at rates of 110, 220, and 440 bits/second.

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT with a viewing area 7.5 inches wide by 6 inches high. The screen is arranged in 25 lines of 72 characters each to total 1800 character positions. A character set of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols, is displayed in green against a black background. Characters are formed by a 5-by-7 dot matrix.

DEVICE CONTROL: Provided by 18 control codes. Control codes can be interspersed with data to control operations such as cursor positioning, line feed, bell, erase functions, etc. Control codes are not stored.

The terminal operates in the character mode. Each character is transmitted as it is keyed and displayed only when returned from the remote computer in the full-duplex mode, or from the terminal's interface in the half-duplex mode. The terminal can also be operated in an off-line mode, which displays each character as it is keyed.

The cursor can be positioned in any of four directions: up, down, left, and right. Repetitive operation is provided for these functions, but no wrap-around capability is provided. The remote computer can control cursor movement, but cursor keys do not generate control codes unless requested at the user's option. The Up and Down cursor controls move the cursor up or down one line until it stops on the first or last displayed line. The Left and Right cursor controls advance or backspace the cursor by one character position. The cursor moves from the left margin of a line to the right margin of the previous line, and from the right margin of a line to the left margin of the next line.

The cursor can be returned to the first character position of a line (Return) or to the initial character position of

Datapoint 3300 and 3000 Display Terminals

The Baud Rate switch allows the user to select the correct speed for the remote computer facility (or time-sharing service). Speed selection ranges from 110 to 300 bits per second in the Datapoint 3000 and 110 to 2400 bits per second in the Datapoint 3300. The price difference is $30 per month.

Error control is limited to character parity generation at the user's option; error detection is not included.

Because the keyboard is connected directly to the communications interface, a message cannot be composed, edited, and then transmitted. Each character is transmitted as keyed and displayed only when returned from the remote computer. In other words, the Datapoint Terminal behaves as if it were a teletypewriter in the full-duplex mode.

Control codes are generated and transmitted in the control case; unless the coded-cursor option is incorporated, the four prime cursor-control keys are not coded. The cursor can be manipulated by the computer.

For users who plan to communicate by means of the public telephone network, Datapoint provides its own telephone-coupler modem (acoustic coupler) at added cost. The coupler can be easily attached to any conventional telephone.

Datapoint announced and exhibited a prototype of the Datapoint 3300 at the 1969 Spring Joint Computer Conference. Deliveries of the 3300 began in September 1969, and those of the 3000 began in September 1971. Initial deliveries of the printer, cassette recorder, and telephone coupler were made in June and July of 1970. Datapoint says it currently has over 3500 units installed. Datapoint also says it can fill orders immediately (4 weeks at most) since it has a number of the terminals in stock.

Service is provided by Datapoint through a growing staff of 50 customer engineers assigned to 30 service centers spread across the nation. Response time to service calls is currently quoted at half a day for locations within reasonable proximity of a Datapoint service center.

Datapro talked with numerous users and found them to be quite satisfied–and downright enthusiastic in some cases–with the overall performance and reliability of the Datapoint terminals. Some users, however, expressed dissatisfaction with the reliability of the thermal printer. Service, when required, was rated as good. □

the first (Home Up) or last (Home Down) displayed line. The Line Feed control moves the cursor down one line; at the bottom line, the displayed text will roll up one line for each line feed, erasing the first line of displayed text.

Erase functions erase either the screen beginning at the cursor or one line beginning at the cursor.

Roll Up and Roll Down controls move the displayed text vertically toward the top or bottom of the screen; as the text moves beyond the first or last displayed line it disappears from view. This function further extends the usefulness of the Datapoint 3300 when the cassette recorder is added. The controls then move the recorded tape forward or backward and on the CRT screen produce the effect of a long page of data (scroll) moving up or down behind a window, allowing only a portion of the text (page) to be viewed. The Roll Up and Roll Down controls step through a line at a time or move through a number of lines until the desired information is displayed without causing cursor movement.

Answerback responds with a programmed 21-character sequence to a keyed Here Is or a received WRU. Break, when keyed, transmits a space sequence; Rubout transmits a mark sequence.

ERROR CONTROL: Parity can be generated for each character keyed, but is not checked on received data.

KEYBOARD: 54-key typewriter-style. Two keygroups to the right of the main keygroup include an 11-key numeric insert (adding-machine key arrangement) and a 10-key cursor and control key insert. The keyboard can generate any of 82 ASCII characters, including upper-case alphabetics, numerics, punctuation, and 18 control codes. Repetitive entry of data or initiation of control functions is performed by sustained key depression in conjunction with the keyed Repeat function.

CASSETTE TAPE RECORDER (Datapoint 3300 only): Records display information on a "Philips-type" cassette, which contains 300 feet of 0.15-inch magnetic tape recorded at 1200 bits/inch (11 bits/character): total cassette storage capacity is 500,000 characters. The on-line data transfer rate is 120 characters/second; off-line, the rate is reduced to 60 characters/second.

PRINTER: Non-impact thermal printer prints at terminal speed (up to 30 characters/second) on an 8.5-inch wide, 150-foot roll of special paper. Characters are formed within a 5-by-7 dot matrix. Provides 80 print columns and can be controlled by the operator or remote program. Prints from any of five switch-selected Datapoint 3300 or 3000 Terminals. Paper is available from Datapoint.

PRICING: The Datapoint 3300 and 3000 are available for purchase, on a short-term lease, or on a one-year lease, which includes prime-shift maintenance. Purchase installment-payment plans are available for periods of three to five years. A separate maintenance contract is available for purchased units.

Device	Rental (1-Year Lease)	Purchase	Monthly Maint.
Datapoint 3300	$110	$3,240	$15
Datapoint 3000	80	2,400	10
Tape Recorder** (cassette)	70	2,040	10
Printer	95	2,860	10
Acoustic Coupler	20	350	10
Answerback	–	120	–

* Includes prime-shift maintenance.
** Datapoint 3300 only. ■

Data Products PortaCom

PortaCom, a portable, interactive data communications terminal designed primarily for time-sharing applications, provides Teletype compatibility, a 128-character ASCII keyboard with numeric inset, printed output, and an optional cassette tape unit. An integral acoustic coupler puts the PortaCom on-line with the user's computer facility via any conventional telephone.

MANAGEMENT SUMMARY

In today's complex business environment there exists a definite need for a small, lightweight, interactive communications terminal that can be hand-carried, tucked under the seat of an airplane, and placed on-line with a computer that has a teletypewriter-oriented data communications capability or with a compatible terminal by simply connecting the terminal to the nearest telephone.

These requirements describe the Data Products PortaCom, a 30-pound portable communications terminal contained in an attache case that measures 18 by 19 by 5 inches. The terminal is readied for operation by placing it on a flat surface next to a telephone and a 110-volt AC outlet (the terminal is not battery-powered). Unlocking and lifting the PortaCom lid (which can be removed for added convenience) exposes a pin-fed impact printer and a full ASCII keyboard complemented by a numeric keygroup just to its right.

Operation is simple. Having checked to ensure that the printer contains enough paper, the PortaCom operator plugs the unit into an AC outlet, switches the power on, and establishes a connection to the computer or compatible terminal by dialing. The terminal is switched to the originate mode and the telephone handset is cradled in the acoustic telephone coupler located on top of the unit. Communications assurance is provided by a built-in ▷

CHARACTERISTICS

MANUFACTURER: Data Products Corporation, Telecommunications Division, 17 Amelia Place, Stamford, Connecticut 06902. Telephone (203) 325-4161.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode at speeds up to 300 bits/second (27.3 char/second). The 7-level, 11-unit (including character parity) ASCII transmission code is used.

An integral acoustic telephone coupler, which operates in the originate or answer mode, provides compatibility with modems equivalent to the Bell System Series 100 modems.

Transmission characteristics are compatible with those of the Teletype Model 33 Teletypewriters.

DEVICE CONTROL: Designed for query/response operation, the PortaCom provides for data entry via keyboard, and for data output via an impact printer. The terminal transmits any of 128 ASCII characters and prints 64. Data is printed as it is received and transmitted as it is keyed.

When the PortaCom is equipped with the PortaTape cassette recorder, keyed data can be recorded on tape as it is printed and transmitted from tape at 10, 15, or 30 characters per second. Data can also be received and recorded at speeds up to 30 char/second, but printing is inhibited at transmission rates that exceed 10 char/second. The PortaTape can perform read, write, and search functions, and, as an option, remote control via received control codes can be implemented. The PortaTape unit can also be used off-line to produce printed copy.

Local control keys initiate functions that include backspace, space, line feed, and carriage return.

The Break key, used to interrupt a computer message, transmits a constant space signal when depressed.

Test keys are provided to allow testing local or remote circuits.

Modem controls allow the selection of the answer or originate mode.

Received control codes initiate carriage-return and/or line-feed operations. ➤

Data Products PortaCom

speaker that allows the operator to monitor the data tones. If the Answer-Back option is incorporated, the operator can identify his terminal by keying "Here Is," which initiates the programmmable response. Communication continues until the call is terminated by hanging up the telephone.

The terminal is capable of generating and checking character parity. The operator can select even or odd parity or inhibit error control altogether.

Printing is performed at a "Teletype" speed of 10 characters per second. The printer uses a standard typewriter ribbon and can produce an original and up to three copies; the print line can contain a maximum of 80 characters. Carriage return and line feed are performed automatically after the 80th print position is reached. The printer handles all lower-case alphabetics as upper-case equivalents.

The ASCII control codes are clearly identified on the individual keys of the full ASCII keyboard.

The PortaCom terminal is built around a Mite printer mechanism and, in addition to its typewriter-style alphanumeric keyboard, provides an arithmetic capability via its numeric keygroup. These keys, arranged in 10-key adding-machine format, are surrounded by 13 additional keys that provide the more frequently encountered arithmetic symbols common to FORTRAN and other programming languages.

Transmission speed can be increased to 30 characters per second through the use of the PortaTape cassette recorder, which significantly enhances the operating flexibility of the PortaCom terminal.

The PortaCom terminal was announced early in 1969. First deliveries were made in March 1970. To date, roughly 2,000 units have been delivered. Lead time on orders is currently quoted at 30 days after receipt of order, and Data Products says it has responded to most of its orders within a two-week period.

Service is provided by Sorbus, a nationwide service organization headquartered in King of Prussia, Pa.

The PortaCom terminal is manufactured by the Telecommunications Division of Data Products, which prior to May 1969 belonged to Stelma, a 20-year old manufacturer of industrial telephone and telecommunications equipment. □

The optional Answer-Back Generator transmits a terminal-identification message containing up to 21 programmed characters in response to a received inquiry (ENQ) code or keyed Here Is code.

An RS 232B interface permits the attachment of peripheral devices such as a tape cassette recorder, tape punch, etc.

ERROR CONTROL: Character parity, when selected, is generated and accompanies each character transmitted and is checked for each character received. Odd or even parity can be manually selected, or parity checking can be inhibited. A detected parity causes printing of a solid box in place of the character received in error.

KEYBOARD: 58-key typewriter style. The keyboard can produce any of 128 ASCII characters, including upper- and lower-case alphabetics, numerics, punctuation, special symbols, and control codes. A row of 6 function keys, which provide local control functions, and 10 control switches, which provide communication, testing, parity, and mode control, is located directly above the main keygroup.

A 23-key numeric keygroup that includes the 10 numerics and 13 special symbols used for arithmetic operations is located to the right of the main keygroup.

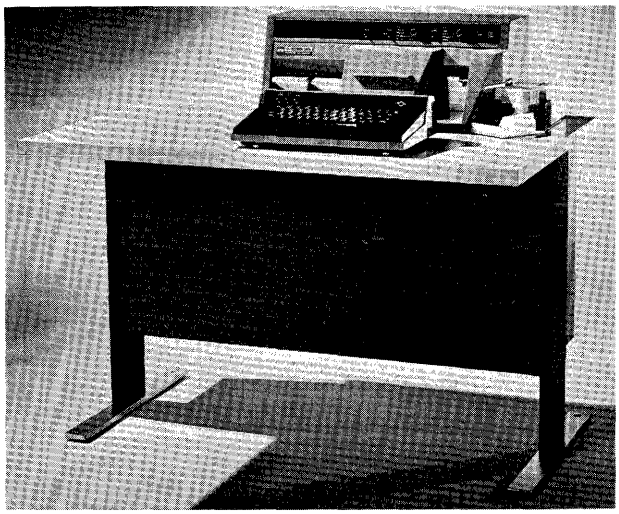
PRINTER: Prints any of 64 ASCII symbols, including upper-case alphabetics, numerics, and special symbols. Received or key-generated lower-case alphabetics are printed as the corresponding upper-case equivalents. Printing is performed by impact at speeds up to 10 char/second. The unit prints up to 80 characters per line, spaced at 10.8 char/inch. Vertical spacing is 6 lines/inch.

The printer accommodates pin-fed, 3-part continuous forms (or single sheets) 8.5 inches wide. A standard half-inch typewriter ribbon is used.

CASSETTE RECORDER: The PortaTape cassette unit employs a Philips-type cassette, which contains 300 feet of 0.15-inch wide magnetic tape. Total cassette storage capacity exceeds 50,000 characters, recorded at 550 bits/inch. Data transfer rate is selectable as 10, 15, or 30 char/second. The unit is equipped with an EIA RS-232 interface and is available with remote control. The drive is incremental and is produced by International Computer Products (ICP) as the TermiCette Series 3000.

PRICING: The PortaCom terminal and PortaTape cassette unit are available from Data Products for purchase only. The PortaCom terminal sells for $1,695; the PortaTape unit sells for $1,450. The Answer-Back Generator is available for $75. Third-party leases are available through Data Products distributorships located in several major cities. A maintenance contract is available for purchased units and is priced at $180 per year. ■

Decision Data 9601 and 9610 Data Recorders



This view of the 9610 Interpreting Data Recorder clearly shows the dual input hoppers at right and dual stackers at left. The non-printing 9601 Data Recorder is identical in appearance except for the absence of one control switch.

Decision Data, the largest independent maker of 96-column punched card equipment, produces a family of 96-column devices for the IBM System/3 and other small computers. Besides the expected price breaks over the equivalent IBM units, Decision Data's 9600 Series card keypunch/verifiers offer numerous functional advantages.

MANAGEMENT SUMMARY

Decision Data now ranks as the largest independent manufacturer of 96-column punched card equipment and is producing a growing line of 80-column equipment as well. The firm announced the delivery of its 5000th 96-column data recorder in August 1973—an amazing growth record for a company that delivered its 1000th unit just one year earlier. Formed in November 1969, the company is dedicated to producing card equipment for the rapidly expanding IBM System/3 market and for other small data processing systems.

At its inception, Decision Data sold strictly on an OEM basis, but since then the company has developed its own sales and service organizations to facilitate end-user sales. The company's engineering and marketing competence in the punched card industry can be traced to the earlier development (by key Decision Data personnel) of the UNIVAC 1700 series card keypunches that have scored a huge success for UNIVAC.

The Decision Data 9601 and 9610 Data Recorders are designed for compatibility with the IBM 5496 Data Recorder, but they also include powerful features not provided by the 5496. Salient features include:

- Rated operating speeds that are double those of the IBM 5496.
- Two input hoppers and two output stackers.
- A visible wait station preceding the punch station.
- Added keyboard functions.

CHARACTERISTICS

MANUFACTURER: Decision Data Computer Corporation, 100 Witmer Road, Horsham, Pennsylvania 19044. Telephone (215) 674-3300.

MODELS: 9601 Data Recorder and 9610 Interpreting Data Recorder; both are buffered units.

CARD OUTPUT: Standard 96-column cards punched in 6-level, 96-column card code.

The IBM 96-column card is about one-third the size of the standard 80-column card and holds 20 percent more data. The card measures 3.25 inches wide by 2.63 inches high. The upper portion of the card can accommodate up to four printed lines, each containing up to 32 characters. The lower portion consists of three "tiers" of punching positions; each tier can hold 32 characters of data. Punched data is expressed in a 6-bit code and represented by tiny round holes.

Print positions at the top of the card correspond by number to the positions below. Although four rows are provided for printing, only three are used by the 9610; the fourth is provided for use by IBM System/3 components other than the IBM 5496 Data Recorder. Rated card speeds are as follows. (Note that these are maximum speeds, for operations that require no manual data entry or other operator intervention.)

Device Function	Card Columns	Rated Speeds, cards/minute 9601 DR	9610 IDR
Punch	96	60	60
Verify	96	60	60
Reproduce	96	45	45
Reproduce and Print	96	–	30
Interpret	96	–	60

When performing card operations on only the first few columns, rated card speed approaches the following maximums: Punch/Verify/Interpret–120 cpm; Reproduce–90 cpm; Reproduce and Print–60 cpm.

Primary and secondary input hoppers hold 600 and 400 cards, respectively. Two output stackers each hold 400 cards. Cards are loaded face-forward with printing at top. Cards are fed front card first (from the primary hopper) or rear card first (secondary hopper). Cards are stacked face-forward with printing at top; stacker overflow is provided.

Decision Data 9601 and 9610
Data Recorders

- Added operating modes.
- An easily replaceable ink cartridge.

Both the 9601 and 9610 Data Recorders provide a substantial increase in operating speed over their IBM counterpart. Cards are fed, read, and placed in a visible wait station at a rate of about 250 cpm. When verifying without printing, correctly-punched cards are slewed through the punch station at this high rate of speed, as compared to 30 cpm for the IBM 5496.

Increased operating flexibility and efficiency are provided by the addition of a second input hopper and output stacker. As an example, blank cards, placed in the auxiliary hopper prior to a verify operation, are automatically fed and punched with corrected data; the verified-incorrect cards are separated out via the second stacker. The additional hopper and stacker are also advantageous in other operating modes. The card capacity of the primary hopper has also been extended beyond its IBM counterpart by 250 cards.

The visible wait station ahead of the punch station will be greatly appreciated by installations that write or type updating data on the face of a card. This is another feature that is not provided on the IBM 5496.

In addition to the operating modes provided by the IBM 5496, Decision Data has added a Reproduce mode, which permits reproducing and interfiling of punched cards for added flexibility. Separate Print modes have been added on the 9610 to provide program-controlled printing during punch or verify operations, in addition to the normal print operations that are available on the IBM 5496. A programmed punch suppression feature permits printing without punching.

Decision Data has made keyboard modifications to both the 9601 and 9610 to increase the flexibility and ease of operation. The Verify Field Correct function has been added to the keyboard; on the IBM 5496 this function is located on the operator panel. A new key, Minus Right Adjust, has been added that right-adjusts a numeric field and adds a minus punch. A Backspace key has also been added to permit the operator to backspace through a field in order to make corrections. By keying Home, control reverts back to the first column of a record.

For those operators who refuse to change the ribbon cartridges on the IBM 5496 because of the messy fingers that usually result, Decision Data's 9610 incorporates a commendable design change. Decision Data has replaced the ribbon cartridge with a Porelon cartridge ink roller. The Porelon cartridge can be replaced quickly and easily without ever touching the ink roller.

Decision Data's family of 96-column card products includes 10 members, but only 4 are currently available to

The card path is arranged in the following sequence: read, wait (visible), punch, and print (9610 only).

DEVICE CONTROL: Data and programs are stored in independent buffers. Buffer storage capacities are as follows:

	Data Storage	Program Storage
9601	288 char. (3 cards)	2,304 bits
9610	384 char. (4 cards)	2,496 bits

Provision is made for storing four programs simultaneously, with manual switching among programs.

The program controls the format of the data by delimiting alphabetic, numeric and special fields and by initiating automatic field skipping, duplicating, right justification (left zero fill), and optional check-digit verification.

New programs are entered automatically from punched program cards on a one-program-per-card basis. Any one of four stored programs can be manually selected, or all can be disabled to permit the operator to completely control the format of the recording.

Operating modes are: Program Load, Punch, Verify, and Reproduce. Additional functions provided by the 9610 are: Interpret, Print, Verify Print, Print Edit, and Verify Print Edit.

The Program Load mode reads the program from an entered program card into the selected program memory. Program cards can be fed from primary or secondary hoppers, but are always stacked in the second stacker. Print Edit programs are loaded into a separate memory reserved for that application.

The Punch mode punches keyed data contained in memory into cards fed from either primary or secondary hoppers and delivers the punched cards to Stacker One.

The Verify mode compares keyed data column-for-column with the data read from a card. The card is fed from the primary hopper, its contents are read into memory, and the card is retained at the visible wait station until its contents have been verified. Corrections made during the Verify mode require reverification of each corrected field unless the reverification is performed manually as each column is corrected by backspacing and reverifying the corrected column. The whole card must be reverified if corrections were made without program control. A card that has been verified without corrections is notched and delivered to Stacker One, and the next card to be verified is fed. A card containing errors is delivered to Stacker Two un-notched; a blank card is automatically fed from the secondary hopper, punched with the corrected data notched, delivered to Stacker One, and the next card to be verified is fed.

The Reproduce mode feeds the card to be reproduced from the primary hopper, reads its contents into memory, and delivers the card to Stacker One. A card is then fed from the secondary hopper, punched with the contents of the previous card, and delivered to Stacker Two. As an alternative, all cards can be delivered to Stacker One. Editing functions operate on a column basis and include skipping and substituting a blank or a character from dup memory. Two card decks can be merged by programming a skip for each card column.

The Interpret mode (9610 only) feeds a card from the primary hopper, reads its contents into memory, prints the

Decision Data 9601 and 9610 Data Recorders

Feature 1020 equips a Decision Data 9601 or 9610 Data Recorder or 9660 Sorting Data Recorder (Report 70D-363-02) to perform 80-column to 96-column card conversions by adding an 80-column card reader (at left). Card files are converted at a speed of 60 to 120 cards/minute.

end users; the rest are marketed strictly on an OEM basis. End-user products include the 9601 and 9610 Data Recorders, the 9620 Alphanumeric Sorter (Report 70D-363-03), and the 9660 Sorting Data Recorder (Report 70D-363-02). OEM products include: two models of card readers (9625 and 9630) with respective rated speeds of 300 and 1200 cpm; a reader/punch (9635) and a printing reader/punch (9645) with rated speeds of 60 to 120 cpm (punching/printing and 300 cpm (reading); a printing punch (9640) with optional read station, two print stations, and three stackers rated at 120 to 240 cpm (punching/printing) and 1000 cpm (reading); and a 6-pocket multi-function card unit (9650) featuring upper and lower input feeds with rated speeds of 120 to 240 cpm (punching/printing) and 1000 cpm (reading).

Users with existing 80-column card files can convert to a 96-column format via the 1020 feature, a combined 80-column card reader and 9601 or 9610 Data Recorder. The feature can be installed in the field on any existing 9601 or 9610. The 1020 feature also permits the continued use of 80-column cards in a 96-column card environment.

System/3 users with small-scale requirements for the conversion of manually- or machine-encoded documents to 96-column punched cards can satisfy their needs by adding the OpScan 17 Source Document Reader (Report 70F-320-01), produced by Optical Scanning Corporation, to a 9601, 9610, or 9660 Data Recorder. The OpScan 17 reads marks or block-printed numerics as well as computer-generated numeric data. Since initial deliveries in March 1973, about 20 of the OpScan units have been delivered for use with Decision Data's 9600 series data recorders. OpScan 17 prices range from $5,750 (basic unit) to $8,095 (with all options) for purchased units and

data on the card, and delivers it to Stacker One. Stacker One automatically overflows into Stacker Two.

Printing (9610 only) can be performed on the cards in either Punch, Verify, or Reproduce mode. Printing can be performed without punching in the Punch mode on a column-by-column basis when operating with the program-controlled Punch Suppress feature. Only corrected cards need be printed in the Verify mode (though all cards can be printed if desired); only reproduced cards are printed in the Reproduce mode. When reproducing under program control with auto skip/dup enabled, fields programmed for skip are not printed; fields programmed for duplication are printed with the data to be duplicated.

Printing can be edited via a program in the print-edit memory. The print-edit program, which operates on a column-by-column basis, can erase specific character positions of the print memory and inhibit the transfer of data into those positions, allow the current contents of print memory to be retained but inhibit the transfer of data into those print memory positions, or print numeric columns with a minus overpunch as numbers, not letters.

Punch Suppress and Print Edit functions are independent operations that can be performed on the same card.

The optional Interspersed Master Card feature controls punching, verifying, and interpreting of interspersed master and detail cards (i.e., cards without an upper-left corner cut). Master or detail card operation is switch-selected and requires the use of two programs. This feature also controls interspersed gang punching.

The operator panel provides a two-digit column indicator to display the current location within the record. Status conditions such as operating mode, active program, error, and fault conditions are displayed in English, but are not visible until lighted.

The Production Statistics feature, an option, consists of three 6-digit counters located over the leftmost stacker. The counters present the total number of cards processed (reset-table counter), total number of keystrokes x 10 in the Punch or Verify mode, and total errors (Verify Corrected).

Decision Data 9601 and 9610
Data Recorders

$195 to $325 per month (including maintenance) for leased units. Maintenance for purchased units is priced at $38 to $51 per month. Total unit support, including installation, is provided by Optical Scanning Corporation.

Decision Data inked an agreement with Burroughs Corporation in April 1971 for the delivery of 96- and 80-column card peripheral devices to Burroughs on an OEM basis. Burroughs is using the Decision Data units (with Burroughs nameplates) at its own customer installations and provides its own service support.

Decision Data began field tests of its 9601 Data Recorders at customer locations early in 1971. First deliveries of the 9610 were made in June 1971. By August 1973 over 5000 units had been delivered.

Sales and service are provided solely by Decision Data, which currently has sales and service facilities located in 40 major cities throughout the U.S. and Canada.

Decision Data also has a European affilate with a 600,000-square-foot manufacturing facility in Castlereagh, Northern Ireland. The affiliate, International Engineering, Ltd. (IEL), serves the European market.

USER REACTION

All Decision Data users contacted by Datapro were well pleased with the overall performance of the 9600 series units and the associated service. Users rated the performance of the Decision Data units to be superior to that of their IBM equivalents and generally commented that a notable increase in productivity was observed after replacing the IBM units.

Reliability was rated as good to excellent. Some failures were reported on early production machines, but these were resolved within a short time either by repair or by replacement. One user noted motor vibration within his keyboard, which he said has been cleared up on newer machines.

Key features that were noted and appreciated by the data recorder users include the visible wait station, punch suppress, print edit, and reproduce features. Most of the interviewed users have several 9610's and at least one 9660; few 9620's were encountered, although their performance was highly rated. □

ERROR CONTROL: In the Punch mode, keying errors detected by the operator can be corrected by backspacing column-by-column and rekeying the correct character. Backspacing can be performed under manual or program control. Field Erase and Record Erase functions permit the operator to erase all data that has just been keyed into a field or record, respectively; duplicated data is not erased. Check digit verification for modulo 10 or 11 self-check numbers is optional.

KEYBOARD: 54-key keypunch-style keyboard can produce any of 64 character codes, including 10 numerics, 26 alphabetics, and 28 special characters. The keyboard is identical to that of the IBM 5496 Data Recorder with the exception of four additional control keys: Verify Correct, Minus Right Adjust, Home, and Backspace. The keyboard is designed for "n-key rollover", a design technique that permits character generation to occur only on the downstroke of a key, thereby permitting faster keying and reducing the likelihood of errors.

CARD CONVERSION: Feature 1020 provides 80- to 96-column, off-line card conversion at speeds of 60 to 120 cards/minute. The feature consists of an 80-column card reader (manufactured by Decision Data) which directly interfaces the 9601 or 9610 Data Recorder and provides hopper and stacker capacities of 600 cards each. The card image of each 80-column card is transferred as the card is read to the data recorder for punching (and printing with the 9610).

In addition to basic column-for-column card conversion, Feature 1020 can be operated under program control to perform the functions of inserting blanks between fields of data, gangpunching duplicate data not in the original 80-column cards, and print-editing and punch-suppressing data in the 96-column card output.

PRICING: The 9601 Data Recorder and 9610 Interpreting Data Recorder are available through five discrete financing methods, including three lease plans and two purchase plans. Lease terms are available for one, three, and five years and include maintenance and unlimited equipment usage. Purchases can be made outright or on a deferred payment basis. A separate maintenance contract is provided for purchased units.

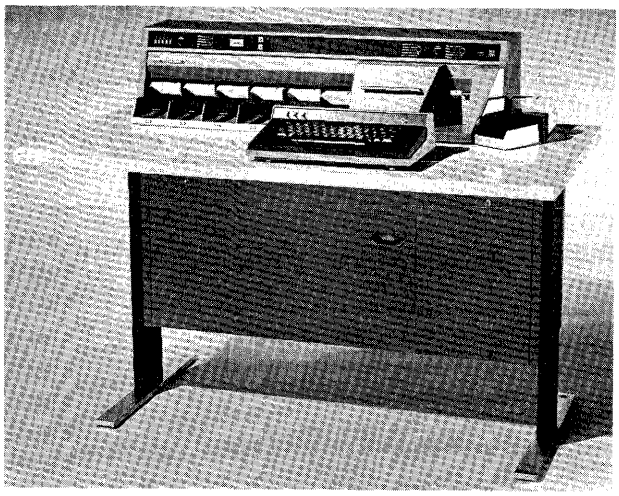
	Monthly Rental*				
Data Recorders	1-Yr. Lease	3-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.
9601	$125	$115	$110	$5,500	$35
9610	155	140	130	7,400	40
Options					
Interspersed Gang Punching:					
Model 9601	10	8	5	300	1
Model 9610	12	10	7	400	1
Mod 10 or 11 Self-Check Number	25	20	14	900	1
Production Statistics	10	8	8	400	2
Feature 1020 (80-to-96-column card conversion)***	125	100	90	3,960	15
Interface**	45	40	30	1,260	10
Ink Cartridge (package of 6)	–	–	–	30	–
Card Rack (6 stackers)	–	–	–	45	–

*Lease prices include maintenance.

**Required for the addition of the OpScan 17 or other products approved by Decision Data.

***Also available on a 3-month rented basis for $180/month. ■

Decision Data 9660
Sorting Data Recorder



This unique 96-column card unit combines the capabilities of Decision Data's 9610 Interpreting Data Recorder with those of a 6-pocket sorter at a substantially lower price than the combined prices of IBM's 5496 Data Recorder and 5486 Card Sorter. Rated sorting speed is 300 cpm.

MANAGEMENT SUMMARY

Decision Data's 9660 Sorting Data Recorder, designed to handle 96-column cards, combines all the capabilities of the 9610 Interpreting Data Recorder with those of a six-pocket alphanumeric sorter. Marketed as an alternative to the IBM 5496 Data Recorder and the IBM 5486 Card Sorter combined, the 9660 offers the user substantial cost savings, though at a considerable reduction in sorting performance.

The 9660 is geared to low-volume operations, as in a small System/3 card installation that is currently doing its sorting on the on-line MFCU, or in a larger System/3 installation that performs most of its sorting via disk drives. For such an environment, the availability of the functions of a keypunch, verifier, interpreter, reproducer, and sorter, all combined in one machine priced well below the combined rental prices of the IBM Data Recorder and Card Sorter, is certainly a tempting consideration.

The chief disadvantages of the 9660 as a sorter are its small card-handling capacity, low-speed operation, and doubled-up pockets. Actually, the 9660 and the IBM 5486 have the same number of pockets and require the same number of card passes per sort, but the cardhandling capability and operating speed of the IBM 5486 far exceed those of the 9660. The 5486 can sort up to 2000 cards in each pass, compared with 600 cards for the 9660. Each stacker on the 5486 can hold 600 cards, compared with 400 each for the 9660. Such a small cardhandling capacity is inconvenient for handling large card files, though this inconvenience can be lessened by the use of an external card rack. Decision Data provides a wire-form rack that holds 11 card trays. The sorting speed of the 9660 is 300 cpm, whereas two models of the IBM 5486 are available that operate at 1000 or 1500 cpm.

Except for its card-handling capacity and operating speed, the 9660's sorting capability is equivalent to that of the IBM 5486. But the 9660 is much more than a sorter. ➢

CHARACTERISTICS

MANUFACTURER: Decision Data Computer Corporation, 100 Witmer Road, Horsham, Pennsylvania 19044. Telephone (215) 674-3300.

CONFIGURATION: The 9600 Sorting Data Recorder combines a six-pocket alphanumeric sorter with the 9610 Interpreting Data Recorder described in Report 70D-363-01.

CARD OUTPUT: Standard 96-column cards punched in 6-level, 96-column card code.

The 9600 contains primary and secondary input hoppers that hold 600 and 400 cards, respectively. Six output stackers hold 400 cards each. Only the first and second stackers are used when operating the 9660 as a data recorder. Cards are loaded face-forward with printing at top. Cards are fed front card first (from the primary hopper) or rear card first (secondary hopper). Cards are stacked face-forward with printing at top.

The card path is arranged in the same sequence as in the 9610: read, wait (visible), punch, and print. Stackers are arranged in the following ascending order: reject, 1/0, 3/2, 5/4, 7/6, and 9/8.

Sort speed is rated at 300 cards/minute. Rated card speeds for the data-recorder functions are the same as those for the 9610 Interpreting Data Recorder; see Report 70D-363-01.

DEVICE CONTROL: The 9660 can function as either an interpreting data recorder or an alphanumeric sorter; the two functions are mutually exclusive. For details of its operation as an interpreting data recorder, see Report 70D-363-01.

The 9660 provides four non-programmable sort modes: Numeric, Numeric Edit, Alphanumeric, and Zone. The Numeric mode ignores zone punches and reads each column as a numeric value. Blanks and special characters are rejected; alphabetics are treated as numerics and are sorted according to their numeric values. The Numeric Edit mode sorts numeric fields only; cards containing zone punches in the sorted column are deposited in the reject stacker. The Alphanumeric mode sorts numerics, alphabetics, and special characters; blanks are rejected. Numerics are deposited in stacker 9/8, alphabetics (in order), in stackers 7/6 (S to Z), 5/4 (J to R), and 3/2 (A to I); specials are deposited in stacker I/O. The Zone mode sorts by zone punches only. The arrangement of cards sorted in the Zone mode corresponds to that of the Alphanumeric mode except that the cards within each stacker are not sequentially arranged.

Numeric and Numeric Edit sorts require effectively one and one-half card passes. Even numbers are sorted first; odd numbers (which include alphabetics in the Numeric mode), special characters, and blanks are rejected. Only the rejected cards are sorted on the second pass. The Alphanumeric mode requires effectively two and one-half card passes. Only the rejected cards are entered for the second pass, but on the third pass, all cards are removed and re-entered. The Zone mode sorts in a single card pass. ➤

Decision Data 9660
Sorting Data Recorder

When not in use as a sorter, it can be used as a keypunch/verifier and interpreter. These capabilities are identical with those of the Decision Data 9610 Interpreting Data Recorder, as described in Report 70D-363-01. Therefore, when considering the 9660, its sorting capability must be placed in the proper perspective: that of a complementary feature to a keypunch/verifier and interpreter that offers numerous advantages over the IBM 5496 Data Recorder. With its sorting feature, the 9660 is priced only $30 per month higher than the 9610. And Decision Data is also marketing a fast 11-pocket alphanumeric sorter for the big operations.

The capabilities of the 9660 can be extended by adding either an 80-column card reader (Feature 1020), which permits 80-column to 96-column card conversions to be performed at 60 to 120 cpm, or an OpScan 17 Source Document Reader, which reads marks or block-printed numerals as well as computer-generated numeric data. Details of both these optional features can be found in Report 70D-363-01.

First customer deliveries of the 9660 were made in August 1971.

Sales and service are provided solely by Decision Data, which currently has sales and service facilities located in 40 major cities throughout the US and Canada.

Decision Data also has a European affiliate with a 600,000-square-foot manufacturing facility in Castlereagh, Northern Ireland. The affiliate, International Engineering, Ltd. (IEL), serves the European market.

USER REACTION

All Decision Data users contacted by Datapro were well pleased with the overall performance of the 9600 series units and the associated service. Users rated the performance of the Decision Data units to be superior to that of their IBM equivalents and generally commented that a notable increase in productivity was observed after replacing the IBM units.

Reliability was rated as good to excellent. Some failures were reported on early production machines, but these were resolved within a short time either by repair or by replacement. One user noted motor vibration within his keyboard, which he said has been cleared up on newer machines.

Key features that were noted and appreciated by the data recorder users include the visible wait station, punch suppress, print edit, and reproduce features. Most of the interviewed users have several 9610's and at least one 9660. □

Sorting is performed on a column-by-column basis, beginning at the least significant character position within a sort field. The 9660 relates the number of card passes per column to sort phases, which are displayed on the operator panel as One, Two, or Zone, corresponding to the first, second, and third card passes. A sort operation is initiated by loading the cards to be sorted in the primary hopper, identifying the sort mode and the column to be sorted, and depressing the start key. Except for the Zone mode, which operates only in the Zone phase, all sorts begin in Phase One. Each pass is et up by depressing the Phase bar, which either advances the process to the next phase or returns it to the beginning phase and decrements the column indicator by one. (The Zone mode remains in Zone Phase and the column counter is decremented.)

The Sort Suppress/Digit Selection option provides two additional sort capabilities. Sort Suppress separates cards that are blank in a column from those than contain data without disturbing the sequence of the cards that contain data. Blank cards are deposited in the reject stacker, data cards in stacker I/O. Digit Select separates cards that contain selected digits in a column from the rest of the deck without disturbing the sequence of the non-selected cards. Any combination of digits can be selected. When using Digit Selection with Sort-Suprress, cards containing selected digits are deposited in their corresponding stackers; the rest of the deck is deposited in the reject stacker. When both features are used together, cards with selected digits are deposited in stacker I/O, and the remaining cards are deposited in the reject stacker.

Other available options include the Interspersed Master Card feature, Self-Check Number verification, Punch Check feature, and a computer peripheral interface for on-line operation. The Punch Check feature requires the peripheral interface and includes a post-punch read station to verify the entire punched image of a card.

The Production Statistics feature, another option, consists of three 6-digit counters located over the leftmost stacker. The counters present the total number of cards processed (resettable counter), total number of keystrokes x 10 in the Punch or Verify mode, and total errors (Verify Corrected).

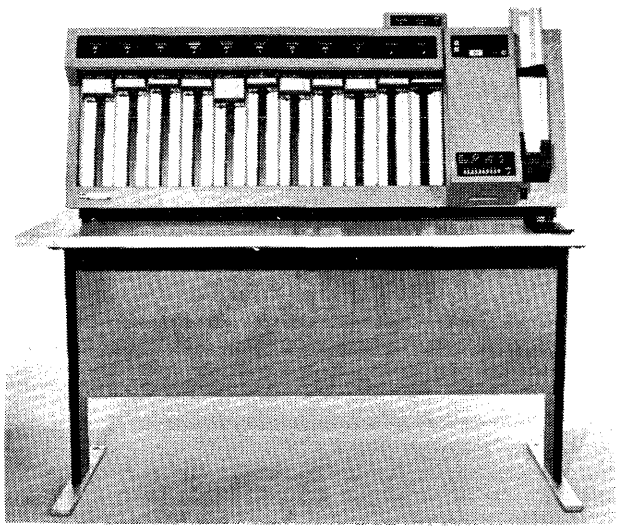
KEYBOARD: The keyboard is identical with that of the 9601 and 9610 Data Recorders; see Report 70D-363-01.

PRICING: The 9660 Sorting Data Recorder is available through five discrete financing methods, including three lease plans and two purchase plans. Lease terms are available for one, three, and five years and include maintenance and unlimited equipment usage. Purchases can be made outright or on a deferred payment basis. A separate maintenance contract is provided for purchased units.

	Monthly Rental*				
	1-Yr. Lease	3-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.
9660 Sorting Data Recorder	$185	$170	$155	$8,400	$45
Options					
Sort Suppress/Digit Select	10	8	7	400	1
Interspersed Gang Punching	12	10	7	400	1
Mod 10 or 11 Self-Check Numbers	25	20	14	900	1
Production Statistics	10	8	8	400	2
Interface**	45	40	30	1,260	10
Feature 1020 (80-to-96-col. card conversion)***	125	100	90	3,960	15
Card Rack (6 stackers)	–	–	–	45	–
Ink Cartridge (package of 6)	–	–	–	30	–

* Lease prices include maintenance
** Required for the addition of the OpScan 17 or other products approved by Decision Data.
*** Also available on a 3-month rental basis for $180/month. ■

Decision Data 9620 Alphanumeric Sorter



This alphanumeric sorter, designed for 96-column cards, is rated at 1500 cpm and is capable of sorting up to 2000 cards into 11 pockets without reloading. The unit offers several advantages over the IBM 5486 Card Sorter at a lower price.

MANAGEMENT SUMMARY

Decision Data's 9620 Alphanumeric Sorter, designed to handle 96-column cards, has no equivalent in IBM's System/3 family of products. The 9620 employs the 11-pocket convention, provides an input hopper capacity of 2000 cards and a per-stacker capacity of 1200 cards, and has a rated operating speed of 1500 cpm.

Besides these distinguishing features, the sorter offers four standard operating modes, plus options such as Sort Suppress and Digit Select, 64-character sorting, and resettable digital counters that tally totals, grand totals, and individual pocket totals. As for its appearance, the unit's smooth and attractive styling lends itself well to an IBM System/3 environment.

But what about application? As you know, IBM's Multi-Function Card Unit (MFCU), which is an integral part of the System/3 architecture, can be used as a sorter in addition to its other functions; but the card-sorting capability of the MFCU is severely limited. For card-oriented installations that need further sorting capability, IBM offers its 5486 Card Sorter, available in two models that differ only in rated operating speed. Although the 5486 substantially increases a System/3 installation's sorting capability, its compressed six-pocket construction and its small pocket capacity (only 600 cards per stacker) complicate its operation and restrict its throughput.

A big sorter designed for high-volume 96-column card operations is not currently available from IBM. But Decision Data's 9620 fills the bill very neatly—and at 4 to 15 percent below the monthly rental price of the 1500-cpm IBM 5486.

The 11-pocket 9620 sorts numerics in just one pass, alphabetics in 1-2/3 passes, and alphanumerics in 2½ passes (assuming even character distribution). By comparison, IBM's 5486 sorts numerics in 1½ passes, alphabetics in 2 passes and alphanumerics in 2½ passes. The major difference between the two sort operations, other

CHARACTERISTICS

MANUFACTURER: Decision Data Computer Corporation, 100 Witmer Road, Horsham, Pennsylvania 19044. Telephone (215) 674-3300.

CARD OUTPUT: Standard 96-column cards punched in 6-level, 96-column card code.

The input hopper has a capacity of 2000 cards. Cards are placed in the hopper face down with the printing at the front. The bottom card is fed first.

Eleven card stackers are provided, each with a 1200-card capacity. Cards are stacked face down in proper ascending file sequence.

Sort speed is rated at 1500 cards/minute.

DEVICE CONTROL: The 9620 provides four sort modes: Numeric, Alphabetic, Alphanumeric, and Special Character.

The Numeric mode sorts numeric fields only and requires one sort phase. Cards containing numeric data in the selected column are deposited in stackers 0 through 9; cards containing other than numeric data in the selected column are rejected.

The Alphabetic mode sorts alphabetic fields only and requires three sort phases; cards must be removed from the stackers after each pass. During the first phase, cards containing letters A through I in the selected column are deposited in stackers 1 through 9, respectively, cards containing letters J through R and the RH bracket symbol (zones only punched) are deposited in stacker 0, and the rest are rejected. During the second phase, cards containing letters J through R are deposited in stackers 1 through 9, respectively, the RH bracket symbol in stacker 0, and all others are rejected. During the third phase, cards containing letters S through Z are deposited in stackers 2 through 9, cards containing numeric data are deposited in stacker 1, cards containing special symbols are deposited in stacker 0, and cards containing no punches are rejected.

The Alphanumeric mode sorts numeric and alphabetic fields. The operation requires four phases; cards must be removed from the stackers after each phase. The first phase sorts numerics and is performed exactly as in the Numeric mode. The second through fourth phases sort alphabetics, and each phase is performed exactly as in the Alphabetic mode.

The Special Character mode sorts fields containing special characters. The operation requires three phases; cards must be removed from the stackers after each phase. Cards are sorted according to an EBCDIC sequence. All cards containing alphabetics and numerics in the selected column are deposited in the reject stacker during each phase.

Decision Data 9620
Alphanumeric Sorter

than the number of card passes per column, is that the 9620 provides the capability to separate individual characters, whereas the IBM 5486 sorts cards into character groups.

Service is facilitated by a plug-in diagnostic circuit board, common to all Decision Data product lines, that helps service technicians to isolate and diagnose malfunctions within the equipment.

Sales and service are provided solely by Decision Data, which currently has sales and service facilities located in over 60 major cities throughout the U.S. and Canada.

Decision Data also has a European affiliate with a 600,000-square-foot manufacturing facility in Castlereagh, Northern Ireland. The affiliate, International Engineering, Ltd. (IEL), serves the European market.

First customer deliveries of the 9620 were made in September 1971. As of June 1975, Decision Data had delivered over 15,000 units of its 96-column card equipment, which includes more than 500 of the 9620 Sorters. Lead time on orders is currently quoted at 60 days after receipt of order.

USER REACTION

Datapro conducted telephone interviews with eight users of the Decision Data 9620 Alphanumeric Sorter, who reported on their experience with a total of eight units. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	2	5	0	1	3.0
Ease of operation	4	4	0	0	3.5
Hardware reliability	3	2	2	1	2.9
Maintenance service:					
Promptness	5	1	1	1	3.3
Quality	3	4	0	1	3.1

*Weighted Average on a scale of 4.0 for Excellent.

The majority of these users were well satisfied with the 9620, as indicated by the preponderance of high ratings. A few users, however, had experienced difficulties with the unit, reporting occasional missorts, read-check errors, and card jams, which the users said were quickly resolved by Decision Data maintenance personnel.

The poor ratings for promptness and quality of maintenance service were supplied by two different users. The one who rated promptness as poor rated quality as good, while the user who rated quality as poor rated promptness as excellent. The poor ratings for overall performance and hardware reliability came from one user whose experience with the 9620 began in October 1973. This user, who had his initial 9620 replaced with a second unit after the first had been installed for nearly a year, has been plagued by equipment failures with both units, including misfeeds, missorts, and card jams. □

Sorting is performed on a column-by-column basis, beginning at the least significant character position within a sort field. The 9620 relates each card pass per column to a specific sort phase, displayed on the operator panel as Numeric, Alpha 1, Alpha 2, or Alpha 3. The sequence of sort phases is automatically determined by the Sort mode selected.

A sort operation is initiated by loading the cards to be sorted in the input hopper, selecting the sort mode and the column to be sorted, and depressing the Start key. Each pass is established by depressing the Phase bar, which either advances the operation to the next sort phase or returns it to the beginning phase and decrements the column indicator by one. (The Numeric mode remains in Numeric phase and the column counter is decremented.) The initial column of a field to be sorted is selected via one of two switches which, when held depressed, increment or decrement the column indicator at the rate of about 15 columns/second.

Digit Select, an optional feature, provides 10 keys that correspond to stackers 0 through 9. These keys, any combination of which can be depressed during a sort operation, permit selection of cards with any specified punch pattern.

Sort Suppress, also an optional feature, separates cards that are blank in the selected column from those that are punched. When selected, the Sort Suppress feature deposits cards containing blanks in the reject stacker; all others are deposited in stacker 0.

Another option, the 64-character mode feature, when selected, sorts all cards in two passes regardless of the setting established by the Sort mode switch. This operating mode sorts cards into the follow descending order (stackers 9 through 0): 9 to 5, 4 to 0, Z to S, R to J,), I to A, " to :, ? to /, - to &, ¦ to ¢; blanks are rejected.

The optional Group Sort feature sorts master and detail cards. Via manual selection, master cards are identified by either the absence or presence of a left corner cut. Master cards are sorted as any other cards; however, all detail cards are deposited in the stacker occupied by the preceding master card.

Digital counters are available as an option. The Total and Grand Total Counters feature provides two individually resettable counters that are incremented for each card fed from the input hopper. Both counters are located on the operator panel. Pocket counters are also available for each of the 11 stackers, and are also individually resettable. These counters, located above their respective stackers, require the Total and Grand Total Counters feature. Switch selection is common to all counters.

Indicator lamps are grouped together on the operator panel. A two-digit, segmented indicator displays the column selected for sorting. Back-lighted indicators are also provided to indicate sort phase and error status, and for the Sort Suppress and Digit Select features.

PRICING: The 9620 Alphanumeric Sorter is available through five discrete financing methods, including three lease plans and two purchase plans. Lease terms are available for one, three, and five years and include maintenance and unlimited equipment usage. Purchases can be made outright or on a deferred payment basis. A separate maintenance contract is provided for purchased units.

	Monthly Rental*				
	1-Yr. Lease	3-Yr. Lease	5-Yr. Lease	Outright Purchase	Monthly Maint.
9620 Sorter	$128	$118	$113	$5,200	$33
Options					
Sort Suppress/Digit Select**	10	8	8	480	1
Total Counters (2)	10	8	8	480	3
Pocket Counters (11)	25	20	18	1,320	5
Table (blue, red or yellow)	–	–	–	145	–
Card Rack (6 stackers)	–	–	–	50	–

* Lease prices include maintenance.
**Option includes the Group Sort and 64-Character Operation features. ■

Decision Data 8001 and 8010 Data Recorders

MANAGEMENT SUMMARY

Having become the largest independent manufacturer of 96-column card equipment within four years after its inception in 1969, Decision Data Computer Corporation entered the 80-column punched card market in June 1973. Its current family of 80-column products includes a data recorder, Model 8001; an interpreting data recorder, Model 8010; a data communications terminal, the CS-200 Model 4; a card reader, Model 8025; a reader/punch unit, Model 8035; and a printing reader/punch unit, Model 8045. These products share many of the same basic mechanisms and electronic circuits.

At the National Computer Conference in May 1975, Decision Data introduced two new features for the 8001 and 8010 Data Recorders: an Accounting feature, (also available for the 96-column 9601, 9610, and 9660 Data Recorders), and a Card Conversion feature. Data verification can be minimized and the accuracy of data entry increased by the Accounting feature, which permits the user to create proof or hash totals and to perform crossfooting and batch balancing as work is transcribed. When combined with the optional Data Reporter (a serial printer), the Accounting feature can be used to create formatted reports with up to four levels of totals, yielding a potentially powerful small accounting system capability. The Card Conversion feature permits data punched into 96-column cards to be transcribed to 80-column cards without the aid of a computer. The feature includes a small, stand-alone 96-column card reader (Model 9625) that cable-connects to the data recorder.

The Data Reporter, a serial matrix printer produced for Decision Data by Centronics, was originally introduced in the third quarter of 1974 for use with Decision Data's 96-column card data recorders. The option is now also available for use with the company's 80-column data recorders in three models which differ in print speed and print line length. The Data Reporter, combined with an

These buffered 80-column keypunch/verifiers, the fastest in the industry, are available with an accounting feature, a serial printer for printed output, and provisions for 96-to-80-column card conversion.

CHARACTERISTICS

MANUFACTURER: Decision Data Computer Corporation, 100 Witmer Road, Horsham, Pennsylvania 19044. Telephone (215) 674-3300.

MODELS: 8001 Data Recorder and 8010 Interpreting Data Recorder.

CARD OUTPUT: Standard 80-column cards punched in 80-column card code. Rated speeds are as follows:

Device Function	Card Columns	Rated Speeds, cards/minute 8001 DR	8010 IDR
Punch	80	45	45
Verify Read	80	200	200
Reproduce	80	30	30
Reproduce and Print	80	–	25
Interpret	80	–	45

When performing card operations on only a few columns located anywhere on the cards, the punching and interpreting speeds approach 75 cpm.

Primary and secondary input hoppers hold 600 and 400 cards, respectively. Two output stackers each hold 400 cards. Cards are loaded face-forward. Cards are fed front card first (from the primary hopper) or rear card first (secondary hopper). Cards are stacked face-forward with printing at top; stacker overflow is provided.

The card path is arranged in the following sequence: read, wait (visible), punch, and print (8010 only).

DEVICE CONTROL: Data and programs are stored in independent buffers. Buffer storage capacities are as follows:

This Decision Data 8010 Interpreting Data Recorder is shown with the optional 96-to-80-Column Card Converter (at left). The 8010's dual input hoppers can be seen at the far right, while the dual output stackers are clearly visible to the left of the keyboard.

Decision Data 8001 and 8010 Data Recorders

8001 or 8010 Data Recorder, can satisfy a host of off-line applications such as printing labels or parts lists, automatically listing data from cards, generating reports via the Accounting feature, etc. All formatting is specified by header cards, which define page and text length, horizontal and vertical spacing, and other parameters.

The 8000 Series data recorders are functionally the same as their 96-column 9600 Series counterparts, including card path arrangement and hopper and stacker capacity. Even the control panels of the related data recorders are quite similar.

The 8000 Series data recorders feature very high reading, punching, and printing speeds—by far the highest in the 80-column card industry. Cards are read at 200 cpm, while punching and printing speed ranges from 45 to 75 cpm (60 columns per second).

Other noteworthy features include: combined keypunch and verifier operation, buffered operation, four program levels (eight levels are optional), program revert, primary and secondary input hoppers, two output stackers, a visible card station, automatic blank card insertion during verification, an Interpret mode (Model 8010), Print Edit and Punch Suppress, check digit verification (optional), file reproduction and change, selectable zero or blank fill, interspersed gang punching (optional), production statistics (optional), and a 51-column card capability (optional).

These impressive features, combined with the units' low price, operating simplicity, and smooth appearance, make them formidable contenders in the 80-column keypunch market.

Decision Data began production deliveries of its 8001 and 8010 Data Recorders in November 1972 and had delivered over 5,000 units by June 1975. Lead time on orders is currently quoted as 60 days after receipt of order. End-user sales and service are provided by Decision Data through its sales and service facilities located in over 60 major cities throughout the U.S. and Canada. Burroughs Corporation is the company's leading OEM buyer. Units shipped to Burroughs are delivered to users under the Burroughs nameplate and are serviced by Burroughs personnel.

Datapro conducted telephone interviews with eight users of the Decision Data 8010 Data Recorder, who reported on their experience with a total of 30 units. Their ratings are summarized below.

USER REACTION

	Excellent	Good	Fair	Poor	WA*
Overall performance	7	1	0	0	3.9
Ease of operation	6	2	0	0	3.8
Hardware reliability	4	3	0	1	3.3
Maintenance service:					
Promptness	8	0	0	0	4.0
Quality	6	2	0	0	3.8

*Weighted Average on a scale of 4.0 for Excellent.

These high scores clearly indicate a high degree of user satisfaction with the 8010. The users liked the reproduction feature in particular and were impressed with the overall features and capabilities of the unit, as compared with the IBM 129 or any other vendor's product. Most of

	Data Storage	Program Storage
8001	240 char. (3 cards)	1,920 bits
8010	400 char. (5 cards)	2,080 bits

Provision is made for storing four or eight (optional) programs simultaneously, with manual switching among the programs. The program controls the format of the data by delimiting alphabetic, numeric and special fields and by initiating automatic field skipping, duplicating, right justification (selectable left zero or blank fill), and optional check-digit verification.

New programs are entered automatically from punched program cards on a one-program-per-card basis. Any one of four or eight (optional) stored programs can be manually selected, or all can be disabled to permit the operator to completely control the format of the recording. The operator can also select an alternate program and automatically return to the original program via the Program Revert function.

Operating modes are: Program Load, Punch, Verify, and Reproduce. Additional functions provided only by the 8010 are: Interpret, Print, Verify Print, Print Edit, and Verify Print Edit.

The Program Load mode reads the program from an entered program card into the selected program memory. Program cards can be fed from primary or secondary hoppers, but are always stacked in the second stacker. Print Edit programs are loaded into a separate memory reserved for that application.

The Punch mode punches keyed data contained in memory into cards fed from either primary or secondary hoppers and delivers the punched cards to Stacker One.

The Verify mode compares keyed data column-for-column with the data read from a card. The card is fed from the primary hopper, its contents are read into memory, and the card is retained at the visible wait station until its contents have been verified. Corrections made during the Verify mode require reverification of each corrected field unless the reverification is performed manually as each column is corrected by backspacing and reverifying the corrected column. The whole card must be reverified if corrections were made without program control. A card that has been verified without corrections is notched and delivered to Stacker One, and the next card to be verified is fed. A card containing errors is delivered to Stacker Two un-notched; a blank card is automatically fed from the secondary hopper, punched with the corrected data notched, delivered to Stacker One, and the next card to be verified is fed.

The Reproduce mode feeds the card to be reproduced from the primary hopper, reads its contents into memory, and delivers the card to Stacker One. A card is then fed from the secondary hopper, punched with the contents of the previous card, and delivered to Stacker Two. As an alternative, all cards can be delivered to Stacker One. Editing functions operate on a column basis and include skipping and substituting a blank or a character from dup memory. Two card decks can be merged by programming a skip for each read column.

The Interpret mode (8010 only) feeds a card from the primary hopper, reads its contents into memory, prints the data on the card, and delivers it to Stacker One. Stacker One automatically overflows into Stacker Two.

Interpreting (8010 only) can be performed on the cards in either Punch, Verify, Reproduce or Interpret mode. Printing can be performed without punching in the Punch mode on a column-by-column basis when operating with the program-controlled Punch Suppress feature. Only corrected cards need be printed in the Verify mode (though all cards can be printed if desired); only reproduced cards are printed in the Reproduce mode. When reproducing under program control with auto skip/dup enabled, fields programmed for skip are not printed; fields programmed for duplciation are printed with the data to be duplicated.

Decision Data 8001 and 8010 Data Recorders

the users reported infrequent failures, with the exception of a lone user who rated the equipment reliability as poor. This user, whose 8010 was installed in August 1974, reported initial and continued failures that were only temporarily resolved by service. He stated that the machine was used for single-shift operation and performed well when operative. □

Printing can be edited via a program in the print-edit memory. The print-edit program, which operates on a column-by-column basis, can erase specific character positions of the print memory and inhibit the transfer of data into those positions, allow the current contents of print memory to be retained but inhibit the transfer of data into those print memory positions, or print numeric columns with a minus overpunch as numbers, not letters.

The optional 1070 Data Recorder can print the data being keypunched, verified, reproduced, or interpreted simultaneously with these operations. Formatted reports can be printed from punched cards under the List Edit function, which provides page headings, page numbering, text length, and overflow capabilities. Card-based reports can be automatically edited to provide data compression, zero suppression, and the insertion of signs, dashes, periods, asterisks, and blanks.

Punch Suppress and Print Edit functions are independent operations that can be performed on the same card.

The optional Interspersed Master Card feature controls punching, verifying, and interpreting of interspersed master and detail cards (i.e., cards without an upper-left corner cut). Master or detail card operation is switch-selected and requires the use of two programs. This feature also controls interspersed gang punching.

The operator panel provides a two-digit column indicator to display the current location within the record. Status conditions such as operating mode, active program, error, and fault conditions are displayed in English, but are not visible until lighted.

The Production Statistics feature, an option, consists of three 6-digit counters located over the leftmost stacker. The counters present the total number of cards processed (resettable counter), total number of keystrokes x 10 in the Punch or Verify mode, and total errors (Verified Corrected).

The Accounting feature, also optional, consists of eight 16-digit accumulators that can be used to perform accounting functions. These functions, including add, subtract, crossfoot, store, carry-forward, and "read-out" of numeric information, can be performed under program control as cards are keypunched, verified, and interpreted. A file of cards can also be listed or tabulated as a separate operation to generate specific reports. This option is mutually exclusive with feature 1090, the 96-to-80-Column Card Converter option.

CARD CONVERSION: Feature 1090 provides 96- to 80-column off-line card conversion at speeds up to 75 cards/minute. The feature consists of a 96-column card reader (manufactured by Decision Data) which directly interfaces the 8001 or 8010 Data Recorder and provides hopper and stacker capacities of 600 cards each. The card image of each 96-column card is transferred as the card is read to the data recorder for punching (and printing with the 8010). This feature is mutually exclusive with the Accounting feature.

In addition to basic column-for-column card conversion, Feature 1090 can be operated under program control to perform the functions of inserting blanks between fields of data, gangpunching duplicate data not in the original 96-column cards, and print-editing and punch-suppressing data in the 80-column card output.

ERROR CONTROL: In the Punch mode, keying errors detected by the operator can be corrected by backspacing column-by-column and rekeying the correct character. Backspacing can be performed under manual or program control. Field Erase and Record Erase functions permit the operator to erase all data that has just been keyed into a field or record, respectively; duplicated data is not erased. Check digit verification for modulo 10 or 11 self-check numbers is optional.

KEYBOARD: The 54-key keypunch-style keyboard can produce any of 64 character codes, including 10 numerics, 26 alphabetics, and 28 special characters. The keyboard is similar to that of Decision Data's 9600 Series Data Recorders. The keyboard is designed for "n-key rollover," a design technique that permits character generation to occur only on the downstroke of a key, thereby permitting faster keying and reducing the likelihood of errors.

PRINTED OUTPUT: The Data Reporter, Feature 1070, is an impact matrix printer produced for Decision Data by Centronics and is available in three models. Model 1 (a Centronics 306) provides 80 print positions and prints 100 char/second (60 full lines/minute). Model 2 (a Centronics 500) provides 132 print positions and prints 120 char/second (40 full lines/minute). Model 3 (a Centronics 306C) provides 80 or 132 print positions via switch selection and prints 100 (80 columns) or 165 (132 columns) char/second. Horizontal spacing is 10 char/inch at 80 columns and 16.5 char/inch at 132 columns. Each character is formed by a 5-by-7 dot matrix. The adjustable tractor feed accommodates continuous, 5-part, sprocket-fed forms from 4 to 9½ inches wide in Models 1 and 3 and from 4 to 14-7/8 inches wide in Model 2. Horizontal and vertical format control is performed under program control through punched control cards. The Data Reporter is mutually exclusive with the Mod 10 or 11 Self-Check Number feature.

PRICING: The 8001 Data Recorder and 8010 Interpreting Data Recorder are available through five discrete financing methods, including three lease plans and two purchase plans. Lease terms are available for one, three, and five years and include maintenance and unlimited equipment usage. Purchases can be made outright or on a deferred payment basis. A separate maintenance contract is provided for purchased units.

	Monthly Rental (1)				
	1-Yr. Lease	3-Yr. Lease	5-Yr. Lease	Outright Purchase	Monthly Maint.
Data Recorders					
8001 (non-interpreting)	$150	$141	$133	$6,000	$38
8010 (interpreting)	177	167	158	7,300	43
Options					
Interspersed Gang Punching	13	11	9	480	1
Mod. 10 or 11 Self-Check Number	35	28	24	1,080	1
Production Statistics	13	12	9	480	2
Eight Program Levels	13	11	9	480	1
51-Column Card	40	34	29	1,080	5
Reverse 10-Key Numeric Keyboard	10	8	8	480	3
Data Reporter (2):					
Model 1 (80 columns)	155	140	130	4,180	40
Model 2 (132 columns)	205	175	160	5,550	45
Model 3 (80/132 columns)	175	150	135	4,880	40
Accounting Feature (3)	45	30	25	1,100	5
96-to-80-Column Card Converter (4)	127	102	92	3,960	17
Special Color, yellow or red	–	–	–	55	–
Ink Cartridge (package of 6)	–	–	–	30	–
Data Reporter Ribbon (package of 6)	–	–	–	39	–

(1) Lease prices include maintenance.
(2) Mutually exclusive with Mod 10 or 11 Self Check Number.
(3) Mutually exclusive with 96-to-80-Column Card Converter.
(4) Mutually exclusive with Accounting Feature.■

Decision Data 6603 and 6606 Printers for the IBM System/3

MANAGEMENT SUMMARY

In May 1975, Decision Data, the world's largest independent manufacturer of 96-column card equipment, introduced two line printers for use with the IBM System/3 Model 10 computer. The Decision Data drum printers are designed as direct replacements for IBM's 5203 Model 1, 2 and 3 and 1403 Model 2 train printers and offer significant price/performance advantages over their IBM counterparts.

No software or hardware changes are required to use the Decision Data printers on the System/3 Model 10 computer. What's more, the printers attach directly to the Model 10's data bus, thus precluding the need for the device attachment features that are required for attaching IBM's own System/3 peripherals—a significant cost saving. Additional savings can be realized when replacing IBM's 1403 Printer with the Decision Data 6606 Printer because the 6606 contains its own controller, thus eliminating the need for the separate control unit required for the IBM 1403.

Decision Data's Model 6603 and 6606 printers are produced by Dataproducts (as Models 2230 and 2260, respectively), and Decision Data adds the control and interfacing logic necessary to attach the printers to the System/3. Dataproducts printers are known for their high print quality and equipment reliability, and represent a wise choice by a quality-conscious firm.

The Decision Data printers can provide increased performance over their IBM counterparts. Model 6603, rated at 300 lpm using a 63-character print set, is 42 percent faster than the IBM 5203 Model 2, which is rated at 212 lpm when using a 63-character print set. Besides, the 6603 is equipped with 132 print positions, an option on the IBM 5203. Model 6606, rated at 600 lpm using a ➢

These drum printers are available to IBM System/3 Model 10 computer users as direct replacements for IBM's 5203 and 1403 Printers. Both models connect directly to the System/3 data bus and offer significant price/performance advantages.

CHARACTERISTICS

MANUFACTURER: Decision Data Computer Corporation, 100 Witmer Road, Horsham, Pennsylvania 19044. Telephone (215) 674-3300.

MODELS: Models 6603 and 6606; both are drum printers rated at 300 and 600 lpm, respectively.

COMPATIBILITY: The Decision Data printers are plug-compatible printers for the IBM System/3 Model 10 computer. Model 6603 is a replacement for the IBM 5203 Printer, and Model 6606 is a replacement for either the IBM 1403-2 or 5203 Printer. The printers connect directly to the data bus of the IBM processing unit, eliminating the need for an IBM Printer Attachment. No software or hardware changes to existing IBM equipment are required. The printers are compatible with existing System/3 software and operate under the standard System/3 Supervisor and normal I/O support routines.

MODEL 6603: The Decidion Data Model 6603 Line Printer is a drum printer that features single-line buffering, EBCDIC coding, and a 63-character print set. The salient characteristics of the Model 6603 and the IBM 5203 are compared in the following table:

	Decision Data Model 6603	IBM 5203*
Print positions:	132	96; 120 or 132 opt.
Print speed, lines/min.:	300 (63 chars.)	100, 200, or 300 (48 chars.)
Skipping speed, inches/sec.:	20	16.7 (6 lpi); 20 (8 lpi)

➤

The Decision Data printers fit neatly into IBM System/3 Model 10 computer installations. The 300-lpm Model 6603 is shown here.

Decision Data 6603 and 6606 Printers for the IBM System/3

63-character print set, is 20 percent faster than the IBM 1403 Model 2, which is rated at 500 lpm when equipped with a 63-character print set. However, the skipping speed, or paper slew rate, of the 1403 Model 2 is 1.3 to 3 times as fast as the 6606, which can offset its slower printing speed in cases where only a limited number of lines are printed on each form.

IBM options not currently provided by the Decision Data printers include the Universal Character Set feature (optional for both IBM printers), which provides accommodation for any character/code set, and the Dual Feed Carriage for the IBM 5203 Printer, which provides for handling two forms simultaneously.

Decision Data's printers are priced substantially below their IBM counterparts, at 15 to as much as 48 percent (on a one- to three-year lease) below IBM's rental prices and 27 to 48 percent below its purchase prices. For example, Decision Data's Model 6606 Printer rents for $825 per month on a one-year lease. By contrast, IBM's 1403 Model 2 Printer rents for $1,228 per month and leases for $1,163 per month under IBM's Fixed Term Plan for 12 to 23 months. (These IBM prices include the cost of 36 additional print positions, a 5410 Attachment, and a Printer Control Unit.) Further savings of up to $628 per month can be realized through extended lease terms.

Production deliveries of the Decision Data printers began in July 1975. Lead time on orders is currently quoted at 90 to 120 days after receipt of order.

Sales and service are provided solely by Decision Data, which currently has sales and service facilities located in more than 60 major cities throughout the U.S. and Canada. □

	Decision Data Model 6606	IBM 1403 Model 2
Single-line advance, msec:	50	?
Character spacing, char/inch:	10	10
Line spacing, lines/inch:	6 or 8	6 or 8
Form width, inches:	4 to 16-3/4	3-7/8 to 16-3/4
Form length, inches:	3 to 14	3 to 14
Character set, chars:	63	48; 49 to 120 opt.
Max. form thickness, inches:	0.020	0.020

*Models 1, 2, and 3.

MODEL 6606: The Decision Data Model 6606 Line Printer is a drum printer that features single-line buffering, EBCDIC coding, and a standard 63-character print set. The salient characteristics of the Model 6606 and the IBM 1403 are compared in the following table:

	Decision Data Model 6606	IBM 1403 Model 2
Print positions:	132	132
Print speed, lines/min:	600 (63 chars)	600 (48 chars)
Skipping speed, inches/sec:	25	33 or 76
Single-line advance, msec:	25	?
Character spacing, char/inch:	10	10
Line spacing, lines/inch:	6 or 8	6 or 8
Paper width, inches:	4 to 16-3/4	3-1/2 to 18-3/4
Paper length, inches:	3 to 14	3 to 14
Character set, chars:	63	48; 49 to 120 opt.
Max. form thickness, inches:	0.020	0.020

FEATURES: Both printers provide easy access for forms loading and ribbon changing via a swing-open drum gate. Noise has been minimized by a quietized enclosure. The printers combine a bank of Dataproducts' highly regarded Mark IV print hammers with a clutchless paper feed. Operator controls and fault indicators are combined on a panel on the printer's right front side. Options include a paper receptacle, viewing light, static eliminator, and a variety of print sets and fonts.

PHYSICAL CHARACTERISTICS: The physical characteristics of each Decision Data printer model are listed below.

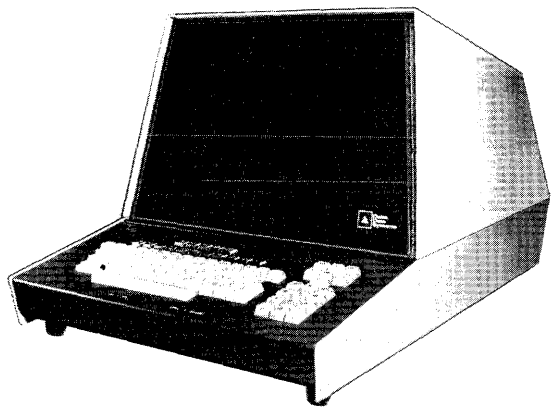
Printer Model	Width, inches	Height, inches	Depth, inches	Weight, pounds
6603	33	22	45	340
6606	33	26	45	370

PRICING: The Decision Data Printers are available for purchase or on a one-, three-, or five-year lease, which includes prime-shift maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental*				
Printers	1-Year Lease	3-Year Lease	5-Year Lease	Purchase	Monthly Maint.
Model 6603	$560	$480	$410	$18,150	$115
Model 6606	825	705	600	25,220	175
Options					
Static Eliminator	12	10	8	250	1
Special Color (yellow or red)	–	–	–	150	–
Printer Ribbon (pkg. of 6):					
3-Mil Nylon	–	–	–	198	–
4-Mil Nylon	–	–	–	162	–

*Includes prime-shift maintenance. ■

Delta 5000 Video Display Terminals



The Delta 5000 family of stand-alone display terminals contains several powerful features not included in most devices competing for replacement of Teletype units and IBM 2265's. The terminals feature a variety of output printers as well as a single or dual cassette recorder.

MANAGEMENT SUMMARY

The Delta 5000 Video Display Terminals represent a second product line for Delta Data Systems, which had previously made initial deliveries of its now-defunct Delta 1 Terminals in April 1969. The Delta 5000 Terminals are a more powerful, more sophisticated breed than the Delta 1, with twice the screen capacity and three times the display memory capacity.

Members of the Delta 5000 family (originally called the TelTerm family) are tailored to meet the needs of different market areas. The Delta 5100 is a Teletype teletypewriter replacement; the Delta 5200 is a general-purpose communications terminal; and the Delta 5300 is an IBM 2265 replacement. Besides their intrinsic differences, the Delta 5000 family members share a number of common characteristics and capabilities, as described in this report.

Paging, a powerful tool for CRT displays, is a basic feature of all Delta 5000 family members. The paging concept equates the CRT screen to a page of information. The terminals are designed to store several "pages" of information in display memory, with the capability to sequence through each page line by line or to immediately display the first or last page. Because a carriage-return character is used to define the end of a line, thereby eliminating the need to store space characters to fill in the line, several pages can be stored in a memory area equivalent to the capacity of the CRT screen.

The insert and delete functions, standard features of the Delta 5200 and 5300, further increase the terminals' power. These functions allow a character or line to be inserted in or deleted from existing text. Insertion spreads the text to accommodate the additional data; deletion closes the text as the data is deleted. Character and line insertion is limited only by the capacity of the display memory, not the screen. A full memory causes the first line in memory to be replaced with new data.

The Format feature is yet another powerful facility included as a standard feature in all Delta Terminals. ➢

CHARACTERISTICS

MANUFACTURER: Delta Data Systems Corporation, Woodhaven Industrial Park, Cornwells Heights, Pa. 19020. Telephone (215) 639-9400.

MODELS: The Delta 5000 Family includes three members: Model 5100, a replacement for Teletype teletypewriters; Model 5200, an enhanced version of the 5100 featuring edit, margin control, tab, and message blocking; and Model 5300, a replacement for the IBM 2265 Display Station.

COMMUNICATIONS: The Delta 5100 and 5200 transmit asynchronously, in half-or full-duplex mode, at switch-selectable speeds of 110, 150, 300, and 600 bits/second. Interface options provide speeds of 1200, 1800, 2400, 4800, and 9600 bits/second. The code used is 10- or 11-unit, 8-level ASCII, including optional parity, one start, and one or two stop bits.

The Delta 5300 transmits asynchronously, in half- or full-duplex mode, at 1200 or 2400 (optional) bits6second. The code used is 10-unit, 8-level ASCII, including parity and unity start and stop bits. Transmission characteristics are compatible with the IBM 2701 Data Adapter Unit equipped with an IBM Terminal Adapter Type III.

Connection to a voice-band communications facility is established via a modem. Two modem options are available for low-speed operation: an integral acoustic coupler (for the public telephone network) and an integral modem equivalent to the Bell System 103A Data Set.

DIRECT CONNECTION: The Delta Terminals can be directly connected to a computer via the optional Party Line I/O Control, a parallel interface. Transfer rate depends on external clocking, but can range from 5,000 to 500,000 characters/second.

CRT DISPLAY: Via a 14-inch (diagonal measurement) CRT with a viewing area 11 inches wide by 6 inches high.

A character set of 64 ASCII characters, including uppercase alphabetics, numerics, and special symbols, is displayed in green against a dark background. An optional set of 96 characters provides both upper- and lower-case alphabetics in addition to numerics and special symbols. Each character is formed by a 7-by-9 dot matrix.

In addition to their alphanumeric capabilities, the terminals can optionally be equipped to generate vertical and horizontal lines, intersections, and corners.

The display arrangement consists of 27 lines of 80 characters each; the total screen capacity is 2,160 characters.

DEVICE CONTROL: The basic Delta 5100 and 5200 operate in the contention mode; provision for polling is optional.

The Delta 5100 operates in the Teletype mode, which simulates a teletypewriter. Each character keyed is immediately transmitted to the remote computer. When ➤

Delta 5000 Video Display Terminals

This feature lets the operator work within a rigid format, much the same as if she were typing data on a printed form using an ordinary typewriter. As each entry in a variable field is completed, the operator simply tabs to begin entry in the next variable field. Formats can be created from the keyboard or via the computer. Several formats can be stored and quickly retrieved with the paging feature.

Columns of data can be quickly entered using the Tab feature, which is standard on the Delta 5200 and 5300. This feature allows up to five tab positions, all of which are cleared simultaneously.

Fields of text can be programmed to blink in order to focus attention on important entries. Margins, adjustable in the Delta 5200 and 5300, are sensed and produce an audible alert.

Character resolution has been substantially improved over most other display units through the use of a 7-by-9 dot matrix to form each displayed character.

An optional line-drawing capability lets the operator draw vertical and horizontal lines, intersections, and corners.

Display memory (MOS shift registers) starts at 1000 characters in the basic terminals and can be expanded to 3000 characters in increments of 1000 characters.

All control functions that appear on the keyboard can also be initiated under control of the program stored in the remote computer by interspersed control characters within a message.

Options include a cassette tape recorder and printer. The cassette tape recorder provides a slick way to store pages of data such as display formats. Two communications-interface options allow for handling transmission speeds up to 9600 bits per second.

Delta also markets a family of multiplexers it calls MultiTerm, which are designed to accommodate the Delta 5000 Terminals and range from a simple hard-wired version for up to 16 displays to sophisticated models that incorporate a microprocessor and can accommodate up to 95 display terminals.

Initial deliveries of the Delta 5100 and 5200 were made in July 1970, and the Delta 5300 followed in January 1972. Delta has installed over 1000 units of its older models and has about 1200 units on order. Delta is currently filling a contract for 135 units for its initial Delta 5300 installation. Current lead time on orders is 60 days.

A Datapro survey of installations using the Delta 5000 terminals found the users to be well pleased with the terminals' overall performance and price/performance advantages. Users reported little or no down-time and competent support. Delta's first 5300 installation, however, experienced severe communications timing problems; it appears that IBM signal-timing parameters are operating in the full-duplex mode, keyed characters are displayed only when "echoed back" from the receiving end.

The Delta 5200 operates in the Block mode. An entire message is keyed and edited prior to transmission. Operation is under control of the program stored at the remote computer. The Block mode is optional for the Delta 5100.

Conversational or Format modes can be selected at the keyboard.

Transmission can be requested locally or remotely, but transmission is initiated by the remote computer. Either the complete contents or a selected portion (message) of display memory can be transmitted. When operating in the Format mode, only the variable data is transmitted.

The Delta 5200 responds to all received message blocks with a positive or negative acknowledgement when the parity option is incorporated. All function-control characters can be interspersed throughout the message block.

The Delta 5300 is completely compatible with the IBM 2265 poll and address sequences and, under program control, can execute any of eight IBM 2265 read and write commands. Line addressing, which enables a received message to be written beginning at the initial character position of the addressed line, is a standard feature.

Messages transmitted from the Delta 5300 begin with a start-of-text character and a two-character address header, and end with an end-of-text character and longitudinal redundancy check character. All commands and messages are acknowledged by the Delta 5300, which also anticipates an acknowledgement for each transmitted message.

The display memory capacity for all basic terminals is 1000 characters. Memory size can be expanded in increments of 1000 characters up to a maximum of 3000 characters.

Cursor controls provide a wraparound capability and include Up, Down, Left, Right, and Home (initial character position of first line). The cursor (blinking underline) can be stepped in any of four directions or slewed (repetitive movement) by holding the key in a depressed position.

The terminals include a special feature referred to as "paging." The paging concept allows the display memory to store several "pages" of information, of which only one is displayed. Each page can contain 1 to 80 characters per line and 1 to 27 lines of characters.

Paging controls and commands include Page-Up, Page-Down, Page Start, and Page End, Page-Up and Page-Down functions produce the effect of a long page of data moving up or down behind a window that allows only a portion of the page to be viewed. These page functions can step through a line at a time or move through a number of lines until the desired information is displayed, without effecting cursor movement. Page Start and Page End functions cause the first or last page in memory to be displayed; the cursor moved to the initial character position of the first page or to the final character position of the last page.

Other standard features include Form Feed, Roll-Up, and Selective Blinking. Form Feed positions the next contiguous page or message at the top of the screen and moves the cursor to home position. Roll-Up moves the displayed page up by one line (the top line disappears from the screen) when data is entered in the last display position (column 80, row 27) or when a carriage return is entered on the 27th line. Selective blinking permits a character or field delimited by blink characters to blink at a fixed rate; only the first blink character is necessary when the field ends with a space, 80th character, end of variable field, or carriage return.

Delta 5000 Video Display Terminals

difficult for the independents to acquire. The problems have now been resolved, and the installation, which is to be completed by August 1973, is continuing on a normal basis.

Service is provided by Delta and by Syntonic Technology, Inc., a wholly-owned subsidiary of Control Data Corporation since August 1972. Syntonic, of Pennsauken, New Jersey, is an independent service organization specializing in computer communications and has 480 employees and 61 service locations in major cities throughout the nation. Delta has announced that it also intends to sign with another leading service organization.

Though Delta has had a financially lean operation since its inception, a recent private offering valued at $766,000, coupled with a profitable second quarter ($25,000 on revenues of $125,000) and the current orders for about 1200 terminals, shed strong rays of hope toward future profitability. □

Erasure functions include memory and message erase. Memory erase clears all data from memory except when in the Format mode, in which case only the variable fields are cleared. Message erase clears a message block only on the variable portion of a message when in the Format mode.

Edit functions that include both character and line insertion and deletion are provided on the Delta 5200 and 5300.

Tab and Margin controls that allow up to five tab positions (with common clearing) and any margin setting are provided on the Delta 5200 and 5300. A fixed margin at column 72 is provided on TelTerm 1. When exceeded, margin settings produce an audible alert.

Formatting is a standard feature for all Delta terminals. When operating in the Format mode, entry is restricted to variable fields, which are displayed with a dotted underline, field descriptors are protected. The Tab feature may be used to position the cursor at the beginning of each variable field; as entry is completed in each variable field, the operator keys Tab to begin entry in the next variable field. Character insert and delete functions are applicable to variable fields only; the line delete function clears all variable data on the line. The line insert function is not used. When clearing or transmitting the displayed data, only the variable data is cleared or transmitted. Variable fields cannot exceed 10 per line. Several formats can be stored simultaneously in memory as a result of the paging technique.

An audible alram signals conditions such as: (1) memory almost full, (2) margin, (3) Page-Down initiation when the first page is currently displayed, and (4) attempted entry into a descriptor field within a fixed format.

ERROR CONTROL: Character parity is optional on the Delta 5100 and 5200. Odd or even parity, as switch-selected, accompanies each transmitted character and is checked for each received character. Characters received in error are displayed as error symbols. Message retransmission in response to a negative acknowledgement is performed automatically an unlimited number of times.

The Delta 5300 provides both character and longitudinal parity generation and checking capabilities.

KEYBOARD: 66-key typewriter-style with 12-key numeric inset to the right of the main key group; 7 cursor and page control keys are located directly above the numeric inset. The Delta 5200 and 5300 keyboards include five additional edit function keys within the main key group. Keys are also provided for drawing vertical or horizontal lines, intersections, and corners.

Repetitive entry of data or initiation of a function corresponding to a keytop symbol is performed by holding the key in the depressed state.

CASSETTE TAPE RECORDER: Records display information on a Philips-type cassette, which contains 300 feet of 0.15-inch magnetic tape. The data transfer rate is switch-selectable at 10, 30, 60, 120, 240, or 480 chars/second. Total cassette storage capacity is a function of the recording density and tape speed and ranges from 4,000 characters at 10 chars/second to 150,000 characters at 480 chars/second. The cassette tape recorder is available as a single or dual cassette unit and requires the optional cassette interface.

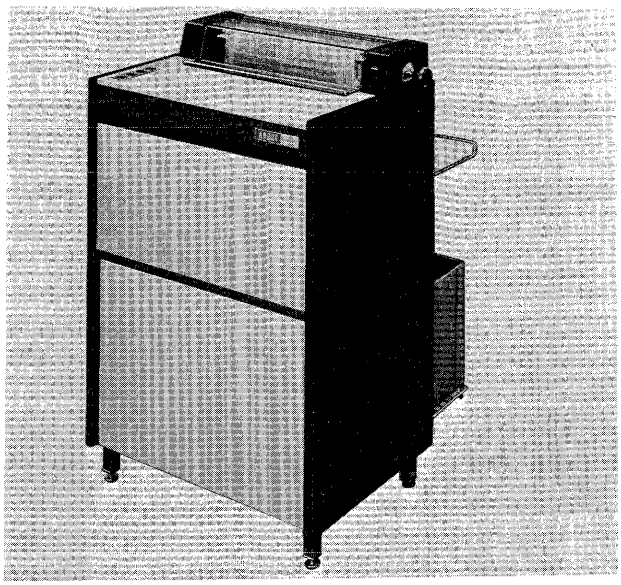
PRINTER: Several printers are available for printed output of displayed data. These include printers from IBM (Selectric) and Tycom (both 15 cps impact printers), Centronics 101 (165 cps), Printec (100 cps), and Texas Instruments' 30-cps thermal printer. The optional printer interface is required.

PRICING: The Delta 5000 Video Display Terminals are available for purchase or lease on an 18- or 36-month lease which includes maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental*			
	18-Month Lease	36-Month Lease	Purchase	Monthly Maint.
Delta 5100	$135	$117	$3,000	$25
Delta 5200	151	131	3,500	25
Delta 5300	200	185	5,000	30
Cassette Recorder:				
Dual cassette**	155	131	2,900	25
Single cassette**	105	87	1,950	15
Printer:				
15 cps Impact	315	249	4,900	***
165 cps Impact	233	188	4,000	***
100 cps Impact	212	174	3,000	***
30 cps Thermal	190	170	2,850	***
Options:				
Memory, 1000 chars.	12	7	200	0
Memory, 2000 chars.	35	22	600	0
Block Mode (Delta 5100 only)	6	4	100	0
Upper/Lower Case	35	22	600	0
Line Drawing/ Upper Case	48	31	800	2
Interface:				
1200/1800/2400 bps	12	7	200	0
4800/9600 bps	23	15	400	2
Printer (RS-232C)	12	7	200	0
Cassette (parallel)	15	10	200	3
General (parallel)	26	18	400	3
Direct Memory Access	42	29	600	0
Detachable Keyboard	–	–	100	4

*Includes prime-shift maintenance.
**Lease and maintenance prices are somewhat higher when cassette recorder is ordered separately.
***Time and materials. ■

A.B. Dick Videojet Terminals



Virtually silent in operation, the A. B. Dick Videojet printer terminals "spew" out data onto conventional computer forms at speeds up to 750 characters per second. Printing is nominally 136 characters per line, on forms up to 14.875 inches wide. Adjustments permit varying the horizontal pitch from 5 to 20 characters per inch (67 to 204 characters per line).

MANAGEMENT SUMMARY

A. B. Dick has added a second printer to its Videojet product line, with initial customer deliveries in June 1972. The new member of the Videojet family can print up to 750 characters per second–over twice the printing speed of the original model. The significant upgrade in performance results from a 65 percent reduction in the number of ink droplets that form each character. (Both printer models spray ink droplets at the same rate.) Character size, however, remains the same for both models.

The Videojet printers are available for a wide variety of applications that require a high-performance, silent serial printer. Besides their use as communications terminals, the Videojet printers can operate directly as computer peripheral units; A. B. Dick provides a variety of interfaces for use with minicomputers produced by leading manufacturers, including Digital Equipment Corp., Data General, and Varian Associates.

The appearance of the Videojet terminals is much like that of a conventional computer printer. Stepping closer to an operating unit reveals a significant difference–no clatter.

A. B. Dick feels that this quietness is a very attractive feature, and the number of "silencer hoods" available for conventional teleprinters tend to justify the feeling.

The company also feels that the inability to produce multiple copies at the printer is not a significant disadvantage. Again, considering the range of copying ▷

CHARACTERISTICS

MANUFACTURER: A. B. Dick Company, 5700 W. Touhy Avenue, Chicago, Illinois 60648. Telephone (312) 763-1900.

MODELS: Videojet Models 9500 and 9600.

COMMUNICATIONS: Receives asynchronous or synchronous transmission at speeds up to 300 char/sec (2400 bits/sec) for Model 9600 and up to 750 char/sec (4800 bits/sec) for Model 9500. The transmission code is 8-level ASCII including character parity.

Communications interfaces include compatibility with the Bell System 201 Data Set (for Model 9600), compatibility with Teletype Models 33, 35, and 37, and compatibility with the IBM 2260/2848 Display Station, which includes a buffered or unbuffered interface. All communications interfaces are designed to EIA Standard RS-232C. The Videojet 9500 requires a modem such as the Bell System 203C.

To allow for nozzle return and line feed operations, data is normally transmitted to a Videojet printer in blocks of one line or less; one line is nominally 136 characters.

DEVICE CONTROL: Generally this is the responsibility of the transmitting station, normally a computer. The Videojet terminal is flexible in the line control procedures that can be implemented.

Because of the time required, A. B. Dick normally discourages line turnaround to transmit acknowledgement messages. One arrangement suggested by the company is having the Videojet terminal automatically disconnect in case of equipment malfunction; the transmitting station could detect the resultant loss of the carrier signal.

One disadvantage, for some installations, in not returning an acknowledgement following each line, is loss of the capability to use the error detection facilities for requesting retransmission to automatically correct errors. However, because the basic unit lacks a buffer, such retransmission would mean printing the same line again. A 400-character buffer is optional.

When connected via a parallel interface directly to a computer, a normal request line is provided to signal when the unit is ready for additional data.

ERROR CONTROL: As an option, received data is checked for odd character parity. Detection of an error ▶

A. B. Dick Videojet Terminals

equipment now on the market, this may well be true. Each potential user will have to judge for himself.

Optional features for both models include 12-channel vertical forms control, a top-of-form-feed capability, and simulated upper- and lower-case alphabetics. Simulated lower-case alphabetics are printed as half-size upper-case alphabetics.

Deliveries of the Model 9600 began in November 1969. To date about 325 have been installed. Initial deliveries of the Model 9500 were made in June 1972. □

causes a question mark symbol to be substituted. In addition, an error symbol is printed in the right margin; this enables an operator to quickly identify lines containing errors and is a valuable feature.

PRINTER: Uses non-impact, ink-jet technique. Uniform droplets of ink, formed by forcing the ink through a nozzle and subjecting them to an ultrasonic energy source, are directed to the paper. Vertical movement is controlled by electrostatic deflection plates; horizontal movement is controlled by the motion of the nozzle itself. The combinations of these two motions is used to form characters within a 9-by-11 (Model 9600) or 5-by-7 (Model 9500) dot matrix.

The stream of ink droplets is continuous. Each droplet is charged as it leaves the nozzle; droplets not to be used in the formation of characters are deflected back into the ink reservoir.

There is a single ink-jet nozzle, which traverses the length of the carriage to form a line of print. At any point in the line, a received carriage return code causes an immediate return to the beginning of the next line; thus, there is no penalty for short lines.

The printed character set is upper-case alphabetics, numerics, punctuation marks, and special symbols; a total of 63 different characters can be printed. Simulated upper- and lower-case alphabetics are optional.

The printer accepts pin-fed, fan-fold forms from 3.5 to 14.875 inches in width. From 20-pound to 125-pound (card stock) conventional paper forms can be accommodated. The maximum printing width is 13.6 inches. Reproducible masters can be prepared if desired.

Normally the printer is set up to produce 10 characters per inch across the page with a character height of 0.09 inch. By adjusting the traverse speed of the nozzle and the bias level of the electrostatic charging circuitry, either horizontal pitch or vertical height can be varied. A. B. Dick states that a horizontal pitch of 5 to 20 characters per inch is well within the range of legible printing; variations in horizontal pitch do not affect the printing rate.

Vertical spacing is 6 lines per inch. Double spacing can be manually selected. Vertical forms control and top-of-form feed are optional.

DIRECT CONNECTION: Interfaces are available that permit direct connection to any of several minicomputers produced by DEC, Varian Associates, and Data General.

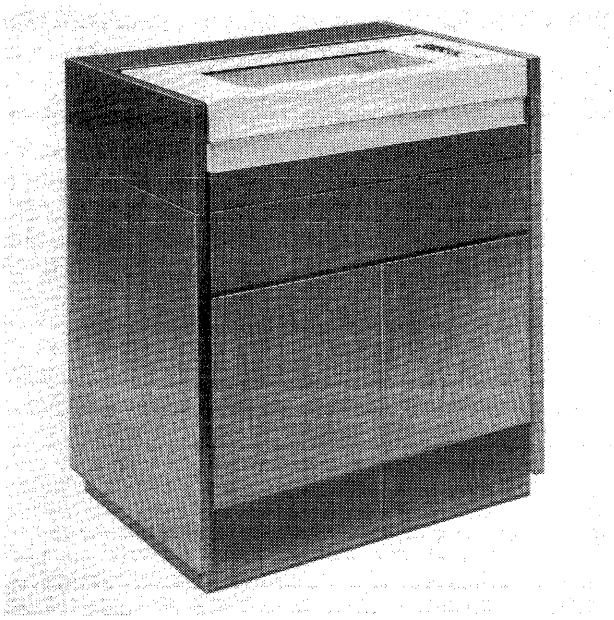
PRICING: The Videojet terminals are available for purchase or on a 3- or 24-month lease, which includes prime-shift maintenance. Basic pricing for the Videojet printers (without an interface) is as follows:

	Monthly Rental			
Model	3-Month Lease	24-Month Lease	Purchase*	Monthly Maint.
9600	$284	$253	$6,250	$65
9500	333	295	7,500	70

*Discounts are provided for quantity purchases.

Options include parallel (direct) and serial (communications) interfaces, several interfaces for minicomputers produced by the leading minicomputer manufacturers, internal buffering (400 characters), vertical forms, control, parity checking, and simulated upper- and lower-case alphabetics. Pricing for these options is available on request to A. B. Dick. ■

Digital Associates DAC/3 Printers for IBM System/3



The DAC/3 Model 700, a chain/train printer rated at 750 lpm, brings high-speed printing to any model of the IBM System/3, including the low-priced Model 6.

DAC offers IBM System/3 computer users 400- and 750-lpm chain/train printers as replacements for IBM's 5203 and 1403 Printers. Both DAC printers connect directly to the System/3 I/O channel (all models) and offer significant price/performance advantages.

MANAGEMENT SUMMARY

Digital Associates Corporation, established in 1971, is dedicated to supplying printers and other peripheral systems to users of minicomputers, small business systems, and, more recently, to IBM System/3 users. Principally a marketing firm, DAC acquires its peripherals on an OEM basis from other vendors, builds the appropriate interfaces, and markets the products to end users. Maintenance is provided by Sorbus, Inc.

DAC introduced its printers to the IBM System/3 market in January 1974 and began making deliveries the following month. The printers are produced to DAC specifications by Data Printer Corporation and include a DAC interface designed for direct connection to the System/3 I/O channel, thus precluding the need for the IBM device attachment features required for attaching IBM's own System/3 peripherals.

The DAC printers are chain/train printer replacements for IBM's 5203 and 1403 printers. Available for all models of the System/3, the DAC printers offer price/performance advantages over their IBM counterparts; and, of even greater significant, they offer the printing capability of the Model 10 to users of the Model 6. On System/3 Models 8, 10, and 15, the printers operate under standard systems software; however, a special software module, supplied by DAC and loaded during installation, is required to operate a line printer on the Model 6. No change or recompiling of user application programs is required for the DAC/3 printers to operate on any System/3.

In September 1974, DAC introduced a new 750-lpm chain/train printer to replace the DAC/3 Model 600, a 600-lpm drum printer that was its original replacement for ▷

CHARACTERISTICS

MANUFACTURER: Digital Associates Corporation, 24 Old Kings Highway South, Darien, Connecticut 06820. Telephone (203) 655-7606.

MODELS: Models 400 and 700, both chain/train printers rated at 400 and 750 lpm, respectively.

COMPATIBILITY: The DAC/3 Printers are plug-compatible printers for the IBM System/3 computers. Model 400 is a replacement for the IBM 5203 and 1403-5 Printers and is available for System/3 Models 6, 8, 10, and 15. Model 700 replaces the IBM 1403-2 Printer in System/3 Model 10 or 15 installations and is also available for the System/3 Models 6 and 8. The printers interface directly to the Input/Output Channel of each processing unit, eliminating the need for an IBM Printer Attachment. No software or hardware changes to existing IBM equipment are required to attach the DAC/3 printers; however, a software module, supplied by DAC, is required to support either printer model on the System/3 Model 6. The printers are compatible with existing System/3 software and operate under the standard System/3 Supervisor and normal I/O support routines.

MODEL 400: The DAC/3 Model 400 Line Printer is a chain/train printer that features single-line buffering, EBCDIC coding, and a standard 48-character print set. Print sets consisting of 64 or 96 characters are optional. The 96-character set includes lower case alphabetics. A sound-deadening cabinet is optional. The salient characteristics of the Model 400 and the IBM 5203 are compared in the following table:

	DAC/3 Model 400	IBM 5203*
Print positions	132	96; 120 or 132 opt.
Print speed, lines/min.	400	100, 200, or 300
Paper slew rate, inches/sec.	15	16.67
Character spacing, char/inch	10	10
Line spacing, lines/inch	6; 8 opt.	6 or 8
Paper width, inches	3½ to 19½	3-7/8 to 16-3/4
Character set, chars.	48; 64 or 96 opt.	48
Max. form thickness, inches	0.020	0.020

*Models 1, 2, and 3.

MODEL 700: The DAC/3 Model 700 Line Printer is a chain/train printer that features single-line buffering, EBCDIC coding, and a standard 48-character EBCDIC print set. Print sets consisting of 64 or 96 characters are optional. The 96-character set includes lower case alphabetics. A sound-deadening cabinet is standard. The salient characteristics of the Model 700 and the IBM 1403 are compared in the following table: ▶

Digital Associates DAC/3 Printers for IBM System/3

the IBM 1403. Production deliveries of the DAC/3 Model 700 are scheduled to begin in March 1975.

The Universal Character Set feature, optional for both IBM printers, is not available for the DAC/3 printers. Character sets of 64 and 96 characters (including upper and lower case) are optional for both DAC/3 printers, and virtually any set that includes the same number of characters as the original chain/train can be accommodated provided changes are made to the application software to accommodate the different character set. IBM offers a dual-feed carriage for its 5203, which can accommodate two forms simultaneously; this feature is not available for the DAC/3 printers.

The DAC/3 printers are available under one- through five-year leases, but two- and three-year leases are most common. On this basis, the DAC/3-700 printer leases for from 20 to 36 percent below the one-year lease price of IBM's 600-lpm 1403-2 printer (including I/O attachments) and from 5 to 25 percent below IBM's 465-lpm 1403-5 printer. The DAC/400 printer leases for either 10 percent above or 15 percent below the one-year lease price of IBM's 300-lpm 5203-3, depending on the lease term chosen. DAC also offers substantial savings on purchased equipment.

DAC plans to introduce a 1000-lpm printer for the System/3 market by January 1976.

DAC is currently concentrating its sales efforts in nine major cities (Boston, New York, Philadelphia, Minneapolis, Detroit, Washington, Baltimore, Houston, and Los Angeles) plus the South Jersey area. DAC plans to expand to other cities consistent with its ability to provide field support.

USER REACTION

Datapro interviewed four users of the DAC/3 Model 400 Printer, each of whom had one printer installed on a System/3 Model 6 computer. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	4	0	0	0	4.0
Print quality	4	0	0	0	4.0
Equipment reliability	2	2	0	0	3.5
Maintenance service**	2	1	0	0	3.7

* Weighted Average on a scale of 4.0 for Excellent.
**Maintained by Sorbus, Inc.

Each of these users was delighted with the DAC printer and impressed with its exceptionally sharp print quality—"even to the sixth copy," as one user noted. Another user even felt the print quality was superior to that of the IBM 1403-N1, and said that IBM personnel were impressed with the installation and print quality. All of the responding users agreed as to the ease of installation, which required only 30 to 45 minutes from the time the printer was wheeled in until it went into actual operation. But what excited these users most was that their DAC-equipped Model 6 systems provided the print throughput of a Model 10. One user explained that the added print capability chopped seven hours off his print load.

Only minor problems were encountered by the users. One had some parts damaged during shipment, which were quickly replaced. Another experiences occasional system halts as a result of printer static problems, and this situation has yet to be resolved. Still another had some initial circuit board failures, which have not recurred since replacements were installed. □

	DAC/3 Model 400	IBM 1403*
Print positions	132	132
Print speed, lines/min.	750	465 (Mdl 5), 600 (Mdl 2), 1100 (Mdl N1)
Paper slew rate, inches/sec.	20	33 or 75
Character spacing, char/inch	10	10
Line spacing, lines/inch	6; 8 opt.	6 or 8
Paper width, inches	3½ to 19½	3½ to 18¾
Character set, chars.	48; 64 or 96 opt.	48; 49 to 120 opt.
Max. form thickness, inches	0.020	0.020

*Models 2, 5, and N1.

FEATURES: Both printers are available with 6 or 8 lines/inch selectable vertical spacing. The IBM type HN or AN font is available as a no-cost option in place of the standard LC font. ASCII character sets of 64 or 96 characters are optional for both printer models. User-specified 48-, 64-, or 96-character fonts are available at extra cost.

Additional options include the Dual Printer Attachment and Time of Day Clock features. Both options are largely software-implemented. The Dual Printer Attachment feature permits the operation of two printers on the System/3 Model 10 or 15; the IBM Dual Programming Feature is prerequisite to implementing the feature on the Model 10. The feature accommodates two DAC/3 printers or one DAC/3 and one IBM printer.

PHYSICAL CHARACTERISTICS: The physical characteristics of each DAC/3 printer model are listed below, along with those of DAC's System/3 printer interface.

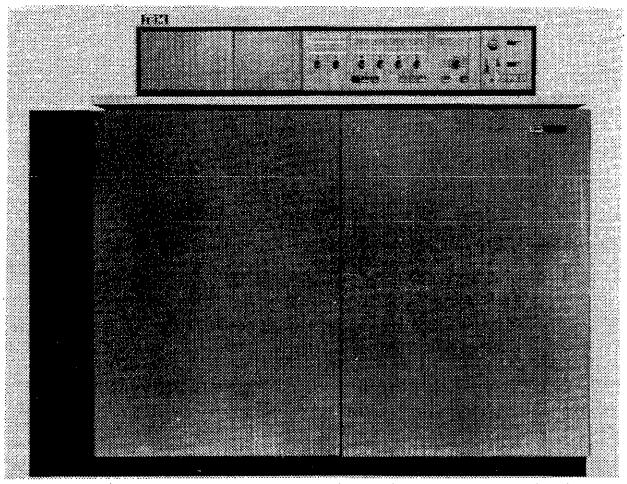
	Width, Inches	Depth, Inches	Height, inches	Weight, pounds
Model 400 Printer	34	18	41	450
Model 700 Printer	36	26	42	500
Printer interface:				
S/3 Mdl. 6	11	15	10	25
S/3 Mdls. 8/10/15	20	20	27	100

PRICING: The DAC/3 Printers are available for purchase or on a one- through five-year lease. A separate maintenance contract is available for leased or purchased units.

	Monthly Rental*			
Printers	2-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Model 400 (chain/train)	$715	$560	$17,750	$115
Model 700 (chain/train)	980	790	25,600	115
Options				
Selectable spacing (6/8 lines/inch; includes 12-channel VFU)	35	27	600	6
Dual Printer Feature	33	24	950	–
Time of Day Clock	34	26	800	6
Canopy Lamp	4	3	90	–
Static Eliminator	10	6	190	–

*Includes maintenance. ■

Econocom Add-On Main Memory for System/360 Model 20



Econocom's add-on core memory (the black section at left) adds just seven inches to the width of an IBM System/360 Model 20 processor and provides up to 32K bytes of additional storage capacity.

ECOM 20 core memory modules can expand the main memory capacity of an IBM 360/20 Submodel 1, 2, 3, or 4 to as much as 48K bytes when combined with existing IBM memory.

MANAGEMENT SUMMARY

Core-bound IBM System/360 Model 20 users who would rather upgrade than switch should focus their attention on Econocom, which offers up to 32K bytes of add-on core memory for the 360/20. Available for Submodels 1, 2, 3, and 4 only, the ECOM 20 memory provides up to 32K bytes of storage in 8K-byte increments. When it is combined with existing IBM memory, the total memory size can go up to 48K bytes. Physically small, the 32K-byte memory is contained in a single cabinet that attaches to the left side of the processor and adds only seven inches to its width.

The ECOM 20 was developed and is fabricated for Econocom by Standard Memories, Inc., one of the early vendors of add-on main memory for the System/360 market and a current suppplier of memory for the larger models. Warranty and spare parts are provided by Standard Memories. Nationwide maintenance service is provided by Sorbus.

No software changes are required for ECOM 20 installations that do not exceed the 16K-byte memory size limit set by IBM for 360/20 Submodels 1 through 4. Memory enhancements (expansions beyond IBM's 16K-byte limit) up to a total of 32K bytes require only slight modifications to the Disk or Tape Processing System control software in the form of two Specify statements. But major changes are required to go beyond a total of 32K bytes.

As of this writing, Econocom has not yet received IBM certification; however, IBM has inspected Econocom's initial installation, and Econocom does not anticipate any problems. Initial deliveries of the ECOM 20 memory began in February 1975. Lead time on orders is 60 days ARO. Due to software development, the maximum module size of 32K additional bytes won't be delivered until April 1975.

Econocom is a 3½-year-old dealer in IBM computer systems and has delivered some 75 to 80 Model 20's alone. The company is currently dealing in System/360 computers as well. □

CHARACTERISTICS

SUPPLIER: Econocom, Inc., 1255 Lynnfield Road, Memphis, Tennessee 38138. Telephone (901) 767-9130.

MANUFACTURER: Standard Memories, Inc. (subsidiary of Applied Magnetics Corp.), 2801 E. Oakland Park Boulevard, Fort Lauderdale, Florida 33308. Telephone (305) 566-7611.

MODEL: ECOM 20, an add-on memory for IBM System/360 Model 20 computers, Submodels 1, 2, 3, and 4.

COMPATIBILITY: The ECOM 20 main memory is designed as a plug-compatible add-on mainframe memory for the IBM System/360 Model 20, Submodels 1, 2, 3, and 4. The ECOM 20 memory can be used to extend the core storage capacity of an existing Model 20 processing unit, to replace all IBM core storage except for the minimum storage capacity (4K), or to replace *and* extend the existing mainframe storage.

The ECOM 20 is available in incremental capacities of 8K bytes up to a maximum capacity of 32K bytes, and can extend the memory capacity of a 360/20 from IBM's maximum limit of 16K bytes to as much as 48K bytes. Memory cycle time is 3.6 microseconds per single-byte access, the same as that of the IBM 2020 Processing Unit, Submodels 1, 2, 3, and 4.

Enhancements beyond IBM's 16K-byte limit require only slight changes to IBM's Disk or Tape Processing System (DPS or TPS) control software as long as the maximum memory size does not exceed 32K. Capacities beyond 32K require extensive software modifications, which are being developed.

The ECOM 20 memory cabinet contains up to 32K bytes of core memory and attaches to the left side of the 2020 Processing Unit, increasing its width by 7 inches. The memory contains its own power supply and attaches to an external power source.

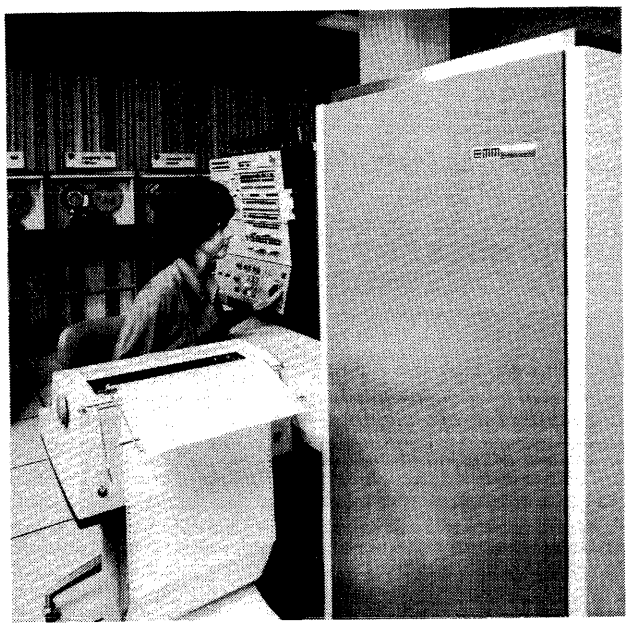
PRICING: The ECOM 20 memory is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Econocom provides lease contracts for 24, 30, 36, 42, 48, 54, or 60 months. The lease prices shown include installation, diagnostic checks, and unlimited usage. A separate maintenance contract is available for leased or purchased units.

Memory Capacity	Monthly Rental*	Purchase	Monthly Maint.
8K bytes	$ 475	$12,975	$40
16K bytes	712	17,975	50
24K bytes	903	21,975	60
32K bytes	1,045	24,975	70

*Rental prices shown are for a 24-month lease and do not include maintenance charges, which are stated separately. Monthly rentals for longer lease periods carry the following discounts from the 24-month rates:

30 months: 17.3%.
36 months: 28.8%.
42 months: 36.6%.
48 months: 43.2%.
54 months: 47.8%.
60 months: 51.6%. ■

Electronic Memories & Magnetics Add-On Main Memory



EM&M offers replacement memory for IBM System/370 Models 145, 155, and 165 and for System/360 Models 30 through 67. Enhancement capacities of up to 4 megabytes are available for the 360/65 & 67 and the 370/155, and an accelerator feature for the 155 promises a substantial increase in performance.

MANAGEMENT SUMMARY

EM&M, a leading manufacturer of main memory for end users and a significant supplier of semiconductor and core memory products to the industry, provides a broad line of add-on or replacement main memory for the IBM System/370 and 360 computers.

EM&M offers memory for System/370 Models 145, 155, and 165 in IBM-standard capacities, and in enhancement capacities for the Model 155 that provide up to twice the IBM-imposed maximum capacity. EM&M memory for the 370/145 employs semiconductor technology, while core memory is used for the 370/155 and 165 replacements. EM&M's memory for the System/360 also employs core technology and is available in both IBM standard and EM&M enhancement capacities for Models 30, 40, 50, 65, and 67. Memory enhancements provide up to twice the IBM-imposed maximum capacity for Models 30, 40, and 50 and up to four times (4096K bytes) that for Model 65.

EM&M also offers an accelerator or processor speed-up feature for the System/370 Model 155. Billed as the Processor Speed Enhancement (PSE), the feature is designed for use with EM&M memory and, according to EM&M, provides a 10 to 15 percent improvement in throughput. The PSE feature yields a 38 percent improvement in the time required for the processor to access data from main memory (when the requested data is not in cache); the PSE accesses the data in 920 nanoseconds as compared with IBM's 1495 nanoseconds. The PSE also improves I/O fetch time by 39 percent and memory write time by 33 percent (both these operations bypass the cache). EM&M's PSE requires only 1265 nanoseconds per I/O fetch cycle and 1380 nanoseconds per memory write cycle. By contract, IBM performs either of these operations in 2070 nanoseconds.

The improved performance provided by the PSE feature becomes even more significant as memory capacity is

CHARACTERISTICS

MANUFACTURER: Electronic Memories and Magnetics Corporation (EM&M), Computer Products Division, 12624 Daphne Avenue, Hawthorne, California 90250. Telephone (213) 644-9881.

IBM SYSTEM/370 MODELS: Three models of replacement memory are each available in IBM-standard incremental storage capacities for System/370 Models 145, 155, and 165. The EM&M models are:

Multimemory 145 – for System/370 Model 145.
Micromemory 3650/155 – for System/370 Model 155.
Micromemory 3650/165 – for System/370 Model 165.

IBM SYSTEM/360 MODELS: Four models of replacement core memory are each available in IBM-standard incremental and in enhanced storage capacities for System/360 Models 30, 40, 50, 65, and 67. The EM&M models are:

Micromemory 3650/30 – for System/360 Model 30.
Micromemory 3650/40 – for System/360 Model 40.
Micromemory 3650/50 – for System/360 Model 50.
Micromemory 3650/65 – for System/360 Models 65 and 67.

COMPATIBILITY: EM&M's memories are designed as plug-compatible add-on or replacement memory for IBM System/370 Models 145, 155, and 165 and for System/360 Models 30, 40, 50, and 65. They can be used to extend the storage capacity of an existing IBM processing unit and/or to replace all existing storage down to the minimum mainframe capacity as specified for the particular IBM model. EM&M memory, combined with the mainframe storage capacity of an existing IBM System/370 or 360 processing unit, provides the following range of standard and enhanced mainframe storage capacities:

EM&M Memory Model	IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	Enhanced EM&M Capacities, bytes
145	3145	160K	160K to 2048K	None
3650/155*	3155	0	256K to 2048K	2560K, 3072K, 3584K, or 4096K
3650/165*	3165	0	512K to 3072K	None
3650/30	2030	8K or 16K	16K to 64K	96K or 128K
3650/40	2040	32K	32K to 256K	384K or 448K
3650/50	2050	128K	128K to 512K	768K or 1024K
3650/65*	2065	0	256K to 1024K	1280K, 1536K, 1792K, 2048K, 2560K, 3072K, 3584K, or 4096K

*All existing IBM memory can be replaced.

Effective cycle times of the EM&M memory are the same as those of the corresponding IBM memory:

IBM Model	Cycle Time, microseconds	Bytes per Fetch
370/145	0.54	8
370/155	2.07	16
370/165	2.00	8
360/30	1.5/2.0	1

Electronic Memories & Magnetics
Add-On Main Memory

increased and, as a result, the hit ratio decreases. According to IBM, the hit ratio for a 370/155 with 512K bytes of main memory is typically 90 to 95 percent, which means that 5 to 10 percent of the time processor-requested data is not in cache and must be accessed from main memory. As memory is expanded beyond 512K bytes to 2048K bytes, the hit ratio typically decreases to 75 to 80 percent, so that main memory accesses occur 20 to 25 percent of the time. An increase to an enhanced main memory capacity of 4096K bytes further diminishes the hit ratio, with substantial degradation in performance. Users considering such memory expansions should seriously consider the PSE feature to offset the resulting performance degradation. The PSE is actually a high-speed memory controller that is substituted for IBM's Storage Adapter. The PSE can accommodate up to 4096K bytes of main memory and can be used in addition to IBM memory for any combination of IBM and EM&M memory capacities to a maximum of 4096K bytes.

Still another important feature that EM&M offers for 360/65, 370/145, and 370/155 users is the Floating Address Switch. This feature permits the user to switch any malfunctioning 256K- or 512K-byte memory segment (including IBM memory) with an identical segment of high-order memory. The switched memory segments are assigned each other's addresses, and normal operation can continue with the remaining portion of operable memory, pending servicing of the malfunctioning segment.

Customer deliveries of EM&M memories began in March 1971, when EM&M installed a Nanomemory 4850/40 on a System/360 Model 40. First customer deliveries for Model 50 and 30 installations followed in April and May 1971, respectively. Initial customer deliveries of EM&M's Micromemory 3650/65 were made in March 1972, with the first Model 65 enhancement (256K to 1536K bytes) following in April. EM&M enhancements for Model 30 installations got off to a relatively late start, with the initial installation (64K to 128K bytes) in April 1972. Initial Model 40 enhancements were made in September 1972. Model 65 enhancements to as much as 2.5 million bytes have been made; over a dozen Model 65's have been enhanced beyond one megabyte. To date, EM&M has installed over 400 memory systems, having an aggregate capacity of 300 million bytes.

Initial deliveries of Micromemory 3650/155 began in February 1973, with Micromemory 3650/165 deliveries following in August 1973. Deliveries of Multimemory 145 began late in December 1973.

The introduction of EM&M replacement memory for the 370/158 is planned for June 1975, with deliveries following in October. The 370/158 memory will be constructed from EM&M's new 4K-bit N-MOS static chips. EM&M has no immediate plans to introduce memory for the 370/135 or 370/168.

The EM&M memories are priced substantially below their IBM counterparts. EM&M's rental prices (under a one-year lease) for System/360 memories average 75 percent below IBM's prices, while its purchase prices average 86 percent below IBM's.

Service is provided by Sorbus, a nationwide service organization with headquarters in King of Prussia, Pa.

IBM Model	Cycle Time, microseconds	Bytes per Fetch
360/40	2.5	2
360/50	2.0	4
360/65 or 67	0.75	8

The Multimemory 145 is an N-MOS static semiconductor memory available for both versions of the 370/145. It features plug-in memory cards, each containing 32 1024-by-1-bit semiconductor memory chips. The 145 can contain up to three Basic Storage Modules (BSM), each containing 72 memory cards, to provide a maximum storage capacity of 256K bytes per BSM and 768K or 1024K bytes per cabinet. The 7370/145 also features Storage Protection and Error Correction Code logic identical with that provided by IBM.

The Micromemory 3650/155 and 3650/165 are core memories designed as direct replacements for IBM 3360 Processor Storage. The 3650/155 is available in three storage capacities: 256K, 512K, and 1024K bytes. The 3650/165 is available in storage capacities of 512K bytes only.

The EM&M Micromemory 3650/65 is designed as a direct replacement for IBM 2365-2 Processor Storage. The 3650/65 comes in two configurations, one with 256K bytes and one with 512K bytes. Both units are designed to interface with both the IBM 2065 and 2067 Processing Units. Up to four 3650/65 units can be used in an IBM standard configuration to provide a maximum main memory capacity of 2,048K bytes. In addition, four more 3650/65 units can be added via an additional port implemented by EM&M to provide a maximum storage capacity of 4096K bytes.

The EM&M memories contain an integral power supply that satisfies the memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, provides an off-line diagnostic capability to facilitate the isolation of malfunctions within the unit.

Physical specifications and heat dissipation for each of the EM&M memories are as follows:

Memory Model	Maximum Storage, bytes	Depth, inches	Width, inches	Height, inches	Weight, pounds	Max. Heat Dissipation, BTU/hr.
145	768K	32	48	60	1,200	12,000
3650/155	512K	32	38	60	870	6,150
3650/165	512K	32	38	60	870	6,150
3650/30	256K	21	32	29	522	4,000
3650/40	256K	21	32	29	522	4,000
3650/50	256K	21	32	29	522	4,000
3650/65	512K	32	38	72	940	7,750

EM&M memories are powered from a 208/230-volt, 3-phase, 4-wire source.

PRICING: EM&M memory units are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. EM&M provides lease contracts for one, two, three, four, and five years.

IBM Processor Conversion		Monthly Rental* 1-Year Lease	2-Year Lease	Purchase	Monthly Maint.**
From 2030D	(16K) to:				
F	(64K)	$ 690	$ 630	$ 14,650	$ 50
FE	(96K)	1,435	1,275	28,750	115
G	(128K)	1,600	1,400	31,625	140
From 2030E	(32K) to:				
F	(64K)	545	490	11,785	50
FE	(96K)	1,090	1,035	24,150	115
G	(128K)	1,550	1,350	29,900	140
From 2030F	(64K) to:				
FE	(96K)	745	690	17,250	80
G	(128K)	1,090	1,035	24,150	90

Electronic Memories & Magnetics
Add-On Main Memory

EM&M prides itself on being "one of the world's largest independent manufacturers of cores, core arrays, core stacks, and core memory systems." Besides the manufacture of core memories and memory components, EM&M, through its subsidiaries and affiliates, also supplies magnetic disk units, disk packs, magnetic recording heads, and semiconductor memories, in addition to products for the electronic field.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 23 users reported on their experience with a total of 35 EM&M replacement memories. These were divided among the System/370 Model 155 (8) and System/360 Models 30 (5), 40 (7), 50 (1), 65 (11) and 67 (3). The 35 memories had an aggregate capacity of 20,764K bytes. The users' ratings of the EM&M memories are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	16	6	1	0	3.7
Equipment reliability	11	9	1	1	3.4
Maintenance service**	6	9	5	1	3.0
Ease of installation	4	12	4	2	2.8

* Weighted Average on a scale of 4.0 for Excellent.

** Serviced by Sorbus.

Judging from the views of these users, as expressed by the large majority of good to excellent ratings in all categories, EM&M memory should be considered by prospective users as a solidly practical alternative to IBM memory. Average installation time was reported as 16 hours, with individual times ranging from 1 to 72 hours. Only six of the 23 users reported serious problems during installation and testing, and only two reported serious problems in diagnosing problems and obtaining service. □

IBM Processor Conversion		Monthly Rental* 1-Year Lease	2-Year Lease	Purchase	Monthly Maint.**
From 2040E	(32K) to:				
G	(128K)	1,070	950	23,000	105
GF	(192K)	1,440	1,325	30,475	170
H	(256K)	1,785	1,585	39,100	215
HF	(320K)	2,990	2,645	63,250	215
HGF	(448K)	3,795	3,335	80,500	280
From 2040F	(64K) to:				
G	(128K)	805	720	16,400	85
GF	(192K)	1,150	1,035	25,600	125
H	(256K)	1,585	1,380	34,250	170
HF	(320K)	2,590	2,275	54,625	175
HG	(384K)	3,165	2,790	65,550	205
HGF	(448K)	3,565	3,140	74,750	230
From 2040G	(128K) to:				
GF	(192K)	805	720	16,400	85
H	(256K)	1,150	1,035	25,600	125
HF	(320K)	2,300	2,020	49,450	175
HG	(384K)	2,645	2,320	58,650	175
HGF	(448K)	3,165	2,790	65,500	205
From 2040GF	(192K) to:				
H	(256K)	805	720	16,400	150
From 2040H	(256K) to:				
HF	(320K)	1,180	1,035	24,150	260
HG	(384K)	1,610	1,410	30,475	405
HGF	(448K)	1,990	1,760	41,400	480
From 2050G	(128K) to:				
H	(256K)	1,380	1,210	26,450	150
HG	(384K)	2,185	1,930	42,550	260
I	(512K)	3,165	2,790	62,100	405
IG	(640K)	4,600	4,060	94,300	480
IH	(768K)	5,465	4,805	113,850	550
IHG	(896K)	6,670	5,865	141,450	625
From 2050H	(256K) to:				
HG	(384K)	1,380	1,210	26,450	150
I	(512K)	2,185	1,930	44,275	260
IH	(768K)	1,380	1,210	26,450	150
J	(1024K)	4,600	4,060	94,300	480
From 2050HG	(384K) to:				
I	(512K)	6,670	5,865	141,450	625
From 2050I	(512K) to:				
IG	(640K)	1,640	1,440	32,200	150
IH	(768K)	2,450	2,160	48,300	260
J	(1024K)	4,600	4,060	94,300	(?)
Model 3650/65 (360/65)					
256K		2,760	2,415	55,200	420
512K		4,060	3,565	86,250	530
768K		6,739	5,925	140,300	685
1024K		7,880	6,875	170,200	860
1280K		10,525	9,260	224,250	1,010
1536K		11,615	10,235	254,150	1,160
1792K		14,260	12,535	307,050	1,355
2048K		15,295	13,455	334,650	1,550
Features for 3650/65 Memory					
First memory port		535	475	10,350	0
Each additional port (up to 6)		40	35	805	0
Floating Address Switch		115	90	2,070	0
Micromemory 155 and 165					
512K		3,855	3,450	90,850	530
1024K		7,305	6,670	178,250	860
1536K		10,810	9,805	253,000	1,160
2048K		14,260	12,855	322,000	1,550
Multimemory 145					
256K		2,500***	–	95,000	300
512K		3,900***	–	140,000	400
768K		5,300***	–	170,000	600
Features					
Processor Speed Enhancement (PSE):					
Without memory (stand-alone)		4,545	4,025	69,000	200
With memory		4,500	4,025	62,000	200
Processor Memory Enhancement (PME)		690	610	16,000	0
Floating Address Switch (370/155 or 145)		230	200	4,370	0

* Includes prime-shift maintenance.

** Prime-shift maintenance: extended maintenance is priced at about 1.5 times prime-shift rates.

***Available on 3-year lease only. ■

Entrex Data Entry Systems
New Product Announcement

In a move to further strengthen its position in the data preparation market, Entrex has added two new members to its family of data entry systems. The new models expand the family both upward and downward, offering users a total of five upward-compatible systems. The top-of-the-line System 580, introduced in April 1975, is essentially a System 480 with substantially enlarged disk storage and advanced operating software. The entry-level System 280-1, introduced in June 1975, is a stripped System 280 that provides most of the 280's functional capabilities but lacks data communications facilities.

SYSTEM 580: The new Entrex System 580, like System 480, is available with up to 32 keystations; and with the exception of disk storage, its hardware configuration is the same as that of the System 480. Disk storage for System 580 can consist of either a single "2314-style" disk pack unit with a capacity of 29 million bytes (3 times the 480's maximum disk storage capacity) or cartridge disk storage identical with that provided for the 480, with a maximum capacity of 9.6 million bytes. Operating software for the 580 includes all software capabilities provided by the 480 plus support for up to five files accessed via the indexed sequential access method (ISAM), additional editing support, selective tape input, the capability to input or output individual Editor Libraries as data (which permits more comprehensive edit program documentation and also allows programs to be read into more than one library), and a few additional software enhancements.

The "ISAM" feature can dramatically reduce the number of keystrokes required during data entry and validation operations, thereby increasing productivity. Up to 99 characters of data can be associated with each keystroke. The associated data resides on disk in up to five indexed value tables, and can be retrieved and displayed by the operator or inserted into the transaction file in process. For example, in an order entry application where a part number is keyed, the associated description, unit price, and quantity on hand can be automatically retrieved and inserted into the record. According to Entrex, access to a table of 500,000 characters is virtually instantaneous, while access to a 3-million-character table requires 4 seconds.

The editing support added to the Entrex Editor Language for the 580 includes the functions Back, Show, and Audit. Back permits access to previous records (e.g., subtotalling across format boundaries) in a Record End Edit routine. Show permits the contents of fields and variables (as well as error messages) to be displayed and the error tone to be sounded. Audit permits a tape record to be created of entered data within a Record End Edit program.

Selective tape input permits selected tape records to be transferred to disk. This feature is advantageous for storing files, such as master files, on tape when they are too large for disk storage. The file can be updated by transferring a batch of selected records to disk for processing.

The large-scale System 580 is intended to satisfy users who require very large value tables and/or a large data storage capability in their data entry applications. Also, System 580 is well suited for use as a remote data entry system because data can be completely validated prior to transmission. The system is available for purchase or on a one-, two-, three-, or five-year lease. A 10-million-byte disk system with 20 keystations sells for $181,015 and leases for $4,196 per month (including maintenance) under a three-year lease. A 29-million-byte disk system with 20 keystations sells for $188,615 and leases for $4,378 per month (including maintenance) under a three-year lease.

System 580 is available for immediate delivery. Customer deliveries began in June 1975. Lead time on orders is currently quoted as 60 days after receipt of order. The 29-million-byte disk will be available for delivery in October 1975. A leased or purchased System 580 with 5 or 10 million bytes of disk storage can be field-upgraded to provide 29 million bytes of disk storage.

SYSTEM 280-1: The new Entrex System 280-1, like System 280, is available with up to 12 keystations, includes 1.8 million bytes of non-expandable disk storage, up to 32K bytes of memory, and one of two tape drives (9-track 800 bpi or 9-track 1600 bpi), and is available with one of the three printer models that Entrex offers for its other data entry systems. The 280-1 cannot be used as a remote data entry system. Operating software is virtually the same as that for System 280 with the exception of the Output Editor. The Output Editor for the 280-1 contains 7 instructions as compared with the 280's complement of 15.

System 280-1 is an entry-level key-to-disk system for users who want a low-cost, high-performance keypunch replacement. It is available for purchase or on a one-year lease only. A typical 5-keystation system leases for $868 per month including maintenance; this is about the same as the cost of leasing five IBM 29 keypunches. The typical 5-keystation system sells for $52,800. Customer deliveries began in July 1975. Lead time on orders is currently quoted as 60 days after receipt of order. □

Four-Phase Systems
System IV/70

Further information was gathered via Datapro's Reader Survey Form on Key Entry Devices that was included in the April 1974 supplement. We received 7 responses on the Four-Phase IV/70 that reported on users' experience with 13 systems representing 162 keystations. Here's how these 7 users rated the system:

	Excellent	Good	Fair	Poor	Weighted Average*
Overall performance	1	6	0	0	3.1
Ease of operation	2	3	2	0	3.0
Hardware reliability	0	4	2	1	2.4
Promptness of mfr's maintenance	1	3	2	1	2.6
Quality of mfr's maintenance	0	4	3	0	2.6
Software and technical support	0	2	4	1	2.1

In Datapro's 1975 CRT Reader Survey, which is presented in Report 70D-010-20 at the beginning of this binder, we received responses from 14 users of IV/70 systems representing a total of 231 displays. This survey indicated improvements in all rating categories compared to the prior year's survey, particularly in the area of hardware reliability. Maintenance service and software/technical support showed modest improvements.

In these surveys, the ratings for software and technical support were less than great. This may well reflect users' reactions to complex, programmable systems. The user has many decisions to make about setting up and implementing the system. A lot more work is required on the user's part when he goes the intelligent system way than when he just plunked down teletypewriters hither and yon or gathered a flock of keypunches into a big room. Many processing tasks that were previously done on the mainframe can be moved to the peripheral subsystem. Operator training is more difficult because the operator is called upon for more skilled efforts. In general, the area of software and technical support has traditionally been the area that received the most criticism from computer users. Now, with intelligent peripheral systems, not only the mainframe vendors but also the peripheral vendors are receiving this type of criticism. □

inch, and is operator-selectable. High-speed paper advance rate is 35 inches per second. An 8-channel vertical forms control unit is included.

CARD READERS: Two desk-top card readers are available. The 8001 reads at 300 cpm, and the 8003 reads at 600 cpm. Each unit includes a controller that performs code translation. A special device, the 8010 Multiple Loading Switch, allows a single card reader to be used for loading up to 8 systems; a separate controller (8011) must be installed in each of the systems.

DEVICE CONTROL: System IV/70 is a multi-display, interactive processing system that executes all operations under program control. The system can be configured and operated in three basic modes: (1) as a data communications terminal subsystem, with interchange of information between the System IV/70 and a remote computer; (2) as a local satellite, connected to a System/360 or 370 computer by a direct channel-to-channel interface; or (3) in a stand-alone configuration in which a dedicated application is supported entirely by the System IV/70 and appropriate I/O equipment and software.

Operation of the System IV/70 is directed from the individual video terminals under control of the operating software. The video terminals are similar in concept and design to conventional CRT terminals and include an extensive set of cursor and edit controls, function controls, and an adding-machine capability. Cursor controls, which provide a wraparound capability, can move the cursor right, left, up, down, to the initial line and character position of the screen (home), and to the initial character position of the next line (return). Roll controls roll the displayed text up or down, line by line. Insert and delete controls insert or delete a character or a line in or from the displayed text.

Screen and line erase are also provided. The Tab control produces any of three codes as the result of shifted, unshifted, or control shift operation. Under program control, these cursor and edit controls can be assigned to virtually any display function. A set of 13 function controls can be programmed to implement application-dependent operations to extend the system's range of usefulness. The adding-machine capability provides separate numeric and function controls for high-volume numeric operations.

SOFTWARE

Two types of software are provided: turnkey program packages for specific applications and systems software for user-developed custom programming.

Applications Software

DATA IV/70: Provides data entry capabilities designed to replace keypunch installations or for source data entry. There are two versions of the package. The IV/70 Models 7001 and 7008 use Version 1; Model 7002 systems may use either version.

In general, both versions provide for data entry using a fill-in-the-blanks approach with prompting messages that are not included in the output record, for extensive data editing and manipulation, for verifying previously recorded records, and for searching for specific records with or without updating when found.

Version 1 provides up to six program formats per job. Multiple jobs can be running at the same time, and formats can be shared among several jobs. Six balance accumulators are provided. Record lengths can be defined as up to 750 characters, the maximum tape block size. Conventional keypunch functions are provided plus a large number of other functions, including "generate" and numeric field relationships. The generate function allows a single key to be used to trigger the output of a stored constant field based on the character keyed. Numeric relationships such as equal, not equal, greater than, and less than can be used to check a group of fields having an arithmetic relationship. A field can be defined as "must enter" or "must fill" to prevent a data entry operator from leaving the specified field blank. Up to four 2.5-million-byte disk drives are supported to provide a data file storage capacity of up to 80,000 80-character records. Either keypunch-style or typewriter-style keyboards are supported, but they cannot be mixed in the

same system. Data can be printed from the screen or from the disk file. Data can be transferred to tape from the disk while key entry continues. Output options supported include magnetic tape, direct connection to an IBM System/360 Model 30 or larger or an IBM System/370, and remote data communications using binary synchronous line discipline.

Version 2 of DATA IV/70 provides all the features of Version 1, plus 24 balance accumulators, up to 15 program formats per job, audible error alarm, conditional field checking, multiple validation checks on the same field, extended table comparisons, and support for mixed keypunch and typewriter-style keyboards.

Provisions for conditional logic are included to enable adaptive data validation during key entry. Conditional branches to different editing sequences and operator prompts can be inserted at any point in a format. Single and nested statements of the form IF . . . THEN . . . ELSE can reference previously entered fields, accumulator values, alphanumeric constants, value sets, and arithmetic and logical combinations of these.

When used with the Model 7008, not all features of Version 1 can be utilized because of the restricted configuration of the Model 7008. In particular, only one disk drive is supported, only a 30-cps printer can be included, and a data communications interface is not provided.

Version 1 of DATA IV/70 operates on a System IV/70 with 24K bytes of memory. Version 2 requires 72K bytes of memory. For those two sizes of memory, the following numbers of display stations are supported:

Screen Size	Max. Data Characters, Including Prompts	Maximum No. of Terminals Ver. 1, 7001	Ver. 1, 7008	Ver.2, 7002
48 x 24	1056	6	–	14
48 x 12	480	9	–	18
48 x 6	192	12	8	22
80 x 24	1760	–	–	8
80 x 12	800	6	–	14
80 x 6	320	9	–	18

The display area not used for data and prompting messages is used for status displays.

IBM 3270 SIMULATOR: Provides all functions of an IBM 3270 Display System through software emulation. This package provides for operation in either local or remote environments and supports 480- or 1920-character display units. It includes support for options such as Variable Intensity and Audible Alarm.

IBM 2260 SIMULATOR: Provides all functions of an IBM 2260/2848 Display System through software emulation. This package provides for operation in either local or remote environments and supports all screen sizes. Features include Supervisory Mode, in which a display unit, acting as a supervisory station, can communicate directly with other display units on the same System IV/70, and Media Conversion, which supports data transcription operations such as card-to-tape, card-to-printer, and tape-to-printer.

Systems Software

Programming is performed in COBOL IV/70 or in IV/70 Code, a two-pass, general-purpose assembly language. Programs written in COBOL IV/70 or in IV/70 Code can be compiled or assembled, respectively, on the System IV/70 under the Disk Operating System (DOS) or on a 65K IBM System/360 or 370 under OS or DOS.

COBOL IV/70 includes ANSI modules Nucleus 1, Table Handling 2, Sequential Access 1, Random Access 1, and Library 1. In addition, it provides a linkage section and call verb to permit the use of assembly-language subroutines, plus display-oriented extensions for operating in a video display environment. COBOL IV/70 requires a Model 7002 processor with 48K bytes, disk, card reader, and printer; it will support all system peripherals and both random and sequential disk files.

System IV/70's Disk Operating System permits source files to be kept on disk, edited, and used as input to the Code Assembler or COBOL Compiler. The IV/70 DOS consists of an extensive family of programs that include the Code Assembler, COBOL Compiler, Relocatable Loader, a Video Display Library, a Sort/Merge package, and a System Relocatable Library. DOS operates with either processor model; it requires at least 24K bytes of main memory, a single disk-cartridge drive, card reader, and printer. DOS supports all system peripherals.

PRICING

The System IV/70 is available for purchase or on a one- or three-year lease which includes prime-shift maintenance and supporting software. A separate maintenance contract is available for purchased equipment. Extended-period maintenance arrangements are available in a variety of plans, at costs ranging up to 11 percent of the monthly rental for a full-time 24 hours per day, 7 days per week arrangement.

The following systems are representative of four applications areas:

- IBM 3270 Simulation–Includes 32 480-character display units with Variable Intensity. One-year lease prices (including maintenance) are $2,395/month for remote operation and $2,462/month for local operation. Purchase prices are $98,440 (remote operation) and $109,590 (local operation).

- IBM 3270 Simulation–Includes 16 1920-character display units with Variable Intensity. One-year lease prices (including maintenance) are $1,944/month for remote operation and $2,209/month for local operation. Purchase prices are $80,350 (remote operation) and $91,500 (local operation).

- IBM 2260/2848 Simulation–Includes 32 960-character display units. One-year lease prices (including maintenance) are $2,455/month for remote operation and $2,512/month for local operation. Purchase prices are $100,690 (remote operation) and $111,840 (local operation).

- Data Entry System–Includes 22 288-character displays, 7002 Processor with 72K memory, 2.5M-byte disk drive, and one 9-track, 800-bpi tape drive. One-year lease (including maintenance) and purchase prices are $2,300/month and $95,965, respectively.

- Data Entry System–Model 7008; includes 8 288-character displays, processor with 24K memory, one 2.5M-byte disk drive, and one 9-track, 800-bpi tape drive. Only data entry software support is provided. One-year lease (including maintenance) and purchase prices are $960/month and $29,000 respectively.

Four-Phase Systems
System IV/70

- **Stand-Alone COBOL System—Includes a Model 7002 Processor with 72K bytes of memory, Decimal Arithmetic, one disk drive (pack type, 50 million bytes), one 300-lpm printer, synchronous communications controller, and four 1920-character display units with Variable Intensity and Audible Alarm features. One-year lease (including maintenance) and purchase prices are $2,197/month and $99,675, respectively.**

	Monthly Rental 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
7001 Processing Unit (includes 12K bytes of memory) (1)	$ 370	$348	$16,000	$ 56
Memory Module, 12K bytes	100	94	6,600	23
7002 Processing Unit (includes no memory)	320	291	13,500	45
Decimal Instruction Set	95	88	4,050	13
Memory, 48K bytes	340	309	14,400	50
Memory, 72K bytes	445	407	18,900	65
Memory, 96K bytes	660	601	27,900	95
Video Support Module (2)	40	34	1,575	6
Video Support Module with Dual Intensity Feature (2)	50	45	2,025	7
Audible Alarm Support	10	9	1,250	5
Options for 7001 and 7002				
I/O Expansion Cabinet	160	146	6,750	23
IBM 360/370 Channel Adapter	320	291	13,500	125
7008 Data Entry System (3)	960	915	29,000	192
CRT Display Stations				
12-inch Video Display (4)	37	35	1,445	9
15-inch Video Display (5)	41	39	1,625	9
Keyboard, typewriter style	8	8	400	1
Keyboard, data entry style	10	10	450	1
Communications				
Asynchronous Data Set Controller	55	49	2,350	8
Binary Synchronous Data Set Controller	55	49	2,350	8
Disk Storage				
8230 Removable Cartridge Disk Drive and Controller, 2.5M bytes	250	228	10,600	60
8231 Additional Drive (3 max.)	225	204	9,500	55
8240 Removable Disk Drive and Controller, 50M bytes	800	752	36,000	190
8241 Additional Drive (3 max.)	600	654	27,000	125
8250 Diskette Cartridge Drive and Controller, 250K bytes	140	132	5,100	30

	Monthly Rental 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Magnetic Tape				
8501 Drive and Controller (9-track, 800-bpi, 10.5-inch reel)	365	335	15,500	70
8511 Additional Drive (3 max.)	320	291	13,500	50
8502 Drive and Controller (9-track, 800-bpi, 8.5-inch reel)	255	233	10,800	60
8512 Additional Drive (3 max.)	200	185	8,600	50
8503 Drive and Controller (9-track, 1600-bpi, 8.5-inch reel)	400	364	16,900	75
8513 Additional Drive (3 max.)	370	339	15,800	50
8504 Drive and Controller (9-track, 1600-bpi, 10.5-inch reel)	505	461	21,375	95
8507 Drive and Controller (7-track, 556/800-bpi, 8.5-inch reel)	305	277	12,825	60
Card Readers				
8001 Card Reader and Controller, 300 cpm	140	132	6,300	30
8003 Card Reader and Controller, 600 cpm	190	179	8,550	50
Multiple Loading Switch	55	52	2,000	10
Printers				
8121 Printer and Controller (30 cps, 96-character set, up to 16 printers	160	146	6,750	40
8122 Printer Only (15 max.)	130	117	6,000	30
8131 Printer and Controller (30 cps, 64-character set)	120	113	5,400	40
8146 Printer and Controller (245 to 1100 lpm, 64-character set)	550	517	24,800	125
8148 Printer and Controller (300 lpm, 64-character set)	300	282	13,500	90
8151 Printer and Controller (700 to 1100 lpm, 64 character set)	1,000	940	45,000	200

(1)7001 Processing Unit includes control logic for up to 16 quarter screens, 8 half screens, 4 full screens, or 2 double screens. These capacities can be doubled through a no-cost Display Expansion feature.

(2)Several models are available, all at the same cost, for 8 full or 4 double screens with audible alarm, 16 half screens with audible alarm, 32 quarter screens without audible alarm, and 16 quarter screens with audible alarm. Different Video Support Modules cannot be intermixed.

(3)7008 System includes 24K bytes of memory, eight 288-character displays, 2.5M-byte disk drive, 9-track, 800-bpi tape drive, desks, cables, and software.

(4)12-inch screen is used for displays with 6, 12, or 24 48-character lines or with 6 or 12 80-character lines.

(5)15-inch screen is used for displays with 24 80-character lines. ■

Four-Phase Systems
System IV/40

Shown here with a single CRT display and serial printer, the System IV/40 can support up to 16 of each. The processor (at left) is available with 24K, 48K, or 72K bytes of MOS memory.

System IV/40, a scaled-down version of the System IV/70, supports from 1 to 16 keyboard/display units and 1 to 16 printers. Using disk-resident software, a System IV/40 can serve as a key-to-disk data entry system, perform off-line processing, or serve as a direct replacement for IBM 3270 or 2260 display terminals.

MANAGEMENT SUMMARY

System IV/40, a scaled-down version of the more powerful and flexible System IV/70, is intended to serve as a remote terminal for data entry and retrieval in a large-scale communications network, as a free-standing computer for local processing, or as a key-to-disk data entry system. Composed of as many as sixteen display units and sixteen 30-cps impact printers, System IV/40 is available in two versions: a limited-capability model with a 290K-byte diskette (floppy disk) drive, and a more powerful model with a 2.5-million-byte disk cartridge drive. Both versions are software-compatible with System IV/70 and incorporate a System IV/70 processor with 24K to 72K bytes of MOS semiconductor memory.

System IV/40, like its larger, more powerful counterpart, is intended as a turnkey system and is supported by three no-charge application packages: Data IV/70, a key-to-disk data entry package that combines the functions of key entry, verification, and validation with the communications and output capabilities of a remote batch terminal; an IBM 2260/2848 Simulator; and an IBM 3270 Simulator. Both of the IBM terminal simulators provide the full capability of their IBM counterparts and are available for either version of System IV/40. Data IV/70, however, is available only with the larger version of System IV/40 equipped with the 2.5-million-byte disk drive.

Distributed processing is the primary application environment for which System IV/40 is intended. A typical ▷

CHARACTERISTICS

MANUFACTURER: Four-Phase Systems, Inc., 10420 North Tantau Avenue, Cupertino, California 95014. Telephone (408) 255-0900.

CONFIGURATION: System IV/40 consists of 1 to 16 CRT display units, 1 to 16 30-cps serial printers, a processor with MOS semiconductor memory, a diskette or cartridge disk drive, and a communications controller. System IV/40 can also accommodate one 300-lpm line printer as an option. The terminal system is available in two models that are differentiated only by their storage capabilities. Model 4300 is equipped with a 290K-byte diskette drive, while Model 4500 is equipped with a 2.5M-byte disk cartridge drive. Both processor models are equipped with a basic 24K-byte memory that can be expanded in 24K-byte increments to 72K bytes. System IV/40 is designed for remote operation in a communications environment only.

COMMUNICATIONS: Either of two communications controllers is available. The Asynchronous Data Set Controller operates asynchronously in the half- or full-duplex mode at data rates up to 4800 bits/second and can accommodate any 9- to 11-bit code; it features an automatic answer capability. The Binary Synchronous Data Set Controller operates synchronously in the half- or full-duplex mode at user-specified data rates up to 9600 bits/second and can accommodate any 7- or 8-bit code. Both controllers provide an EIA RS-232C interface.

CRT DISPLAYS: Three models of display units are available; they differ in screen capacity and size. The two smaller models contain a 12-inch (diagonal measurement) CRT, while the larger model contains a 15-inch CRT. The standard display arrangements are shown below.

Characters/Display:	288	576	1152	480	960	1920
Lines/Display:	6	12	24	6	12	24
Characters/Line:	48	48	48	80	80	80

A character set of 125 ASCII symbols, including upper and lower case alphabetics, numerics, and special symbols, is displayed in green against a dark background. Characters are generated by a 7-by-9 dot matrix.

Options include a Selector Pen, Variable Intensity, and Audible Alarm.

The Selector Pen is intended for indexing ("menu selection") applications where a particular item is selected from a number of displayed entries. Software support is provided by the IBM 3270 Simulator Program. ►

Four-Phase Systems
System IV/40

application for branch-office operation would include off-line activities such as entering customer orders, printing picking lists for warehouse stock, updating order files with quantities actually packed, and generating invoices for inclusion with shipments. After hours, the terminal system could be polled by the home-office computer for unattended transfer of branch transactions to the central data base.

Such specialized applications require customized software created by the user. Program development is usually performed on the larger System IV/70, since this activity is not supported on System IV/40. The two Four-Phase terminal systems are software-compatible. Application programs created on System IV/70 are generated under Four-Phase's Disc Operating System using either COBOL IV/70 or CODE Assembler, a two-pass general-purpose assembly language (see report 70D-435-01 for details). As an alternative, Four-Phase supports program development on an IBM System/360 or 370 computer with at least 65K bytes of main memory. Programs can be created under OS or DOS using Four-Phase's FCODE/360 Assembler, a CODE-compatible assembly language used to produce IV/70 object code.

Formed from System IV/70 components, System IV/40 is available with any of the six screen formats and ten keyboard arrangements offered by System IV/70. Printing can be performed at 30 characters per second or at 300 lines per minute. The other System IV/70 peripherals, including a card reader, magnetic tape drives, and IBM 2314-type disk drives, cannot be used on System IV/40. Interchange of programs and data between Systems IV/70 and IV/40 is supported via disk storage. The 2.5-million-byte disk cartridge drive available with System IV/70 (Diablo Model 31) is also usable with System IV/40, which is restricted to one drive compared with up to four for System IV/70. The Model 8250 Diskette Drive (a floppy disk unit) was introduced with System IV/40, and is now available for System IV/70 to promote compatibility between the two Four-Phase systems. The storage capacity of the 290K-byte diskette is equivalent to that of 3,667 80-column punched cards.

System IV/40 is serviced by Four-Phase Systems, which provides nationwide service and support. First deliveries are scheduled to occur during the third quarter of 1973. Lead time on orders is 90 days. □

Messages can be highlighted for attention or blanked for security by means of the Variable Intensity feature, which permits characters to be displayed at normal or high intensities or blanked (not displayed). Control is provided by non-displayed attribute characters, which can be interspersed within the data stream. Software support is provided by the IBM 3270 Simulator Program.

The Audible Alarm feature alerts the operator to special conditions such as errors or end of line. Software support is provided under several operating programs.

DEVICE CONTROL: System IV/40 is a multi-display, interactive processing system that executes all operations under program control. Four-Phase currently supports the System IV/40 for three basic turnkey applications: (1) data entry/remote batch, (2) IBM 2260 emulation, and (3) IBM 3270 emulation. Support for these applications is provided by the following standard software packages.

- **DATA IV/70–A key-to-disk data entry system for use in either keypunch replacement or source data entry applications. Available in two versions: Version 1 supports up to 12 display units and requires 24K bytes of memory, while Version 2 supports up to 22 displays and requires 72K bytes of memory. DATA IV/70 is available for the Model 4500 only and supports binary synchronous communications between the System IV/40 and a System IV/70 or IBM System/360 or 370 computer.**
- **IBM 2260 Simulator–Provides all the functions of an IBM 2260/2848 Display System via software emulation. Supports all IBM screen sizes and features Supervisory Mode, in which a display unit, acting as a supervisory station, can communicate with the other display units on the same System IV/40.**
- **IBM 3270 Simulator–Provides all the functions of an IBM 3270 Information Display System via software emulation. Supports 480- or 1920-character display units and the Variable Intensity and Audible Alarm features.**

Although it contains the same processor used in the larger System IV/70, System IV/40 lacks support for program development, which can be performed on a System IV/70 via either COBOL IV/70 or IV/70 CODE, a two-pass, general-purpose assembly language. Application programs created on the System IV/70 must be transferred to cartridge disk or diskette for entry into a System IV/40 Model 4500 or 4300, respectively. Data communications, as an alternate method of program transfer from System IV/70 to System IV/40, is currently under development.

KEYBOARD: Ten models reflect six keyboard styles: IBM 3270, IBM 2260, IBM 29 Card Punch, typewriter, IBM 2260 data entry, and general-purpose. All keyboard styles provide a complete alphanumeric capability via an 85-key main keygroup. All except the 2260 data entry and keypunch-style keyboards also include a numeric inset to the right of the main keygroup,which is arranged in an adding-machine format and includes total, subtotal, and minus keys. All keyboards include a row of 13 control and function keys located directly over the main keygroup.

DISK STORAGE: The specifications for the cartridge disk and diskette drives are as follows:

Processor model:	4300	4500
Disk medium:	diskette	cartridge
Drive capacity, bytes:	293,376	2.5 million
Transfer rate, bytes/sec:	25,000	312,000
Cylinders/drive:	64	203
Tracks/cylinder:	1	2
Access time, msec –		
Average:	42	70
Track-to-track:	20	15
Average rotational delay, msec:	80	20

Four-Phase Systems
System IV/40

PRINTED OUTPUT: Three impact printers are available, including two serial printers and a line printer. The serial printers are each rated at 30 char/second and provide 132 print positions; however, one provides a 96 character set (Diablo), and the other, a 64-character set (UNIVAC). The line printer (Data Products), a drum-type unit, is rated at 300/lines/minute, provides 132 print positions, and is equipped with 64 character set. System IV/40 employs the Diablo printer where as many as 16 printers are required; only one UNIVAC printer (detailed in report 70D-435-01) can be attached.

The 96-character Diablo printer accommodates pin-fed or friction-fed, 6-part continuous forms up to 15 inches wide. Horizontal spacing is 10 char/inch. Vertical and horizontal positioning is under program control. Vertical positioning can be specified to 48 lines/inch, and horizontal positioning can be specified to 60 positions/inch. The printer features a snap-in ribbon cartridge. Maximum carriage return time for 132 columns is 400 milliseconds. Paper feed speed is 4 inches/second plus 50 milliseconds settling delay.

The line printer (one per System IV/40) accommodates pin-fed, 6-part continuous forms from 4 to 16-3/4 inches wide. Horizontal and vertical spacing are 10 char/inch and 6 or 8 lines/inch, respectively. Vertical formatting is implemented via a 12-channel tape loop. Line advance time is a maximum of 50 milliseconds per line, and skipping speed is 20 inches/second.

PRICING: The System IV/40 is available for purchase or on a one- or three-year lease which includes prime-shift maintenance and supporting software. A separate maintenance contract is available for purchased equipment. Package prices for three typical System IV/40 configurations are as follows:

- Data Entry System–Includes three 1152-character display units, a Model 4500 processor with 24K bytes of memory and a 2.5M-byte cartridge disk drive, and a bi-sync communications controller. The one-year lease price (including maintenance) is $680/month. The purchase price is $30,860.

- IBM 2260/2848 Simulation System–Includes eight 960-character display units, a Model 4300 processor with 24K bytes of memory and a 290K-byte diskette drive, and an asynchronous communications controller. The one-year lease price (including maintenance) is $735/month. The purchase price is $32,085. A terminal system with sixteen 960-character display units leases for $1,240/month and sells for $53,420.

- IBM 3270 Simulation System–Includes eight 1920-character display units, a Model 4300 processor with 48K bytes of memory and a 290K-byte diskette drive, and a bi-sync communications controller. The one-year lease price (including maintenance) is $932/month. The purchase price is $41,000. A terminal system with sixteen 480-character display units leases for $1,210/month and sells for $52,295.

System IV/40 Processors	Monthly Rental (1) 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Model 4300 Processor (2)				
24K-byte memory	$335	$305	$15,750	$ 70
48K-byte memory	440	402	20,750	85
72K-byte memory	545	499	25,750	100
Model 4500 Processor (3)				
24K-byte memory	505	461	23,750	115
48K-byte memory	610	558	28,750	130
72K-byte memory	690	630	32,500	140
Decimal Instruction Set (4)	95	88	4,050	13
Audible Alarm Support	5	4	1,250	5
Video Support Module (5)				
Supports 8 960-char., 4 1920-char., or 16 576- or 288-char. displays (includes Audible Alarm feature)	40	34	1,575	6
Same as preceding module but includes Dual Intensity feature	50	45	2,025	7
Supports 16 960-char. or 8 1920-char. displays (includes Audible Alarm feature)	80	68	3,150	12
Same as preceding module but includes Dual Intensity feature	100	88	4,050	14
CRT Display Stations				
12-inch Video Display (6)	37	35	1,445	9
15-inch Video Display (7)	41	39	1,625	9
Keyboard, typewriter style	8	8	400	1
Keyboard, data entry style	10	10	450	1
Printers				
Serial printer and controller (30 cps, 132 col., 96 char.) (8)	160	146	6,750	40
Serial printer without controller (same as preceding printer)	130	117	6,000	30
Serial printer and controller (30 cps, 132 col., 64 char.)	120	113	5,400	40
Line printer and controller (300 lpm, 132 col., 64 char.)	300	282	13,500	90

(1) One- and three-year lease prices include maintenance.
(2) All 4300 Series processing units include a 290K-byte diskette drive, data communications controller, main memory and I/O controller.
(3) All 4500 Series processing units include a 2.5M-byte cartridge disk drive, data communications controller, main memory and I/O controller.
(4) Decimal Instruction Set includes 119 instructions, including 113 instructions of the standard instruction set plus decimal add and subtract, high-speed character moves and compares.
(5) System IV/40 requires one (and is limited to one) Video Support Module.
(6) 12-inch screen used for 6, 12, or 24 48-character line display or 6 or 12 80-character line display.
(7) 15-inch screen used for 24 80-character line display.
(8) Supports up to 15 additional printers of the same type. ■

General Computer Systems 2100 Data Entry System

MANAGEMENT SUMMARY

Until recently, General Computer Systems seemed to surface only at the trade shows and in the offices of major computer users. With an installation record of more than 360 systems representing over 6800 keystations, the company can definitely defend that marketing approach. Now, with an established track record, GCS is buying some space advertising and becoming more visible to the data processing community at large.

Perhaps the reason for the low profile was that the company catered to the market for large, complex data entry systems. Consequently, its equipment was not price-competitive–at first glance–with other key/disk systems designed for more limited environments. The factors that have endeared the GCS 2100 to its users appear to be the high reliability of the hardware components and the willingness of GCS to work with them in developing effective data entry systems.

Even by today's standards, some five years after its original announcement, the 2100 is a large system. It can accommodate up to 64 local or remote keystations. That's a lot. Few users push the configuration limitations. Most settle for between 12 and 24 keystations per processor, and the overall average is 19. Some users have expanded up to 40 or more keystations, however. The configurational possibilities are more frequently used in another way: for system backup. Many users have installed dual-processor arrangements (called system duplexing by GCS). In this arrangement, the two systems operate independently until one processor goes down. Then its string of keystations can be switched over to the other one, and business continued as usual.

Catering initially to large, complex data entry installations, GCS has built up a strong reputation in the key/disk field among users of all sizes. The 2100 system accommodates up to 64 local or remote keystations and earns high ratings for reliability and ease of operation.

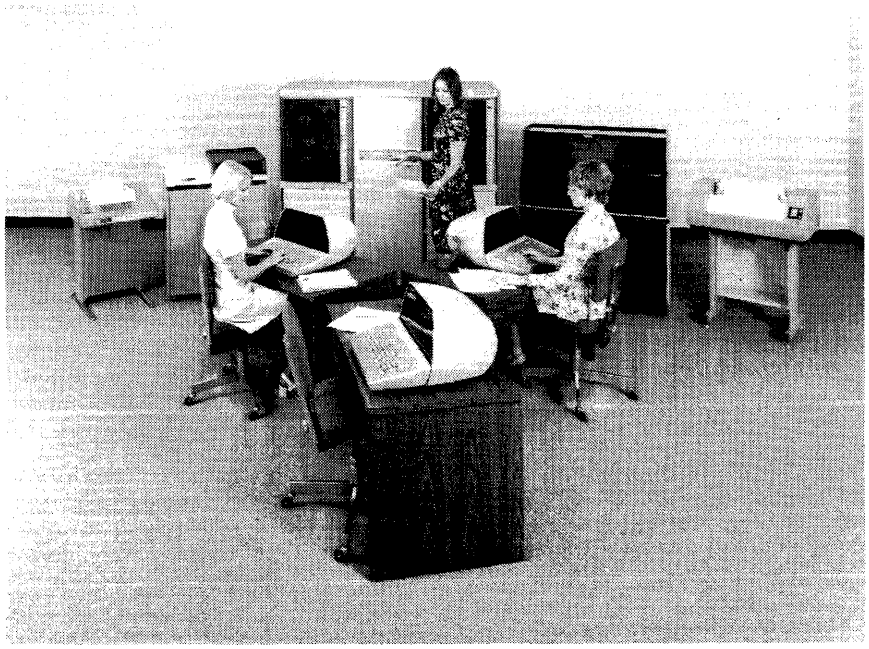
CHARACTERISTICS

MANUFACTURER: General Computer Systems, Inc., 1600 Dooley Road, Addison, Texas 75001. Telephone (214) 233-5800.

CONFIGURATION

The main components of a GCS 2100 system are 7 to 63 local or remote CRT data entry stations (DataTerminals), 1 local supervisory station (CRT station plus teletypewriter), a minicomputer central processor, 1 to 4 magnetic tape drives, and 1 to 3 fixed-head or 1 to 4 moving-head disk storage drives. The supervisory station is used for system control, but can also be used for data entry. A second printer (teletypewriter or matrix printer) can be added to the supervisory station to serve as an audit device. Additional input/output devices available include a card reader (300 or 600 cpm) and a line printer (60, 120, 300, or 600 lpm). Remote data entry stations require a controller at the remote site.

The central system can be equipped to operate as a remote job entry terminal emulating an IBM 2780; this option is called DataTel. One or more CRT keystations can be equipped to function as control stations (Intercept Operators) for a total of up to 32 telephone lines for receiving data from Touch-Tone telephones; this option is called DataTone. Two 2100 systems can be duplexed to provide backup support in the advent that one processor goes down. Separate components are required for fixed-head and moving-head systems.



Shown here are most of the hardware components of the GCS 2100 Data Entry System, including three of the CRT keystations that serve as the principal input units.

General Computer Systems
2100 Data Entry System

Another reason for General Computer System's low profile may have been its emphasis on European sales. Nearly two-thirds of the installations have been made outside the U.S., though domestic sales have recently been growing rapidly. Many of the 2100's features, such as convenient accommodation of variable-length records, are well adapted for the European market with its historic use of punched tape data entry as opposed to punched cards in the U.S. But the 2100 was not designed only for that market. There are many domestic applications which are ill-suited for the traditional 80-column card approach. Recent software enhancements have added to the system's capability for dealing with such applications.

From the very beginning, GCS recognized that input source documents and input requirements for computers were seldom well matched. However, the cost of converting computer input procedures pretty much defined what the output of a key/disk system had to be. To achieve improvement, you could work only on the source document side. The data flow and programming of the 2100 is oriented toward providing as much flexibility as possible in accommodating data as it appears on the document and outputting it as needed for the computer. While this concept is commonplace today, five years ago it provided some input-procedure-bound users with strikingly effective ways of improving their data preparation operations.

Initially, data editing and validation requirements were handled on an individual basis. General-purpose capabilities came later. The latest GCS software facility, the DEAL compiler, permits an appreciable amount of local record processing, with selective printing to produce reports at the local level without bothering the computer center. (Distributed processing grows and grows.)

USER EXPERIENCE

Datapro talked at length with six users of the GCS 2100, including two who responded to our 1974 reader survey on key entry equipment. Of the six systems represented, four of them were duplexed, so this sample actually represents 10 systems. These users represented a wide cross-section of the GCS customer base, ranging from a single-processor, 8-keystation configuration up to a duplexed 42-keystation system. Also included was a single-processor, 44-keystation system, so the advertised system expansibility is believable. One of the users employed remote keystations, and one utilized DataTone (Touch-Tone telephone input). None, however, was using the 2100 in a batch communications mode. Altogether, a total of 154 CRT keystations were represented.

Five of the six users (all except the one-processor, 44-keystation configuration) were using the 2.2-megabyte disk and one 1600-bpi tape drive per processor. The other user had the 29-megabyte disk pack drive. All of the users were oriented toward 80-character record output, although most blocked their records on tape.

In general, installing non-standard peripherals or expanding the system beyond the standard peripheral complement indicated above requires negotiation with GCS for software support. The standard software supports the peripheral complement described above.

COMPONENTS

KEYSTATIONS: Each keystation consists of a keyboard and CRT display.

The keyboard includes two keygroups. One follows the conventional data entry (keypunch) style. It is supplemented by a 10-key numeric group arranged in adding-machine style. Control keys surround each group. Some of the control keys are duplicated between the two groups for the convenience of the operator. The keyboard includes an "N-key rollover" feature to prevent loss of the first data character when additional keys are depressed before the first is released.

The CRT displays up to 512 characters in 16 lines of 32 characters each. A 5-by-7 dot matrix character formation technique is used. The character set includes 64 graphics. Scroll up is a standard feature for displaying linked data beyond the capacity of the screen. Displayed information includes keyed data, job status information, and/or prompting messages depending on the mode of operation and programming. A blinking cursor, under control of the system software, indicates the next entry position.

Local CRT stations can be located up to 2500 feet from the central processor.

SUPERVISORY STATION: Consists of a CRT keystation as above plus a Teletype ASR 33 teletypewriter.

DISK STORAGE FACILITY: Consists of one to three fixed-head disk units (2.2, 4.4, or 6.6 million bytes capacity) or one to four moving-head disk units (29 million bytes each).

The fixed-head disk provides an average access time of 17 milliseconds.

The moving-head disk drive uses an IBM 2316-style disk pack and provides an average access time of 62.5 milliseconds; the average positioning time is 50 milliseconds, and the average rotational delay (latency) is 12.5 milliseconds. Special buffer handling is provided for moving-head disk transfers so that performance exceeds that of the fixed-head disk.

MAGNETIC TAPE DRIVES: Three IBM-compatible tape formats can be selected: 7-track, 556/800 bpi; 9-track, 800 bpi; or 9-track, 1600 bpi. Intermixing of 7- and 9-track, 800 bpi drives is standard; intermixing of 800 and 1600 bpi tape drives requires an extra-cost option. All of the tape drives accommodate 2400-foot reels. The drives operate at a tape speed of 25 inches/second (7- or 9-track, 800 bpi) or 12.5 inches/second (9-track, 1600 bpi).

LINE PRINTERS: Four different models are available. The two low-speed models (60 or 120 lpm) are matrix printers capable of printing up to 132 columns. There are actually serial printers operating at 165 or 330 characters/second. They accommodate 1- to 5-part sprocket-fed forms from 4 to 14.875 inches wide. Characters are formed using a 5-by-7 dot matrix. A total of 64 characters can be printed.

The higher-speed models (300 or 600 lpm) are chain printers capable of accommodating up to 6-part forms from 6 to 18.75 inches wide. They can print up to 132 columns using a character set of 96 characters including upper and lower case alphabetics.

General Computer Systems
2100 Data Entry System

Having set the stage by describing the users' configurations, we present a summary of their ratings:

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	4	2	0	0	3.7
Ease of operation–					
Operator	5	1	0	0	3.8
Supervisor	5	1	0	0	3.8
Hardware reliability	4	2	0	0	3.7
Maintenance–					
Promptness	2	3	1	0	3.2
Quality	5	1	0	0	3.8
Software	2	2	2	0	3.0
Technical support	0	5	1	0	2.8

*Weighted Average on a scale of 4.0 for Excellent.

Most of these ratings speak for themselves. Overall, the users were well satisfied. But some discontent did surface. Promptness in responding to maintenance calls, software, and technical support were not rated as highly as the other categories. We probed further to try to find out why.

Promptness of maintenance is a problem only in relation to some of the other scores. Some users felt that the company's growth with multiple systems in an area improved its performance. Others felt that the company's maintenance personnel were spread a little thin at times. We were not able to establish whether the system's high overall reliability contributed to the intensity of the users' reactions when a maintenance call was necessary.

The software problem (again relative to other categories) was as much related to the size of main memory as to bugs or deficiencies. Several users said they were squeezed for space and unable to do as much validating/processing as they would like. One user said he had no room for any of the table-oriented operations such as range or value checking. All were using the 64K-byte memory size. A doubling of that size is now possible and should do much to alleviate the space problem, at least until the users start to do data base management on the system (and some undoubtedly will). One user voiced annoyance at bugs in new software releases, but said that they were soon cleaned up. Another user would prefer a shorter time lapse between announcement and delivery of new features.

The technical support question centered on "getting hold" of the GCS personnel rather than a dissatisfaction with their competence.

Most of the GCOS users were taking advantage of many of the available system features, particularly the table-oriented functions such as range checking, value checking, and code expansion (table lookup). □

CARD READERS: Read 80-column cards at 300 or 600 cards/minute.

PROCESSOR: A Computer Automation Alpha 16 is used. It is a 16-bit minicomputer with 32K to 64K words (64K to 128K bytes) of 1.6-microsecond memory. The processor includes a single accumulator plus an index/secondary accumulator register, hardware multiply/divide, and five vectored priority interrupts.

COMMUNICATIONS

REMOTE KEYSTATION TO SYSTEM: One or more remotely located keystations can communicate with the 2100 processor over a leased line at 300 bps. The remote keystation has the same capabilities as a local one. The Communications Modem provides control and line interfacing for a single remote DataTerminal. The Multiplexing Modem combines the transmission for up to five DataTerminals over a single line.

SYSTEM TO SYSTEM: A DataTel On-Line Batch Transmission option equips the 2100 to transmit data at up to 9600 bps over a leased line or up to 4800 bps over the switched telephone network (DDD). An external modem is required. Most independent and Bell System modems can be used, but GCS states that interface problems may exist on some modems that operate at over 2400 bps.

DataTel essentially provides the capability to emulate the IBM 2780/3780 batch terminals operating under BSC (bisync) line protocol. In general, variable or fixed-length records are transmitted in blocks of up to 512 characters. Operation can be half-duplex or full-duplex. In full-duplex operation, only control information is transmitted over the second data path. Variations from the above procedures can be accommodated to some extent. EBCDIC transmission code is used. Standard cyclic checking (CRC) is used. Any system peripheral (disk, tape, printer, card reader) can be used as the source or destination for transmitted data.

The DataTel option can be used to permit communications between two 2100's or between a 2100 system and an IBM System/360 or System/370 computer through IBM's support for remote job entry.

DATATONE: Equipped with a DataTone Controller and Intercept Operator Terminal, the 2100 can accept input directly from Touch-Tone telephones. At present, only numeric information can be received. If the sender wants to add alphabetic information, however, he merely tells the intercept operator, who keys it on the Intercept Terminal. Data received through the DataTone option is treated like any other data batch. The Intercept Terminal is a regular DataTerminal CRT keystation with a Line Status Indicator added for each line. The maximum number of lines handled per system is 32.

SYSTEM OPERATION

OVERVIEW: All operations of a GCS 2100 are under the basic control of an operating system. Overall responsibility for data control is vested in the supervisor, who initiates any transfers between tape and disk, the assembly of Job Specifications, the output of batch and operator statistics reports, and the deletion of any data batches or Job Specifications from disk. Data is organized by batch and job. A batch is the output of a single operator. Related batches using the same format controls are grouped into a job. A single set of Job Specifications controls the checking, editing, and processing performed on a data batch while it is being keyed and while it is being output to tape. Only one station can be designated as a supervisor station, and that station can also operate in a data entry mode.

OPERATOR FUNCTIONS: Key entry and verification are performed at the operator keystations. In addition, the operator can add data to an existing verified or non-verified batch, insert new records into an existing batch, and selectively modify existing records following a search

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operation. The operator works with data stored in the computer main memory or resident on disk. The supervisor controls the loading onto disk from tape of any required but non-resident data batches.

Data is displayed as it is keyed. If implemented as a system option and set up in the Job Specification, the operator can call for prompting messages identifying the fields. When faced with a data field that does not meet the system checking specifications and cannot be resolved (i.e., the source document itself is in error), the operator can force a continue; this will force verification at a later time, and an error flag will be recorded that can be used later in finding and correcting the field. Critical fields can be identified in the Job Specification to prevent a forced continue. To correct errors detected when keying, the operator can delete by character, field or record. The previously completed records in a batch can be retrieved for entire or selective rekeying.

Release of a field or record can be performed manually by the operator or automatically by the system, depending on programming specifications. In general, fields and records are automatically released only when all positions have been keyed. Manual field and record release can be used if the data does not entirely fill the assigned positions and if permitted by programming. The key entry operator can force an alteration of format number assignments; this permits flexibility in accommodating complex keying tasks.

In the verify mode, the operator key-verifies fields so designated in the Job Specification. Non-verify fields are displayed (a system option) with prompts if selected. Display of non-verify fields permits sight verification by the verify operator. The verify operator can force the acceptance of a character different from that keyed during entry; an automatic reverification is required. Rekeying can be on a character, field, or record basis at the option of the operator. The verify operator can accept format number assignments by the entry operator or can verify them. The operator can delete a record and/or insert a record. (This is the only way a verify operator can alter the non-verify fields of a record; the facility is also used to eliminated duplicated records and pick up skipped records). Record insertion requires an immediate reverification.

The operator establishes the operating mode and selects system options by entering mnemonic codes and job parameters (usually batch number and two-character operator identification).

The operator is informed of the failure of keyed entry to meet programmed field specifications or system requirements through a series of displayed error codes.

SUPERVISORY FUNCTIONS: The supervisor must initiate the transfer of data from disk to tape. Header labels can precede the data batches and trailer labels can follow the data batches to permit file building. The tape blocking factor can be controlled individually for each transfer, if desired. The supervisor can set system parameters to control writing of batches to tape for such conditions as verification status, out-of-balance status, error-flag status, and job number. Active batches being keyed are inhibited by the system from being written to tape. The supervisor can direct the data to be written to multiple tape units or to the supervisory teleprinter or line printer. Job Specifications are handled as a data batch for purposes of control. The supervisor can also initiate the printout of operator or batch statistics.

The supervisor also controls loading of data onto disk from an external device such as a card reader or tape drive. Batches can be loaded selectively, and data fields can be validated as part of the load process. New fields can be created. This is helpful in handling the keying of data from turnaround documents. Space for empty fields need not be used when the documents are created. Any validation proceeds under a Job Specification.

The supervisor normally uses the CRT keystation to enter commands and display English-language error responses. The teletypewriter is normally used to print out batch statistics and other data as programmed or requested by the operator.

OPERATING MODES

- Data Entry–Data is keyed into the system under control of a Job Specification that defines fields and any checking and validating to be performed. Keying errors are corrected or flagged for later correction. Data is accumulated on disk in batches. Additional processing can be performed when the data is written to tape.
- Data Verification–Data is verified by selectively rekeying fields so identified in the Job Specification. Only closed batches can be verified. Visual verification by the verify operator is possible.
- Data Re-entry–Permits adding records to the end of an existing batch. Keying is under the same conditions as in Data Entry.
- Data Update–Permits selective examination and alteration of records. The record can be retrieved from a specified batch by record sequence number, data field contents, error flag, or out-of-balance flag.
- Background–Includes batch transfers from disk to tape, from tape or card reader to disk, from disk to printer, or from disk to a communications line. Depending on the software release employed, only one or multiple background operations can run concurrently with key entry, verification, re-entry, or update.

SYSTEM PROFILE

- Keystations–7 to 63 local and/or remote CRT keystations plus supervisor keystation, which can double as a data entry keystation.
- Record length–any length up to the limit specified when the control software is generated for a system. The maximum number of fields in a record is 100.
- Formats–A single Job Specification can include up to 99 record formats with manual or automatic linking. Up to 255 Job Specifications can be accommodate within the system.
- Output block length–Any blocking factor can be set for outputting to tape or for inputting from tape; the blocking factor can be set selectively for individual batches or groups.
- Data storage–There are no practical limits on the number of records that can be grouped in a batch or on the number of batches that can be grouped into a job. The wide range of disk capacities available should satisfy almost any data storage requirements. Normally, main memory space is more limiting than disk capacity. The 2.2-megabyte fixed-head disk should be able to accommodate one day's output of 16 key entry operators (32 keystations, if half are verifying). Extensive use of editing tables may reduce this. Unverified or corrected batches can be spooled to tape for intermediate storage if space becomes critical for a rush job.

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SOFTWARE

All operations of the GCS 2100 are carried out under software control. The basic control software is centered around assembling Job Specifications into parameter-driven programs which are executed during key entry/verification and output to tape. All data keying control and processing, whether performed as data is keyed or when output to tape, is specified by means of a Job Specification. Only data transfer operations initiated by the supervisor, such as disk to tape, batch data communications, card to disk, etc., are specified outside the Job Specifications. The basic Job Specification functions delimit fields, specify data types, specify elementary data editing operations, identify record or batch balancing, and specify elementary reformatting operations during output. To these basic functions are added three significant capabilities: Programmable Extension Package, Special Edits, and an output editing language, DEAL. Routines for input/output control of data transfers are invoked by the supervisor.

JOB SPECIFICATIONS: A simple expedient is used to divorce the input keying sequence from the output record sequence: fields are defined in the order keyed but carry in their definitions the output locations. This technique permits a simple conversion of procedures for keying from a document in a natural order but maintaining compatibility with previous computer input formats. This capability is usually referred to as reformatting.

A Job Specification is composed of a series of up to 99 formats. A format consists of two parts: the header defines the characteristics of the record such as length, number of fields, transfer to tape or retain for future use, automatic record complete, and a Special Edit to be performed at the record level; the field definitions identify the characteristics of individual fields.

Each input field requires a definition of character type, fill character, and left or right justify. Character type may be any combination of alphabetic, numeric, special, or space. The fill character may be zero, space, asterisk, or dollar sign. In addition, a field can be identified as complete entry required, verify required, and automatic field complete. The automatic field complete specification indicates that the operator need not key a field complete character (semicolon) if the field is completely filled.

Other field types permitted include Transfer, Constant, and Fill. The Constant specification allows a literal of up to 25 characters to be identified. The Transfer function permits a separately defined field to be relocated during output; the field transferred appears in both the original and transferred positions, without special handling. The Fill field is used to fill the unused portion of a record with any specified character.

Up to 255 accumulators, held in main memory, can be identified. Definition and use of accumulators is common across all formats within a Job Specification. Because of the multiple form capability, a single source document, which might contain several similar entries, can be considered a single logical record. Accumulation and balancing can be specified at any point, so totals can be accumulated for similar entries within a logical record to produce cross-footing. Batch balancing can be accommodated as well. An out-of-balance condition will cause the operator to be notified. The accumulators can be conveniently used for record sequence checking through an automatic increment specification. Field tags of up to 36 characters for operator prompting can also be defined selectively. Any Special Edits can be specified for individual fields. Table-oriented operations, implemented through PEP (below), can also be specified.

Job Specifications are keyed as a data batch; assembly is initiated by the supervisor. Unless removed, both source and object code are retained on disk.

PROGRAMMABLE EXTENSION PACKAGE (PEP): Provides a series of functions for logical comparisons with table entries for data validation or format switching, for automatic format changing, for inhibiting some operator actions on critical fields, and for specifying data transfers to disk from tape or cards. In general, a table can be composed of up to 255 entries, each with up to 16 characters, but most of the functions deal with tables containing one or two entries. Up to 254 tables can be defined, which are available to all jobs. A series of eight logical comparisons form the basic capabilities. Four (Greater or Less Than and Equal or Not Equal To) reference the first entry in a table. Two (In or Not In Range) reference the first two entries of a table. Two (In or Not In Table) can refer to a full table of values. Comparisons can be linked with AND or OR constructions to permit a wide range of tests to be performed. (Cleverness in the layout and use of the tables is the key to minimizing storage requirements.) If the comparison tests specified are not met, the operator is notified. If the error is accepted, the record is flagged for later correction.

Format chaining can be specified as mandatory, or the operator can be allowed to override the automatic linking. Chaining can also be made dependent on the result of logical operations of the same sort as mentioned above for data validation.

Any field can be protected from certain operator actions, including accepting an error condition, duplication, skipping, or not entering data. When a field is so specified, the operator is required to key the field (or rekey it if an error is detected).

All of the above functions are performed as the operator is keying data.

Output options provided by PEP include transferring the first entry of a table to an output field (usually a constant) or transferring to the output a table entry that corresponds to the location in a second table of the data keyed (usually used to expand a data code to a descriptive entry).

Options provided for loading data onto disk from tape or cards include data-dependent format switching, as discussed above, and Special Edits.

SPECIAL EDITS: This is essentially a library of subroutines generated by GCS to handle processing tasks not covered by the basic editing specifications or PEP, or tasks that are cumbersome to program using these capabilities. At present there are more than 100 routines in the library. They provide such functions as check-digit generation or checking, conditional must-key fields (if field A is keyed, then field B is required), arithmetic operations, date format validation, comparisons with a literal, etc.

The complete library is available at no extra charge to customers, and new edits can be programmed by GCS on a price-negotiated basis. The full facilities of the minicomputer can be brought to bear using Special Edits. The importance of the library of Special Edits may diminish as the output editor language, DEAL, comes into widespread use among GCS 2100 users. However, for processing options at data entry time, only the Special Edits can be used to supplement the basic capabilities.

DEAL: This high-level language was being released as this report was written. Some users have received it, but not all. Initially, current users may have to include at least one memory expansion module in their configuration to accommodate DEAL. The language uses an English-like

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format in contrast to the codes used in the other programming facilities. Facilities provided by the language include field arithmetic (add, subtract, multiply, and divide); alteration of program flow depending on whether the results of an arithmetic operation is positive, negative, or zero; printer-oriented editing operations such as insertion of periods, commas, signs, constant filler, floating dollar (or pound) signs, and zero suppression; call subroutines; tests for error flags, out-of-balance records, verified records, arithmetic errors, tape switch setting, or up to eight user set switches; and provisions to set or reset any conditions or user switches. A single keyed input record can be separated into multiple output records.

Use of DEAL can greatly simplify processing other than straight data entry and validation. Previously, such processing might have required Special Edits and perhaps extra passes of the data to accomplish special data manipulation and report generation.

PRICING

The GCS 2100 is available for purchase or under a three-year or five-year leasing arrangement. Monthly charges are shown below for a three-year plan; five-year rates can be obtained by reducing the three-year lease-only rates (excluding maintenance) by 7 percent. The monthly lease prices below include prime-shift maintenance for locations within 50 miles of a GCS service center.

	Monthly Cost*	Purchase	Monthly Maint.
GCS 2100 Processor (includes 64K bytes of memory, 7- or 9-track, 800 bpi tape drive, 2.2-megabyte fixed-head disk, teletypewriter, and controller for 32 CRT keystations)	$1,330	$64,160	$330
System Upgrades			
Extended Memory Controller (1 max.)	110	4,200	10
Extended Memory Module, 16K bytes (requires Memory Controller)	180	8,400	20
Fixed-head disk expansion–			
To 4.4 megabytes	665	27,000	65
From 4.4 to 6.6 megabytes	665	27,000	65
Disk Pack Storage–			
1 drive, 29 megabytes (upgrade from 2.2-megabyte fixed-head disk drive; requires Extended Memory Controller and Module)	395	14,900	55
Additional drive (3 max.)	555	20,000	55
Magnetic Tape Drives–			
Upgrade to 9-track, 1600 bpi from standard drive	230	9,500	20
Additional 9-track, 1600 bpi drive	345	20,000	45
Controller for intermixing 800 and 1600 bpi drives	165	6,300	15
Input Peripherals			
DataTerminal CRT keystation	86	3,270	11
Desk	5	210	–
Controller Expansion for over 32 keystations	175	6,720	15
Card Reader, 300 cpm	305	9,450	80
Card Reader, 600 cpm	385	12,600	85
Output Peripherals			
Additional ASR 33 Teletypewriter	90	3,150	15
Matrix Printer, 60 lpm	182	7,500	22
Matrix Printer, 120 lpm	253	11,000	33
Line Printer, 300 lpm	555	27,000	110
Line Printer, 600 lpm	745	36,600	135
Communications Options			
DataTone Input (Touch-Tone)–			
Controller	765	26,880	125
Intercept Operator Terminal	145	5,460	15
Line Interface (one per line)	50	1,890	5
DataTel On-Line Batch Transmission	217	9,000	22
Communications Modem (one DataTerminal per line)	86	3,150	11
Communications Multiplexing Modem (up to 5 DataTerminals per line)	415	13,860	85
System Duplexing Options			
For fixed-head disk systems (requires Controller Expansion on each system)	215	7,980	25
For moving-head disk systems (requires Controller Expansion and an additional Expansion Memory Module on each system)	235	8,820	25

*For 3-year lease; includes prime-shift maintenance for locations within 50 miles of a GCS service center.■

GE TermiNet 300
Data Communication Terminal

The TermiNet 300, a high-performance teleprinter terminal, provides switch-selectable transmission speeds ranging from 10 to 120 characters per second, full ASCII keyboard, upper- and lower-case printing, and a magnetic tape cassette recorder. Several options enhance the unit's basic capabilities.

MANAGEMENT SUMMARY

The TermiNet 300 was designed to serve the needs of the teleprinter market as a high-performance keyboard/printer terminal compatible with Teletype's Model 33 and 35 teleprinters, and also to provide a terminal for users of GE's Time-Sharing Service, the largest of all the commercial time-sharing systems. One of the first high-performance terminals to be introduced as a direct contender for Teletype's huge teleprinter market, the TermiNet 300 has since been followed by several competitive entries from other manufacturers and by GE's own improved TermiNet 1200 (Report 70D-450-04). First customer deliveries of the TermiNet 300 were made in July 1969. Lead time on orders is currently quoted at 90 to 120 days.

An impact printer, the TermiNet 300 prints by means of a type-belt that moves horizontally in front of a row of actuators. Inking is provided by a standard office typewriter ribbon. A severe limitation is the operator's inability to see the characters being printed while she is keying data.

Since its initial introduction, GE has added a number of frills to the TermiNet 300, including line control, selective addressing, code transparency, increased transmission speed, and a magnetic tape cassette recorder, which can be substituted for paper tape in the ASR configuration. These added features lend a greater degree of sophistication to the basic terminal, providing capabilities that are nonexistent in the standard variety of teleprinters.

CHARACTERISTICS

MANUFACTURER: General Electric Company, Data Communication Products Department, Waynesboro, Virginia 22980. Telephone (703) 942-8161.

MODELS: ASR—contains keyboard, page printer, and punched tape reader and punch; KSR—contains keyboard and page printer; RO—contains page printer only. The Tape Cassette Accessory, an optional magnetic tape cassette recorder, can be substituted for paper tape on the ASR model.

COMMUNICATIONS: Transmits asynchronously in half- or full-duplex mode, using 10- or 11-unit, 7-level ASCII code plus character parity at switch-selectable rates of 110, 150, or 300 bits/second (10, 15, or 30 char/second). The optional High Speed Tape Transmission feature provides one additional data-rate selection of 60 or 120 char/second (600 or 1200 bits/second). This feature is available only for models that use paper or magnetic tape as a data communications medium; however, only paper tape can operate at 60 char/second.

The communications interface is designed to EIA Standard RS-232B/C and is compatible with the Bell System 100 Series modems or GE's hard-wired TDM 110 or 111 modems or acoustic TDM 114 or 115 modems (see DATAPRO 70 Report 70G-500-01). Operation at speeds up to 1200 bits/second requires the Bell System 202 Series modems or GE TDM 210 or TDM 211 modems. An integral modem that operates asynchronously in the half- or full-duplex mode at rates up to 300 or 1200 bits/second is optional.

DEVICE CONTROL: Manually controlled at the sending unit, the unit responds to received control codes, which initiate operations such as carriage return, line feed, space, and backspace. The following options are provided to enhance terminal operations.

The Line Control feature responds to received or transmitted line-control codes (ENQ, ACK, NAK, and ETX) by reversing the direction of transmission when operating in the half-duplex mode. This feature also includes transmission of terminal alarm status where interrogated by a received ENQ code (full-duplex operation only), automatic disconnect, and transmission delay in response to received control codes.

The Selective Addressing feature is provided for terminals operating in a party-line environment. The feature provides a maximum of 96 unique addresses; addressing can be used to select a single terminal, a group of terminals, or a combination of both.

The Answerback feature responds to a received ENQ code or a keyed "Here Is" by transmitting a unique terminal identification message up to 20 characters in length.

Transparency, standard on leased units only, permits non-ASCII codes to be received or transmitted. The switch-

GE TermiNet 300
Data Communication Terminal

Users' experience with the TermiNet 300 has been mostly good. Datapro talked to users whose installations ranged from 15 to over 65 TermiNet 300 terminals and have been in operation for periods of from one to three years. Little or no down-time was reported, and service was rated excellent. One user with a "worst-case" environment reported extensive clutch wear, keyboard failures, and ribbon-reverse malfunctions, but conceded that the units received heavy abuse by inexperienced operators and would probably provide highly reliable operation in a more normal operating environment. □

selectable feature is used with terminals equipped with paper tape units or other auxiliary devices. Operation in the Transparency mode defeats parity detection.

The Form Feed and Vertical Tabulation feature controls form feeds and vertical tabulation via holes punched in a user-programmable disc. Form feed or vertical tabulation, initiated by a received or keyed FF or VT code, advances the paper to the top of the next form or to the next line, as indicated by a hole in the programmable disc. Vertical tabs can be "set" for each print line.

The Horizontal Tabulation feature permits tabs to be set at every print position. Horizontal tabs can be set or cleared remotely, through received control codes, or locally from the keyboard.

Automatic Motor Control, a standard feature, connects power to the printer's motor when connection with a remote device has been established and disconnects the power when the line is disconnected. An optional Status feature provides a negative or positive status at the terminal interface to indicate a ready or non-ready condition due to a terminal contingency.

ERROR CONTROL: Limited to manual retransmission. Character parity is generated and accompanies each character transmitted. Error detection for character parity is optional. With the option, the terminal can be wired to print a special error symbol, sound a momentary alarm, and continue printing, or transmit a break code to the transmitting device, sound a momentary alarm, and switch to a standby state.

KEYBOARD: A 4-row typewriter arrangement. All 128 graphics and control codes of the ASCII character set can be generated from the keyboard. Control and shift keys are used in conjunction with character keys to generate the full range. Repetitive key operation is provided.

PRINTER: Prints any of 94 ASCII symbols, including upper- and lower-case alphabetics, numerics, punctuation marks, and special symbols.

The standard print line contains 118 print positions; alternative line lengths of 75 or 80 print positions are available for purchased units only. Horizontal pitch is 10 char/inch; vertical spacing is 6 lines/inch.

The standard impact printer employs a friction-feed platen that accommodates paper widths up to 12-27/32 inches; as an option, the printer can accommodate seven-part, sprocket-fed continuous forms up to 8-1/2, 9, 9-1/2, or 12-27/32 inches wide. A tractor-feed mechanism is available which accommodates forms from 3 to 12-27/32 inches wide. Standard teleprinter roll paper fits the TermiNet 300, and standard office typewriter ribbons can be used.

TAPE READER: Photoelectrically reads 8-level, 1-inch-wide strips of fully punched tape. The unit operates at the selected speed of 10, 15, or 30 char/second when used with the printer, but can skip/delete at 120 char/second. The Paper Tape Reeler option provides two tape reelers, one located on each side of the tape-read head.

TAPE CASSETTE ACCESSORY: A small desk-top unit (measures 5.75 inches high by 7.75 inches wide by 12.5 inches deep) that accommodates a "Philips-type" cassette containing 300 feet of 0.15-inch wide magnetic tape. The unit records data serially by bit and can record up to 50,000 characters on a cassette. The data transfer rate is the same as the terminal's selected transmission rate. Fast forward and rewind are each performed at 20 inches/second. Panel controls provide read, write, advance, rewind, and stop-tape functions.

A search mode is provided for both forward and reverse directions. Searching is performed on inter-record gaps at a speed of 240 char/second. When searching forward, the unit momentarily turns off a lighted indicator lamp for each encountered record gap; when searching in reverse, the tape stops at each encountered record gap.

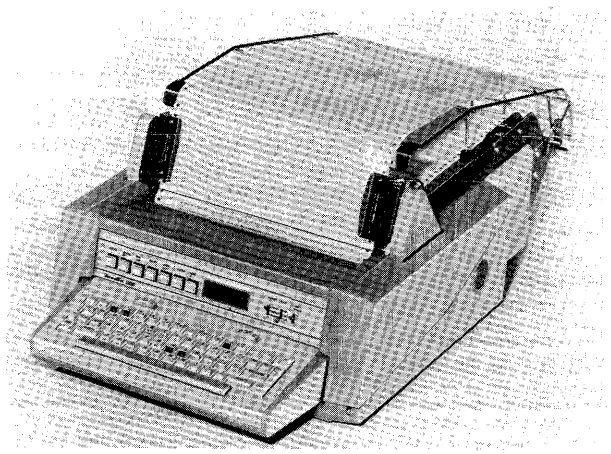
PARALLEL INTERFACE: Provides an interface for entering data from an external device. The external device can be switched on or off locally or remotely via received control codes. The use of this option precludes using Selective Addressing.

PRICING: The GE TermiNet 300 is available for purchase or on a one-year lease, which includes maintenance. Leases can be cancelled, but a penalty payment is involved. A separate maintenance contract is available for purchased equipment.

TermiNet 300[2]	Monthly Rental [1]	Purchase	Monthly Maintenance
RO	$103	$3,390	$16.20
KSR	110	3,935	21.60
ASR (paper tape only)	237	6,170	32.40
ASR (magnetic tape only)	173	5,366	32.40
Options			
80 Print Positions	NA	(5)	–
75 Print Positions	NA	(5)	–
Pinfeed (all platen widths)	2	75	–
External Paper Handler[3]	2	60	–
External Tractor [4]	7	200	–
Paper Tape Reader Reeler	25	775	–
Line Control	3	40	–
Selective Addressing	Std.	120	–
Status (for Auto Motor Control)	–	25	–
Horizontal Tab	6	190	–
Vertical Tab/Form Feed	7	240	–
Transparency	Std.	40	–
Parity Detection	2	80	–
Answerback	2	80	–
Parallel Interface	5	125	–
High Speed Tape	1	40	–
Acoustic Telephone Couplers:			
TDM 114 (Originate only)	10	320	5.40
TDM 115 (Originate/Answer)	15	380	5.40
Integral Modem:			
300 baud (hardwired)	10	275	–
1200 baud (hardwired)	30	350	–

(1) Includes on-call maintenance.
(2) Each model includes 118 print positions.
(3) Includes a wide-roll paper holder.
(4) Includes External Paper Handler.
(5) A TermiNet 300 with 80 or 75 print positions is priced $274 or $310, respectively, below the purchase prices shown for the terminals with 118 print positions. ■

GE TermiNet 1200
Data Communication Terminal



The TermiNet 1200, latest member of GE's family of high-performance teleprinters, operates at switch-selectable speeds up to 120 characters per second and provides several enhancements over the older TermiNet 300.

MANAGEMENT SUMMARY

General Electric's TermiNet 1200 is a second-generation member of the TermiNet line of high-performance teleprinters produced by GE's Data Communication Department at Waynesboro, Virginia. The TermiNet 1200 embodies most of the features and options that characterize the original member of the family, the TermiNet 300; appearance and operation are much the same. Essentially, the TermiNet 1200 is an enhanced version of the 300.

Salient features of the TermiNet 1200 include:

- Operation at transmission speeds of up to 120 characters per second.
- A standard set of three operator-selectable transmission speeds (10, 30, or 120 characters per second), replaceable with one of two optional sets.
- A standard 80-character or optional 120-character print line.
- A pin-feed adjustable tractor that accomodates form widths of from 3 to 12-27/32 inches.
- A standard set of 94 ASCII symbols, including both upper- and lower-case alphabetics.
- A full 128-character ASCII keyboard.
- An optional magnetic tape cassette recorder with data transfer rates equal to the selected transmission rates.

An impact printer, the TermiNet 1200 prints by means of a type-belt that moves horizontally in front of a row of actuators. Inking is provided by a standard office typewriter ribbon. A severe limitation is the operator's inability to see the characters being printed while she is keying data.

CHARACTERISTICS

MANUFACTURER: General Electric Company, Data Communication Products Department, Waynesboro, Virginia 22980. Telephone (703) 942-8161.

MODELS: ASR–contains keyboard, page printer, and punched tape reader and punch; KSR–contains keyboard and page printer; RO–contains page printer only. The Tape Cassette Accessory, an optional magnetic tape cassette recorder, can be used as a substitute for paper tape on the ASR model.

COMMUNICATIONS: Transmits asynchronously in half- or full-duplex mode, using 10- or 11-unit, 7-level ASCII code plus character parity at switch-selectable rates of 110, 300, or 1200 bits/second (10, 30 or 120 char/second). Either of two optional sets of operating speeds can be specified in place of the standard set. The options provide selectable data rates of 10, 20, and 120 char/second or 30, 60, and 120 char/second.

The communications interface is designed to EIA Standard RS-232C and is compatible with the Bell System 100 Series modems, GE's hard-wired TDM 110 or 111 modems, or GE's acoustic TDM 114 or 115 modems (see Report 70G-500-01) at speeds up to 300 bits/second. Operation at speeds up to 1200 bits/second requires the Bell System 202 Series modems or GE TDM 210 or TDM 211 modems.

Integral modems are available for speeds up to 300 or 1200 bits/second. The 300-bps modem is designed for use with the manual Data Access Arrangement CDT. The 1200-bps integral modem is designed for unattended operation and can be used with the automatic Data Access Arrangement CBS.

DEVICE CONTROL: Manually controlled at the sending unit, the TermiNet 1200 responds to received control codes, which initiate operations such as carriage return, line feed, space, and backspace. The following options are available to enhance the terminal's capabilities.

The Line Control feature responds to received or transmitted line-control codes (ENQ, ACK, NAK, and ETX) by reversing the direction of transmission when operating in the half-duplex mode. This feature also includes transmission of terminal alarm status where interrogated by a received ENQ code (full-duplex operation only), automatic disconnect, and transmission delay in response to received control codes.

The Selective Addressing feature is provided for terminals operating in a party-line environment. The feature provides a maximum of 96 unique addresses; addressing can be used to select a single terminal, a group of terminals, or a combination of both.

The Answerback feature responds to a received ENQ code or a keyed "Here Is" by transmitting a unique terminal identification message up to 20 characters in length.

The Transparency feature permits non-ASCII codes to be received or transmitted. This switch-selectable feature is

GE TermiNet 1200
Data Communication Terminal

Paper tape is used with the basic ASR configuration, which incorporates an integral paper tape reader/punch unit. Operation with paper tape is limited to a maximum speed of 30 characters per second when punching.

Magnetic tape, provided by the optional Tape Cassette Accessory, can be used at any line speed up to 120 characters per second and can replace the paper tape capability of the basic ASR configuration. The magnetic tape feature can be operated remotely via transmitted control characters to permit unattended operation.

Integral modems are available for operation at speeds up to 30 or 120 characters per second and are designed to interface a Data Access Arrangement for communication over the public telephone network. Unattended operation is possible via the 120-cps modem.

Service is provided by GE through its nationwide service organization, ServiNet, which provides on-call service 24 hours per day.

Initial customer deliveries of the GE TermiNet 1200 were made in October 1972; to date, about 120 units have been shipped. Current lead time on orders is quoted as 60 to 90 days. □

used with terminals equipped with paper tape units or other auxiliary devices. Operation in the transparency mode defeats parity detection.

The Form Feed and Vertical Tabulation feature controls form feeding and vertical tabulation through holes punched in a user-programmable disc. Form feed or vertical tabulation, initiated by a received or keyed FF or VT code, advances the paper to the top of the next form or to the next line, as indicated by a hole in the programmable disc. Vertical tabs can be "set" for each print line.

The Horizontal Tabulation feature permits tabs to be set at every print position. Horizontal tabs can be set or cleared remotely, through received control codes, or locally from the keyboard.

The Automatic Motor Control feature connects power to the printer's motor when connection with a remote device has been established and disconnects the power when the line is disconnected. An optional Status feature provides a negative or positive status at the terminal interface to indicate a ready or non-ready condition due to a terminal contingency.

ERROR CONTROL: Limited to manual retransmission. Character parity is generated and accompanies each character transmitted. Error detection for character parity is standard. A detected error causes the terminal to print a special error symbol, sound a momentary alarm, and continue printing; or, as an option, to transmit a break code to the transmitting device, sound a momentary alarm, and switch to a standby state.

KEYBOARD: A 4-row typewriter arrangement. All 128 graphics and control codes of the ASCII character set can be generated from the keyboard. Control and shift keys are used in conjunction with character keys to generate the full range. Repetitive key operation is provided.

PRINTER: Prints any of 94 ASCII symbols, including upper- and lower-case alphabetics, numerics, punctuation marks, and special symbols. Printer speed corresponds to the selected transmission speed. A print line of 80 characters is standard, and 120 print positions are optional. Horizontal pitch is 10 char/inch; vertical spacing is 6 lines/inch. The standard impact printer employes a pin-feed, adjustable tractor that accommodates seven-part continuous forms from 3 to 12-27/32 inches wide and includes an external paper handler. Standard business-machine ribbons are used.

PAPER TAPE INPUT/OUTPUT: Accommodates 8-level, 1-inch-wide strips of paper tape and operates at printer-selectable speeds of 10, 15, or 30 char/second when punching and at all speeds up to 120 char/second when reading. The Paper Tape Reeler option provides two tape reels, one located on each side of the tape read head.

TAPE CASSETTE ACCESSORY: A small desk-top unit (5.75 inches high by 7.75 inches wide by 12.5 inches deep) that accommodates a "Philips-type" cassette containing 300 feet of 0.15-inch-wide magnetic tape. The unit records data serially by bit and can record up to 50,000 characters on a cassette. The data transfer rate is the same as the terminal's selected transmission rate. Fast forward and rewind operations are performed at 40 inches/second. Panel controls provide read, write, advance, rewind, and stop-tape functions.

A search mode is provided for both forward and reverse directions. Searching is performed on inter-record gaps at a speed of 500 char/second. When searching forward, the unit momentarily turns off a lighted indicator lamp for each encountered record gap; when searching in reverse, the tape stops at each encountered record gap.

PARALLEL INTERFACE: Provides an interface for entering data from an external device. The external device can be switched on or off locally or remotely via received control codes. The use of this option precludes using the Selective Addressing option.

PRICING: The GE TermiNet 1200 is available for purchase or on a one- or three-year lease, which does not include maintenance. Leases can be cancelled, but a penalty payment is involved. A separate maintenance contract is available for leased or purchased equipment. At this writing, GE had not yet released lease prices for the TermiNet 1200.

Device	Purchase Price
RO	$4,050
KSR	4,595
ASR (with paper tape)	6,830
ASR (with magnetic tape)	6,026
Options	
120 Print Positions	360
Speed Options:	
10, 20, and 120 char/second	40
30, 60, and 120 char/second	40
Line Control	40
Selective Addressing	120
Automatic Motor Control	25
Horizontal Tabulation	190
Vertical Tabulation/Form Feed	240
Transparency	40
Parity Error Detection	80
Answerback	80
Parallel Interface	125
Paper Tape (Reader/Punch	2,235
Magnetic Tape Cassette Accessory	1,431
Paper Tape Reader Reeler	775
Integral Modems	
300 bps modem	275
1200 bps modem (for unattended operation)	?
Acoustic Telephone Couplers	
TDM 114 (Originate only)	320
TDM 115 (Originate/Answer)	380 ■

GTE IS/7800 Video Display Systems

GTE's IS/7800 systems are direct replacements for the IBM 3270 Information Display System. They can operate locally with IBM System/360 or 370 computers or remotely as stand-alone or cluster terminals. Enhancements include extended display and printer capabilities and transmission rates of up to 9600 bps.

MANAGEMENT SUMMARY

GTE Information Systems introduced its IS/7800 Video Display Systems in May 1973 as direct replacements for the IBM 3270 Information Display System. Production deliveries began in February 1974, and over 2,000 display units have been installed as of August 1975. The IS/7800 systems are available for local or remote applications as clustered terminals combining as many as 26 display units and printers; a mini-cluster system for remote applications combines up to 5 display units and printers, but is priced the same as the larger systems on a per-display-unit basis.

The IS/7800 systems provide complete compatibility with the IBM 3270 with respect to the IBM BSC line discipline, commands and command-code structure, and addressing sequence. (GTEIS plans to implement the newer SDLC line protocol for future availability.) Moreover, the GTE terminals provide all features and functions that are currently available with the IBM 3270, as well as several worthwhile enhancements.

The salient features of the IS/7800 systems as compared with those of the IBM 3270 system include:

- *Display capacity*—The IS/7800 offers a choice of four screen sizes: 240, 480, 960, and 1920 characters. IBM provides two screen sizes: 480 and 1920 characters.
- *System configuration*—The clustered IS/7800 systems can accommodate up to 5 or up to 26 directly attached devices (printers and display units) as compared with 32 devices for the IBM 3270. However, the IS/7800 systems can accommodate additional printers, each operating as a local-copy printer to a directly attached display unit. In addition to a

CHARACTERISTICS

MANUFACTURER: GTE Information Systems, Inc., One Stamford Forum, Stamford, Connecticut 06904. Telephone (203) 357-2000.

MODELS: Models IS/7801 and IS/7801A remote cluster display systems and Model IS/7802, a local cluster display system.

CONFIGURATION: The IS/7801, IS/7801A, and IS/7802 are cluster display systems that include a separate microprocessor-control unit which can accommodate up to 26 devices (Models IS/7801 and IS/7802) or up to 5 devices (Model IS/7801A), including any mix of CRT display units and printers. Each device is buffered and can be located up to 2,500 cable-feet from the control unit. Each display unit can support a local-copy printer, a light pen, and a 12- or 23-inch (measured diagonally) auxiliary CRT monitor. Buffer capacity of the local-copy printer corresponds to the screen capacity. A 165-cps impact printer is provided as a device-addressable systems printer; a 30-cps non-impact printer is provided for local-copy use.

The IS/7801 and IS/7801A display terminal systems connect to a communications facility via a modem. Cable length between modem and controller is 10 feet or (optionally) 50 feet.

The IS/7802 display system contains a channel interface for direct connection (via up to 200 feet of cable) to an IBM System/360 computer, Models 25 through 195, or an IBM System/370 computer, Models 115 through 195, via a Selector, Multiplexer, or Block Multiplexer channel. The maximum data transfer rate for local operation is 650,000 char/second.

COMMUNICATIONS: Transmission is half-duplex, synchronous at 9600, 7200, 4800, 2400, 2000 or 1200 bits/second using 8-level EBCDIC or ASCII (with parity). The IS/7801 and IS/7801A employ the IBM Binary Synchronous Communications (BSC) technique and are transmission-compatible with the IBM 3270 Information Display System. Compatibility with the IBM SDLC communication protocol is proposed for future availability.

The terminals provide an EIA Standard RS-232C interface and connect to a voice-grade communications facility via a modem. The following table shows the relationship between transmission speed and modem type; although Bell System modems are shown, equivalent modems from independent manufacturers can be used.

Transmission Rate	Bell System Modem
1200 bps	202C/D/E/R
2000 bps	201A
2400 bps	201B/C
4800 bps	208A/B
7200 bps	209A
9600 bps	209A

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT. The four standard display arrangements are as follows:

GTE IS/7800 Video Display Systems

local-copy printer, each display unit can accommodate an auxiliary CRT monitor (12- or 23-inch screen). A light pen is optional, as with the IBM 3270. A badge reader is no longer offered.

- *Printed output*—Two printer models are available with the IS/7800 systems: a non-impact printer rated at 30 cps and a matrix printer rated at 165 cps. The 30-cps non-impact printer is available as a local-copy printer only, while the 165-cps impact printer is available as a systems printer (on-line) only. By contrast, IBM offers two matrix printers for use with its 3270, one rated at 40 cps and the other at 66 cps; each printer attached to the IBM 3270 operates essentially as an on-line device.

  The IS/7800 system also permits printers to be pooled, meaning that a single printer can be assigned to respond as a local printer for a cluster of display units. Significantly, a printer dedicated to local-copy operation receives data into its print buffer directly from the display unit's refresh memory under operator control. By contrast, the IBM 3270 requires a Copy command to be issued by the remote computer to initiate a local-copy function; the operation cannot be manually initiated. The IS/7800 can also make use of the Copy command as an alternative to the direct local-copy function.

- *Display output*—The IS/7800 systems feature display enhancements over the IBM 3270. The IS/7800 systems can display any of 99 or 121 (optional) ASCII symbols (versus 64 symbols for the IBM 3270), including upper and lower case alphabetics as normal-size or double-width characters. The image can also be inverted to display black characters on a white background; individual characters and fields can be blinked; and data can be underscored. Like its IBM counterpart, the IS/7800 provides two beam intensity levels and a beam blanking level; individual characters or fields can be displayed at a brighter-than-normal intensity to contrast with data displayed at a normal level of brightness, or the data can be blanked (not displayed) for security purposes. The IS/7800 system, as an option, also offers a limited graphics capability that can produce bar charts, line drawings, and histograms.

- *Key entry*—Three keyboard styles are available with the IS/7800, which duplicate those offered with the IBM 3270: typewriter, data entry, and operator console. Noteworthy differences between the IBM and IS/7800 keyboards are in the total number of characters that can be generated, the number of Program Function and Attention keys provided on the data entry keyboard, and the optional 10-key numeric pad, available for GTE's operator console and typewriter keyboards. IBM's keyboards can generate 64 characters, versus 92 characters for the IS/7800 keyboards. The data entry keyboard for the IS/7800 includes 11 Program Function keys and 9 Program Attention keys, compared with 5 PF and 3 PA keys for the same keyboard style offered with the IBM 3270.

- *Communications*—Transmission speeds for the IS/7800 range from 1200 to 9600 bits per second.

Characters/display:	240	480	960	1920
Lines/display:	6	12	12	24
Characters/line:	40	40	80	80

A character set of 99 ASCII characters, including upper and lower case alphabetics, numerics, fractions, and special symbols, is displayed in white against a dark background or in an inverted image where dark characters appear on an illuminated background (reverse video).

Beam intensity, via program control, can be switched between normal and bright intensity levels, or the beam can be turned off (blanked).

Each character is formed by one of two program-selectable dot matrices, 5-by-7 or 10-by-7; the latter forms a double-width character by illuminating two adjacent dots for each single dot position in a standard-width character.

An optional Extended Character Set includes symbols for creating bar charts, histograms, and line drawings. This feature extends the total displayable character set to 121 characters.

SOFTWARE SUPPORT: The IS/7800 systems are supported under existing IBM software support for the IBM 3270, including the DATA/360 and VIDEO/370 on-line data entry programs. Additional software support is provided by GTE Information Systems through two proprietary software packages, Intercomm and Minicomm; both are communications monitor systems and are products of Programming Methods, Inc., a subsidiary (see reports 70E-457-01 and 70E-457-04).

DEVICE CONTROL: The IS/7800 systems operate under the control of the program stored at the remote computer and provide complete compatibility with the addressing sequence, command code structure, and line discipline employed by the IBM 3270 Information Display System. The IS/7800 systems respond to and execute the full repertoire of IBM 3270 commands via a microprocessor with read-only memory. In addition, the IS/7800 systems feature some enhancements that are supported under the existing framework of IBM software and can be user-implemented through slight modification to individual application programs.

The Format Mode, initiated by a computer-generated message containing a fixed format, permits the operator to enter data into a displayed format. Data entry is restricted to the variable fields; format descriptors are protected from inadvertent entry by the operator. The cursor moves between non-protected (variable) fields by tabbing (if tab stops are provided) or automatically when the end of a field is reached. When transmitting, only the variable (keyed) data is transmitted. The format remains displayed for the next operation unless it is erased by the operator. Character insert and delete functions can be used to edit the keyed data prior to transmission. Format descriptors can be 1) made to blink, 2) underscored, or 3) displayed in reverse video via the use of attribute codes for ease of identification.

Features include all those provided by the IBM 3270 plus a few extra features such as additional editing and display functions. The extra editing features include line and memory erasure. The line erasure function erases the line occupied by the cursor. The memory erasure function erases the entire contents of the unit's display buffer and positions the cursor to Home. Additional display features include blink, underscore, double-width characters, and an inverted display (black characters on a white background). These additional features are implemented through the use of one or more characters to blink or be underscored via program control.

Cursor control is functionally the same as in the IBM 3270, with the addition of a Home position. The cursor can be moved up, down, left, or right, step-by-step or repetitively (if the key remains depressed), backspaced one character position, moved to the beginning of the next line, tabbed to the beginning of the next unprotected data field, and backtabbed to the beginning of the previous unprotected data field.

GTE IS/7800 Video Display Systems

compared with 1200 to 4800 bits per second for the IBM 3270. Transmission is compatible with the IBM BSC line protocol.

- *Software support* -The IS/7800 is compatible with all existing IBM software for the 3270. In addition, two separately priced communications monitor systems are available from GTE for use with the IS/7800.

First customer deliveries of the IS/7801 and IS/7802 systems were made in February 1974. Initial deliveries of the IS/7801A mini-cluster system followed in May 1975.

Service is provided by GTE Information Systems through locations in more than 50 U.S. cities nationwide.

USER REACTION

In Datapro's 1975 survey of alphanumeric display terminal users, only four users reported on their experience with a total of 107 IS/7800 display terminals. To increase the sample size, telephone interviews were conducted with six more users, who reported on a total of 600 IS/7800 terminals. The ratings assigned by the 10 users are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	5	4	1	0	3.4
Ease of operation	6	4	0	0	3.6
Hardware reliability	4	4	2	0	3.2
Maintenance service	1	5	3	1	2.6
Software & technical support	1	6	2	1	2.7

*Weighted Average on a scale of 4.0 for Excellent.

These users were well pleased with their IS/7800 systems, as indicated by the first three categories. Maintenance service, however, was reported to be "spotty," meaning that in some geographic areas the maintenance was less than satisfactory with respect to response time and competence level, and was said to need improvement. However, most of these users indicated they planned to expand their installations with additional IS/7800 terminals. The majority of the respondents were not using the GTE enhancements that would have required changes to their application programs.□

Program Function and Program Attention keys, designated PFn and PAn, respectively, an optional feature of the IBM 3270, are a standard feature of the IS/7800 systems. Each of these keys generates a unique code recognized by the controlling software as a specific program request or data identifier. The two key functions differ in that the Program Function code accompanies the displayed data as it is transmitted to the computer, while the Program Attention code is transmitted separately.

A light pen is available as an option and functionally corresponds to IBM's Selector Pen, a 3270 option. Any one or several alphanumeric or numeric fields of fixed or variable format can be selected by the pen, which transmits the address of the selected entry to the computer to initiate the programmed function.

KEYBOARD: Any of three basic keyboard arrangements can be specified: typewriter, data entry, or operator console. The keyboards are identical in layout and key arrangement with the equivalent IBM 3270 keyboards, and include a separate group of 12 Program Function keys located at the right of the main keygroup and a row of 15 function keys located above the main keygroup. A 10-key numeric pad is optional for typewriter and operator console keyboards.

PRINTED OUTPUT: Two printers are available. The non-impact thermal page printer (Texas Instruments) prints up to 80 columns at 30 char/second on an 8.5-inch-wide, 300-foot roll of special paper. Any of 64 characters is formed within a 5-by-7 dot matrix.

The impact page printer (Centronics 101A) prints up to 132 columns at 165 char/second and accommodates pin-fed, continuous 5-part forms up to 14-7/8 inches wide via an adjustable tractor. Horizontal pitch is 10 char/inch, and vertical spacing is 6 lines/inch. Vertical format control is standard and is implemented via a paper tape loop. Any of 64 characters is formed within a 9-by-7 dot matrix.

PRICING: The GTE IS/7800 systems are available for purchase or on a one-year lease that includes maintenance. A separate maintenance contract is available for purchased equipment.

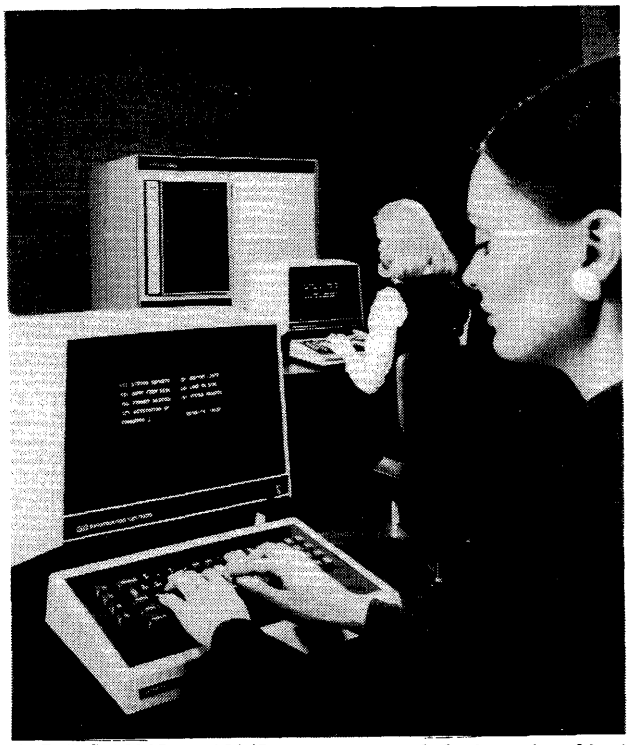
	Monthly Rental*	Purchase	Monthly Maint.
Control Units			
IS/7801 or IS/7801A (remote)	$200	$5,696	$22
IS/7802 (local)	225	6,496	22
Display Units**			
240-char. screen	120	3,144	22
480-char. screen	120	3,144	22
960-char. screen	120	3,144	22
1920-char. screen	120	3,144	22
Printers			
Local copy (30 cps thermal)	135	5,300	30
System (165 cps impact)	200	5,000	40
Auxiliary Monitors			
12-Inch CRT	15	470	6
23-Inch CRT	23	730	10
Options			
Expanded Char. Set	5	164	0
Light Pen	21	935	5
10-Key Numeric Pad	7	85	0
Security Key Lock	35 OTC	35	0
Desk Top (for IS/7801A Control Unit)	150 OTC	150	0

* Includes prime-shift maintenance.

**Includes any of five keyboards: 3 typewriter styles (EBCDIC, ASCII-A, ASCII-B), data entry, and operator console.

OTC–One-time charge.■

GTE IS/1500 Series
Shared-Processor Data Entry Systems



A GTEIS 1511B or 1514B system can include from 4 to 32 of these CRT keystations. The cabinet in the background houses the processor, terminal controller, magnetic tape drive, and one or two disk drives.

Competing in the 4 to 32 CRT keystation key/disk arena, the 1500 Series emerges as a highly user-oriented product line. Coming software developments promise to take full advantage of the powerful minicomputer that forms the core of the systems.

MANAGEMENT SUMMARY

When GTE Information Systems introduced the IS/1500 Series systems in May 1973, the Tempo minicomputer that formed the base for the shared-processor data entry systems was a heavyweight compared to the central processors in most of the competing key/disk systems of the day. While many of GTE's competitors have spent the intervening time beefing up their hardware and software capabilities, GTEIS has been principally concerned with configuration adjustments to find just the right combinations to appeal to the customers.

Soon after delivering the first production systems in early 1974, GTEIS announced special reduced-configuration "A" models (4 keystations) and renamed the 32-keystation versions as "B" models. The "B" designations remain, but the "A" models have vanished. The emphasis in the industry has shifted toward larger configurations.

To date, GTEIS has installed a total of about 100 IS/1500 systems representing about 1000 keystations. About 40 percent of these are the communications-oriented IS/1514, and GTEIS states that about 70 percent of its current backlog is for the IS/1514.

The current "B" models are essentially the same as the originally announced systems, with some significant software improvements. The distinction between the ➢

CHARACTERISTICS

MANUFACTURER: GTE Information Systems, Inc., One Stamford Forum, Stamford, Connecticut 06904. Telephone (203) 357-2000.

CONFIGURATION

The basic IS/1511B configuration includes four CRT keystations, one 2.5-megabyte cartridge disk drive, one 7- or 9-track, 556/800 bpi tape drive, and a central processor that includes 24K words (48K bytes) of main memory. The basic IS/1514B configuration is identical, except that a communications interface is added and the memory size is 32K words. Either system can be expanded to include 32 keystations; a Keystation Expansion software module is required for configurations including more than 16 keystations.

Disk storage capacity can be expanded to a single 5-megabyte or 10-megabyte drive; up to four disk drives of one capacity can be included. A second tape drive can be added. Tape format can be 9-track, 1600 bpi in place of 7- or 9-track 556/800 bpi, or the two formats can be mixed. A 165-cps serial matrix printer or a 600-lpm drum or chain printer can be added. The processor memory can be expanded to 131K words (262K bytes). Processor memory expansion required for expanded keystation configurations (more than 16) is not extra-cost, but additional memory modules can be added for special needs.

Peripheral switches for switching keystations (in groups of four) or a printer between two processors are available.

COMPONENTS

KEYSTATION: Consists of a 12-inch CRT display monitor and a keyboard patterned after an IBM 29 keypunch; a table is included.

The CRT displays 240 characters in 6 lines of 40 characters each. Characters are formed by a 5-by-7 dot matrix. A total of 128 graphic symbols are displayable, including numerics, upper and lower case alphabetics, conventional punctuation and special symbols, plus many special graphic symbols such as "pi," "sigma," barred numerics, equal to or greater than, equal to or less than, and others. Using the keyboard in conventional fashion, a 64-character set is available. The extra graphics can be displayed from data transferred from the processor or by entering a hex mode at the keyboard and keying the hexadecimal-code equivalent of each graphic (2 characters). When entering data, the top two lines of the display are used for job, batch, record, and operating mode information; the bottom three lines are used to display the data record as it is entered. Other uses for the display include status information (supervisory stations), error messages, and function lists. A keystation can be located up to 1000 feet from the processor.

The keyboard includes 63 character and control keys laid out in a data entry arrangement (with numerics in ➤

GTE IS/1500 Series
Shared-Processor Data Entry Systems

IS/1511B without communications and the IS/1514B with communications is primarily due to an internal project control arrangement rather than to differences in hardware. The IS/1511B can easily be field-upgraded to an IS/1514B.

The product-line adjustments are not over yet. During the first quarter of 1975, GTEIS plans to introduce another version to be called the 1520. It will not need the software/memory expansion required to get the 1511/1514 beyond 16 keystations. It will also include a powerful compiler as a standard feature. The compiler will become an option for the current "B" models. More about the new compiler later.

Overall, the IS/1500 Series shapes up as a user-oriented system. Extensive use is made of the CRT display for guiding supervisors and operators through functions to be performed by displaying selection lists and entering set-up information in dialog fashion. In addition, specialized control keys are provided to permit the initiation of many operations with a single key depression. However, the handling of non-reconcilable errors (i.e., those where the source document itself is wrong) detected by the validity checks is not as automated as some would prefer. Generally, such cases are handled in one of three ways: (1) setting aside the source document and eliminating that record from the batch; (2) forcing the entry of the field as shown on the source document; or (3) filling the offending field with a special code recognizable by the central computer (or perhaps an IS/1500 using the compiler). Techniques (2) and (3) require an accommodation on the part of the input section of the main computer's programs—something key/disk systems are supposed to eliminate. Method (1) is quite adequate except that it may interfere with the accumulation of control totals and does not provide the satisfying capability for getting all the records on disk and separating out the error records to "play with" later. The control total problem is not too serious because batch balancing is controlled by visual inspection of printed reports by the supervisor.

The strong user orientation carries over into the programming of Formats for controlling data input and Reformats for controlling data output (to tape). These forms are relatively easy to code, while retaining a significant degree of flexibility and power. The details are covered under the "Software" heading in the Characteristics section of this report. Particularly strong are the capabilities for reformatting, which include explosion and implosion of input records into output records, and for producing job, batch, and sub-batch totals in addition to zero balancing. Missing from the input side is the capability to use a data code in the input to trigger an expanded entry in the output. Missing from the output are data manipulation capabilities. (Both will be provided using the forthcoming compiler and planned enhancements.)

Datapro had an opportunity to witness a demonstration of GTEIS's new compiler referenced above. It is based on the compiler developed for the earlier Logic 720 system.

keypunch layout). Also provided are an array of error lamps and a speaker for sounding key clicks (adjustable volume) and error tones. A comprehensive set of control keys is provided, including character, field, and record advance/backspace; format viewing; search; hex mode; spot verification; and end/suspend batch. If multiple keys are depressed simultaneously, only one character is entered. The keyboard is attached to the CRT monitor by a short, flexible cable.

DISK DRIVES: Three models are available that differ in storage capacity: 2.5, 5, and 10 million bytes. Rotation speed is 1500 rpm, giving an average rotational delay of 20 milliseconds, and the average positioning time is 30 milliseconds. The disks are serviced by one head per surface. The 2.5-megabyte drive uses one fixed disk. The 5- and 10-megabyte drives use a combination of one fixed and one removable disk. These drives use the top-loading IBM 5440-style cartridge.

MAGNETIC TAPE DRIVES: Operate at 25 ips (9-track, 1600 bpi) or 37.5 ips and accommodate 10.5-inch, 2400-foot tape reels. Formats available include 7- or 9-track, 556/800 bpi and 9-track, 1600 bpi (phase-encoded); all are IBM-format-compatible. Data compatibility with IBM, Honeywell, and others is available. Rewind speed is 150 inches per second.

PRINTERS: Two printers are available: a 165-cps serial matrix printer and a 600-lpm line printer.

The matrix printer prints a 64-character set using a 9-by-7 dot matrix arrangement. Sprocketed forms from 4 to 14.5 inches wide can be accommodated; 5-part forms can be used. Maximum print width is 132 columns. Vertical pitch is 6 lines per inch. Top-of-form vertical format control is provided and can be adjusted to forms from 3.5 to 11 inches in length.

The line printer may be either a drum or chain printer. It prints a 64-character set on sprocketed forms with up to 5 parts and from 3.5 to 19.5 inches wide. Maximum print width is 132 positions. Vertical pitch is operator-selectable at 6 or 8 lines per inch. A vertical format control mechanism is included and can accommodate form lengths of 3.5 to 11 inches.

CARD READER: A 400-cpm card reader will be available in the second quarter of 1975.

PROCESSOR: The processor is a 16-bit minicomputer developed by another segment of GTE Information Systems previously known as Tempo Computers. It employs core memory with a cycle time of 750 nanoseconds. The minimum memory size used in 1500 Series key/disk systems is 24K words (48K bytes). It can be expanded to 131K words (262K bytes). The basic 1514B communications system includes 32K words.

The processor is housed in the upper right half of a two-bay cabinet. The terminal controller is housed below the processor. The first tape drive is housed in the upper left of the cabinet, and the first disk drive is located in the lower left half, with room for a second. All memory expansion can be contained in the basic cabinet. An expansion cabinet holds one tape drive and/or two disk drives.

COMMUNICATIONS

The communications capability of the IS/1514B provides emulation of an IBM 2780 Model 2 Data Transmission Terminal (card reader, card punch, and printer). Tape or disk is substituted for the card media. Transmission is in BSC (bisync) mode at 2000 to 9600 bps, using Bell System or independent modems.

GTE IS/1500 Series
Shared-Processor Data Entry Systems

(Logic Corporation was acquired by GTEIS some time ago; existing Logic 720 customers are being supported, but the system is no longer marketed to new customers.)

The compiler demonstration involved playing a game of Tic Tac Toe–a trivial exercise until you realize the implications. First, there is the capability for logical comparisons of entered data and program flow alterations (branches) based on the comparisons. In addition, the data exchange was made interactively, providing the capability for human decision-making in those situations where the programmed logic flow cannot cope with the data as it actually happens. Foreground processing can be initiated at record beginning, character end, field end, record end, or batch end. Background processing on closed batches can be disk-to-disk and can use the tape and printer as output. Random access to a data batch based on a key field in the entry record will be provided later. (This was called File Fetch on the Logic 720 and is usually called table look-up or code expansion on other systems.)

For those users who wish to do something with their data, once entered, besides feed it to the big computer next door, these capabilities raise many possibilities. Multiple file handing is not planned, so the IS/1500 won't replace your System/370 (or equivalent) computer system. But it will handle a substantial amount of report generation from a small data base (or single file if you prefer) in addition to permitting conditional data entry.

USER REACTION

To cross-check our own evaluations, we talked with five users of GTE IS/1500 Series systems. In all, they were using 10 systems, totaling 114 keystations. A summary of their ratings is presented below.

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	2	0	3	0	2.8
Ease of operation–					
Supervisor	3	2	0	0	3.6
Operator	4	1	0	0	3.8
Hardware reliability	1	2	2	0	2.8
Maintenance–					
Promptness	2	1	2	0	3.0
Quality	2	2	1	0	3.2
Software	2	2	1	0	3.2
Technical support	2	1	2	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

A proper perspective on these diverse ratings can best be achieved by means of a thumbnail sketch of each interview.

One user assigned low ratings to overall satisfaction hardware reliability, and software. Specific problems he mentioned were the 2.5-megabyte disk and the matrix

At present, there is no provision for location of keystations remotely from the 1500 Series processor.

SYSTEM OPERATION

OVERVIEW: System operations are controlled from a primary supervisor's keystation and, if desired, up to two secondary supervisors' keystations. The secondary stations are inhibited only from initiating system start-up or shut-down, writing disk to tape for a system save, and locking out data entry keystations. Any of the supervisor stations can also be used to enter and verify data in the same fashion as a regular key entry station.

Once the system tape is loaded into disk storage, the system is entirely controlled in a tutorial mode from the supervisory or key entry keystations. In general, the supervisor or operator selects a function from a list (multiple levels of lists are used in some operations) and enters system, job, or batch information in response to prompts displayed on the CRT. The operations of the key entry operators are further constrained/enhanced by parameter-driven programs called Formats. Output of completed batches to tape from disk is under the control of Reformatting programs. A library of up to 500 Formats and up to 500 Reformats can be maintained. One Reformat is associated with each Format.

A batch is the collection of records keyed by one operator. Multiple batches using the same formats can be grouped into a job. For totaling purposes, records within a batch can be grouped into a document. Jobs carry alphanumeric names, and batches carry numbers. Control of data flow is maintained by specifying both job name and batch number.

OPERATOR FUNCTIONS: The principal functions of the keystation operators are record creation and verification. An active batch (one that has records being keyed) can be accessed for verification by a different operator; verification will lag entry by at least two records. The operator is responsible for creation of job names and batch numbers. The system cross-checks for duplications. Format programming can include up to eight formats per job. In addition, the operator can create a local format for the immediate task without having it logged and stored in the system. This is a useful feature for quick generation of occasional, simple entry jobs. The operator can search for a particular record or group based on the content of one or more data fields. Records can be retrieved and modified or deleted. New records can be inserted into existing batches. The operator can also selectively retrieve a record and verify that record only.

When keying data under the control of a particular format, violations of the field type or data check criteria cause an error message to be displayed. The operator can display the controlling format if desired. Data can be displayed or blanked as it is keyed. Proper coding of the entry format can produce field tags to help the operator in keying the right information.

SUPERVISOR FUNCTIONS: The supervisor maintains control over data flow within the system, creates and maintains Formats and Reformats, and monitors performance statistics by system, batch, and keystation. Displayed status information can be printed if a printer is included in the system. A special part of the system data flow is the creation of a dump onto tape that can be used to restart the system in case of catastrophic failure. Several levels of restart capability are provided, ranging from a cold start in which all previous system and data information is lost to a hot start with all directories, libraries, data batches, and keystation statuses as recorded on disk retained. Unless the supervisor is using the station to key data into a batch, all jobs initiated at a supervisor's station run in the background. Data entry and verification run in the foreground.

GTE IS/1500 Series
Shared-Processor Data Entry Systems

printer. He also mentioned bugs in the systems software. However, he felt that it was a good system for the money.

"FANTASTIC" summarizes the opinion of another user. (The capitals were necessary to properly convey his enthusiasm for the system.) This user had particularly complex output formats.

Another user low-rated everything except ease of operation, hardware reliability, and software—and said that the latest software release had some bugs in it. He was particularly critical of the field support personnel, feeling they had insufficient training when his system was installed. He did mention that he has seen improvement recently. His biggest disappointment seemed to be slow delivery of the compiler and/or other more advanced processing software. He said the basic system was reasonably good.

A fourth user rated everything but hardware reliability excellent, and that he rated good. He has had some problems with the 2.5-megabyte disk. He feels that he has halved his input preparation time as compared to his previous paper-tape-oriented system.

The fifth user was also disgruntled. He was, and continues to be, a user of Logic 720 key/disk systems as well. The compiler delivery has been repeatedly delayed, according to this user. And he needs the capabilities of this software to accomplish his data entry needs. The lack of sophisticated data entry processing has apparently soured this user on the whole system, although he does state that the basic system is good—for what it does.

A summary of the three dissenting votes seems to indicate primarily an impatience with the delivery of the new compiler. Most of the other low-rated categories were said to be improving, with the exception of bugs in the new software releases (mentioned by two users). All really seemed to feel that the system was worth what it cost; it just didn't do enough yet.

In discussions with Datapro, GTEIS acknowledged the difficulties expressed by the users, particularly the 2.5-megabyte disk drive and the alteration in delivery schedules for software enhancements. GTEIS was concerned about customer satisfaction and initiated a meeting with each and every installation by teams organized specifically for the purpose. These investigations led to changes in the quality assurance program for disk drive procurement and spares stocking. The company indicated that the 2.5-megabyte disk was no longer a major problem, and the users seem to agree. The stretchout in delivery schedules for software, and the bugs in new software releases that appeared in places that worked in the previous release, were due to the reorganization and shifting of some responsibilities and to a reevaluation of the resources required to deliver particular features.

Because of the close association between the Logic 720 and the GTEIS 1500 systems in the minds of many existing and potential customers, many may have ex-

OPERATING MODES

- **Data Entry—Data is keyed into the system under control of a record Format that delimits fields, specifies data validation checks, and specifies arithmetic manipulations to be performed. Keying errors are corrected immediately if possible. If not, the document may be set aside (record not entered), the field can be forced (unless the Format prevents this), or a specified constant field can be inserted.**

- **Data Verification—Data is verified by rekeying under the same Format by the same or different operator. Data entry and verification of the same batch can overlap. Data fields specified for non-verification can be displayed for visual verification if desired.**

- **Record Search—Permits the operator to retrieve a previously keyed record and verify or modify it.**

- **Background Functions—Data batches can be batch-balanced. Data batches can be dumped to tape with reformatting, including explosion and implosion of keyed records. Data batches can be loaded onto disk from tape under the Data checking and validation of an entry Format. Data batches can be transmitted from tape or disk. Data batches can be received to tape or printer. System, batch, and keystation status can be monitored. Format and Reformat libraries can be created and maintained. In general, one major function involving the tape, the disk, and the processor (batch balancing) can be performed concurrently with data entry and verification.**

SYSTEM PROFILE

- **Maximum record length is 120 characters. Minimum field length is 1 character.**

- **Up to 8 formats per job are permitted.**

- **Maximum block length for tape output is 4096 characters.**

- **The approximate data storage capacity of the 2.5-megabyte disk unit is 16,500 120-character records. System capacity when using larger disk configurations increases proportionately. A maximum of 500 Formats and 500 Reformats can be accommodated in the system.**

SOFTWARE

The two basic programming facilities are the Formats, which are operative when entering data, and Reformats, which are operative when transferring data from disk to tape. A tape-to-printer utility for IBM 1403 or Honeywell printers is also available.

FORMATS: Preparation of an entry Format is simple. Fields are identified by number in order to be entered at the keystation; length is specified by writing a beginning and ending position. The mode (data type) is identified by a two-character code. Then a series of "yes-no" questions is answered for data checking and validation functions. For some table-oriented functions, such as range check, the table values are coded directly on the entry Format form.

Permissible data types are made up of all combinations of four modes (key, dup, skip, and unconditional skip) and four cases (alphabetic, numeric, upper, and lower). Some of the seemingly odd data types, such as unconditional skip, numeric, have useful functions; in the case mentioned, a fill character of zero is implied in the skip field.

The data checking and validation functions are divided into four groups: General, Extension, Check Digit, and Other.

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pected too much from the 1500's. The Logic 720 was and is a very powerful data entry system—it was also expensive. Successful delivery of the compiler for the 1500 systems, due in the first or second quarter of 1975, will silence much of the criticism we heard. □

The General group permits specification of 1 of 8 accumulators, non-verify, left zero, must enter, must follow Format, and right boundary check. The "must follow Format" specification prevents the operator from switching to manual mode and violating the Format specifications.

The Extensions group is used to specify arithmetic and compare operations. A field can be loaded into an accumulator (zeroing the accumulator first), added to or subtracted from an accumulator, multiplied by the accumulator (result stored in accumulator), or compared with the accumulator. Compare results are implied as zero or non-zero. An accumulator can also be stored in a data field. Accumulators are 16 digits long. Arithmetic and compare functions can be used for internal field checking or for document, batch, and job totaling and batch zero-balancing as initiated by the supervisor keystation.

The Check Digit group permits specifying the checking or generation of one of three modes. Modulo 7, 10, and 11 are normal; others can be made available on special request. Not counting the check digit position, base numbers for Modulo 7 can be up to 19 digits long; and base numbers for Modulo 10 or 11 can be up to 79 digits.

The Other group includes range check, valid value check, invalid value check, and literal insertion. The table entries to be compared for range and value checking can be up to 8 digits long and are specified directly in the entry Format. The literal can also be up to 8 characters.

Formats are created at a supervisor station. They are required for original key entry, key verification, and when loading batches onto disk from tape. Loading against the Format permits validating data received over a communications line.

REFORMATS: A Reformat is specified as a sequence of steps creating a record for output to tape. Any portion of the keyed record can be moved to any portion of the output record. In addition, up to three sequential records can be temporarily stored in a working buffer for combining with a fourth record. The four records must have been keyed under four different entry Formats. Output records can be written to tape at any point in the sequence of steps comprising a Reformat. Thus, any one, two, three, or four sequential input records can be output as one to any number of output records. A literal of up to 8 characters can be inserted or a fill character can be specified for any size field. Obviously, input data keyed for multi-record Reformat specifications must be keyed in repetitive groups of the same number of records as expected in the Reformat.

PRICING

IS/1500 systems are available on a two-year lease, on a three-year lease/purchase arrangement, or for purchase. Prime-time, local-zone maintenance rates are included in the monthly cost figures below, and are also presented separately to accommodate users interested in purchasing the equipment.

	Monthly Rental, 2-Year*	Purchase	Monthly Maint.
Basic 4-Keystation 1511B**	$1,011	$31,200	$168
Basic 4-Keystation 1514B**	1,111	34,200	173
Additional Keystations**	64	1,200	12
Keystation Expansion Module**	50	1,800	–
8K Memory Module**	100	4,000	10
Conversion of 1511 to 1514	125	3,000	25
Keystation Switch (for up to 4)	50	1,750	10
Printer Switch	17	500	2
Disk Storage			
Replacements for standard 2.5-megabyte disk–			
5-megabyte drive	200	7,000	5
10-megabyte drive	300	10,400	10
Add-on disk drives–			
5-megabyte drive	350	10,800	35
10-megabyte drive	450	14,200	40
Magnetic Tape Drives			
Replacement for standard tape drive–			
9-track, 1600 bpi	130	4,500	5
Add-on tape drives–			
7- or 9-track, 556/800 bpi	240	8,400	35
9-track, 1600 bpi	375	12,600	40
Printers			
165-cps matrix printer	200	7,000	40
600-lpm line printer	675	21,600	100
Software			
Multiple Tape Codes	25	900	–
Tape-To-Print; IBM 1403 or Honeywell 200	25	900	–

* Includes prime-time maintenance for local area. Extended coverage is available.

**The basic configuration of the 1511B includes a processor with 24K 16-bit words of memory, a 2.5-megabyte disk drive, and one 7- or 9-track, 556/800 bpi tape drive. The basic configuration of the 1514B includes 32K words of memory, a 2.5-megabyte disk drive, one 7- or 9-track, 556/800 bpi tape drive, and a bisync communications interface. Extra-cost memory modules are not required when expanding a configuration beyond 16 keystations, but the Keystation Expansion Module is. ■

Genesis One G77 (The Plug) Information Display Terminal

Billed as "The Plug," the G77 is a direct replacement for IBM's 3277-2 Display Station for use with IBM controllers in local or remote IBM 3270 cluster arrangements, and is priced well below IBM's displays.

MANAGEMENT SUMMARY

In November 1974, Genesis One addressed itself to the end-user market as a vendor of add-on or replacement CRT display terminals. Its initial offering, the G77 Information Display Terminal–billed as "The Plug"– is a large-screen replacement for IBM's 3277 Model 2 Display Station, a 1920-character CRT display unit used in local or remote cluster arrangements. IBM 3270 users can expand their existing installations and/or replace existing IBM display units with the G77 terminal, which provides complete compatibility with the IBM 3277-2 Display Station. No hardware or software changes are required. What's more, existing IBM cables can be used to attach the G77 terminals to the IBM controller. Cables are also available from Genesis One.

All current functions and capabilities of the IBM 3277-2 have been implemented in the G77. Genesis One has also added a few enhancements that give the G77 a slight edge over its IBM counterpart with respect to operating flexibility. One of the more significant enhancements (a no-cost option for applications such as text editing) is the capability to display true upper and lower case alphabetics.

Because the G77 displays each character via a 5-by-7 dot matrix, it is reasonable to assume that its character clarity and sharpness (resolution) is somewhat less than that of IBM 3270, which uses a 7-by-9 dot matrix to form each character. This deficiency was quite apparent in the original models of the G77, but Genesis One has since alleviated the problem (without changing the character matrix) by refining the character generator.

CHARACTERISTICS

SUPPLIER: Genesis One Computer Corporation (a subsidiary of Management Assistance, Inc.), 300 East 44th Street, New York, N.Y. 10017. Telephone (212) 557-3500.

MANUFACTURER: Texas Scientific Corporation, 8000 Harwin Drive, Houston, Texas 77036. Telephone (713) 785-7731.

COMPATIBILITY: The Genesis One G77 Information Display Terminal is a keyboard/CRT display unit designed as a plug-compatible replacement for the IBM 3277 Model 2 Display Station for use in IBM 3270 Information Display Systems. The G77 terminal connects directly to an IBM 3271 Model 2 Remote Control Unit or IBM 3272 Model 2 Local Control Unit via existing IBM cables or cables supplied by Genesis One (at additional cost). The G77 terminal provides complete hardware and software compatibility with its IBM counterpart; no changes to existing IBM hardware or software are required.

CRT DISPLAY: The G77's viewing screen size, capacity, and display arrangement are identical with those of the IBM 3277-2. Screen size measures 14 inches diagonally. Data is displayed in 24 lines of 80 character positions each, totaling 1920 character positions.

A character set of 96 characters, including upper and lower case alphabetics, numerics, and special symbols (as compared with IBM's standard 64-character set), is displayed in green against a dark background, as in the IBM 3277-2. Unlike the IBM 3277-2, which forms each character via a 7-by-9 dot matrix, the G77 uses a 5-by-7 dot matrix.

DEVICE CONTROL: The G77 terminal provides all the functions that are currently provided by the IBM 3277-2 Display Station, plus a few of its own. The added functions include a Home cursor control, an optional cursor blinking capability, Field Erase, Automatic Variable Initialization, and Character Repeat. The added Home key moves the cursor to the initial character position of the first unprotected field. When activated by the operator, the Automatic Variable Initialization function identifies variable fields by displaying a dot in each character position. The Character Repeat function permits a character to be repeatedly displayed.

The G77 is available with IBM-equivalent options. Extra-cost options include Security Lock, Audible Alarm, Light Pen, and ID Card Reader. Keylock and numeric lock keyboard features are no-cost options.

KEYBOARD: Three keyboards are currently available: 66-key EBCDIC typewriter style, 66-key EBCDIC data entry style, and 78-key EBCDIC typewriter style. A numeric keypad is optional. For operator convenience, the keyboard can be detached and located up to 2 cable-feet from the CRT display unit.

Genesis One G77 (The Plug)
Information Display Terminal

Like its IBM counterpart, the G77 is available with or without a keyboard. Genesis One currently offers three keyboard styles: two 66-key arrangements that compare with IBM's 66-key EBCDIC keyboards and one 78-key arrangement that compares with IBM's EBCDIC typewriter-style layout. An optional numeric pad facilitates volume entry of numeric data.

Printed output of received or displayed (local copy) data is available by means of the G87 or G88 printers (Centronics Model 500 or 501 units, respectively). Both printers print up to 132 columns, but the G88 is faster–165 cps with a paper slew rate of 8 inches/second, as compared with 120 cps and half the paper slew rate for the G87. Both printers are equipped with line buffers for increased operating efficiency. These printers provide substantial increases in performance over the 40- and 60-cps IBM printers that are offered with the 3270 system..

Light pen and ID card reader, which are optional features for the IBM 3270, are also available for the G77 terminal, with initial deliveries scheduled for the second quarter of 1975.

Genesis One prices the G77 terminal well below the rental and purchase prices of the IBM 3277-2. Lease prices range from 16 percent (2-year lease) to 30 percent (4-year lease) below the monthly rental of the IBM 3277-2, while the purchase price of the G77 is 25 percent below that of the IBM display. The user stands to save as much as $528 per year under a four-year lease over the cost of each IBM terminal.

Production deliveries of the G77 terminal began in January 1975. The current lead time on orders is 60 to 90 days. Service is provided by Sorbus, Inc., a prominent nationwide service organization and a fellow member of the MAI corporate family.

USER REACTION

Datapro interviewed three early users of the Genesis One G77 terminal, who reported on their experience with a total of 57 displays; 49 of these were the new model, all belonging to one user who has a standing order for well over 100 units. The remaining eight units were earlier models with a 12-inch screen and white-on-black display. The ratings assigned by these users are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	1	2	0	0	3.3
Character clarity	0	3	0	0	3.0
Equipment reliability	2	1	0	0	3.7
Maintenance service**	2	1	0	0	3.7

* Weighted Average on a scale of 4.0 for Excellent.
**Maintained by Sorbus, Inc.

The users were well pleased with the product and its ease of installation. Actually, these users installed the displays themselves, by merely plugging each unit into the controller cable. Two of these users (including the one with the 49-tube installation) have been using the G77 display units for at least six months, while the remaining user has had his installed for four months. Little or no downtime has been experienced.

Only two complaints were registered. One user commented about the fuzziness of data displayed on the early models. This problem has been corrected on the newer production models, as verified by another user who was especially pleased with the sharpness and clarity of the displayed data. This user humorously commented that the operators were annoyed because they could not use the screen as a mirror when applying cosmetics because of the screen's antiglare shield, a standard feature of the newer models. Another user complained that the keyboard feel was not stiff enough and that it should feel more like that of the IBM 3270. (For this reason, the keyboards emit an audible "click" with each key depression.) □

PRINTED OUTPUT: Two matrix printers are available that differ in rated print speed and paper slew rate. The G87 (Centronics 500) is rated at 120 cps with a 4 in./sec. slew rate; the G88 (Centronics 501) is rated at 165 cps with a slew rate of 8 in./sec. Both printers provide 132 print positions, a 64-character print set (with options for 96 or 128 characters), and an adjustable tractor feed that will accommodate pin-feed, six-part continuous forms from 3 to 14-7/8 inches wide. Printed characters are formed via a 5-by-7 or optional 9-by-7 dot matrix. Buffering for one print line is also provided.

PRICING: The G77 Information Display Terminal is available for purchase or on a 2-, 3-, or 4-year lease, excluding maintenance. A separate maintenance contract is available for leased and purchased units. The G77 is priced as follows:

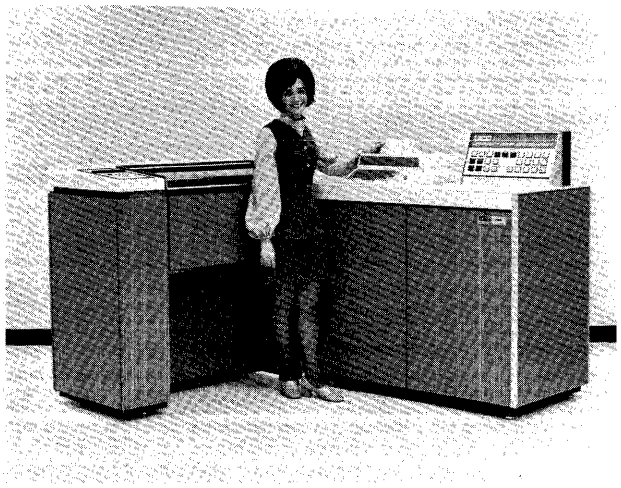
	Monthly Rental*			
	2-Yr. Lease	4-Yr. Lease	Purchase	Monthly Maint.
G77 Display Station (1920 characters)	$101	$85	$3,392	$12
Keyboard:				
66-key EBCDIC typewriter	12	10	408	3
66-key EBCDIC data entry	12	10	408	3
78-key EBCDIC typewriter	24	22	816	5
Audible Alarm	3	2	136	–
Security Lock	70**	70**	70	–

*** Includes maintenance.**
****One-time charge.**

The installation charge is $25. Cables, if required, are priced at $11 per cable plus $0.11 per foot.

Pricing is currently not available for the ID card reader, light pen, or printers.■

Harris 1200/COPE Remote Batch Terminals



Harris CSI has revamped the successful COPE line of remote batch terminals by incorporating its own processor and modularizing the configuration possibilities. The result is a wider range of performance capabilities at generally lower prices than before. Two fixed-configuration models, the COPE 1280 and 1281, are marketed as direct replacements for the IBM 2780.

MANAGEMENT SUMMARY

Communication Systems, Inc., the developer of the extensive COPE line of remote batch terminals, was founded as a wholly-owned subsidiary of University Computing Company. It became Harris Communication Systems, Inc., a subsidiary of Harris-Intertype Corporation, on December 8, 1972, through outright purchase of CSI from UCC by Harris-Intertype. UCC divested itself of CSI primarily to raise capital to support DATRAN, its ambitious digital switching network. Under Harris, CSI is continuing with essentially the same personnel, facilities, and product lines. A brief account of the development of the COPE product line follows.

In the mid-1960's, University Computing Company became one of the first companies to actively develop and market remote batch processing as a service. In this concept of data processing, the remote location is essentially a logical extension of the computer room. To support this concept, high-performance terminals were needed. At first, UCC used UNIVAC 1004's because they were available, they had reasonably good communications interfaces already developed, and they were compatible with the UNIVAC computers around which UCC was building its network.

Shortly, UCC introduced the first of its COPE terminals, the COPE .45, with a 1500-card-per-minute reader and 1250-line-per-minute printer. To fully utilize these speeds, a high-capacity, high-cost communications facility was required. As the years progressed and the market for remote computational facilities broadened to include smaller users, UCC expanded the COPE line by introducing additional models with reduced performance and price tags. At its peak, this product line included some eight models ranging in cost from about $1,000 to $3,000 per month, including maintenance.

In December 1971, UCC introduced the new 1200 line with expanded configuration possibilities, larger memory expansion capabilities, and lower prices. UCC replaced the line of fixed-configuration terminals with a modular building-block line. (Devotees of the pun can bemoan

CHARACTERISTICS

MANUFACTURER: Harris Communication Systems, Inc. (a subsidiary of Harris-Intertype Corporation), 11262 Indian Trail, P.O. Box 44076, Dallas, Texas 75234. Telephone (214) 241-0551.

MODELS: Two general-purpose models and two specialized configurations comprise the current 1200/COPE terminal line. The general-purpose models are the 1200/I and the 1200/II; these differ only in the number and type of communications lines that can be accommodated and in the number of peripheral channels. The special configurations are the COPE 1280 and COPE 1281, which include a card reader, line printer, and card punch (optional) in addition to the processor; they are intended as a direct replacements for IBM 2780 terminals.

CONFIGURATION: The 1200/I includes 4K 12-bit words of main memory and 6 I/O channels. Main memory can be expanded to 16K words. One or two of the I/O channels can be used for communications interfaces capable of up to 9600 bps transmission rates. Peripheral devices can be chosen from the common pool; each device requires one channel.

The 1200/II includes 4K 12-bit words of main memory and 12 I/O channels. Main memory can be expanded to 16K words. Up to four of the I/O channels can be used to interface communications lines operating at up to 50,000 bits per second. Peripheral devices can be chosen from the common pool; each device requires one channel.

The common pool of peripheral devices includes a keyboard/printer console, line printers, card readers, card punches, magnetic tape units, punched tape readers, punched tape punches, and plotters. Certain combinations of devices are required for particular applications. In general, the keyboard/printer console is required except for certain emulation modes such as the IBM 2780, IBM 3780, or HASP terminal without console. In emulating particular terminals, an equivalent complement of peripherals is required.

The 1280 includes 4K words, a 600-line-per-minute printer, a 400-card-per-minute reader, and an optional 200-card-per-minute punch. The 1281 also includes 4K words, but is equipped with a 300-cpm card reader, a 400-to-480-lpm printer, and a 75-to-200-cpm card punch. No main memory or peripheral expansions are permitted for either the 1280 or 1281. A communications interface is included for transmission of up to 4800 bits per second. Only one communications line can be interfaced, but a switch can be installed for alternate connection to two modems/lines for back-up.

COMMUNICATIONS: Three separate categories of communications interfaces are available, which differ in interface characteristics and possible transmission speeds. Each can operate in half-or full-duplex mode.

The first interface category is compatible with EIA Standard RS-232 and can operate at 2000, 2400, 3600, 4800, or 9600 bits per second.

Harris 1200/COPE Remote Batch Terminals

the passing of the COPE .32, .38, and .45 with their "high-caliber" performance. And all of you sons of Texas can bemoan the dropping of the carved reproduction of the doors of the Alamo that appeared on the cabinetry of the COPE .45.) COPE .30's through .41's are now being refurbished as COPE 1281's to emulate the IBM 2780 via emulation software as each is returned from the field. COPE .45's are available on an "as returned" basis only. The COPE 1280, similar in configuration to the 1281, employs the UNIVAC 1004 as a terminal controller and was the first of the fixed configuration to emulate the IBM 2780.

The primary innovation appearing in the 1200/COPE line is a proprietary minicomputer, the COPE 12, developed by CSI while it was still part of UCC. Previous COPE models had been built around the DEC PDP-8/L. The UCC-12 is logically an enhanced version of the PDP-8/L and includes the I/O logic added to the 8/L by UCC to support multiple high-speed peripherals.

The present COPE line shows a broader price and performance range than the older line. Models start at about $670 for a complete terminal and range up to over $3,500 per month for a terminal with fully expanded memory (16K 12-bit words), the fastest card reader and line printer, a card punch, and two 9-track magnetic tape drives. Additional peripherals such as more magnetic drives, punched tape reader/punches, and plotters can be attached to further increase the flexibility (and cost) of the terminal.

For all of its COPE terminals except the 1280 and 1281 (which are special fixed-configuration models), Harris CSI supplies software for emulating many of the popular remote batch terminals, including the IBM 2780, 3780, and System/360 Model 20, the UNIVAC DCT 2000, and the Control Data 200 User Terminal. Operation as a Multi-Leaving terminal under IBM's HASP software is supported. In addition, off-line utilities and an RPG (IBM-compatible) permit additional flexibility of operation. Harris CSI also supports the COPE line of terminals for operation with its COPE 4705 Controller acting as a front end for an IBM System/360, UNIVAC 1100 Series, or Control Data 6000 Series computer system; in the proprietary COPE mode of transmission, full-duplex transmission is standard.

The COPE line of terminals has been successful. Over 700 have been installed, and about half of these are members of the new 1200 line. A "typical" COPE terminal incorporates a 300-card-per-minute reader, a 300-line-per-minute printer, and a 4800-bps communications interface. It rents for about $1,075 per month. This is substantially more than competitive equipment marketed primarily as replacements for the IBM 2780. The COPE 1280 and 1281, hard-wired terminals, were introduced to satisfy this growing market as direct replacements for the IBM 2780. They rent for only $715 to $795 per month–significantly below the "typical" terminal above, but with better performance. However, with the 1280 and 1281, you don't get the programmability and flexible software that come with the other COPE terminals. You can emulate the 2780, and that's it.

The second interface category is compatible with Mil 188C and can operate at 10,000, 12,000, 14,000, or 19,000 bits per second over a coaxial cable.

The third interface category is compatible with the Bell System 300 Series modems for operation over Telpac facilities at 19,200, 40,800, or 50,000 bits per second.

When the COPE mode transmission is employed, the transmission code is six-bit BCD. When a terminal is emulated, the native code of that terminal is used.

The Modem "X" Switch option provides flexibility in configuring redundant or alternative connections to communications facilities. Three possible configurations can be made; one modem switched between two voice-grade communications interfaces; one voice-grade communications interface switched between two modems; and two voice grade communications interfaces switched between two modems. Configurational changes are made by manually operating the switch.

DEVICE CONTROL: All operations of each COPE Terminal are under control of the stored program. The 1200/I and 1200/II are supported for emulation mode, COPE mode, and off-line operations. The 1280 and 1281 are supported for emulation of the IBM 2780 terminal only.

Within the emulation mode, a variety of programs is available to emulate specific terminals, such as the IBM 2780 Terminal, the IBM 1130 and System/360 Model 20 or 25 computers used as terminals, the UNIVAC DCT 2000 Terminal, the UNIVAC 1004, 1005, 9200, and 9300 computers used as terminals, and the Control Data 200 User Terminal. In general, the COPE Terminal functions in the same manner as the original terminal, but there may be some procedural differences in the manipulation of the terminal. For example, a different layout and use of switches is normal. Also, a teletypewriter replaces the CRT for operator control procedures when emulating the Control Data 200. To the remote computer, however, there is no apparent difference between the COPE terminal and the terminal it is emulating. All emulation-mode programs are for half-duplex operations.

In the COPE mode, full-duplex communications are supported. CSI incorporates several significant features into the COPE mode software that runs on the terminals, including extensive compression and error-control procedures. This mode of communications is not directly compatible with the software offered by any computer mainframe vendor; it is intended for communication between a COPE Terminal and a COPE Controller. The Controller is a programmable unit intended for use as a "front end" for a central computer. Currently, the COPE Controller is built around a DEC PDP-8/I, but CSI plans soon to use the COPE 12 processor that is used in the 1200 terminal line. Software support for the Controller includes operational programs for controlling a communications network of up to 20 intermixed COPE and other terminals. Additional software support is provided for making changes in the operating system of the host computer; these are oriented toward removing the housekeeping and line control procedures from the host computer and installing them in the CSI Controller software.

In the off-line mode, various routines are provided for transcribing data from one medium to another; e.g., from cards to a printed listing. In addition, an RPG is provided that is fully compatible with IBM's RPG for card-oriented System/360 Model 20 systems; it also includes some of the extended features of RPG II for the IBM System/3. In general, CSI's RPG permits specifying record selection criteria for multiple input files, computation to be performed on each selected record, and the format of a resulting printed report. Since the great majority of Model 20 installations are programmed in RPG, this facility allows a COPE Terminal to functionally replace most card-oriented Model 20's used as remote batch terminals, including their off-line processing functions. Existing RPG programs would have to be regenerated, of course. CSI's

Harris 1200/COPE Remote Batch Terminals

The COPE 12 processor is object-code-compatible with the DEC PDP-8 family except for I/O. It would not take a great deal of work to convert the myriad of programs available for the PDP-8 for use with a COPE terminal.

The 1200/COPE terminals are marketed and serviced by Harris Communication Systems through its own nationwide service organization, composed of 165 customer engineers with service locations in 55 cities. Harris CSI quotes a 2-hour service response time for service calls within a 25-mile radius of a service point.

Currently there are some 700 COPE terminals in use. In general, COPE users appear to be quite satisfied with their terminals. In most cases, users report good performance and acceptable reliability. Downtime was reported as moderate and primarily of a mechanical nature, involving adjustments on the various peripheral devices. Service was reported as being generally good. □

RPG requires an 8K-word COPE Terminal. Not currently provided for the COPE Terminals, however, is a maintenance or sort capability for magnetic tape files.

ERROR CONTROL: When emulating a particular terminal, the same kinds of checks are made as in the original terminal; e.g., character and longitudinal parity or cyclic redundancy check characters, with retransmission on receipt of a negative acknowledgement.

In the COPE mode, use is made of the programmability of the terminal to perform more extensive error checking. For example, control portions of the message carry individual redundancy checks to provide added security against "misplacing" a message.

PERIPHERALS: The keyboard/printer is a Teletype Model 33 KSR unit in an attractively restyled enclosure. It operates at 10 characters per second.

A wide range of print speeds is provided by three line printer models, with peak printing speeds of 615, 1200, and 1700 lines per minute. These printers have a 64-character set and 132 print positions, and include vertical format control provisions. In addition, a high-speed serial printer that prints at 50 to 205 lines per minute is available.

Four card readers are available, which operate at speeds of 150, 300, 600, and 1200 cards per minute. Two card punches provide rated punching speeds of 20 and 200 cards per minute.

Either 7-track or 9-track industry-compatible magnetic tape drives can be connected. Both operate at 25 inches per second (125 ips rewind). Recording densities for the 7-track model are 200, 556, and 800 bits per inch, giving a maximum transfer rate of 20,000 characters per second. The 9-track models offer a density of either 800 or 1600 bits per inch, giving a peak transfer rate of 20,000 or 40,000 bytes per second, respectively.

Punched tape units are available that will function with 5, 7, or 8-level tape. The peak operating speed of the reader is 500 characters per second. The rated speed of the punch is 125 characters per second; a separate model is offered that can punch Mylar tape as well as paper tape.

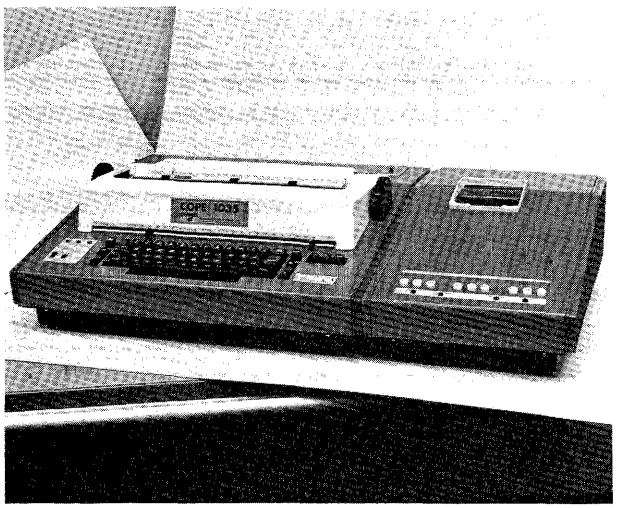
In addition, an interface is available for connecting incremental plotters to a COPE Terminal. The plotters are available from Broomall Industries, Inc. as a result of its April 1973 acquisition of the former UCC line of incremental plotters from Harris. The line includes models that can handle rolls of paper from 12 to 30 inches in width and range from 400 to 2000 steps per second in speed.

PRICING: The COPE Terminals are available on a one-, two-, or five-year lease or for purchase. The rentals below include maintenance; a separate maintenance contract is available for purchased equipment.

Terminal Model	Monthly Rental* 1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
1200/I (includes 4K words and 6 I/O channels)	$ 215	$ 205	$ 7,800	$ 20
1200/II (includes 4K words and 12 I/O channels)	380	365	14,400	20
Memory Expansion–				
4K-Word Module	110	105	3,600	20
8K-Word Module	190	185	6,000	40
1280 (includes 4K words, printer, card reader, and comm. interface	715	695	17,900	260
1281 (includes 4K words, printer, card reader, and comm. interface	795	715	22,200	240
Peripherals				
Keyboard/Printer	80	75	2,400	20
Line Printers–				
150 char/sec	185	180	4,200	80
300 lpm	430	420	12,400	120
800 lpm	850	835	25,600	210
1500 lpm	1,285	1,260	41,000	260
Card Readers–				
150 cpm	140	135	3,600	50
300 cpm	220	210	6,400	60
600 cpm	375	365	11,600	80
1200 cpm	500	480	16,000	100
Card Punches–				
200 cpm	295	290	7,800	100
20 cpm	250	240	8,000	50
75 to 200 cpm (for 1281)	150	135	6,000	100
Magnetic Tape–				
7-track (200, 556, 800 bpi)	260	255	8,400	50
9-track (800 bpi)	275	270	9,000	50
9-track (1600 bpi)	450	435	14,800	80
Punched Tape–				
Mylar Tape Reader; 500 cps	260	250	8,000	60
Paper Tape Punch; 125 cps	510	495	15,400	125
Mylar Tape Punch; 125 cps	630	620	20,000	130
Plotter Interface	135	125	4,200	25
Communications Interfaces				
Voice-Grade (RS-232)–				
Up to 4800 bps	130	125	4,200	25
Up to 9600 bps	140	135	4,600	25
Telpak (up to 50,000 bps)	200	195	6,600	35

*Includes maintenance. ■

Harris Cope Conversational Terminals



The COPE 1035 features a magnetic tape cartridge recorder that uses a unique cartridge containing co-axial tape reels. The 1035 is still in limited production, whereas the COPE 1030 and 1040 terminals are now available only on an as-returned basis.

MANAGEMENT SUMMARY

Originally produced by now-defunct Datel Corporation, which was acquired by University Computing Corporation in March 1969, the COPE Conversational Terminals became a product line of Harris Communication Systems, Inc. through a December 1972 acquisition from UCC.

Designed around the ubiquitous IBM Selectric Typewriter, the COPE Conversational Terminals are available in three models. Two models (the COPE 1030 and 1035) are transmission-compatible with the IBM 2741 Communication Terminal, while the third (the COPE 1040) exhibits transmission compatibility with the IBM 2740-1 but can also operate in the IBM 2741 mode. All models are bufferless; data is printed and transmitted as it is keyed and printed as it is received. The COPE terminals can also be used off-line as standard office typewriters.

The COPE 1035 (shown above) is basically a COPE 1030 with an added magnetic tape cartridge recorder. The recorder uses a special tape cartridge that can accommodate up to 90,000 recorded characters—more than adequate storage for a full day's work. The added cartridge recorder significantly enhances the unit's flexibility. Recorded data can be edited prior to transmitting, and then transmitted at 15 characters per second, thereby realizing savings in line costs as compared with the COPE 1030, which transmits at the speed of the typist.

Designed around the IBM Selectric Typewriter, these interactive terminals serve as compatible alternatives to IBM's 2741 and 2740 Model 1 Communication Terminals. The COPE terminals transmit and receive data at 15 characters per second.

CHARACTERISTICS

MANUFACTURER: Harris Communication Systems, Inc. (a subsidiary of Harris-Intertype Corporation), 11262 Indian Trail, P. O. Box 44076, Dallas, Texas 75234. Telephone (214) 241-0551.

MODELS: COPE 1030, 1035, and 1040. Each is a typewriter terminal that contains an IBM Selectric Typewriter mechanism, integral logic, and a modem interface (or, as an option, an integral or external modem). In addition, the COPE 1035 includes a stand-alone magnetic tape cassette recorder.

The COPE 1030 and 1035 are designed as replacements for the IBM 2741 Communication Terminal. The COPE 1040 is designed as a replacement for the IBM 2740 Model 1 Communication Terminal, but can also operate in the IBM 2741 mode.

COMMUNICATIONS: Asynchronous in the half-duplex mode at up to 15 char/second (134.5 bits/second). The terminals are unbuffered; therefore, transmission speed is dependent on the operator's typing speed. When transmitting or receiving via the 1035's cassette recorder, data transfer speed is also 15 char/second.

The user can specify either of two 6-level, 9-unit transmission codes: IBM Standard Selectric Typewriter code (Correspondence code) or IBM PTTC/EBCD, the expanded version of the IBM Paper Tape Transmission Code. The unit code structure includes six data bits, one parity bit, and single start and stop bits.

All models are equipped with an EIA Standard RS-232B interface. As an option, all are available with an integral modem with an acoustic or hard-wired communications line interface. The integral modems are compatible with Bell System 103 Series modems and feature originate-only or originate and answer modes. IBM Limited Distance and Leased Line Adapters are available as alternatives.

DEVICE CONTROL: The COPE Terminals can be used in an off-line mode as conventional Selectric Typewriters or in an on-line mode as data communications terminals. In the on-line mode, the terminals print and transmit data as it is keyed and print data as it is received.

The Model 1035 provides added on-line flexibility through its magnetic tape cartridge recorder. Recorded data can be transmitted directly and can be accompanied by a printed copy of the transmitted data. Received data can be recorded on tape and simultaneously printed. Printing is under operator control. The Model 1035's tape cartridge recorder can also be used off-line to produce printed copy or to record keyed data. Interrupt is provided as a standard feature and is used to interrupt a transmission from the remote computer by means of a 250-millisecond space signal.

Harris COPE Conversational Terminals

The COPE 1035 can also be used in the off-line mode to duplicate printed information such as form letters, tables, and fixed formats. An unsophisticated but usable form of tape searching can be implemented by recording stop codes to halt the tape between blocks; a particular block can be found by counting logged stop codes. Tape can be searched in either direction.

The COPE 1040, as an option, can be equipped to operate on a multipoint line in a polling/addressing environment.

All models provide an EIA Standard interface, and all can be equipped with an external or internal modem or telephone coupler that provides compatibility with the Bell System 103 and 113 Series Data Sets or the IBM Limited Distance or Leased Line Adapters.

Featuring upper and lower case alphabetic printing and the standard Selectric keyboard, these terminals are well suited for text handling. IBM supports data entry, text manipulation, and documentation processing under its Administrative Terminal System (ATS/360), which runs under OS/360. ATS/360 is designed to receive data from low-speed IBM 2741 remote terminals, and the COPE terminals can serve as direct replacements for the 2741 in this and other applications. Optional keyboards are available for APL and Call 360.

Initial customer deliveries of the COPE 1030 were made in August 1969, and deliveries of the COPE 1035 began in June 1970. Initial deliveries of the COPE 1040 were made in July 1971. Currently, about 4000 COPE Conversational Terminals are in use by about 800 users, most of whom use the terminals in time-sharing activities. The COPE terminals (still frequently referred to as Datel terminals) are supported by many of the leading time-sharing service companies.

The COPE 1030 and COPE 1040 terminals are no longer in production and are available only as returned. The COPE 1035 is still produced, but on a limited basis. □

The COPE 1040 is available with optional features that include the following:

- **Record Checking–transmits an LRC character at the end of each block.**
- **Auto EOB–transmits a Record Check/EOB sequence in response to a keyed carriage-return function.**
- **Transmit Control–initiates the transmit or receive mode via received control codes.**
- **Station Control–supports multipoint operation in a polling/addressing environment.**

SOFTWARE SUPPORT: The COPE 1030 and 1035 terminals operate under the following IBM software systems: APL (OS/DOS), CICS, ITF/Basic (OS/DOS), ITF/PL/1 (OS), Faster LC, and Learn/ATS (DOS/OS). The COPE 1040 operates under APL (OS/DOS), CICS/DOS-Entry, CICS/DOS-Standard, Financial Terminal System, and SHAS Compatible Teleprocessing.

ERROR CONTROL: Parity is generated and accompanies each character transmitted. Parity checking is performed on each character received. As an option, a special symbol can be substituted and printed in place of a character received in error. A read-after-write check is performed on data recorded on tape.

KEYBOARD: 55-key typewriter style. The keyboard can produce any of 88 upper and lower case alphabetics, numerics, and special characters through upper and lower case control codes. The Typamatic key option provides repeat action for backspace, hyphen/underscore, carriage-return, index, and space-bar keys. The Repeat key provides automatic repetition for all other keys. APL or 360/Basic keyboard arrangements are available as no-cost options.

PRINTER: Rated printing speed is 15 characters per second; print symbols total 88. A variety of interchangeable print elements is available for each code set.

The printer accommodates friction-fed or pin-fed fanfold forms up to 15.5 inches wide; the writing width is 13 inches. Horizontal spacing is 10 to 12 characters per inch; vertical spacing is 6 or 8 lines per inch.

An optional forms aligner is available for the friction-fed platen and can accommodate 6-part forms.

CARTRIDGE TAPE RECORDER: Records data on a unique cartridge (contains co-axial tape reels) that holds 300 feet of 0.15-inch magnetic tape recorded at 25 characters/inch (400 bpi); total cartridge capacity is rated at 90,000 characters. Read/write and rewind tape speeds are 0.6 and 24 inches/second, respectively. The maximum data transfer rate is 15 char/second.

PRICING: The COPE Conversational Terminals are available for purchase or on a one-, two-, or five-year lease that includes maintenance. A separate maintenance contract is avaiiabie for purchased units.

Terminal Model	Monthly Rental* 1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
1030	$ 96	$ 90	$2,580	$ 30
1035 **	175	160	4,945	45
1040	90	88	2,580	30
Options				
Modem:				
External ***	10	10	350	0
Integral ***	20	20	415	0
Pin-Feed Platen	–	–	85	0
156-Character Line	0	0	0	0
Carbon Ribbon Attachment	6.50	6.50	295	0
Portable Case	15	15	300	0

* Includes maintenance.
** Includes magnetic tape cartridge recorder.
*** Includes acoustic coupler. ■

Hazeltine Display Terminals

MANAGEMENT SUMMARY

Generally recognized as the leading manufacturer of Teletype-compatible display terminals, Hazeltine has spawned a family of four terminals from its original and highly popular Model 2000. Hazeltine introduced the 2000 in May 1970 and since October 1970 has shipped more than 18,000 units.

Family members range from the bare-bones Model 1000 to the microprocessor-based Model 3000. The other two members are the Model 1200, essentially a large-screen version of the 1000, and the Model 2000 itself. Models 2000 and 3000, now both microprocessor-based, are essentially the same unit, but Model 3000 is designed for a multi-station environment and features a polling/addressing capability. Also, Model 3000 can emulate virtually any specified communications discipline via microprogram control.

Hazeltine, like many other vendors, is reaping the benefits of modern technology by using a microprocessor in place of hard-wired logic to provide terminal control. Microprocessor control directly benefits the vendor by reducing production costs and by substantially increasing product flexibility and adaptability through microprogrammed functions, thus greatly extending product viability. The user, of course, also benefits from the use of microprocessors in terms of potentially lower equipment costs and delayed product obsolescence. But in most cases, the microprocessor is transparent to the user; i.e., the user cannot make any changes to the microprogram. Nor is user programmability provided. In some instances,

Hazeltine's family of display terminals now includes four members that range from a $49-per-month economy model to a $125-per-month microprocessor-based terminal with top-of-the-line features. Options include a dual cassette recorder and printers.

CHARACTERISTICS

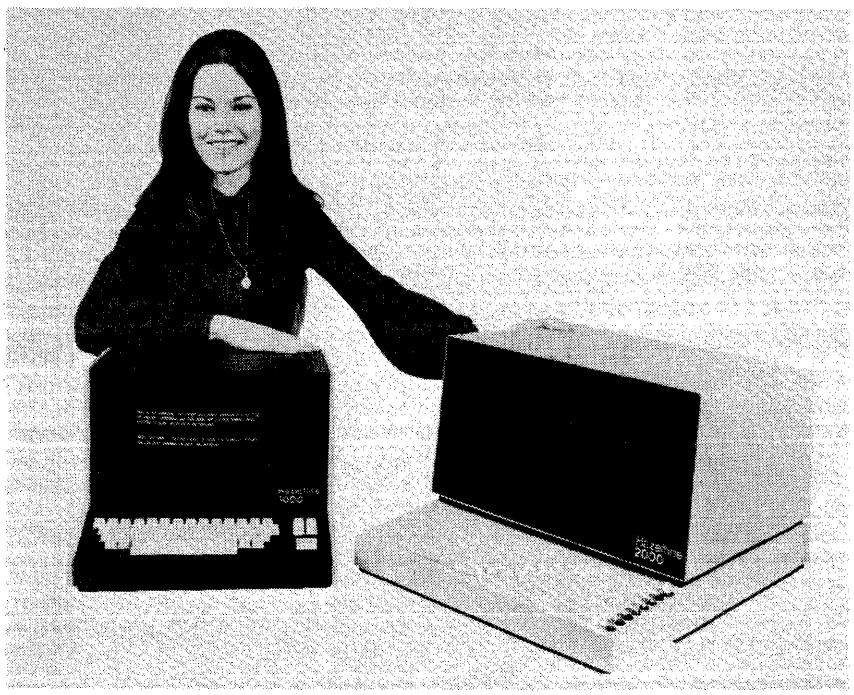
MANUFACTURER: Hazeltine Corporation, Computer Peripheral Equipment, Greenlawn, New York 11740. Telephone (516) 549-8800.

MODELS: Models 1000, 1200, 2000, and 3000.

COMMUNICATIONS: Transmission is asynchronous in the half- or full-duplex mode for Models 1000, 1200, and 2000. Model 3000 is available with either an asynchronous or a synchronous communications interface, and can also operate in the half- or full-duplex mode. Transmission rates are user-specified for all models and range from 110 to 9600 bits/second. Models 1000 and 1200 provide two switch-selectable transmission rates; any two can be specified. Models 2000 and 3000 provide five switch-selectable rates; any one of the following three groups of transmission rates can be specified:

- 110, 150, 300, 600, or 1200 bits/second.
- 110, 300, 1200, 2400, or 9600 bits/second.
- 110, 1200, 2400, 4800, or 9600 bits/second.

The transmission code is 8-level ASCII (including parity). A 10- or 11-bit character consisting of 7 data, 1 parity, 1 start, and 1 or 2 stop bits is transmitted for asynchronous transmission.



The Hazeltine 1000 (left) is an economy version of the more sophisticated and widely used Model 2000 (right). Both terminals are marketed as direct replacements for Teletype Model 33 and 35 units.

Hazeltine Display Terminals

however, as in the case of the Hazeltine 3000, the vendor permits the user to specify the communications protocol.

Because pricing is usually the most important single factor affecting user reaction in this highly cost-conscious segment of the display terminal market, it presents a valid starting point for analysis. On this basis alone, the Hazeltine terminals offer strong user appeal as a result of their strikingly low price tags, which are probably the lowest among the competing terminals in their respective classes.

Now let's examine and compare the salient features of the four Hazeltine terminals.

Models 1000 and 1200 are both basic terminals and do not provide edit or data entry functions. The only differences between the two are in display capacity and provision for hard-copy output. Model 1200 provides twice the display capacity of Model 1000, which can display up to 960 characters. Model 1200 can accommodate a non-impact printer, whereas Model 1000 is not equipped with a printer interface. However, a serial auxiliary interface (RS-232) is optional for both Model 1000 and 1200 to permit attaching a user-supplied printer.

In contrast to the bare-bones 1000 series terminals, the large-screen 2000 and 3000 terminals feature extensive editing capabilities, data entry functions, expanded cursor control (including an addressable cursor) and five switchable transmission speeds. These top-of-the-line features greatly extend the terminals' usefulness and provide significantly increased operating flexibility over the other models.

Data entry functions include protected format operation, tabulation, and partial screen transmission. The user can call for any of several formats that can be stored on a tape cassette or at the remote computer. When requested, the format is transmitted to the terminal and displayed. The format's field descriptors are protected from inadvertent typeover and are displayed at diminished intensity to contrast with the data keyed into the "blank" spaces. A tab function allows the operator to tab to the next format entry after she completes an entry. Clearing or transmitting the completed page clears or transmits only the entered data and not the format.

Cursor controls on Models 1000 and 1200 are somewhat limited as compared with those on Models 2000 and 3000, which feature a character-addressable cursor in addition to discrete controls for each of five cursor positions.

Keyboards also differ among the four models. Models 1000 and 1200 provide a typewriter-style keyboard, as do the Models 2000 and 3000; but the 1000 and 1200 do not provide the additional numeric keygroup or the separate cursor controls associated with Models 2000 and 3000.

All models provide an EIA Standard RS-232C modem interface, and all except Model 3000 are transmission-compatible with the Teletype Model 33 or 35 teletypewriters. Hazeltine can implement virtually any communications discipline (as specified) on the Model 300 via microprogramming. Bell System or equivalent modems can be used, such as the 103 series (300 bps), 202 series (1200 bps), 201 series (2400 bps), 208 series, (4800 bps), and 209A (7200 and 9600 bps).

CRT DISPLAY: The display characteristics of the four models are presented in the following table.

Hazeltine Terminal Model	Viewing Area Width, inches	Viewing Area Height, inches	Display Format Char/ Line	Display Format Lines/ Display	Screen Capacity, Chars.
1000	9.2	4.6	80	12	960
1200	9.2	4.6	80	24	1920
2000	8.5	5.75	74	27	1998
3000	8.5	5.75	74	27	1998

All models display a standard character set of 64 symbols including upper case alphabetics, numerics, and special symbols. As an option, all models are available with a 96-character set of displayable symbols that includes lower case alphabetics and six additional special symbols. Data is displayed in white on Models 1000 and 1200 and in green on Models 2000 and 3000. Characters are formed via a 5-by-7 dot matrix. Lower case characters are formed by a 5-by-8 dot matrix on Models 1200, 2000, and 3000. All models use the standard 525-line raster-scan display technique.

DEVICE CONTROL: Model 2000 operates in either character or block mode, while Model 3000 operates in the block mode only. Both models provide extensive editing capabilities and feature split-screen operation with format protection. Models 1000 and 1200 operate in the character mode only and do not provide editing or split-screen features.

In the character mode, transmission occurs on a character basis; data is transmitted as keyed and displayed as received. In the block mode, keyed or received data is displayed as in the character mode, but transmission occurs only on a block or message basis, where the entire contents of the display buffer or the variable fields within a fixed format are transmitted on operator command. The block mode must be selected in order to compose and edit messages and to operate with a fixed format.

Cursor control differs among the four models. In Models 1000 and 1200, cursor control is limited to four functions: Home, which positions the cursor to the initial character position on the screen; Space, which moves the cursor one step to the right; Carriage Return, which positions the cursor at the beginning of the current line; and Line Feed, which moves the cursor down one line. The controls are not repetitive, but the functions can be programmed and can be interspersed with data in a received message.

In Models 2000 and 3000, the cursor is character-addressable. Manual controls position the cursor in any of four directions: up, down, left, and right. Repetitive operation is provided for these functions, but screen wrap-around is inhibited. The Up and Down cursor controls move the cursor up and down one line until it stops on the first or last displayed line. The Left and Right cursor controls advance or backspace the cursor by one character position. The cursor can be returned to the first character position of the next line (Carriage Return) or to the first character position of the display (Home). The cursor can

Hazeltine Display Terminals

Models 1000 and 1200 are restricted to operation on a character-only basis; i.e., one character at a time is transmitted. Model 2000 can operate in either character or block mode, as selected by the operator, while Model 3000 operates in the block mode only. In the block mode, an entire message can be composed and edited prior to transmission. In a multipoint environment, this "off-line" data composition promotes increased line usage efficiency.

Transmission rates from 110 bps to 9600 bps can be specified. Models 1000 and 1200 can employ any two rates via switch selection, while Models 2000 and 3000 can employ any of five rates via switch selection. Speed selection increases the terminal's operating flexibility by providing transmission compatibility with more than one remote facility.

Hard-copy options for Models 2000 and 3000 include a 30-cps non-impact (thermal) printer produced by Texas Instruments and a 120-cps impact printer produced by General Electric (the TermiNet 1200), which Hazeltine plans to supersede with the new GE TermiNet 120, a 240-cps impact printer.

Auxiliary storage via a dual magnetic tape cassette unit is also available for Models 2000 and 3000 only. The option can be used to batch data or to store record formats for data entry applications. The cassette unit responds to either programmed or keyed commands and operates in either of two modes.

Service is provided by Hazeltine and Syntonic Technology, Inc. Syntonic, headquartered in Pennsauken, New Jersey, has service locations in principal U.S. cities. Hazeltine is quoting a maximum 24-hour response time to service calls, but it anticipates that most calls within a reasonable distance of a service point will be serviced within four hours.

Initial production delivery dates are as follows: Model 1000, June 1973; Model 1200, October 1974; Model 2000, October 1970; Model 3000, March 1974. Lead time on orders is currently quoted as 60 days after receipt of order.

USER REACTION

In Datapro's 1975 survey of alphanumeric display terminal users, 44 users reported on their experience with a total of 250 Hazeltine 1000 and 2000 display terminals. All but 13 of these terminals were Model 2000's. The 13 Hazeltine 1000's were installed in 7 user locations. Combined user ratings for the Hazeltine display terminals are presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	19	20	3	1	3.3
Ease of operation	19	19	3	1	3.3
Hardware reliability	16	19	5	2	3.2

also be moved to any character position by a received cursor address command.

Edit functions, provided only by Models 2000 and 3000, include both character and line insertion and deletion. Character insertion or deletion affects all data to the right of the cursor up to the end of a variable field (format operation) or the last displayable position of the screen.

Erasure functions include screen erasure (provided by all models), which clears all displayed data and returns the cursor to the Home position, and format erasure (Models 2000 and 3000 only), which erases only the variable fields within a fixed format. The erasure functions are programmable.

Models 2000 and 3000 feature split-screen operation, which permits the use of fixed formats for data entry applications that require the operator to key pertinent data into blank spaces within the displayed format. Formats received from the remote computer or read from tape are displayed at a diminished intensity to contrast with the data entered in the variable fields. Entry is restricted to variable fields; field descriptors are protected. The Tab function is used to position the cursor at the beginning of each variable field; as each entry is completed, the operator keys Tab to begin entry in the next variable field. Character insert and delete functions are applicable to variable fields only; line insert and delete functions do not apply to format operations. When clearing or transmitting the displayed data, only the variable data is cleared or transmitted.

Other features provided by all models include Roll and Break. The Roll feature automatically rolls all displayed lines up by one line when data is received after the last line has been completely filled; data rolled off the top of the screen is lost. Models 2000 and 3000 also feature selective roll-up, which permits the function to be initiated at any operator-designated line. The Break feature transmits a space sequence to request interruption of an incoming message.

Answerback, optional for Models 1000 and 1200 only, responds with a programmed 16-character sequence to a keyed command or received WRU. Rubout (Models 1000 and 1200 only) transmits a mark sequence.

The optional magnetic tape cassette unit (used with Models 2000 and 3000 only) contains two cassette recorders and operates in either of two modes. Paper Tape Emulation Mode records data character-by-character as it is keyed or received from the remote computer at data rates up to 1200 bits/second (up to 9600 bps with use of padding characters). Page Mode records a complete "page" of data as displayed on the CRT screen; this mode permits data to be keyed and edited prior to recording it from the terminal's 2048-character buffer. In the Page Mode, data is transferred between terminal and cassette at a fixed rate of 2400 bits/second. The cassette unit can be controlled locally via keyed commands or remotely via received control codes. Either recorder can be selected to read, write, rewind, or write an end-of-file mark. Extra functions, including a duplicate capability, are provided via the unit's manual controls.

The optional printer (impact or non-impact) operates in either of two modes. Conversational Mode prints all data exchanged between the terminal and remote computer at the selected transmission rate. Page Mode prints a complete "page" of data as displayed on the CRT screen. This operating mode, which can be initiated manually or by a received control code, permits data to be keyed and edited prior to printing from the terminal's buffer. The printing rate is determined by the selected transmission rate;

Hazeltine Display Terminals

	Excellent	Good	Fair	Poor	WA*
Maintenance service	9	16	9	6	2.7
Technical support	2	13	18	4	2.4

*Weighted Average on a scale of 4.0 for Excellent.

Most of the responding users were well pleased with the Hazeltine products themselves. Not surprisingly, low price was cited as their main attraction. Users mentioned editing and data entry functions, Teletype compatibility, the 10-key numeric pad, and batch capability as principal advantages of the Model 2000.

The users' negative remarks primarily reflected individual problems. Specific complaints included poor-quality keyboard (two users), poor keyboard touch, reflections from tube shield, sticking keys, and poor character clarity. Two of the users reported poor equipment reliability, but the overall ratings clearly show that most Hazeltine users are satisfied with the products' reliability. However, many of the users criticized the company's maintenance service and technical support, as can be witnessed from the ratings above. □

however, data cannot be transferred at a rate exceeding that of the printer (30 cps for the non-impact printer and 120 cps for the Model 1200 impact printer).

Options for the impact printers only include horizontal tab and vertical tab with form feed. Horizontal tab stops can be set at each print position either manually by the operator or under program control.

ERROR CONTROL: Character parity is generated for each keyed character and accompanies the transmitted characters. Parity checking is performed on received data. A character found to be in error is replaced in Models 1000 and 1200 by a special symbol, which is displayed on the screen in place of the incorrect character; Models 2000 and 3000 alert the operator via a lighted indicator.

KEYBOARD: All models have a typewriter-style keyboard; however, Models 2000 and 3000 also include a 12-key numeric keygroup (adding-machine key arrangement) and a separate group of function keys (including cursor control) located to the right of the main keygroup.

Models 2000 and 3000 can generate any of 128 ASCII characters, including upper and lower case alphabetics, numerics, punctuation, and control codes. Repetitive entry of data or initiation of control functions is performed by sustained key depression in conjunction with the keyed Repeat function. Models 1000 and 1200 can generate any of 97 ASCII characters, including upper case alphabetics, numerics, punctuation, and control codes. As an option, Models 1000 and 1200 can be equipped to generate 128 ASCII characters, including lower case alphabetics.

CASSETTE RECORDER (Models 2000 and 3000 only): Records data on a "Philips-type" cassette, which contains 300 feet of 0.15-inch magnetic tape recorded at 400 bits/inch. Total cartridge capacity is rated at 150,000 characters. The self-contained unit, which is cable-connected to the terminal, contains two cassette recorders that can be individually selected.

PRINTER: Two printer models are available, a non-impact (electrothermal) printer and an impact printer. Either printer can be used with the Model 2000 or 3000 display terminal, but only the non-impact printer can be used with Model 1200. Model 1000 cannot accommodate either printer, but a serial (RS-232) interface is available for a user-supplied printer.

The non-impact printer employs an electrothermal printing mechanism manufactured by Texas Instruments. Characters are formed within a 5-by-7 dot matrix and are printed in upper case format at rates up to 30 char/second. The printer has a friction-feed platen and accommodates a 300-foot roll of thermographic printing paper, stored within the unit. Line length is 80 characters (8 inches). Horizontal spacing is 10 char/inch; vertical spacing is 6 lines/inch.

The Model 1200 impact printer is rated at 120 char/second and is produced by General Electric as the TermiNet 1200. It has 120 print positions and prints any of 94 ASCII characters, including upper and lower case alphabetics, numerics, and specials. Horizontal and vertical spacing are 10 char/inch and 6 lines/inch, respectively. The standard tractor feed accommodates 7-part continuous forms from 3 to 12-27/32 inches wide and includes an external paper handler. Options include horizontal tab and vertical tab with form feed, implemented via a user-programmable disk.

Hazeltine plans to begin offering the new GE TermiNet 120 in place of the TermiNet 1200. The TermiNet 120 is rated at 240 char/second (120 lines/minute for upper and lower case; 180 lines/minute for upper case only) and prints up to 120 (or optionally 80) characters per line. Character set, spacing, acceptable paper widths, and paper handling mechanism are all identical with those of the TermiNet 1200. Vertical tabulation is optional.

PRICING: Hazeltine Models 1000 and 1200 are available for purchase or rental only. Models 2000 and 3000 are available for purchase, rental, or on a one-, two-, three-, four- or five-year full-payout lease. Rental includes prime-shift maintenance and is contracted on a yearly basis. A separate maintenance contract is available for leased or purchased units.

	Monthly Rental*	Purchase	Monthly Maint.
Model 1000	$ 49	$1,495	$20
Model 1200	65	1,590	20
Model 2000	98	2,995	25
Model 3000	125	3,900	30
Dual Cassette Unit	89	1,990	20
Thermal Printer	83	2,350	15
Model 1200 Printer	150	4,350	35
Horizontal Tab	8	200	0
Vertical Tab/FF	8	150	0
Program Punch	50**	50	0
Model 1000/1200 Options			
Lower-Case Alphabetics	100**	100	0
Answerback (16 chars.)	100**	100	0
Auxiliary RS-232 Interface	50**	50	0
Bell 202C Interface	100**	100	0
Parallel Printer Interface (1200 only)	50**	50	0
20/40/60 ma. dc Interface	100**	100	0
Model 2000/3000 Options			
Lower-Case Alphabetics	9	150	0
80-Character Line	12	135	0
Field Blink	100**	100	0
20/40/60 ma. dc Interface	100**	100	0

* Monthly rental (12 months minimum) includes maintenance for 8 hours/day, 5 days/week.

**One-time charge. ■

Honeywell Keynet and Keytape

MANAGEMENT SUMMARY

Honeywell's Keynet terminals and Keytape stations are individual, self-contained units designed for direct transcription of data from a keyboard to computer-compatible magnetic tape. Keynet terminals, in addition, are designed to transmit magnetic-tape data to another Keynet terminal or a remote computer at speeds up to 4800 bits per second. (A Keynet terminal, by the way, is any Keytape station equipped with a communications interface.) Both devices are logical substitutes for keypunches and verifiers in magnetic tape-oriented installations. Optional attachments include several I/O devices that add operating strength and flexibility to the basic units.

Honeywell delivered the first Keytape station in July 1968. Initial deliveries of models with auxiliary devices ranged from the first quarter of 1969 for the standard-speed communications interface to April 1970 for the high-speed communications interface.

Although Honeywell continues to market its Keytape stations for data preparation applications, it has redirected its major market thrust toward the data communications environment and is strongly emphasizing the communications capabilities of the Keynet terminals–primarily the 760 and 960 High-Speed Communicators. Probably the single most important advantage of the Keynet unit as a

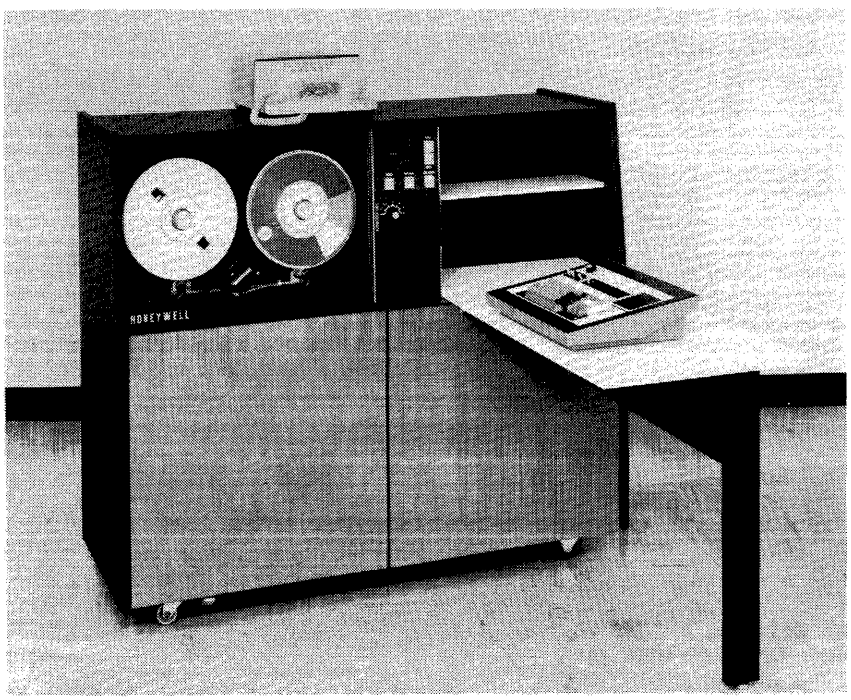
Honeywell's Keynet and Keytape units record keyed data on computer-compatible 7- or 9-track tape, feature data entry and verify functions in the same unit, and accommodate several auxiliary I/O devices. Now that user interest has swung toward multi-station data preparation systems, the major role of these free-standing units has shifted to data communications.

CHARACTERISTICS

MANUFACTURER: Honeywell Information Systems, Inc., 60 Walnut Street, Wellesley Hills, Massachusetts 02181. Telephone (617) 237-4100.

CONFIGURATION: The Keytape family of keyboard-to-magnetic-tape units includes nine members: five 7-track models and four 9-track models. The 7- and 9-track models each include a basic model (Models 700 and 900, respectively) that operates as a key-to-tape device only and cannot be expanded to accommodate device attachments. The expandable models include 7-track Models 701, 702, 702A, and 702B and 9-track Models 901, 901A, and 901B. Models 702, 702A, and 702B correspond to Models 901, 901A, and 901B, respectively, with respect to their features and options. The prime difference among the various expandable models is in the available options for expanding the buffer capacity and for varying record length. Salient differences among models are detailed in the following paragraphs.

The expandable models (all models except 700 and 900) can accommodate any two (with some exceptions) of the following devices:



The basic Model 701 expandable Keytape station is shown at left. This one includes a 710 Standard-Speed Communicator attachment, as evidenced by the Bell System data set on top of the cabinet. Keytape's distinctive L-shaped cabinet has proved to be popular with most operators.

REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

Honeywell Keynet and Keytape

data communications terminal is its large blocking capability of up to 400 characters per block. Honeywell reported approximately 1000 Keynet terminals in use worldwide as of January 1975 and says the number is still reasonably accurate as a result of about-equal returns and new orders.

USER REACTION

During the past year, Datapro has heard from 11 users of Honeywell Keytape units representing a total of 87 keystations. Of these, five users employed 7-track models, five used 9-track models, and one did not specify which tape format was used. A total of seven of the users typically used a record length of between 61 and 80 characters; two used shorter record lengths; one used a record length between 81 and 150; and one used a record length of over 150 characters. A summary of the users' ratings follows.

	Excellent	Good	Fair	Poor	WA*
Overall performance	1	8	2	0	2.9
Ease of operation	1	6	3	0	2.8
Hardware reliability	0	8	2	0	2.8
Promptness of maintenance	1	5	2	2	2.5
Quality of maintenance	0	6	4	0	2.6

*WA–Weighted Average on a scale of 4.0 for Excellent.

Five of these users reported no present plans to change to another key entry technique. The other six mentioned plans to move to on-line terminals (3 users), key/diskette (1 user), and key/disk (2 users).

A cross-check of the five most recent responses (April 1975) produced ratings that were in all cases equal to or higher than the overall ratings summarized above. □

7-Track Model	9-Track Model	Device Attachment
710	910	Standard-Speed Communicator(1)
711	911	Card Reader
712	912	Pooler
713	913	Adding Machine(2)
714	914	Check Digit
715	915	Line Printer(2)
716	916	Paper Tape Reader
717	917	Serial Printer(3)
760	960	High-Speed Communicator(1)
–	970	Pooler Converter(4)

(1) Mutually exclusive attachments; not available for 701.
(2) Cannot be specified with Serial Printer.
(3) Excludes the attachment of Adding Machine or Line Printer.
(4) Used in conjunction with a 7-track Keytape with 712 Pooler attachment; permits transcribing data between 7- and 9-track formats.

A Keytape station equipped with either of the Communicator attachments is known as a Keynet terminal.

TAPE OUTPUT: 7-track models are fully compatible with IBM's 729 Series tape units; 9-track models are fully compatible with IBM's 2400 Series tape units. Tape movement is reel-to-reel; a full 10.5-inch (2400-foot) reel can be recorded. Rewind speed is 24 inches/second in all models. A high-speed rewind of 72 inches/second is available for Models 702, 702A, 702B, 901, 901A, and 901B.

Standard recording density is 556 bits/inch (7-track) or 800 bits/inch (9-track). Optional recording densities include 200 or 800 bits/inch (7-track) and 200 or 556 bits/inch (9-track).

An 80-character buffer is standard on all models. Larger buffers are available in two styles. One is a dual-length buffer, which offers a choice between 80 characters and a longer length of 130 to 400 characters; it can be ordered in increments of 10 characters for the longer length. This style is available for all models except 700, 701, and 900. The second style offers variable length in one-character increments by means of an operator-settable switch, from 8 characters to 200 or 400 characters. This style is available for all models except the 702 and 901.

Various options, some free and others not, permit code compatibility with IBM, Burroughs, and GE even-parity and Honeywell, RCA, and UNIVAC odd-parity data codes.

STANDARD-SPEED COMMUNICATIONS: Permits transmission and reception of data asynchronously in a half-duplex mode at 1200 or 1800 bits/second, using a 10-unit code composed of 8-level ASCII (includes character parity) plus 1 start and 1 stop bit. Data sets must be equipped with a reverse-channel feature.

Messages are preceded by a start-of-text character and a device-control character indicating whether the block is odd or even. Following a message, an end-of-text character is transmitted, followed by a block-check character that contains longitudinal parity. Character and longitudinal parity are checked when received.

Normally, two programs are used at the transmit and receive terminals to control data format; the first program controls the data format of the first record of a block and the alternate program controls succeeding blocks. This arrangement allows constant information to be transmitted in the first record and duplicated in succeeding records to reduce the amount of data that must be transmitted. Blank fields can also be programmed for omission from retransmission. Format of the records at the receiving end can be altered, but fields cannot be interchanged.

Effective transmission rates vary from about 45 records per minute to about 175 records per minute, depending upon record length, density, and transmission speed. Records can be composed and then sent immediately. In models containing an additional input or output device, the device can be used in the composition of records prior to transmission or as output for received records. Printing simultaneously with reception or transmission is possible.

HIGH-SPEED COMMUNICATIONS: Provides synchronous transmission in a half-duplex mode, using ASCII 8-level code (includes character parity) at 2000, 2400, or 4800 bits/second. Operation of the high-speed interface is similar to the standard-speed interface except for error control and two new features–polling and double buffering.

Polling provides generation and recognition of terminal addresses. The Keynet station does not provide automatic calling. Once the communication link is established, the transmitting station initiates the transfer by sending a terminal address; the receiving station responds with a positive indication.

Honeywell Keynet and Keytape

Following the transmission of each message, the receiving station responds with a positive or negative acknowledgement depending upon whether any errors were detected within the received message. The transmitting station will automatically repeat a message up to three times before an error condition is signaled and operator intervention is required. Optionally, a switch is provided that allows substitution of a blank record for an error record to permit uninterrupted data transfer.

The optional double buffer allows blocking five data records into one message to reduce the amount of time spent in reversing the direction of transmission in the data set (turn-around time) and to reduce the number of synchronization and control characters required. Keynet models with the high-speed interface are normally equipped to operate with echo suppression on communications lines unless otherwise requested.

Transmission at 2000 bits/second over the public telephone network with the high-speed interface is only slightly faster than transmission at 1800 bits/second with the standard-speed interface. This apparent anomaly is caused by the additional turnaround time required with the different error-control technique. If the double buffer option is added, transmission over the switched network is increased by approximately 50 percent.

Transmission rates over private lines with or without echo suppression depend upon the tape density and the direction of transmission (i.e., from Keynet to Keynet, from Keynet to Honeywell Series 200 computer, or from computer to Keytape). Keynet-to-Keynet terminal throughput with no echo suppression ranges from 108 to 151 80-character records/minute when transmitting at 2000 bits/second, 123 to 178 80-character records/minute when transmitting at 2400 bits/second, and 185 to 248 80-character records/minute when transmitting at 4800 bits/second. These throughput rates are based on block sizes of 1 to 5 records at 2000 and 2400 bits/second and 1 or 2 records at 4800 bits/second. Throughput rates are somewhat lower with echo suppression.

DEVICE CONTROL: Programs are stored in an independent core buffer. Provision is made for storing two programs simultaneously, with manual switching. The two-program capability is standard for all models other than Models 700 and 900. One program, with an alternate program option, is available for the 700 and 900 models.

The program controls the format of the data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or right justification (left zero fill). The program also controls the operation of input/output devices and a check-digit function.

New programs are entered manually from the keyboard or automatically from an optional mark-sense card reader. The Automatic Program Loader feature, which uses mark-sense program cards, is available for Models 702, 702A, 702B, 901, 901A, and 901B. The program can be locked out, which permits the operator to completely control the format of recording.

Modes of operation include Data or Program Entry, Data or Program Verify, and Search. In the Data Entry mode, all data for a complete record is accumulated in a data buffer prior to writing on tape. In the Data Verify mode, a complete record is read from tape into the buffer memory and compared character for character with the data rekeyed by the operator from the source document. The Search mode allows the finding of a record with the same identifier as that keyed in by the operator; any portion of a record can be used as an identifier.

Display of current location within a record, data character stored in the buffer in the current location, program code stored at the current location, and status conditions is provided by a rear-lighted arrangement on the keyboard. Buffer address, data, and program code share the same display; the address is normally displayed, with the data and program codes selected by a spring-loaded switch. An engraved chart on the keyboard correlates the two- or three-digit displays and the graphics they represent. Status information displayed includes the type of error and the correction sequence.

ERROR CONTROL: Conventional read-after-write checking as tape records are written, plus several additional provisions.

Character parity is produced along with character generation for each data key depression and checked when the data is transferred to the buffer. Character parity is also checked when data is read from memory.

Following the writing of each record, the tape is backspaced, and the record is read and compared bit for bit with the data retained in the buffer. This feature applies equally in the Verify mode when a record is corrected.

In addition, short records of seven characters or less are automatically bypassed during Verify and Search operations.

KEYBOARD: 35-key keypunch style; the keyboard can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters including space. Up to 17 control keys provide for initiating functions such as tape movement, manual duplication and skipping, program selection, error correction, etc. Key modules can be interchanged, at the user's discretion, without changing the character bit configuration produced by the key. Repetitive entry of a character or initiation of a function corresponding to the keytop is performed by holding a key in the depressed position. A half-second delay prior to repetitive operations prevents inadvertent entry of a character.

CARD READER: Permits data to be transferred from punched cards to the magnetic tape. Data fields on the cards can be selectively interspersed (but not rearranged) with data entered from the keyboard. Options allow face-up or face-down reading.

Keytape models including a card reader can also be used to perform off-line card-to-tape transcription; records can be modified under control of the stored programs. Card code is automatically translated to either IBM or Honeywell tape code.

Along with the larger buffer sizes, an option permits multiple-card records. Another option allows the operator to switch between reading 80- and 51-column cards.

POOLING: Allows short tapes to be consolidated onto one longer tape; up to three pooler models can be interconnected.

In a three-station pooling system, the operator can be reloading one station while the second is transferring data.

A moderate amount of editing can be performed via the main and alternate stored program through the automatic skip and duplicate functions. The 970 Pooler attachment allows pooling between 7- and 9-track tapes, with appropriate conversions between the BCD and EBCDIC tape codes.

Honeywell Keynet and Keytape

Effective pooling rates can vary from about 300 to 400 records/minute, depending upon recording density and record length.

ADDING MACHINE: Allows data fields entered from the keyboard or read from tape to be entered into the adding machine accumulator for listing and totalization. The totalizing function can be suppressed and only a listing obtained. Keying errors in data fields can also be corrected by backspacing in a normal manner, because the adding machine is not activated until the operator presses the left zero key following entry of a data field.

CHECK DIGIT: Allows validation and, in one case, generation of check digits for numeric fields. Check digit models are equipped to handle either modulo 7, modulo 10 (odd or even parity check), or modulo 11 (complemented or uncomplemented remainder) check digit validation; the modulo 10 model includes check digit generation. The check digit function is identical with that performed by the IBM keypunches.

LINE PRINTER: Permits off-line tape-to-print transcription on a 300 line-per-minute drum printer, with optional keyboard insertion of additional data. Vertical spacing is manually selected at 6 or 8 lines per inch; the character set includes 63 characters plus horizontal space. Up to five carbon copies can be produced.

Data can either be printed in the same format as on tape or, in a special format control mode, form advance and spacing control characters included in the record can be used to position data fields.

The typeface is similar to the familiar one used on the IBM 407. Zero suppression is available at extra cost if the left zero option is included; 132 print positions are standard.

PAPER TAPE: Allows data read from strips of punched tape to be transferred directly to magnetic tape. For codes containing more than 6 data bits, a special feature is available for transferring one paper tape frame to two magnetic tape frames on the 7-track Keytape. Reels of paper tape can be handled with an optional feature.

The reader can also recognize control codes contained in the data stream. As with other auxiliary devices, automatic skip and duplicate codes in either program allow for a moderate edit.

SERIAL PRINTER: An IBM 735 I/O Typewriter arranged to allow transcription of data from magnetic tape. The tape can be recorded in either Honeywell or IBM tape code. Unlike other Keytape auxiliary devices, data cannot be alternately selected from the magnetic tape and Keytape keyboard; this device allows only a transcription operation.

The unit can be used off-line as a conventional electric typewriter, except for the location of special and punctuation symbols and the fact that lower-case letters are not included.

PRICING: The Keytape and Keynet stations are available on a 1-year, 3-year, or 5-year lease. The lease price allows unlimited usage and includes maintenance. The units can also be purchased and a separate maintenance contract arranged.

Prices of the basic Keytape models are as follows:

Keytape Model	Monthly Rental*	Purchase	Monthly Maintenance
700	$152	$2,500	$23
701	160	3,250	30
702/A/B	169	8,400	30
900	177	3,000	27
901/A/B	182	8,550	34

* For one-year lease; includes maintenance.

Discounts for long-term leases range between 4 and 8 percent for two-year leases, between 10 and 19 percent for three-year leases, and between 20 and 28 percent for five-year leases; all discounts are from the one-year prices above.

The charges for auxiliary devices are as follows:

Device	Monthly Rental*	Purchase	Monthly Maint.
710/910 Standard-Speed Communicator	$85	$2,600	$12
711/911 Card Reader	164	4,910	25
712/912 Pooler**	41	1,220	12
713/913 Adding Machine**	63	2,210	8
714/914 Check Digit	21	1,050	5
715/915 Line Printer	505	22,760	79
716/916 Paper Tape Reader**	117	3,770	9
717/917 Serial Printer**	177	5,710	11
760/960 High-Speed Communicator	140	4,900	17
970 Pooler	80	2,400	13

* For one-year lease; includes maintenance.

**On an "as available" basis.

Discounts for long-term leases for attachments, excluding the 712/912 Pooler, are about 15 percent for two-year leases, between 17 and 19 percent for three-year leases, and about 20 percent for five-year leases. Discounts for the Pooler are 15, 20, and 46 percent, respectively.

Alternate Program and Record Counter features are standard on all models except the 700 and 900; each of these features rents for $6 per month (one-year) and sells for $100 per month. Dual-Length Buffer options rent for $20 per month ($1,000 purchase) for sizes up to 200 characters and $30 per month ($1,500 purchase) for larger sizes. The 200-character variable-length buffer rents for $30 per month ($750 purchase), and the 400-character model rents for $40 per month ($1,000 purchase).

All of the maintenance charges listed above are for locations within 50 miles of a Honeywell service center. Charges for more remote locations are about 50 percent higher. ■

Honeywell Model 5500 Keyplex System

MANAGEMENT SUMMARY

The Honeywell Keyplex system shares with the UNIVAC 1900 CADE key/disk system the distinction of being marketed directly by a major computer manufacturer. But the Honeywell system has maintained a surprisingly low profile since its introduction in March 1970. With about 250 systems installed for about 90 customers, the Keyplex system has achieved a measure of success. Marketing continues, but development of new features and capabilities seems to have halted.

The Keyplex system is built around a Honeywell 316 minicomputer system. The 316 is no longer part of Honeywell's active line; it was phased out in favor of the 716, which is faster and has an enhanced instruction repertoire and architecture.

Although the configuration rules permit the attachment of up to 64 keystations, 32 represents a practical limit before performance degradation occurs. (Degraded performance is observed primarily by system delays in accepting data keyed by the operators, causing them to lose keying rhythm.) The capability for 64 keystations is present expressly for system backup in case of processor malfunction. In such a case, the keystations from one system can be switched to another system. Obviously, if two 32-keystation configurations are installed, performance will suffer when operating in the backup mode, but at least all the operators can continue work. Performance will not drop off to 50 percent, which would invalidate the combined system as a practical solution. To allow for maximum performance in case of a processor

This shared-processor key/disk system is suitable for high-volume data entry applications that do not need extensive post-entry data processing. It can handle up to 32 non-CRT key entry stations, or up to 64 in backup mode at a reduced performance level.

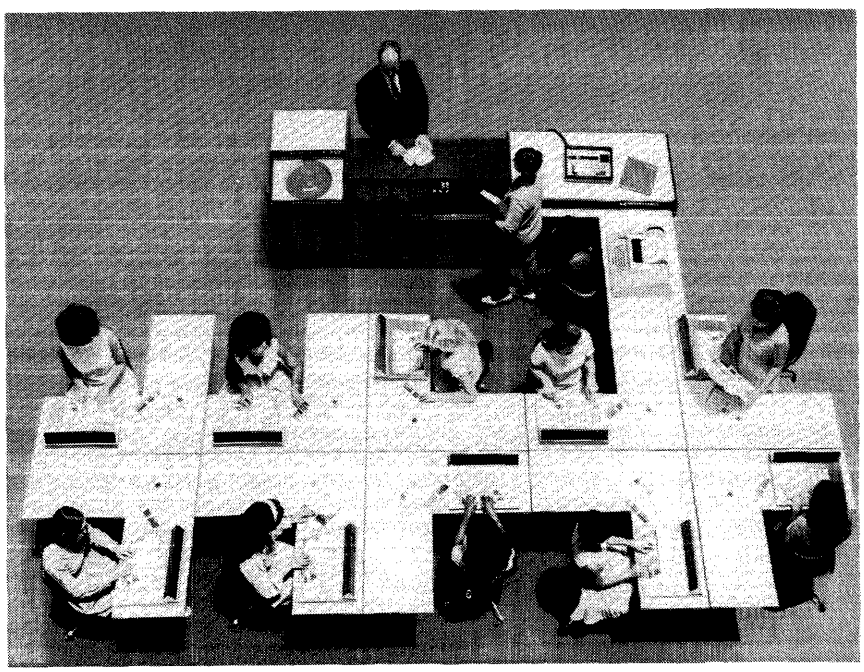
CHARACTERISTICS

MANUFACTURER: Honeywell Information Systems, Inc., 60 Walnut Street, Wellesley Hills, Massachusetts 02181. Telephone (617) 237-4100.

CONFIGURATION

A Honeywell Keyplex system consists of up to 64 non-CRT data entry stations and a shared minicomputer-based central processor. The processor includes a Teletype Model 33 ASR supervisor station, a 7.5- or 15-million-byte disk pack drive, and one or two magnetic tape drives (of mixed formats if desired). Tape formats supported include 7-track, 556 and 800 bpi, odd or even parity, and 9-track, 800 and 1600 bpi. Packing four 6-bit characters into three 9-track tape frames (24 data bits) is supported for both Honeywell Series 400/600 and Series 200 data format styles. A 300-lpm line printer can be added.

Honeywell 702B and/or 902B Keytape units can be substituted for the second system tape drive. Auxiliary devices, such as a data communications interface, card reader, line printer, punched tape reader, etc., are supported off-line through the attached Keytape unit. Data transfers between the Keytape magnetic tape drive and a Keyplex magnetic tape drive or disk drive are supported.



Here's an overhead view of a typical 10-station Keyplex system. Note the supervisory station (a Teletype Model 33 ASR unit) and the disk and tape drives (top).

REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

Honeywell Model 5500 Keyplex System

failure, configurations should be limited to 16 keystations per system.

Relative costs are $138 per month per keystation in an arrangement of 32 and $173 per month per keystation in an arrangement of 16; these prices are based on systems with a 9-track, 1600-bpi tape drive, minimum processor memory and disk unit for the 16-keystation configuration, and maximum processor memory and disk storage for the 32-keystation configuration. However, larger configurations will, in general, be more cost-effective than an equivalent number of smaller ones, given any reasonable processor reliability factor, even accepting the degradation in performance with configurations larger than 32 keystations.

The Keyplex keystations display only one data character at a time, in contrast to the currently popular record-display CRT keystations. As such, the Keyplex system is almost an anachronism. Full field or record display is not needed for high-volume data entry; in fact, it can interfere with efficiency if the operator looks at the display instead of keeping her eyes glued on the source documents. However, for search operations used for information retrieval or to make changes or corrections in an existing data batch, the full field/record display is obviously helpful. In addition, a full display permits convenient operator training and the capability to make use of untrained operators (at considerably reduced output rates) in a fill-in-the-blanks approach to data entry. Logical reasons aside, most users have decreed that a key/disk system should have full display keystations. Intangible benefits, such as glamour and operator satisfaction, coupled with the low cost of today's CRT units, permit manufacturers to satisfy the desires of the users with little cost penalty.

Input data checking and data validation capabilities are extensive in the Keyplex system, and are implemented in a manner not common among key/disk systems. Comparisons with tables are used to provide range checking and value checking. The comparisons can be used to check a data field or to switch to another record format. Up to three table-oriented checks can be combined to provide logical AND relationships for a single field. Complete check digit control is optional. Data-type checking includes an unusual capability for specifying exactly what character set is allowable for each field.

The Honeywell Keyplex system does not directly provide for data communications or for entry of data from media other than the keyboards. Data communications capabilities are implemented in installations requiring it through the use of a Honeywell Keynet unit, a Keytape unit with a data communications interface (Report 70D-480-01). In a like manner, auxiliary input from punched cards, punched tape, or an adding machine can be accommodated by means of an associated Keytape unit. Communication between the Keytape and Keyplex system can be effected by physically transferring tape reels, or the Keytape unit can be attached to the Keyplex system and can function as a tape drive. Direct key entry from the Keytape unit to the Keyplex disk is not supported.

If it bothers you to have your Keyplex system standing idle for any portion of the day, you can, for a nominal charge, equip it to function as a free-standing small

COMPONENTS

KEYSTATIONS: Consist of a work table with a keyboard similar to that of the Honeywell Keytape units and a display panel immediately behind the keyboard.

Display indicators provide a single-character display of the last character keyed (entry mode) or the character in the current record location (verify mode), and a three-digit display of the current record position. Back-lighted indicators identify certain program code information, operating mode, active program level, error check types, and information displayed in the position indicator, which can be used to display the current record number, job number, batch number, batch type number, or error type code by entering the control mode and depressing a two-character sequence.

Without options, a keystation can be located up to 200 feet from the control processor. With the Remote Cluster feature, a group of two to eight keystations can be located up to 1000 feet from the processor. The End-of-Record alarm feature provides an audible signal when a record is released. The Manual System Control Switch allows all keystations to be transferred to a second, similarly equipped Keyplex system in case of processor failure. The disk on the failed system is not accessible by the operating system, but may retain data usable when the system is restarted.

DISK STORAGE: Consists of a single disk pack drive with a storage capacity of 7.5 or 15 million bytes. The smaller unit uses a 10-surface disk pack, while the larger unit uses a 20-surface disk pack. Average head positioning time is 75 milliseconds, and average rotational delay is 12.5 milliseconds. Data transfer rate is 156K bytes per second.

MAGNETIC TAPE: All models accommodate 10.5-inch reels (2400 feet). One tape drive is included in the basic Central Control Unit; a second can be added. Available formats include 7-track, 556 bpi; 7-track, 800 bpi; 7-track, 556/800 bpi; 9-track, 800 bpi; and 9-track, 1600 bpi. Tape drives can be converted from one format to another in the field at no charge.

KEYTAPE: One Honeywell 702B and/or one902B Keytape unit can be attached to a Keyplex system in place of the second system tape drive. Attachment does not require an extra-cost option. Direct data entry from a Keytape device to the Keyplex system is not supported. However, when attached, the Keytape tape drive functions as a system tape drive for data transfer between a Keyplex disk or system tape and the Keytape unit. The Keytape unit can be used off-line for data recording, with all auxiliary features operative. See Report 70D-480-01, immediately preceding this report, for a complete discussion of the Honeywell Keytape units.

LINE PRINTER: The printer operates at a nominal speed of 300 lines per minute and prints up to 132 positions per line. A vertical format control unit with an effective 9-channel capacity, including top-of-form, is provided.

PROCESSOR: The Central Control Unit is a 16-bit Honeywell 316 minicomputer. The basic memory size is 40K bytes of 1.6-microsecond core storage. The memory can be expanded to 65K bytes with the optional Performance Enhancement Package. Memory expansion is required for certain combinations of large keystation configurations, simultaneous use of multiple complex formats, simultaneous use of multiple user-defined tables, and use of batch balance or check digit features, all of which use extra memory space.

COMMUNICATIONS

All data communications capabilities are provided off-line through attached or free-standing Keynet units; see Report 70D-480-01.

SYSTEM OPERATION

OVERVIEW: The basic unit of data grouping is a batch, or the collection of records keyed by one operator under a

Honeywell Model 5500 Keyplex System

computer system. All you need add is the Model 316 Software Support Package, which lists for $50 per month or $2,000 purchase. In practice, you will probably want to add some peripheral equipment. Up to four tape drives, four disk drives, medium- and high-speed line printers, punched card units, punched tape units, and single/multi-line communications controllers are supported. The key entry stations are not supported by the 316 software package, nor would they be particularly useful because they display only one character at a time. The 316 software and the Keyplex software are mutually exclusive; i.e., you can run either, but not both at the same time. Included in the software support for the 316 in free-standing mode are a macro-assembler, a FORTRAN compiler, and a BASIC compiler.

USER REACTION

During the past year, Datapro has heard from a total of 10 users with 16 Keyplex systems installed, representing a total of 260 keying stations. The average system size was 16 keystations, but two users had configurations with 25 and 26 keystations per system. The smallest system included five keystations.

Of the 10 users, 4 typically employed record lengths of over 80 characters, 5 between 60 and 80 characters, and 1 under 40 characters.

A summary of the ratings assigned by these users is presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	5	3	2	0	3.3
Ease of operation	6	3	1	0	3.5
Hardware reliability	3	5	1	1	3.0
Promptness of maintenance	2	5	2	1	2.8
Quality of maintenance	3	3	3	1	2.8
Software and technical support	2	3	5	0	2.7

*Weighted Average on a scale of 4.0 for Excellent.

We received information from three of the users represented above in May 1975 and also one year earlier. (Their latest ratings, but not their original ratings, are included in the above summary.) Two of the users rated the system essentially the same as a year ago and had upped their installed equipment from a total of 73 to 85 keystations. The third user, however, has experienced severe hardware reliability problems which Honeywell has not resolved entirely to his liking.

The Honeywell Keyplex system shows its age by the lack of a full record display and by the lack of a processing-oriented output editing facility. Nevertheless, it has held up well. The data validation and data-type checking capabilities, although unusual in their format, are quite powerful. □

single system control definition. Each batch is also associated with a job. The supervisor can manipulate data on disk by job (all batches), by batch, by range of batches within a job and by combinations of these. Job and batch numbers are three-digit values.

The central facility for controlling data entry and verification is the Batch-type descriptor format. This format lists up to 10 Input Control formats with associated Output Editing Control formats and File-type Control formats.

Each of these four types of control formats (Batch-type, Input, Output Editing, and File-type) are maintained in separate libraries. Each carries a three-digit name, permitting up to 1000 of each to be resident.

The Batch-type descriptor format is entered by the keystation operator for entry operations and identifies to the system the control formats to be loaded into computer memory during data entry/verification and output processing operations. For other than first-time data entry operators, the system associates a Batch-type descriptor format with the Job/Batch number, and appropriate format loads are automatically called. A fifth library is maintained for tables, which are used to specify conditional format switching based on range checks or specific sets of data values and to specify data validation checks for ranges or specific values. In addition, special tables can be constructed for input/output code conversion, to specify a set of characters that will be ignored when entered, and to specify a restricted character set for data entry. Each table is referenced by a three-digit number (1000 maximum) and is accessed in the Input, Output Editing, or File-type formats as needed.

The File-type control format specifies the input/output devices, code conversion tables, block size, and label processing. Table processing is executed under control of separate output editing formats. Beginning and ending label processing is provided for volume, file, and intermediate file (multi-reel file).

Subtotaling, totaling, and/or batch balancing are implemented in a separate pass of the data batch. On-line (background) or off-line (dedicated processor use) transfer of data from disk to tape are alternatives.

Specific programming capabilities provided under Input and Output Editing Control formats are discussed under the Software heading.

OPERATOR FUNCTIONS: The operator is entirely concerned with the entry, verification, and correction of data. Modes of operation include Data Entry, Data Verification, and Data Change. Data Verification can be performed on an open active batch by a different operator, but the system enforces a minimum lag of 40 records. In the Verification mode, character replacement is performed after the second keying of a character different from the originally keyed character. Fields not meeting format validation checks can be bypassed; an error flag is set. In the Data Change mode, fields are selectively accessed for modification. Format specifications are observed for the selected field, but the whole record need not be handled. The Data Change mode is intended for making corrections in fields that have validation errors which could not be resolved by the original data entry operator.

Two additional operational modes provide additional capabilities. The Special mode enables forward and backward spacing through a data batch. The Control mode enables record insertion/deletion, multifunction display using the position indicator, and data searching, in addition to batch opening and suspending.

Several search modes are implemented. In any of the three basic modes, a search can be made based on data content (matching), record number, next occurrence of a specified program level number, and next field containing a validity error flag. The matching search compares an argument of up to 30 characters field by field with existing data. The search can be speeded up by restricting it to a specific field number within a record and/or a specific program level number. In the Entry or Change Data modes, a search can be made for the end of a batch to simplify adding records at the end of a batch. In the Entry mode only, a special content search is implemented for card image batches; in this method, an eight-character field is compared with the contents of each record.

When closing a batch of data upon completion of data entry, the operator can initiate the totals pass; alternatively, this pass can be initiated by the supervisor.

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SUPERVISOR FUNCTIONS: The supervisor exercises system control through procedures for system power up/down, initialize/close, save/restore libraries and data, attach/detach keystations, translation of control formats and tables, and activation of operator statistics collection for individual operators. To determine conditions, the supervisor can list job/batch status, keystation status, disk status, operator analysis statistics, and all types of control format tables.

Save/restore refers to writing system libraries and data batches to tape for system recovery in case of failure or shutdown. Two procedures are provided. The on-line procedure runs in the background simultaneously with key entry and verification. The off-line procedure runs much faster but requires a dedicated system; i.e., nothing else can be operative while the dump or load is in progress. The tape formats used for the two procedures are not compatible.

Data flow control is exercised through procedures for: 1) establishing job numbers, with or without batch-type specification; 2) modifying job status to change permitted operations; 3) initiating subtotal/total/batch balance passes; 4) outputting data from disk to tape, on- or off-line; and 5) deleting data batches, operator statistics sets, and control formats/tables. Off-line data transfer is much faster, but it eliminates any other activities. File format specifications can be changed from those indicated in the Batch-type descriptor format during an off-line data dump. Output Editing Control formats, including label processing and data transcription from one tape format to another, are executed during output to tape. If a Keytape unit is used for tape input or output, the supervisor may have to set the switches on the Keytape for operating mode and record length.

Supervisor commands to the system are entered at the Teletype Model 33 ASR console and usually take the form of a one-, two-, or three-letter mnemonic followed by a parameter list. In general, data flow can be handled by specific batch within a job, all batches within a job, range of batches within a job, or combinations of these in one command.

OPERATING MODES

- Data Entry–Data is keyed into the system under the control of an Input Control Format that defines fields and any checking or data validation to be performed. Up to 10 different record types (Input Control formats) can be linked together as specified in a Batch-type Descriptor format. Keying errors are corrected immediately or flagged for later correction. Data is accumulated on disk in batches and logically grouped in jobs. Data rearrangement can be performed during output to tape.
- Data Verification–Data is verified by selectively rekeying fields identified on the Input Control Format. Simultaneous key entry and verification of the same batch is possible, but the system enforces a minimum lag of 40 records between entry and verification. Another mode, Data Change, is similar to the Verify mode, but format control is exercised only on selected fields.
- Search–The operator can search a batch based on a 30-character argument, for a particular record number, for the end of a batch, or for the next field containing a validity error flag.
- Background–Data transfer to tape, save/restore (libraries and data), and tape-to-tape transcription can all proceed simultaneously with data entry and verification.
- Off-line–Data transfer to tape and save/restore operations can be performed on a dedicated system faster than background data transfers, but the tape format for save/restore is different from that for the on-line background operation.

SYSTEM PROFILE

- Keystations–1 to 64 non-CRT keystations.
- Record length–Up to block size limit.
- Formats–Up to 1000 each of the Input, Output, and File-type formats can be maintained in individual libraries. Up to 10 Input formats and associated Output and File-type formats can be linked together in a Batch-type format. Up to 1000 Batch-type formats can be maintained.
- Output block length–Up to 400 characters if a Keytape unit is used; up to 3600 characters if a system tape is used.
- Data storage–Typical system code and format/table storage requirements are about 3.75 million characters of disk storage. The remaining 3.75 million characters of data storage on the basic disk unit is sufficient to hold a day's output from up to about 30 to 40 keystations. Extensive format and table usage may decrease the capability, as will holding data batches on disk for more than one day. A 15-million-byte disk unit is available for large and/or complex systems.

SOFTWARE

The key entry operations of a Keyplex system are entirely controlled by the operating software as directed by the supervisor and keystation operators. Capabilities for data validation are primarily contained in the Input Control Format. The Output Editing Control Format provides capabilities for rearranging (reformatting) data for output and extensive provisions for generating tape label records. A separate off-line utility program (KOLOP) is available for system save/restore dumps and loads; in addition, KOLOP provides a higher-speed off-line data-only dump capability.

INPUT FORMATS: The specifications for an Input Control Format are primarily grouped into two categories: table-oriented validation by field and data type checking by subfield. Mandatory or conditional format switching can be specified, and fields can be totaled selectively in up to seven 12-digit registers. Batch totaling and check digit operations require extra-cost options.

Each field can have up to three tables associated with it, linked together in effect by logical AND's. The type of operation is defined explicitly for each table when entered into the system library. Table types include check digit generation/checking; conditional program level changes based on range checks or comparisons with a set of values; and data checks based on range comparisons or comparisons with a set of values. The conditional program level changes are operative at the end of the record, if the conditions are met.

Extensive control over the method of calculating the check digit is permitted. The modulus can be 7, 10, or 11. The check digit can be calculated as a quotient, as the sum of weighted products, or as the sum of the digits of weighted products. (Weighted calculations can be used only for modulo 10 or 11.) The resulting check digit can be placed anywhere in the field. For modulo 10 and 11, special characters can be assigned for a check digit result of "10" or "11," or two digits can be used.

Range check tables (for conditional program level changes or data validation) consist of one or more pairs of values of up to eight digits each. The value check tables consist of one or more entries of up to 10 alphanumeric characters.

Each field can be subdivided into as many subfields as desired; the only limitation is that the maximum size of the subfield cannot exceed 127 characters. For each subfield, the programmer identifies upper/lower case shift, mandatory or conditional (based on the setting of a keyboard switch) duplication/skipping, allowable character set, minimum number of characters acceptable, must-enter requirement, and field-end character for variable-length fields. The allowable character set is identified by individually specifying whether blanks, numerics, alphabetics, and special characters (the remainder of the basic 64-character set) are allowed in each subfield. In addition, special tables can be used to specify particular characters to ignore or to allow. With these facilities, the allowable

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characters can be compltely controlled on a subfield basis. If the specifications conflict, the blank/numeric/alpha/special definitions take precedence over the ignore (IG) set, which in turn takes precedence over the allowable (VA) set. By skipping entries in the first specification set, the VA set can be used to control special combinations (e.g., the letters "A, Q, T, Z" only). This arrangement, while unusual, allows convenient checking of structured data items, such as a 9-character part number that always begins with two alphabetic characters and has a third alphabetic character in the seventh position, with numeric digits in all the other positions.

Totaling is specified simply by indicating an accumulator number by the appropriate field on the coding sheet. Four types of totaling can be accomplished: batch totals, batch subtotals, crossfooting, and batch balancing.

In batch totaling, a special record format is reserved, which uses one of the 10 available format levels. It is the last record of the batch. Accumulated totals are recorded in reserved fields. Verification of these totals cannot be performed, but new totals will be generated during a totals pass after a verification pass if any fields have been changed. An error message is typed out at the supervisor's console if invalid characters (i.e., non-digits) occur in fields specified for totaling. The totals record can be carried with the data batch for output if desired.

Subtotaling requires two accumulators for each field specified, for accumulating the subtotal and a grand total. A second record format is reserved for the subtotals. The subtotals record will occur following the indication in the Input Format that a break has occured. The subtotal records carry the subtotal values; the final total record carries the grand total values.

Batch balancing is similar to batch totaling, except that the key entry operator enters a value in the appropriate fields of the totals record. During the totals pass, the entered values are decremented, and a zero result test is performed. The supervisor is informed if a zero result is not achieved. Correction of batches not in balance can be performed in the Verification mode, with the operator working only with those fields contributing to an out-of-balance accumulator. In-balance fields need not be verified even if verification is specified in the Input Format. The operator can, of course, perform a complete verification if desired.

Crossfooting is a special form of batch balancing oriented toward records rather than batches. One or two accumulators can be specified for crossfooting. The operator is required to enter a value for each crossfooted total. The system compares the accumulated totals with the entered values. Simple crossfoot totaling cannot be accomplished; neither can the two accumulations be compared with each other as in true crossfooting.

All totaling is accomplished during a separate pass through the data batch following all data entry by the operator.

OUTPUT EDITING FORMATS: Output Editing is oriented primarily toward data rearrangement and label generation; however, extensive provisions for handling the insertion of literals (constant data) into the output records are included.

Data flow during output editing is as follows: an input record on disk is loaded into an input buffer in the processor; data in the input buffer is retrieved; code conversion is performed; the data is transferred to an output buffer; and the output buffer is written to tape. Access to data in the input record is independent of field delimitations of the Input Format under which the data was entered. Data can also be transferred directly to a 128-character working storage area. Segments of the working area can be incremented by a constant (literal) or can be compared with a constant. A branch in the Output Editing program can be made based on the results of the comparison. A branch in the program can also be generated based on the program level number of the input field, if a field is negative, if a field has been completely skipped during input, or if a validation error flag is present for a field. Reading of records into the input buffer and writing of records from the output buffer are performed independently.

Thus, implosion and explosion can be accomplished; i.e., an output record can combine multiple input records, or an input record can be broken down into multiple output records.

Extensive volume and file label generation facilities are provided for single- and multiple-reel files. Complete control over output code is provided; the programmer can generate a complete code translation table if required.

The Output Editing Format is executed when writing data from disk to tape. It can also be used to control data transcription from one magnetic tape format to another. Simultaneous output to magnetic tape and to a line printer is permitted for either data dumping or data transcription.

PRICING

The Keyplex system is available for purchase or on a one-, three-, or five-year lease arrangement. The figures below include prime-shift maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental*				
	1-Yr. Lease	3-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.
Keyplex Central Control Unit (includes 7.5-megabyte disk and tape drive)–					
7-track, 556 bpi or 7-track, 800 bpi	1,473	1,432	1,329	59,840	294
7-track, 556/800 bpi or 9-track, 800 bpi	1,607	1,535	1,416	61,200	325
9-track, 1600 bpi	1,710	1,638	1,509	65,310	325
Performance Enhancement Package	74	72	67	3,084	21
Batch Balance	289	274	252	12,100	32
Check Digit Control	105	102	95	4,270	11
Keyplex Keystation	90	87	95	3,610	11
Manual System Control Switch	184	169	158	7,700	31
End-of-Record Alarm	5	4	3	215	–
Remote Cluster Feature	53	50	47	2,200	–
Peripheral Devices					
Additional magnetic tape drive–					
7-track, 556 bpi; 7-track, 800 bpi; or 9-track, 800 bpi	368	357	332	14,960	55
9-track, 1600 bpi	377	342	325	10,080	94
Replacement disk drive (15 megabytes)	357	321	305	13,450	31
Line Printer, 300 lpm	730	650	605	21,840	188

*Includes prime-shift maintenance within 50 miles of a Honeywell Field Engineering District Repair Office.■

IBM Model 50 Magnetic Data Inscriber

The IBM 2495 Tape Cartridge Reader (right) reads data directly into a System/360 or System/370 computer from cartridges prepared on the Model 50 Magnetic Data Inscriber (foreground).

The Model 50 is a comparatively expensive, unbuffered unit for preparing keyboard-to-tape input for IBM computers. Distinctively different from competitive data recorders, it uses tape cartridges that require a special (and slow) computer input device, the 2495 Tape Cartridge Reader.

MANAGEMENT SUMMARY

Staring in 1965, with the introduction of the Mohawk Data Recorder, the data processing community became aware of the possibilities of keying data directly onto computer-compatible magnetic tape. This started what has become one of the most explosive developments in the feeding of computers.

In 1968 IBM entered the race, but not with a "me too" philosophy. The Model 50 Magnetic Data Inscriber is totally different from the "Mohawk" class of units.

IBM's design objective for the Model 50 was essentially to develop a keyboard-to-magnetic tape device that would not differ significantly from its 29 Card Punch and would require little operator retraining.

The IBM Model 50 magnetic tape cartridge is not compatible with conventional computer tape drives. The only link that IBM provides to read and transfer the data recorded by the Model 50 is the 2495 Tape Cartridge Reader, which connects to the Multiplexer channel of an IBM System/360 or System/370 computer.

A maximum of 12 tape cartridges can be loaded in the 2495, which automatically loads, reads, rewinds, and stacks cartridges at about one per minute. The peak transfer rate from tape to computer is 900 characters per second. The effective reading rate, considering the full time for each cartridge read, corresponds to about 300 cards per minute–slower than most of the card readers currently in use.

Those interested in text generating and editing applications should note that IBM designed the 2495 to be ▷

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

TAPE OUTPUT: IBM magnetic tape cartridge; contains 100 feet of sprocketed, 16mm magnetic tape. Tape code is 8-level EBCDIC plus odd character parity. The magnetic tape cartridge is compatible with the IBM 2495 Tape Cartridge Reader (TCR).

Recording density is 20 characters per inch. Record length is variable from 1 to 720 characters. IBM conservatively rates the tape capacity per cartridge at 23,000 characters (equivalent to about 290 punched cards).

The magnetic tape handler is designed so that the operator need only place the magnetic tape cartridge on the tape-drive spindle; the tape is automatically threaded and wound on a take-up reel.

The incremental tape drive moves the magnetic tape at 117 characters per second when performing "dup", skip, or search operations. Rewinding the complete tape requires about 45 seconds.

DEVICE CONTROL: Programs are punched into a program card with a capacity for 720 program positions, each corresponding to a character position within a record. The card can identify up to 50 data fields; field size can vary up to 15 positions per field. Fields can be linked together by program to any desired length up to the 720-position maximum card capacity.

Up to eight discrete programs can be punched into the program card; programs can be repeated, sequenced, or performed once with operator intervention to determine the next operation. An out-of-sequence program change can be manually initiated.

The program controls format of the data recorded by de-limiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or right justification (left zero fill) and controlling optional check-digit functions. Left-zero and check-digit fields cannot be linked.

The unpunched portion (right half) of a program card can be used to handwrite or type information relating to the fields of each program. This information is visible through a window in the display panel.

The program card is manually attached by the operator to the program drum, which moves in synchronization with the magnetic tape. The card contains prescored holes and can be prepared without the need for a special punch.

Because the Model 50 lacks a buffer, data to be duplicated from record to record cannot be stored. The ▶

IBM Model 50 Magnetic Data Inscriber

compatible with tapes generated on both the Model 50 and the IBM Magnetic Tape Selectric Typewriter (MTST).

The recording technique used in the Model 50, because the unit is bufferless, is different from that of its major competitors. The only consideration here is that while "dup", skip, and left-zero codes are resolved by a standard IBM input utility program, computer time is required for the operation.

Designing a device without a buffer, however, removes restrictions on record length. The Model 50 can record records up to 720 characters in length, a major improvement over competitive data recorders. This feature is probably the main justification for using the Model 50 instead of one of its many competitors. However, in the Model 50, the long record length provides only convenience in system design and does not increase input performance significantly as it would in one of the "computer-compatible" units.

The programming technique is essentially the same as that used on an IBM keypunch, except that the program card is not an 80-column card and is a great deal more complex; instead of a maximum of two programs associated with keypunches, the Model 50 card can contain up to eight.

Punched cards may well be on the way out as the primary means for entering data into a computer, but their passing will be mourned. The tangible characteristics of cards provide a "security blanket" not present in magnetic tape. □

problem is resolved by recording special "dup" and skip codes in each character position of a duplicate or skip field. An input utility program in the System/360 processor must replace these codes with correct data from a previous record. In addition, each record written on tape contains a program level code, to identify the program used to format the record, and a record separator. These codes are automatically written at the beginning and end of each record.

Modes of operation include Write, Read, Verify, and Search.

The Write mode is synonymous with the data entry mode of most keyboard-to-tape devices. With each keystroke, a character is recorded directly on magnetic tape and the tape is automatically advanced to the next data entry position.

The Read mode allows data written on tape at the current position to be displayed via the character readout matrix. Subsequent characters are read and displayed via spacebar depression. The operator can advance to the beginning of the next record or the end of a skipped field or backspace to the beginning of a field. When entering the Verify mode, the first character of the record to be verified is read; i.e., the program level code. The program card is then advanced to the beginning of the proper program and the verify operation is initiated. Data rekeyed from the source document is compared character for character with the data written on magnetic tape.

The Search mode advances the tape at 117 characters per second until an end-of-group (record separator) or end-of-data (last complete record) is encountered. Tape motion is halted, Read mode is entered and the special code is displayed. The Search mode can be entered any number of times until until the end of tape is reached.

Display of current location within a record is partially presented through the program card, but is limited to field identification. The graphic representation of each character read from tape is identified by a character readout matrix. Two rows of 10 lamps each are positioned along x and y coordinates within the matrix. The character read from tape is identified by noting the positioning of the x light and y light with respect to the graphics symbol at the intersection of the lighted coordinates.

Optionally, a record counter is available to help find specific records and maintain control over the data preparation process. It automatically increments and decrements as records are passed. It is a five-position counter and can be manually reset.

Status conditions include error, rewrite character, end-of-media, character check, and first character; these are directly displayed via indicator lamps.

ERROR CONTROL: Character parity is produced along with character generation for each data key depression. Character parity is checked when in the Read mode, during a search operation, and during a record backspace or field backspace operation in the Write or Verify modes. A parity error detected during any of these operations halts the Model 50, locks the keyboard, and visually alerts the operator.

Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character.

KEYBOARD: 49-key keypunch style; keyboard can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters. Any character code can be produced when the Special Code option is incorporated.

The keyboard can also be used as a 48-character keyboard by manually disabling 16 special characters on the upper-case shift. Up to 12 control keys provide for initiating functions such as alpha and numeric shift, program select, left zero, field and record backspace, skip, etc.

PRICING: The Model 50 is available on a month-to-month rental basis or for purchase; no extended-term plans are available. The rental prices below include monthly maintenance; a separate arrangement is available for purchased units.

Component	Monthly Rental	Purchase	Monthly Maint.
Model 50	$175	$9,065	$66
Record Counter	10	550	2.25
Self Checking Number–			
Modulo 10	30	1,650	9
Modulo 11	35	1,925	9
Special Code Key	5	275	– ■

IBM 2740 Communication Terminal

MANAGEMENT SUMMARY

The IBM 2740 is one of three Selectric-based communication terminals offered in IBM's standard product line. The 2740 falls in between the other two, the 1050 and the 2741, in both capability and price. It does not offer as much flexibility as the 1050 in the number and type of auxiliary devices, but it does allow more sophisticated line control procedures, such as polling and addressing, than the 2741, which it resenbles in appearance.

The 2740 Model 1 can be used for communications between two terminals or with a computer over a leased line or the public telephone network. Options permit use in a multistation network operating over one line to an IBM System/360 (Model 22 or larger) or System/370 computer.

The 2740 Model 2 includes the multistation features as standard equipment and also includes a buffer, which permits automatic retransmission when parity errors are detected. Through the use of the buffer and an option, transmission speed can be increased to 600 bits per second; received data is stored in the buffer and printed out after the transmission.

An interesting option, the 2760 Optical Image Unit, for Model 1 terminals communicating directly with a computer, provides a low-cost alternative to CRT display units for some applications. This unit displays a projected image from a 16mm film cartridge on one side and an overlay on the other side of a 9-inch by 14-inch screen. A light probe is used to identify response points on the projected image or overlay. Light-sensitive sensors behind the screen pick up the light. Coordinates of the response and an image identification are transmitted to the remote computer via the 2740. The overlay must be coordinated by the terminal operator. The film in the cartridge can be advanced by the operator or by the remote computer.

The 240 response points (120 on each half) of the screen are located about three-quarters of an inch apart, which permits easy selection with little chance of inadvertantly activating the wrong one. However, there is no feedback to indicate which responses have actually been selected before transmission.

The normal use for the 2760 is in an environment that requires absolute simplicity of operation and can be satisfied with preprogrammed requests, replies, etc. Combined use with the typewriter facility of the 2740 could lead to some very interesting possibilities.

The 2740 is a remote System/360 typewriter terminal designed around the IBM Selectric typewriter. Suitable for either point-to-point or multistation arrangements, it can be used in a polling or non-polling environment at printing speeds up to 14.8 char/sec and transmission speeds up to 600 bps. Two models provide for buffered and unbuffered operation. An option, the 2760 Optical Image Unit, allows "finger-pointing" data entry or retrieval.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS: The two models, 1 and 2, differ primarily in that Model 1 is unbuffered and Model 2 is buffered. In addition, Model 1 can operate over the public telephone network or over a leased facility; whereas Model 2 is limited to use over a leased facility.

COMMUNICATIONS: Asynchronous, half-duplex at 14.8 characters per second; optionally, Model 2 can be equipped to transmit at 600 bits per second (66.7 characters per second) or 75 bits per second (8.33 characters per second).

IBM offers a selection of three transmission codes. The user can select IBM Standard Selectric Typewriter Code, IBM Paper Tape Transmission Code (PTTC/BCD), or the expanded version of the same (PTTC/EBCD). Only the latter two codes are software-supported for transmission between the terminal and an IBM 360 or 370 computer system.

The unit code structure totals nine bits, composed of six data, one parity, and unity start and stop bits.

The 2740 Model 1 can intercommunicate with other terminals of the same model.

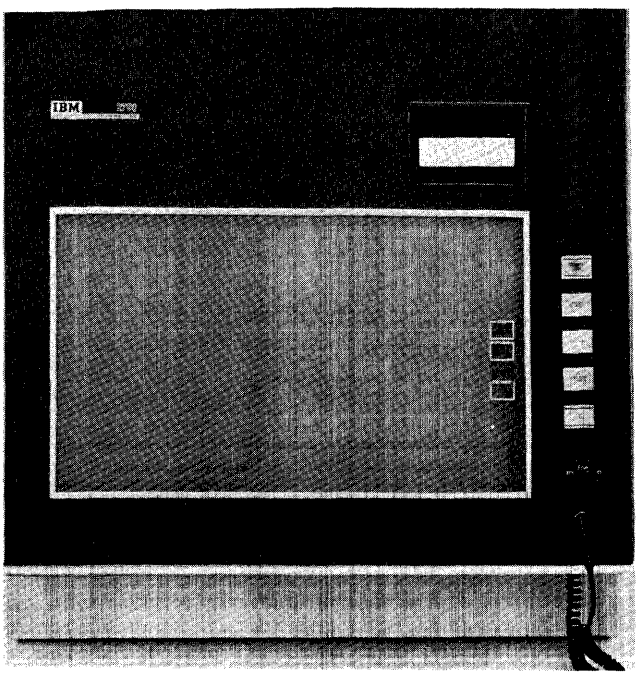
Both models are designed for operation over a leased or privately-owned narrow- or voice-band facility via an IBM Line Adapter or a modem compatible with the Bell System 103F Data Set.

With the Dial-Up option, the Model 1 can be connected to the public telephone network via a modem compatible with the Bell System 103A Data Set.

The Model 2 can interface with a telegraph-grade facility rated at 75 bits per second when the optional Telegraph Line Adapter is used. The transmission speed with this option is 8.33 characters per second.

The optional 600 bps Speed Base enables the Model 2 to operate over a leased or private facility at 66.7 characters per second. (The printer rate remains 14.8 characters per second.) A modem compatible with the Bell System 202D

IBM 2740 Communication Terminal



The 2760 Optical Image Unit, usable with the 2740 Model 1, allows an operator to enter data by simply pointing a light probe.

The 2760 is supported under System/360 DOS and OS. The standard software takes care of interfacing the 2760 terminal to the user program, but the user program must perform all interpretation of the response matrix.

The 2760 must be located in close proximity to the companion 2740 (within 6 feet), and only one 2760 can be attached to a 2740. □

Data Set is required for this option, as is the Buffer Receive option.

IBM offers a variety of Line Adapters (modems) that can be used to interface the 2740 to a leased or privately owned communications facility.

DEVICE CONTROL: Operating modes are Local, for conventional typing only, and Communicate, for communicating with the remote computer or another 2740 Terminal (Model 1 only). Data keyed in the Communicate mode is printed by the sending terminal.

The standard 2740 Model 1, although designed to operate on a point-to-point basis, can also operate on a broadcast basis where all terminals on the same line receive the message transmitted from the sending terminal. Contenders bid for the line using the Bid key, which signals all terminals to automatically enter the receive mode.

The Model 1 can be employed in a polling/addressing environment when it includes the Station Control option. This option enables each of a total of 41 terminals connected to a leased or private line to recognize and respond to a unique, customer-specified, two-character polling or addressing sequence.

The terminals can be logically grouped to permit group addressing in response to a customer-specified, two-character addressing sequence. A predesignated terminal in each group functions as the group master to acknowledge the transmitted message.

All-call addressing (transmitting to all terminals on the same line) is executed via a special two-character sequence.

The 2740 Model 1 can be connected to the public telephone network via the appropriate modem when incorporating the Dial-Up option. This option and the Station Control option are mutually exclusive.

The send/receive status of a Model 1 connected to the public telephone network can be controlled by a special two-character control sequence transmitted from the remote computer via the Transmit Control option.

With the Automatic EOB option, messages transmitted from the Model 1 are divided into a number of blocks; each block is equivalent to a line of print followed by an end-of-block code and a longitudinal parity character. The Record Checking option is a prerequisite to this option.

The IBM 2760 Optical Image Unit can be connected to the 2740 Model 1 via the optional IBM 2760 Attachment.

The 2740 Model 2 incorporates a buffer memory with a basic 120-character capacity. Optional buffer expansion modules increase the basic capacity to 248 or 440 character positions.

The Station Control feature, a Model 1 option, is standard for Model 2 and dedicates its use to a polling/addressing environment.

Keyed data is printed and entered in the buffer when operating in either Local or Communicate mode. If addressed by the remote computer while entering data in the Communicate mode, the Model 2 responds with a negative acknowledgement.

While in the Communicate mode, a manual request for a polling sequence is initiated via the Bid key. The data is transmitted from the buffer in response to the polling sequence.

Data stored in the buffer can be automatically printed any number of times while in the Local mode.

Additional options for the 2740 Model 2 include Buffer Receive, Edit, Header Control, Document Insertion, and a Split Friction-Feed Platen.

The Buffer Receive option allows messages to be received by, and printed from, the buffer memory; printing follows message termination. The terminal responds to an addressing sequence which occurs during the printout operation with a negative response.

The Edit option, through the use of two extra keys, allows editing the stored message before transmitting.

The Header Control option allocates the initial 28 positions of the buffer in increments of four positions (as specified by the user) for storing repetitive header information.

IBM 2740 Communication Terminal

The Document Insertion option facilitates the handling of single-part ledger cards. The option is available for either of two card widths: 6 or 7-3/8 inches.

The Split Friction-Feed Platen option implements simultaneous printing of two forms; the left print line is 5.5 inches wide and the right is 7.5 inches.

ERROR CONTROL: Data-entry errors can be detected by visual verification.

Character and longitudinal parity are generated. Character parity accompanies each character transmitted; longitudinal parity is transmitted at the end of each message block. The optional Record Checking feature is required to perform character and longitudinal parity checking.

Error correction is performed by retransmission by the sending station following a negative acknowledgement by the receiving station.

KEYBOARD: 55-key typewriter style. The keyboard can produce any of 88 upper and lower case alphabetics, numerics, and special characters through upper and lower case control codes. Three keyboards are available; each corresponds to one of the three transmission codes.

PRINTER: The Selectric printing mechanism prints data received from the communications facility or entered from the keyboard.

Rated printed speed is 14.8 characters per second; print symbols total 88.

A variety of interchangeable print elements are available for each code set. The PTTC/BCD and PTTC/EBCD codes are compatible except for punctuation and special symbols. IBM emphasizes the importance of using identical keyboards and print elements based on the selected code for all terminals within the same network.

The printer accommodates friction-fed or pin-fed (optional) fanfold forms up to 15.5 inches wide; the writing width is 13 inches.

Horizontal spacing is 10 or 12 characters per inch; vertical spacing is 6 or 8 (optional) lines per inch. IBM recommends the avoidance of intermixed character spacings on terminals within the same network.

OPTICAL IMAGE UNIT: Provides a 2740 Model 1 with the capability for "finger-pointing" data entry or retrieval. A light probe handled by the operator is used to identify information on a 9-inch by 14-inch screen.

An image projected from 16mm film contained in a cartridge occupies the right half of the screen. A clear overlay can occupy the left half of the screen. The light probe projects a light beam that is picked up by sensors behind the screen. The projected image or overlay is coordinated with the sensing points so that the operator is directed to the right point to apply the light probe. A total of 240 sensing points are provided, half on each side of the screen. Three sensing points are reserved for loading, unloading, and ending an entry.

Over 200 images can be stored on one cartridge.

The image identification and the coordinates of the response point selected are transmitted via the 2740 to the remote computer. Movement of the film in the cartridge can be controlled locally by the operator or remotely from the computer.

Use of the 2760 requires Record Checking and precludes the use of Station Control and Transmit Control.

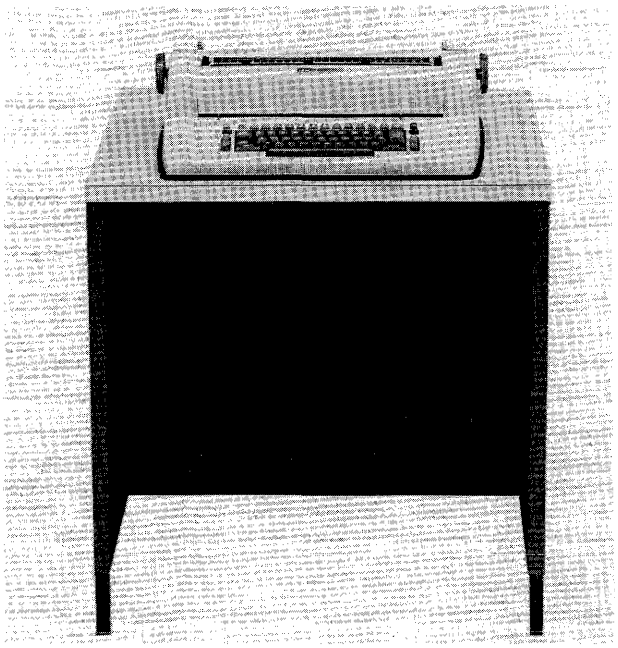
The Optical Image Unit is mounted on a customer-supplied desk or table.

PRICING: The 2740 is available on a month-to-month rental arrangement or on a purchase basis. Extended Term Leasing Plans are not available. The rental prices listed below include maintenance; a separate maintenance contract is available for purchased units.

Component	Monthly Rental	Purchase Price	Monthly Maintenance
2740 Model 1	$ 95	$3,930	$23
2740 Model 2	145	6,015	23
2760 Optical Image Unit	189	9,240	27
Options for 2740 Model 1			
Automatic EOB	3.50	160	–
Dial Up	3.00	135	–
Record Checking	16.50	745	–
Station Control	15.00	675	–
Transmit Control	5.00	225	–
2760 Attachment	10.00	450	–
Options for 2740 Model 2			
Buffer Expansion (248 char.)	10.00	450	0.50
Buffer Expansion (440 char.)	15.00	620	0.50
Buffer Receive	5.00	205	–
Document Insertion (6 or 7-3/8 inch)	6.00	250	1.50
Edit	10.00	415	–
Header Control	5.00	205	–
Record Checking	16.50	745	–
Speed Base–600 bps	10.00	415	–
Telegraph Line Attachment	3.00	130	1.00

A split friction-feed platen is available for the Model 2 at $76, purchase only. A pin-feed platen is available for either model for $61.75, purchase only. IBM Line Adapters range between $3 and $20 per month ($135 to $800 purchase). ■

IBM 2741 Communication Terminal



The IBM 2741 is a remote System/360 or 370 typewriter terminal designed around the IBM Selectric typewriter. The terminal is rated at 14.8 characters per second and is designed for simplicity of operation.

MANAGEMENT SUMMARY

The IBM 2741 Communication Terminal is one of three (2740, 2741, and 1050) Selectric-typewriter-based terminals marketed by IBM in its standard product line. The 2741 features the simplest operating procedures of the three and is widely supported by systems and application programming within the IBM software offerings.

The 2741 is also the least expensive IBM typewriter terminal.

The 2741 is intended primarily for time-sharing applications. No provision is made for multiple terminals to operate over the same communications line; the 2740 and 1050 are available for this type of application.

Featuring upper and lower case alphabetic printing and the standard IBM Selectric keyboard, the 2741 is promoted for text handling. Indeed, if the output from a conventional IBM Selectric office typewriter is suitable for an application, then the 2741 will probably meet the needs. Its chief deficiency seems to be the lack of half-line spacing, a feature that is available with IBM electric typewriters. This lack makes the typing of equations and formulas less than neat. The actual typing does vary somewhat from that of a standard Selectric typewriter, and the quality of the terminal's printed output is not as good as that of the office version. ▷

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604.

COMMUNICATIONS: Asynchronous in the half-duplex mode at up to 14.8 characters per second (134.5 bits/second).

IBM offers a selection of three transmission codes; the user can select IBM Standard Selectric Typewriter Code, IBM Paper Tape Transmission Code (PTTC/BCD), or the expanded version of the same (PTTC/EBCD).

The unit code structure totals nine bits, composed of six data, one parity, and unity start and stop bits.

Transmission characteristics are compatible with the IBM 2701 Data Adapter Unit, the IBM 2702 and 2703 Transmission Controls, the IBM Integrated Communications Adapter (System/370 Model 135), and the IBM Integrated Communications Attachment (System/360 Model 25). The 2741, via one of these line controllers, is designed for communicating with an IBM System/360, Models 22 through 195, or System/370.

The 2741 is designed for operation over a leased or privately-owned narrow- or voice-band facility via an IBM Line Adapter or a modem compatible with the Bell System 103F Data Set.

The 2741 cannot directly intercommunicate with other 2741 Terminals; indirect communication can be established through a store-and-forward technique using the central processor.

With the Dial-Up option, the 2741 can be attached to the public telephone network via a modem compatible with the Bell System 103A Data Set.

IBM offers a variety of Line Adapters (modems) that can be used to interface the 2741 to a leased or privately-owned communications facility.

DEVICE CONTROL: Operating modes are Local, for conventional typing only, and Communicate, for communicating with the remote computer. Data keyed or received in the Communicate mode is printed.

When in the Communicate mode, unsophisticated line control procedures, under control of the program stored at the remote computer, effect the transmit/receive state of the 2741. The keyboard is locked when the terminal is in the Communicate-receive state.

The optional Interrupt feature permits the 2741 operator to interrupt a transmission from the remote computer via ▶

IBM 2741 Communication Terminal

The familiarity of the device means a minimum of operator training or, alternatively, easier use by untrained operators such as engineers, which is certainly a desirable feature for time-sharing use. □

a transmitted break signal. This feature precludes the use of the IBM 2701 Data Adapter Unit and the Integrated Communications Attachment (System/360 Model 25).

Two options increase control of the remote central processor. Print Inhibit permits prevention of printing of transmitted or received data by the 2741. The transmit inhibit portion of this option may be of value in preventing the printing of access codes (to enhance security); the receive inhibit apparently serves no useful purpose besides making it easier to implement the other inhibit function. The Transmit Interrupt option allows the processor to interrupt a transmission from the 2741.

ERROR CONTROL: character parity accompanies each character transmitted. The 2741 does not provide for error detection. Data entry errors can be visually verified.

KEYBOARD: 55-key typewriter style. Keyboard can produce any of 88 upper and lower case alphabetics, numerics, and special characters through upper and lower case control codes. Three keyboards are available; each corresponds to one of the three transmission codes.

The Typamatic key option provides repeat action while the backspace, hyphen/underscore, and space-bar keys are held depressed.

PRINTER: prints data received from the communications facility or entered from the keyboard.

Rated printing speed is 14.8 characters per second; print symbols total 88.

A variety of interchangeable print elements are available for each code set. The PTTC/BCD and PTTC/EBCD codes are compatible except for punctuation and special symbols. IBM emphasizes the use of identical keyboards and print elements based on the selected code for all terminals within the same network.

The printer accommodates friction-fed or pin-fed (optional) fanfold forms up to 15.5 inches wide; the writing width is 13 inches.

Horizontal spacing is 10 or 12 characters per inch; vertical spacing is 6 or 8 (optional) lines per inch. IBM emphasizes the avoidance of intermixing character spacing on terminals within the network.

PRICING: The 2741 is available for purchase or on a month-to-month lease; an extended-term lease plan is not available. Rentals below include maintenance; a separate agreement is available for purchased units.

Component	Monthly Rental	Purchase	Monthly Maintenance
2741	$95	$3,930	$25
Options			
Dial Up	3	135	–
Interrupt	2.50	115	–
Print Inhibit	10	350	–
Transmit Interrupt	8	280	–
Typamatic Keys	5	225	–

The Pin-Feed Platen is priced at $61.75 on a purchase basis only. The IBM Line Adapters range between $3 and $20 per month ($135 to $800 purchase). ■

IBM 1050 Data Communication System

The 1052 Printer-Keyboard provides keyboard input and hard-copy output and is the central component in most 1050 configurations.

With appropriate options, the 1050 is far more than just a low-speed typewriter terminal. A complete communications network with polling and addressing can be implemented for long-distance or in-plant applications. I/O media include punched cards, paper tape, and a specialized data entry keyboard.

MANAGEMENT SUMMARY

The IBM 1050 is one of the oldest terminals in the current product line actively marketed by IBM. It was introduced not long after the introduction of the IBM Selectric Typewriter.

Much more than any other IBM communications terminal, the 1050 reflects the IBM philosophy of marketing computers–serve as many needs as possible under one title. Configuration possibilities allow a user to select or mix keyboard, paper tape, and punched card input and printed, paper tape, and punched card output.

Application areas for the 1050 are many and varied. With appropriate selection of components and options, a 1050 system can function as a general-purpose communications terminal or as a specialized data input station (via Programmed Keyboards).

A choice of line control options permits use of the 1050 as a single terminal communicating with another terminal or with a computer, or a user can implement a network of intercommunicating terminals complete with polling and selective addressing.

A 1050 terminal station can be used as a remote terminal, complete with software support, with almost any IBM computer system, including the older 1400 Series and 7000 Series system. Within the System/360 computer line, there is a large body of systems and application software support for the 1050 as a remote terminal.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

CONFIGURATION: The rules governing the components that can constitute a valid 1050 configuration are intricate. The basic rules require a 1051 Control Unit and permit a maximum of two readers, two printers, and two punches to be attached. An attachment feature is required for each other member of each group (six features maximum). If a keyboard/printer (1052) is not included in a system, a special Switch Unit containing system switches and indicators is required.

In the printer group, the permissible maximum configuration possibilities are a 1052 and a 1053 or two 1053's.

In the reader group, a 1092, a 1093, or a 1092/1093 in tandem is treated as one reader unit. Only one 1056 Card Reader can be attached; otherwise any combination of two reader units is possible.

In the punch group, any combination of two punches can be connected.

COMMUNICATIONS INTERFACE: Transmission is half-duplex, asynchronous at 134.8 bits/sec (14.8 char/sec) using 9-unit IBM PTTC/BCD code, which consists of 6 data bits, a parity bit, and start and stop bits.

IBM, common-carrier, or independent data sets can be used for interfaces.

Optionally, the 1050 can be adapted to operate at 75 bits/sec (8.33 char/sec) over a telegraph-grade line.

DEVICE CONTROL: The 1051 Control Unit controls all operations of a 1050 system. Operator control is via switches located on the 1052 Printer-Keyboard if this component is included, or on a separate Switch Unit if the 1052 is not included.

Two basic operational modes are provided: on-line and home-loop. In the home-loop mode, the 1051 is disconnected from the communications line and components within the station can transfer data to each other. This mode is used for input preparation or when the 1050 is used as a computer console I/O device.

The 1051 Model 1 can operate in either mode (or both simultaneously). Model 2 operates only in the on-line

IBM 1050 Data Communication System

A 1050 system can also be connected directly to a System/360 computer for use as a console. With the I/O options available, the 1050 can make a particularly powerful console. However, punched-card console I/O is not supported in the standard IBM software.

In addition, many individual components of the 1050 system are used in other IBM systems.

Though similar in transmission characteristics to the IBM 2740 and 2741 Terminals, the 1050 is not compatible with these two typewriter terminals.

Evaluating a 1050 system for a particular application is even more difficult than figuring out the exact combination of components, features, and options required for a specific configuration. The numerous configuration options are more suited for alternatives than for expansion.

High cost and low speed rule the 1050 out of many potential applications. On the other hand, high print quality, flexible configurations (both station and network), and ready software support for IBM computers make it a contender for other applications. Many 1050 systems have been installed and are in everyday use. While this is not necessarily a measure of worth for every potential installation, the advantages of proven components should not be overlooked either. □

mode, and Model N1 operates only in the home-loop mode.

Line control is exercised through the exchange of messages and responses. With the Master Station option, Models 1 or 2 can request transmission from (polling) or initiate transmission to (addressing) one or more terminals.

A two-character polling message identifies any one of up to 26 terminals and the desired component, which can be the keyboard, either reader unit, or a component selected by the station operator. A polling operation can be performed via a 1052 Printer-Keyboard, a card reader or a paper tape reader; sequential locations can be polled automatically from the card or tape reader.

Addressing is performed in a similar fashion; groups within the maximum of 26 remote locations can be set up for selective addressing. Single locations or all locations can also be addressed.

Several options are available to improve operational flexibility. The Keyboard Request feature allows elimination of the time delay (9 to 18 seconds) associated with sending information from the keyboard as a result of a poll. The Receive Interrupt option permits a terminal to signal the other end of a need to reverse the communications flow while receiving data. The Transmit Interrupt option allows a 1051 to recognize, while transmitting, the interrupt signal from another 1050 system. The Interrupt features require a full duplex facility. The Automatic Ribbon Shift and Line Feed Select option permits these functions to be initiated by two-character sequences in the data stream; the option is installed individually for each printer in the system. The Automatic Fill Character Generation option can be implemented only on the 1051 Model 1 for automatically inserting idle characters in a punched tape or card (if the Operator Panel feature is installed) during printer functions such as carriage return, line feed, and tab. This simplifies later transmission of data from tape or cards to a printer.

ERROR CONTROL: The basic technique for error detection is the generation and checking of character and block parity.

Without options, block parity is formed for a complete message as defined by an EOB (end-of-block) character. With the Automatic EOB option, block parity is formed for each line; i.e., an EOB is automatically generated following each carriage return.

Without options, correction of errors is performed manually by retransmission, after the operator is alerted by a lighted indicator. With the Line Correction option, non-keyboard messages are automatically retransmitted once or twice if errors persist.

When errors are detected, printed lines are followed by a hyphen, cards are punched in column 81 and ejected, and punched tape is back-spaced and delete-punched. A further option, Line Correction Release, permits continued operation after a second retransmission that also contains errors, but no indication is provided if the final retransmission contains errors; this option is primarily intended for unattended operation.

An Audible Alarm can be fitted to the 1051 to signal component conditions, such as paper out or unit selected and not ready, that would halt communications. The Open Line Detection option provides monitoring of the carrier signal to detect loss of communications connection. An open line is treated essentially as if it were a data error but without any retransmission, and the audible alarm will sound (if incorporated) and a disconnected will occur (if operating over the public telephone network) within 20 to 30 seconds.

For home loop operations, a Home Correction option can be included. With this option, depression of a CR key causes a reader to recycle and reread the record, a paper tape punch to reverse and delete punch the record, and a card punch to eject a card. The Home Loop Input Component Interlock option causes reader units to stop and interlocks the keyboard of the 1052 when the units run out of paper tape, cards, or paper. They are restarted by a key depression.

READERS: Included in this category are the 1054 Paper Tape Reader, the 1056 Card Reader, and the 1092/1093 Programmed Keyboard.

The 1054 Paper Tape Reader reads 1-inch-wide, 8-channel paper tape at 14.8 or 8.33 char/sec, depending on the line interface. Seven channels are used for the six data bits and the one-character parity bit. Options allow feeding and reading edge-punched documents and provide feed and take-up reels; rolls of tape are fed from the center.

The 1056 Card Reader is available in three models. Model 1 can accept and feed card decks of up to 300 cards. Model 2 can accept only one card at a time. Model 3 is similar to Model 1 but reads PTTC/EBCD codes. Model 1

IBM 1050 Data Communication System

can be adapted to read 111 PTTC/BCD card codes and translate them to transmission code, including up-shift and down-shift control codes where needed. This feature is standard (for PTTC/EBCD codes) on the Model 3. Other options for all models include a card-reader program feature for automatically controlling starting, stopping, and ejecting as well as for inserting a limited amount of fixed data. Model 2 can be adapted to read 51-column cards as well as 80-column cards. Models 1 and 3 can be adapted to read packs of up to 300 22-, 51-, or 80-column cards, but not intermixed.

The 1092/1093 Programmed Keyboard provides for data entry with visual verification prior to transmission. Data is entered via a multi-column keyboard of pushbuttons that light when depressed. Plastic keymats fit over the keyboard to identify entry fields.

The two units can be coupled to work in tandem to expand the size of the data entry. Various combinations provide 10, 15, 16, 25, or 26 columns for data entry.

Both keyboards come in two models. One model of each includes automatic sensing of a notch code on the keymats; up to 48 different overlays can be identified, permitting the same keyboard to be used for different data entry applications or to expand the data entry for the same application. The identifier code is transmitted with the data.

Ten buttons are provided in each column, corresponding to the ten digits. Once a data entry has been completed, the keyboard is activated and the columns are scanned.

Data is transferred serially by digit to the 1051 Control Unit. The two right-hand columns can be optionally conditioned to allow multiple key depressions; when so equipped, each of these columns is scanned as two 5-bit binary characters.

PRINTERS: Included in this category are the 1052 Printer-Keyboard and the 1053 Printer. Both are built around an IBM Selectric Typewriter.

The 1052, when included in a 1050 system, carries the system switches and indicators. There are two models, corresponding to the two communications models of the 1051 Control Unit. The primary difference is the inclusion of a different set of switches and indicators corresponding to the communications/home-loop and communications-only modes of operation of the two 1051 models. The data entry portion of the keyboard and the printer portion of the two models are the same.

The printer can print 88 different symbols including upper and lower case alphabetics at 14.8 or 8.33 char/sec. A 15-inch, friction-feed carriage with a 13-inch writing line (130 characters) is provided. A pin-feed platen is optional.

Vertical spacing can be 6 or 8 lines per inch. Optionally, the 1052 can be equipped with a vertical forms control mechanism to allow automatic spacing to predetermined positions on a form. This feature is controlled by a beaded chain with oversize beads to indicate stopping locations.

Another option speeds the return of the typing element on a carriage return operation by about 50%.

The 1053 Printer is similar to the printer portion of the 1052 Printer-Keyboard, including availability of the options mentioned for the 1052.

PUNCHES: Included in this category are the 1055 Paper Tape Punch and the 1057/1058 Card Punch.

The 1055 Punch accommodates 1-inch-wide paper tape and punches the 6-bit IBM PTTC with odd parity. It can optionally be equipped to punch edge-punched documents and to wind tape on a 6-inch take-up reel.

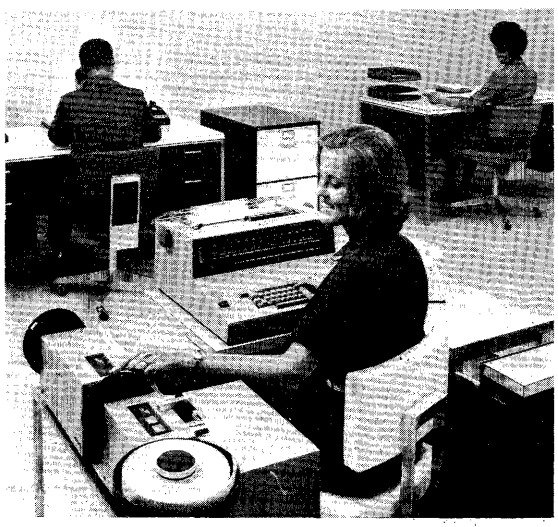
The 1057 is an adaptation of the IBM 24 Card Punch; the 1058, of the 26 Printing Card Punch. Only the 1057 Model 1 is designed for use in a 1050 system. It accepts the 6-bit transmission code and converts it to the standard PTTC/BCD card code; shift characters are deleted. The standard 1057 can punch 64 codes, of which 44 are printable characters; only the down-shift codes are recognized. Optionally, the 1057 can accommodate up-shift characters; with this option 111 codes can be punched, including the 88 printable characters in the transmission code used by the 1050.

The 1058 Model 1 is similar to the 1057 Model 1 with the extended punching option. In addition to punching, characters are printed at the top of each column punched. A total of 44 symbols can be printed on the cards; lower case alphabetics are punched but not printed on the cards. The 1058 Model 2 is equipped to punch PTTC/EBCD card codes. A total of 85 codes can be punched, of which 62 can be printed on the card; lower case alphabetics are not punched or printed.

All card punch models can be used off-line as ordinary keypunches; Alternate Program is a standard feature.

Incoming control-code sequences can initiate field duplication, switching to the alternate program, and card release to supplement the control provided by the program card.

Optionally, an operator panel can be fitted on any of the punches to allow the user to make individual code assignments for function codes such as tab, line feed, up-shift, down-shift, end of transmission, etc. Related card punch



This "full-barreled" 1050 configuration includes paper tape reader and punch at left and card reader at right.

IBM 1050 Data Communication System

actions can also be controlled through this panel. Without this panel, functions are assigned when the unit is installed, and service personnel are required to make changes.

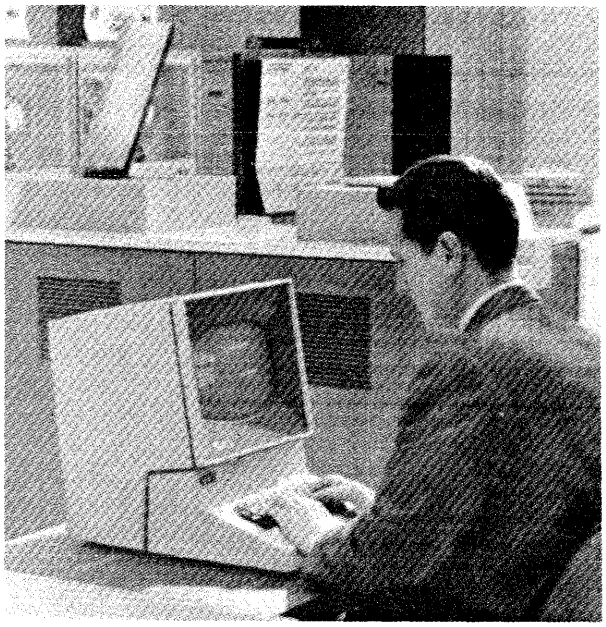
PRICING: The 1050 is available for rent or purchase. Rental prices below include maintenance; a separate arrangement is available for purchased units. The 1050 is available only on a month-to-month rental arrangement; extended-term plans are not available.

Component	Monthly Rental	Purchase	Monthly Maint.
1051 Control Unit–			
Model 1	$ 73	$3,410	$10
Model 2	49	2,475	9.75
Attachment Features			
First or Second Printer	10	500	0.50
First Reader	10	500	0.50
Second Reader	5	275	0.25
First or Second Punch	5	275	0.25
Special Features for 1051 Model 1 or 2			
Master Station	15	820	0.50
Switch Unit	3	150	0.25
Audible Alarm	5	230	0.50
Automatic EOB	5	230	0.50
Keyboard Request	5	250	0.75
Line Correction	10	560	0.75
Line Correction Release	2.50	115	0.50
Open Line Detection	5	250	–
Receive Interrupt	10	390	–
Transmit Interrupt	10	390	–
Automatic Ribbon Shift and Line Feed Select	3	105	0.25
I/O Components Table	62 SUC	50	–
Vertical Forms Control	9	400	2
Telegraph Line Attachment	5	250	0.50
Special Features for 1051 Model 1 only			
Automatic Character Fill	2	100	0.25
Home Component Recognition	3	135	0.25
Home Loop Input Component Interlock	2.50	115	0.50
Home Correction	10	560	0.50
Reader Stop–Prefix J	5	230	0.50

Input/Output Units			
1052 Printer-Keyboard (any model)*	63	2,645	18
Accelerated Carrier Return	3	135	–
1053 Printer (any model)*	49	1,940	10
Accelerated Carrier Return	3	135	–
1054 Paper Tape Reader (any model)	29	1,505	4.25
Edge-Punch Read	5	195	0.25
Feed and Take-Up Reels	5	195	0.25
1055 Paper Tape Punch (any model)	39	1,965	6.50
Edge Punching	5	245	0.25
Take-Up Reel	3	120	0.25
1056 Card Reader–			
Model 1	68	3,515	8
Model 2	58	3,030	6.75
Model 3	115	4,000	24
Card Reader Program	20	970	1
Extended Character Reading (Model 1)	20	970	1.75
51-col. Feed (Model 2)	2	90	0.25
Short Card Feed (Model 1 or 3)	5	185	0.50
High-Speed Skip (Model 1 or 3)	7	315	1.25
1057 Card Punch	73	3,005	18
Extended Character Punching	15	750	1.75
Operator Panel	10	400	0.50
1058 Printing Card Punch–			
Model 1	92	3,955	20
Model 2	136	4,415	40
Operator Panel	10	400	0.50
Special Character Arrangement A thru K	125 SUC	55	–
1092 Programmed Keyboard–			
Model 1	51	2,025	3.50
Model 2	56	2,220	5.50
Multiple Key Depression	7	280	0.50
1093 Porgrammed Keyboard–			
Model 1	46	1,830	2.25
Model 2	51	2,025	4.50
Multiple Key Depression.	7	280	0.50

*Forms Stand/Stacker ($50), Pin Feed Platen ($61.75), and Pin Feed Platen with Forms Control ($89.75) are available on a purchase-only basis. ■

IBM 2260 Display Station



The IBM 2260 is a multiple-station CRT display system designed for local or remote operation with IBM System/360 and 370 computers. A wide range of display station configurations is available.

MANAGEMENT SUMMARY

The 2260 was IBM's sole multi-station display subsystem for local or remote operation with an IBM System/360 or System/370 computer until the 3270 was announced in the summer of 1971. Because 3270 deliveries are just beginning, the 2260 is still the standard subsystem in use as of this writing. The obvious advantages of the 3270 (see Report 70D-491-12) assure the gradual demise of the 2260, even though some reprogramming is required to implement a 3270 replacement for a 2260.

The 2260 has been extensively used in both remote and local installations. As a local configuration, the 2260 has represented about the only serious competition IBM has mounted against the multi-station key-to-disk data entry systems produced by independent manufacturers such as Inforex, Computer Machinery Corporation, and Mohawk.

The chief complaint against the 2260, other than price, has been the lack of editing controls to facilitate free-form text entry.

Software support is provided for remote operation under both DOS and OS, using either BTAM or QTAM. In addition, the 2260 is supported as a direct input/output device under OS. No provision is made for supporting the 2260 as a console device. Local operation under BTAM or QTAM is also supported for both DOS and OS.

As a local device, the subsystem connects to a System/360 or System/370 multiplexer or selector channel. For remote operations, up to 24 display units share a controller and one communications line.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corp., 1133 Westchester Avenue, White Plains, New York 10604.

CONFIGURATION: The IBM 2260 display system includes one of five models of the 2848 Display Control, up to 8, 16, or 24 2260 Display Stations, and an optional IBM 1053 Model 4 Printer.

The 2848 Display Control Models, 1, 2, and 3 are primarily designed for operation in a communications environment, but are capable of operating as a computer peripheral subsystem for low-volume applications.

The 2848 Models 21 and 22 are designed for local operation as a computer peripheral subsystem only and are applicable to fast-keying, high-volume applications.

The five controller models are listed below with the appropriate 2260 Display Station model, the maximum display size per display, and the maximum number of displays that can be attached to the 2848 controller.

2848 Model	2260 Model	Characters per Display	Maximum Displays
1	2	240	24
2	2	480	16
3	1	960	8
21	2	240	24
22	2	480	16

The following table outlines the configuration rules for expansion.

Control Model	Display Adapters** Accommodated by . . .			
	Basic Control	Basic Control And . . .		
		3858 EU	3859 EU	3868 EU
1	2	6	12*	–
2	1	4	8*	–
3	1	4	4	–
21	6	–	–	12
22	4	–	–	8

*Requires 3858 Expansion Unit, which also provides attachment for 1053 Printer for Model 1 and 2 Controls.

**Each Display Adapter accommodates two displays.

Each 2260 Display Station can be located up to 2,000 cable-feet from the 2848 Controller.

IBM 2260 Display Station

The maximum of 7,680 characters of storage in the 2848 Controller can be divided among 8, 16, or 24 stations, giving a maximum display capacity of 960, 480, or 240 characters per station, respectively. For local operations, the 960-character display is not implemented.

Transmission speed can be 120 or 240 characters per second. Operation is half-duplex, with character and longitudinal parity checking. Each data of control message is acknowledged (positive or negative), thus involving numerous line-reversals and the consequent delays. At 240 characters per second, using the Bell System 201 Data Set, turnaround time is not too costly; but at the lower speed of 120 characters per second, using the Bell System 202 Data set, turnaround can require more time than transmission of control and data messages. Obviously, for large 2260 arrays, users should choose the higher transmission speed; the throughput will be more than doubled.

Only one printer can be attached to a 2260 subsystem, and it operates at only about 15 characters per second. This provides what can at best be described as an occasional-use hard-copy output facility. Printout is controlled entirely from the remote computer. □

When operating in a computer environment, the 2848 Controller is directly attached to the multiplexer or selector channel of an IBM System/360 (Model 22 up) or System/370 computer. The data transfer rate in this mode is 2560 characters per second.

COMMUNICATIONS: Asynchronous in the half-duplex mode at a transmission speed of 1200 or 2400 bits per second (120 or 240 characters per second). Transmission speeds can be field-interchanged.

The 8-level (including parity) ASCII transmission code is used; the unit code structure is 10 bits per character including unity start and stop bits.

The 2848 is connected to a voice-band communications facility via a modem compatible with the Bell System 201 or 202 Data Sets.

The 2848/2260 display system is designed to operate in an addressing and polling environment where all communication is under control of the stored program at the remote computer.

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT with a viewing area 9 inches wide by 4 inches high. The display arrangement is dependent on the 2848 Controller model. The display arrangements are:

2848 Model	Lines per Display	Characters per Line	Characters per Display
1	6	40	240
2	12	40	480
3	12	80	960
21	6	40	240
22	12	40	480

A character set of 64 ASCII characters, including uppercase alphabetics, numerics, and special symbols, is displayed in orange against a gray background. Each character is formed by a 5-by-7 dot matrix.

DEVICE CONTROL: The 2848/2260 complex operates under the control of the program stored at the remote computer. Under program control, the display complex can execute any of eight read and write commands.

Read commands initiate transfer of a displayed message, printer status (if the 1053 Printer is used), display and/or printer status, and the entire contents of the buffer memory.

Write commands condition the display or the printer to receive a message from the remote computer. Depending on the type of Write command, the computer message can be displayed in one of three ways: (1) the screen is erased and the message is written beginning at the initial memory position; (2) the message is written beginning at the current cursor location; or (3) the message is written beginning at the initial character position of the addressed line (available with the Line Address option).

Computer commands and messages directed to a 2848/2260 complex must be accompanied by a two-character address header, which identifies the control unit and display unit or printer to receive the message or command.

Messages transmitted from the 2848/2260 complex begin with a start-of-text character and a two-character address header, and end with an end-of-text character and longitudinal redundancy check character.

All commands and messages are acknowledged. The 2848/2260 complex anticipates acknowledgement from the computer following each transmitted message.

The standard cursor is destructive; each character under the cursor is erased. An optional non-destructive cursor is available.

Cursor controls provide a wraparound capability and include Advance, Backspace, Space/Erase, Down, and Up. Advance and Backspace functions space the cursor one position to the right and left, respectively. Backspace allows the cursor to retreat from the beginning of a line to the end of the previous line. Space/Erase advances the cursor by one position, erasing the character in that position. Down and Up keys function as space keys with the standard destructive cursor. With the optional non-destructive cursor, the cursor moves down or up one line; the cursor remains at the same character position within the line.

The Extended Cursor Control option requires different keyboards, with the additional control keys, and an optional feature on the 2848 Control. Basically, this option adds tab, rapid cursor movement, erase to end of line and erase to end of screen functions under operator control.

A fixed format can be entered from keyboard or received from the computer. The format uses the New Line symbol to separate variable and fixed data fields. Fixed fields contain format descriptors, immediately follow the New Line symbol, and appear to the right of the screen. Only the variable data within the format is transmitted; the fixed data remains displayed for the next data entry operation.

IBM 2260 Display Station

The Line Addressing option permits a computer message to be written beginning at the initial character position of an addressed line.

An erase function is provided to erase the entire display screen.

Keyboard operation is inhibited once message composition has been completed and is unlocked only after completion of a successful transmission.

ERROR CONTROL: Character and longitudinal parity generation and checking is performed on all commands and messages transmitted to and received from the remote computer. The 2848 Controller automatically retransmits the last message when it receives a negative acknowledgement. Computer commands are not acknowledged when incorrect parity is detected. The 2260 displasy a special symbol and the 1053 Model 4 Printer prints a special symbol in place of a character received in error. A parity error detected prior to transmission is followed by a cancel control character in the transmitted message.

The display facilitates operator recognition of keying errors.

KEYBOARD: Either of two keyboards is available as an option: 50-key alphanumeric or 26-key numeric. The alphanumeric keyboard can generate any of 64 ASCII characters including upper-case alphabetics, numerics, and specials. The numeric keyboard can generate any of 10 numerics and 10 special symbols. An alphanumeric keyboard with a numeric inset is available.

PRINTER: The 1053 Model 4 Printer is a modified version of the IBM Selectric Typewriter. This option requires a 1053 Adapter corresponding to the 2848 controller model.

The 1053 Printer prints from a set of 64 characters at a rate of 14.8 characters per second; total message length is dependent on display memory size. Printing can be initiated from the keyboard or by the program stored at the remote computer.

Forms are friction-fed on the standard printer; pin-fed forms are optional. Printing width is 13 inches; maximum form width is 15 inches.

PRICING: The 2260 and associated controller and options are available for purchase or on a month-to-month rental arrangement; extended-term lease arrangements are not available. Rentals listed below include maintenance; a separate agreement is available for purchased units.

Pricing is complex and is dependent on the size of the configuration, which can range from a single display station and a controller with minimal memory size to the maximum of 24 display stations with a 1053 Model 4 Printer.

Component	Monthly Rental	Purchase	Monthly Maint.
2260 Model 1 or 2	$ 30	$ 970	$ 8.25
Keyboards, with Extended Cursor Control–			
Alphameric with Numeric Inset	39	1,170	5.00
Alphameric	30	900	1.50
Numeric	20	600	1.00
Keyboards, without Extended Cursor Control–			
Alphameric with Numeric Inset	29	900	5.00
Alphameric	20	600	1.50
Numeric	10	300	1.00
2848 Display Control–			
Model 1	360	15,715	23.00
Model 2	390	16,840	23.50
Model 3	420	17,975	24.00
Model 21	725	32,735	28.00
Model 22	775	34,920	28.00
Display Adapters–			
Model 1	40	1,505	2.00
Model 2	80	3,005	4.00
Model 3	100	3,765	5.00
Model 21	58	2,620	2.00
Model 22	116	5,240	3.00
Expansion Units–			
3858	55	2,260	–
3859	45	1,835	–
3868	49	2,180	–
Extended Cursor Control	45	1,665	1.00
Line Addressing	10	450	1.25
Non-destructive Cursor	10	430	1.00
Non-destructive Cursor Adapter (required on each Display Adapter)	5	215	0.50
1053 Adapter for Models 1 or 2 (requires Expansion Unit 3858)	40	1,505	3.25
1053 Adapter for Model 3	40	1,505	3.25
1053 Adapter for Models 21 or 22	102	4,585	5.50
1053 Model 4 Printer	49	1,940	10.00
Carrier			
Accelerater Return	3	135	–
Pin-Feed Platen	–	61.75	–

Typical Average Cost Per Display

Display Size, Characters	Cost per Month per Display* Number of Displays					
	4	8	12	16	20	24
Remote System:						
240 chars.	$170	$132	$115	$109	$103	$ 99
480 chars.	211	156	141	130	–	–
960 chars.	226	168	–	–	–	–
Local System:						
240 chars.	270	180	149	137	128	121
480 chars.	312	215	187	170	–	–

*Includes Control, Displays, Alphanumeric Keyboards, Display Adapters, and Expansion Units, where needed; no other options are included. ■

IBM 2265 Display Station

The IBM 2265 is a single-station video display system with optional printer, designed as a remote terminal for IBM System/360 and 370 computers. A maximum of 16 units can be attached to a communications line to operate in a party-line environment.

MANAGEMENT SUMMARY

The 2265 Display Station was introduced by IBM for installations needing only a few displays at a location. Although the companion multi-station 2260 can be configured for just a few displays, its cost is substantially more than for an equivalent 2265 arrangement. Operator, editing, and display characteristics of the two display units are very similar.

If multiple 2265's are desired at the same location, they can share the same line in a party-line arrangement, though separate data sets are required for each station.

The announcement of the IBM 3270 display systems (Report 70D-491-11), which include stand-alone models that are cheaper, faster, and more powerful than the 2265, assuredly marked the passing of the 2265 Display Station in spite of compatibility questions. The 2265, like the IBM 2260 multi-station display system, was designed for structured data entry applications. As such, editing functions for free-form text entry were not provided. Advances made by independent CRT display manufacturers informed users that such capabilities were entirely feasible. This lack is the chief criticism of the 2265, other than its comparatively high price. □

CHARACTERISTICS

MANUFACTURER: International Business Machines Corp., 1133 Westchester Avenue, White Plains, New York 10604.

CONFIGURATION: An IBM 2265 display system includes one 2845 Display Control, one 2265 Model 1 Display Station, and, optionally, a keyboard and a 1053 Model 4 Printer.

The 2845 Display Control contains a communications interface, a 960-character buffer memory, and character generation and control logic.

COMMUNICATIONS: Asynchronous in the half-duplex mode at 1200 or 2400 bits per second (120 or 240 characters per second). Transmission speeds can be field-interchanged.

The 8-level (including parity) ASCII transmission code is used; the unit code structure is 10 bits per character including unity start and stop bits.

The 2845 is connected to a voice-band communications facility via a modem compatible with the Bell System 201 or 202 Data Sets.

The 2845/2265 display system is designed to operate in an addressing and polling environment where all communication is under control of the stored program in the remote computer. Up to sixteen 2845/2265 display systems can be connected to a single leased or private line to operate in a party-line arrangement.

The 2845/2265 display system is compatible with the IBM 2701 Data Adapter Unit equipped with an IBM Terminal Adapter Type III. The Integrated Communications Adapter for the System/370 Model 135 also supports a 2845/2265.

CRT DISPLAY: Via a 14-inch (diagonal measurement) CRT; either of two display arrangements can be specified by the user: 15 lines of 64 characters each or 12 lines of 80 characters each. The first display arrangement provides a viewing area 10.3 inches wide by 4.6 inches high; the second, a viewing area 10.3 inches wide by 3.0 inches high. Both display arrangements total 960 characters per display; display arrangements can be field-interchanged.

A character set of 64 ASCII stroke-generated characters, including upper-case alphabetics, numerics, and special symbols, is displayed in green against a gray background.

DEVICE CONTROL: The 2845/2265 complex operates under the control of the program stored in the remote computer. Under program control, the 2845/2265 can execute any of eight read and write commands. ➤

IBM 2265 DISPLAY STATION

Read commands initiate transfer of a displayed message, printer status (if the 1053 Printer is attached), display and/or printer status, and the entire contents of the buffer memory.

Write commands condition the display or the printer to receive a message from the remote computer. Depending on the type of Write command, the computer message can be displayed in one of three ways: (1) the screen is erased and the message is written beginning at the initial memory position; (2) the message is written beginning at the current cursor location; or (3) the message is written beginning at the initial character position of the addressed line (available with the Line Address option).

The 2845/2265 requires all computer commands and messages to be accompanied by a two-character address header.

Messages transmitted from the 2845/2265 begin with a start-of-text character and a two-character address header, and end with an end-of-text character and longitudinal redundancy check character.

All commands and messages are acknowledged. Acknowledgement to transmitted messages is anticipated by the 2845/2265.

The standard cursor is non-destructive; an optional destructive cursor is available. The destructive cursor erases each character under the cursor.

Cursor controls provide a wraparound capability and include Advance, Backspace, Space/Erase, Down, and UP. Advance and Backspace functions space the cursor one position to the right and left, respectively. The Backspace function allows the cursor to retreat from the beginning of a line to the end of the previous line. Space/Erase advances the cursor by one position, erasing the character in that position. The Down and Up functions move the cursor forward or backward by one line; the cursor remains at the same character position within the line.

Repetitive cursor movement can be initiated by holding down the Advance, Backspace, and Space/Erase keys.

A fixed format can be entered from the keyboard or received from the computer. The format uses the New Line symbol to separate variable and fixed data fields. Fixed fields contain format descriptors, immediately follow the New Line symbol, and appear to the right of the screen. Only the variable data within the format is transmitted; the fixed data remains displayed for the next data-entry operation.

The Tab feature permits the operator to initiate a tab function via the keyboard. Once initiated, the keyboard is locked and the cursor searches line by line for a colon, which is used for a tab stop. The cursor halts at the character position following the colon and the keyboard is unlocked. The Tab feature ignores the New Line symbol. Colons can be entered from the keyboard or by program.

The Line Addressing option permits a computer message to be written beginning at the initial character position of an addressed line.

Keyboard erase functions include Display Erase (erases entire screen), Line Erase, and Screen Erase (erases from cursor to end of screen).

Keyboard operation is inhibited once message composition has been completed and is unlocked only after completion of a successful transmission.

ERROR CONTROL: Character and longitudinal parity generation and checking are performed on all commands and messages transmitted to and received from the remote computer. Even parity is employed. The 2845 Controller automatically retransmits the last message when it receives a negative acknowledgement. Computer commands are not acknowledged when incorrect parity is detected. The 2265 displays a special symbol in place of a character received in error.

A parity error detected prior to transmission is followed by a cancel control character in the transmitted message.

The display facilitates operator recognition of keying errors.

KEYBOARD: 50-key typewriter-style. A separate group of 5 keys provides control and erasure functions.

Any of 64 ASCII characters, including upper-case alphabetics, numerics, and special characters, can be generated from the keyboard.

The keyboard can be attached to or physically separated from the display unit by a 5-foot cable.

PRINTER: The 1053 Model 4 Printer is a modified version of the IBM Selectric Typewriter. This option requires a 1053 Adapter corresponding to the user-specified display arrangement.

The 1053 Printer prints from a set of 64 characters at a rate of 14.8 characters per second; total message length is 240 characters. Printing can be initiated from the keyboard or by the program stored in the remote computer.

Forms are friction-fed on the standard printer; pin-fed forms are optional. Printing width is 13 inches, and maximum form width is 15 inches.

PRICING: The 2265 and its associated controller and options are available on a purchase basis or on a month-to-month rental arrangement; no extended-term lease is available. The rentals listed below include maintenance; a separate arrangement is available for purchased units.

Component	Monthly Rental	Purchase	Monthly Maint.
2265 Model 1	$170	$5,430	$40
Alphameric Keyboard	29	900	5
2845 Display Control	170	8,295	28.25
Destructive Cursor	–	–	–
Line Addressing	10	450	–
Tab	5	180	–
1053 Adapter	73	3,275	2.25
1053 Model 4 Printer	49	1,940	10
Accelerated Carrier Return	3	135	–
Pin-Feed Platen	–	61.75	–

IBM 2770 Data Communication System

MANAGEMENT SUMMARY

The IBM 2770 system is designed to fill the gap between the 1050 system and the 2780 terminal. It is another in the growing number of terminals using IBM's own line discipline technique called Binary Synchronous Communications (BSC). Besides the 2770, this non-ASCII group includes the 2922, the 3780, the 3735, the 2780, the 1130 computer system, and the System/360 Model 20 computer system. (While ASCII code can be accommodated, BSC line control technique differs from ASCII.)

In fact, all of these devices can share a common communications line, with a System/360 or System/370 acting as the central control.

The 2770 is billed as a media-oriented terminal rather than a device-oriented one. What this means is that the basic control unit can accommodate a wide range of units, including punched cards, punched tape input/output, printer/keyboard input/output, display/keyboard, MICR input, and magnetic tape input (via Model 50 Magnetic Data Inscribers). There are, of course, limitations on configuration. If each of the items in the preceding list is taken as a "group", then a maximum 2770 configuration could include the printer/keyboard and any two or three other groups, with no group allowed to repeat. The Model 50 group can include one or two Inscribers, which can also be used off-line. If the printer and display are used in the same configuration, only one keyboard is provided.

The result of all this is a terminal that will immediately excite the imagination of a good many systems analysts. In addition to the configuration possibilities, IBM has implemented a double buffer and control system that allows mixed conversational and batch operations. Inquiry/response operations can be performed using, say, a display and keyboard, while a deck of cards is being read. These operations are controlled by the remote computer through selective addressing and polling of individual components and block transmission.

The 2770 fills the gap between the low-volume applications handled by the IBM 1050 system and the high-volume applications handled by the 3780. Configurations can include provisions for printed copy, keyboard input, punched card I/O, punched tape I/O, displayed data, magnetic tape input, and input from documents encoded with magnetic ink characters.

CHARACTERISTICS

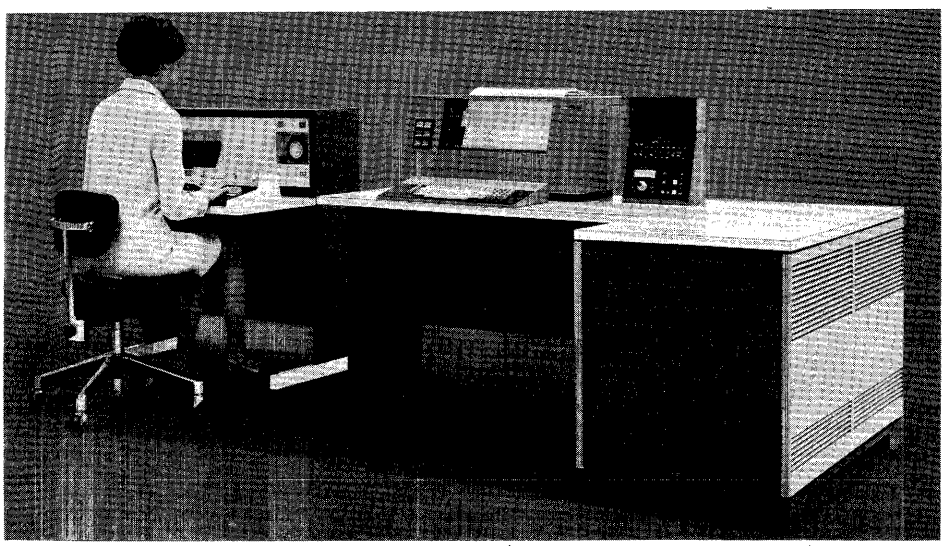
MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604.

CONFIGURATION: The basic 2772 Control includes four pairs of input/output positions. The first pair is dedicated to a printer (output) and keyboard (input). Another pair is dedicated to a data communications interface. Each of the two remaining pairs can accommodate an input and output device of the same medium. The Expanded I/O Capability option adds one I/O position; with this option three media can be accommodated in addition to the keyboard and a printer. Media accommodated by the 2770 include:

- 80-column cards (input and output);
- 96-column cards (input and output);
- CRT display (output);
- Paper tape (input and output);
- Magnetic tape (input);
- Magnetic ink character-encoded documents (input).

With one exception, different media cannot be mixed on the same I/O pair. The 2203 Line Printer can be mixed with either a magnetic tape or a MICR input unit. The 2203 can also share an I/O pair with the keyboard in place of a serial printer or be placed on a separate I/O pair. Two Model 50 Magnetic Data Inscribers can share a single input position.

COMMUNICATIONS: Transmission is half-duplex, synchronous at 4800, 2400, 2000, or 1200 bits/second using either 8-level EBCDIC or 8-level ASCII (with parity) transmission code. The 2770 employs the IBM Binary Synchronous Communications technique. IBM, common-



One of the almost endless configuration possibilities, this 2770 system features a Model 50 Data Inscriber on the left for magnetic tape input and off-line data preparation. Also shown is the 2213 matrix printer and control console. The configuration flexibility is exciting in terms of systems analysis, but the system is difficult to cost-justify in most "ordinary" information handling applications.

IBM 2770 Data Communication System

The disparity between the transmission speed and some of the slower devices is handled by the simple expedient of not acknowledging the second buffer load until the first is emptied. The slowest unit, the card punch, will require several seconds to punch out the contents of a buffer; any provision at the transmitting end of using a time-out check to identify loss of connection or other malfunction will need to be examined carefully.

The place of the 2770 in the overall scheme of data communications is difficult to ascertain. The system was introduced in July 1969, and customer deliveries began in mid-1970. The experience of the Datapro staff is talking with users and IBM competitors reveals that the 2770 has surprisingly little visibility. Yet the system is still in production, indicating that IBM is finding buyers for it. The 2770 covers an immense price range. A simple terminal with just a keyboard and low-speed printer rents for $350 per month, whereas a configuration with all control options, the high-speed printer, and an 80-column card reader rents for about $1,650 per month. Adding more peripherals can inflate the price even further. And the system does not have programmability.

The 2770 does have one very significant thing going for it – flexibility. For those locations that have a low volume of data communications, but have a wide-ranging need for various types of data input and output, the 2770 is an easy choice. It can be easily fitted into an existing IBM telecommunications network and is cheaper than several separate IBM terminals. This ease reduces the need for management decisions about changing existing procedures involving several types of input/output media. (One of IBM's strongest assets in the marketing of computers and computerized procedures is that its product line is extensive enough to support nearly any kind of system that a user can dream up. And some of those dreams have been nightmares.) No doubt there are applications that can benefit from a wide range of input/output media to simplify interchanging information among related departments. If you are considering the 2770, take care that its flexibility is indeed worthwhile and cost-justifiable, and not merely convenient.

The 2770 is supported under both DOS and OS. Under DOS, it is supported by BTAM for both point-to-point and multi-point data communications. Under OS, it is supported by BTAM and TCAM for point-to-point and multi-point operation as well as for RJE work station operation. □

carrier, or independent modems can be used to interface the 2770 with a voice-band communications facility. A synchronous clock is available for data sets not having an internal clock.

The 2770 can operate in a point-to-point arrangement with another 2770 or computer, or in a multipoint arrangement.

Transmission characteristics are compatible with the IBM 2701 Data Adapter Unit, the 2703 Transmission Control, and the Integrated Communications Attachment (ICA) in the IBM System/360 Model 25 and System/370 Model 135, when equipped for Binary Synchronous transmission.

The 2770 can operate in a multipoint arrangement with other IBM Binary Synchronous devices such as the IBM 2780 and the 1130 and System/360 Model 20 computers when the Multi-Point Data Link Control is specified.

BSC compatibility also means that the 2770 can dial through the same computer telephone number as other BSC terminals. Automatic answering is provided as an option for operation over the dial network.

DEVICE CONTROL: The 2772 Control Unit controls all operations of a 2770 system. Operator control is via switches located on the operator's console supplied with the 2772.

Two basic operating modes are provided: Line and Home. Line mode is used for communicating with a remote 2770 or computer. In the home mode, the 2772 is disconnected from the communications line, and data can be transferred under manual control between the components within the station. This mode is used for performing local input/output operations such as input preparation.

A pair of 128-character buffers service the communications line and the I/O units alternately to provide overlapping operation. The Buffer Expansion feature expands each buffer to 256 characters. A second feature, Buffer Expansion, Additional, in conjunction with Buffer Expansion, increases each buffer to 512 characters. With either expansion, multiple, variable-length card records can be inserted into one block. Blanks at the ends of cards are deleted and not transmitted.

Communication in a point-to-point arrangement between two 2770 systems is performed by a line-contention procedure; i.e., the station ready to transmit contends for the line by bidding.

Communication in a multi-point arrangement is performed by polling and selection initiated under program control at the remote computer. Both station and input/output device can be polled or selected.

With the optional Conversational Mode feature, a 2770 terminal can accept a response to an inquiry without having been selected prior to the response.

Record length is variable except for basic-buffer card input/output, which remains fixed at 80 charcters. Record length is defined by control characters.

The EBCDIC Transparency option permits the operator to manually disable the control-character recognition capabilities of the 2772 to allow transmission and reception of all code combination of the EBCDIC code. Transparency defeats the transmission of variable-length records to the printer.

An optional feature, Keyboard Correction, permits changing a character or line of data contained in the buffer.

Another option, Transmit Receive Monitor Print, permits printing the contents of a buffer after it has been filled by an I/O device or after the data has been transferred to an I/O device independent of devices selected by the communications procedure.

Terminal identification is provided at two levels, both optional, for 2770 configurations transmitting to a computer over the switched telephone network. ID causes an initial transmission of two identical characters selected by the user from 64 EBCDIC or 32 ASCII characters. Security ID adds another three distinct characters to the two-character sequence provided by the ID option; a total of five characters are transmitted. The three additional characters can be selected from a group of 192 characters (EBCDIC) or 96 characters (ASCII).

Efficiency of transmission can be improved in most cases by the Space Compression/Expansion optional feature. With this option, data transmitted from any device except a 5496 Data Recorder or 1255 Magnetic Character Reader

IBM 2770 Data Communication System

is automatically checked for contiguous blanks. If a sequence of two or more is found, it is replaced by a two-character sequence identifying the number of blanks. Incoming data is automatically reconstituted if the control sequence is encountered. Naturally, this feature is inoperative when transmitting in transparency mode.

ERROR CONTROL: Cyclic redundancy check characters (two) are generated for EBCDIC-coded transmissions; a cyclic redundancy check is performed on all received EBCDIC-coded messages. Odd character parity and longitudinal parity checks are performed on all received ASCII-coded messages.

A format check in addition to an odd/even block check count is performed on all transmissions.

Automatic retransmission in response to a negative acknowledgement is a standard feature.

KEYBOARD: Typewriter style with Typamatic action (repetitive keys). The keyboard includes all necessary control functions, including display control functions when the 2265 Display Station is included in the 2770 system configuration.

PRINTERS: The 2213 Printer is rated at 66 characters/second; printing is performed via a 5-by-7 dot wire matrix. The unit prints up to 132 characters/line, spaced at 10 characters/inch, and accommodates ASCII or EBCDIC character sets, as specified by the user. Both sets provide upper-case alphabetics and numerics; EBCDIC includes 26 special symbols; ASCII, 27.

Model 1 has a 15-inch friction or pin (optional) feed platen and accommodates continuous single-part (friction-feed) or six-part (pin-feed) forms up to 12 inches (friction-feed) or 13-7/8 inches wide (pin-feed). Forms can range from 3 to 14 inches in length. Veritcal spacing is 6 or 8 lines/inch. Roll paper feed and forms stacking are optional; roll paper feed includes a paper guide and tear bar.

Model 2 has a tractor carriage controlled by a 12-channel tape loop and accommodates continuous forms from 3 to 14-7/8 inches wide and up to 0.025 inches thick. Forms can range from 3 to 14 inches in length. Vertical spacing is 6 or 8 lines/inch. Forms stacking is standard.

The 1053 Model 1 Printer is the same unit used in the 1050 System and is built around an IBM Selectric Typewriter. It can print 88 different symbols, including upper- and lower-case alphabetics, at 14.8 or 8.33 characters/sec.; a 15-inch, friction-feed carriage with a 13-inch writing line (130 characters) is provided. A pin-feed platen is optional. Vertical spacing is 6 or 8 lines/inch.

The 2203 Printer uses an oscillating bar mechanism and interchangable character sets of 39, 52, or 63 characters. Two models are available, differing only in operating speed. Model A1 operates at a peak speed of 425, 350, or 300 lines per minute when equipped with a 39-, 52-, or 63-character set, respectively. Corresponding speeds for Model A2 are 300, 260, and 230 lines per minute. Skipping speed is about 15 inches per second. Printing pitch is 10 characters per inch horizontally and 6 or 8 lines per inch vertically; 120 printing positions are standard, with 144 optional. Allowable forms width is from 4 to 16.75 inches. Vertical format control is exercised through a 12-channel tape. Optionally, the 2203 can be equipped with a dual-feed carriage that locates a second carriage above the first; forms can be separate or overlapped. The second carriage has a 6-channel tape control, with an additional 6 channels optional.

80-COLUMN PUNCHED CARDS: The 2502 Card Reader reads 80-column cards punched in ASCII or EBCDIC code (determined by transmission code selection). Two models are available, which differ only in rated speed. Model A1 reads 150 cards/minute, while Model A2 reads 300 cards/minutes. The input hopper holds 700 cards, and the output stacker holds 600 cards.

Options permit reading 51- or 80-column cards, 66- or 80-column cards, and mark-sense (optical) reading. Mark-sense reading permits marking up to 40 columns; marked and/or punched data can be read from the same card. Cards having unacceptable marks are offset-stacked.

The 545 Output Punch punches 80-column cards in EBCDIC or ASCII codes (determined by transmission code selection). Two models are available.

Model 3 punches only, at a rated speed of 20 columns/second, while Model 4 punches and prints at a rated speed of 16 columns/second.

In "keyboard mode," the punch operates as a free-standing keypunch (it has its own keyboard) and performs the functions of a basic IBM 29 Card Punch.

96-COLUMN PUNCHED CARDS: The 5496 Data Recorder can be used as a card reader or card punch, as determined by a switch setting on the control panel. Alternatively, it can be used off-line as a keypunch. The 5496 is discussed in Report 70D-491-22.

PAPER TAPE READER: The 1017 Paper Tape Reader reads fully punched 11/16-, 7/8-, or 1-inch, 5-, 6-, 7-, or 8-level paper or laminated polyester tape at a rated speed of 120 character/second. Two models are available. Model 1 is a strip reader, while Model 2 includes 8.5-inch supply and take-up reels which can accommodate 1000 feet of tape.

PAPER TAPE PUNCH: The 1018 Paper Tape Punch punches 5-, 6-, 7-, or 8-level codes into 11/16-, 7/8-, or 1-inch chad-type paper tape or laminated polyester tape at a rated speed of 120 characters/second. A 10.5-inch supply reel can accommodate 1000 feet of tape; a 10.5-inch take-up reel is optional.

CRT Display: IBM 2265 Display Station. The 2265 Model 2 is used with the 2770; however, its characteristics do not differ from Model 1, as described in Report 70D-491-06.

MAGNETIC TAPE READER: IBM Model 50 Magnetic Data Inscriber, described in Report 70D-491-01. Two Model 50's can share a single input position.

MAGNETIC CHARACTER READER: The 1255 Magnetic Character Reader reads and/or sorts up to 500 six-inch documents/minute into six stackers. The unit reads any or all of six fields and sorts on any field. Two passes are required to sort both even and odd digits. As an option, sorting can be performed in two passes on digits 0 to 4 and 5 to 9. The encoded fields are designated as amount, transit-routing (both fixed-length), process control, serial number (both variable-length), and account number (variable or fixed length).

The input hopper holds 5.5 inches of documents, and each of the six output stackers holds 2.5 inches of documents. The 1255 accommodates intermixed paper and card documents having widths of 2.5 to 4.25 inches, lengths of 5.75 to 8.875 inches, and thicknesses of 0.003 to 0.007 inches. Paper stock can be 20 to 44 pounds. The type font, print quality, and code line arrangement on the documents must meet the specifications recommended by the American Bankers Association Technical Committee on Check Handling.

Adding the 1255 requires buffer expansion to 256 characters. The number of records (documents) held by the buffer is determined by the maximum record length for the fields selected for reading. The number of records per buffer is set to 4, 6, 8, 10, 12 and can only be changed by an IBM customer engineer. Maximum record length is 53, 41, 30, 24, or 20 characters, respectively, including special symbols. An error condition results from exceeding the record length.

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➤ **Options available for the 1255 include Balance-List, 51-column sorting, and self-checking numbers.**

PRICING: Pricing is complex due to the number of components and optional features that make up a 2770 configuration. The 2770 is available for purchase or on a month-to-month rental arrangement. Only the 2203 Printer is available under an extended-term lease agreement. Rentals below include maintenance; a separate agreement is available for purchased units.

Component	Monthly Rental	Purchase	Monthly Maintenance
2772 Multi-Purpose Control Unit	$ 265	$11,660	$ 54.00
Automatic Answering	10	440	1.00
Buffer Expansion	25	1,065	11.00
Buffer Expansion, Additional	55	2,420	1.50
Conversational Mode	5	220	–
EBCDIC Transparency	10	440	1.00
Expanded I/O Capability	40	1,760	0.50
Identification	10	440	1.00
Security Identification	15	660	1.00
Keyboard Correction	5	220	1.50
Keylock	–	35	–
Multi-Point Data Link Control	15	660	2.00
Space Compression/Expansion	40	1,760	2.50
Synchronous Clock	25	1,065	3.00
3875 Attachment Feature	5	220	0.50
Transmit-Receive Monitor Print	20	880	2.50
Model 50 Magnetic Data Inscriber –			
First*	244	12,915	82.50
Second*	211	11,469	81.50
1053 Model 1 Printer*	89	3,640	11.50
Ribbon Shift	5	220	–
Accelerated Carrier Return	3	135	–
Forms Feed Control (1)	15	660	1.00
Pin-Feed Platen	–	61.50	–
Forms Stand/Stacker (1)	–	50	–
2213 Printer–			
Model 1*	155	5,665	47.50
Roll Paper Feed	10	500	–
Pin-Feed Platen	–	61.75	–
Forms Stand/Stacker	–	50	–
Model 2*	195	8,165	51.50
2203 Printer –			
Model A1*	740	28,510	107.50
Model A2*	620	24,140	107.50
Additional 24 Print Positions	65	2,860	5.50
Dual-Feed Carriage	100	4,000	8.50
Tape Channels, 6 Additional	10	340	1.00
1017 Paper Tape Reader –			
Model 1*	74	3,395	20.00
Model 2*	98	4,630	23.00
1018 Paper Tape Punch*	153	6,885	47.50
Take-Up Reels	25	1,190	6.00
1255 Magnetic Character Reader –			
Model 1*	849	40,740	213.00
Model 2*	1,024	46,355	338.00
Model 3*	1,344	62,335	443.00
Balance List	68	3,260	6.00
Dash Transmission	(2)	35	–
51-Column Card Sorting	15	720	–
High-Order Zero and Blank Selection	30	1,440	5.00
Self-Checking Number	49	2,075	3.00
2502 Card Reader –			
Model A1*	170	8,830	41.50
Model A2*	203	9,545	41.50
Interchangeable Feed, 51/80 or 66/80 column	25	1,260	13.00
Optical Mark Read	125	660	2.00
545 Card Punch –			
Model 3*	150	6,740	48.00
Model 4*	169	7,855	48.00
2265 Model 2 Display Station*	238	8,420	52.00
Display Format Control	5	220	–
5496 Data Recorder*	300	14,205	92.00

*Includes attachment features.
(1) To combine Forms Control and Pin-Feed Platen on 1053 costs an additional $28 on a purchase-only basis.
(2) $50 one-time charge

A major part of the complexity of pricing out a 2770 configuration is the pairs of special features required for almost all peripheral attachments and some optional functions – one feature on the peripheral device and one on the 2772 Control. To simplify this situation, the prices of such required features are included in the indicated prices for each peripheral and option. The thing to keep in mind is that if you go to order a 2770 system, there will be many additional features to specify for connection of the peripheral devices – but their prices are included in the figures shown in this report. ■

IBM 2780 Data Transmission Terminal

MANAGEMENT SUMMARY

The IBM 2780 has carved for itself a permanent place in the field of data communications, even though it will soon be seen no more. The announcement of IBM's 3780, with higher performance and lower cost, has sounded its death knell. However, the 2780 is one of the most widely used remote batch terminals, with an estimated 8000 in use. The 2780's niche is largely due to the rise of intelligent terminals with the capability to emulate other terminals. The most commonly emulated terminals are the IBM 2780, the Control Data 200 User Terminal, the UNIVAC DCT 2000, and the UNIVAC 1004 – all now obsolescent (except possibly the DCT 2000).

The 2780, initially delivered in 1967, was not the first high-performance remote batch terminal, but it was the first really popular one. Although punched card output was offered, it was seldom used. The chief use of the 2780 has been as a high-speed printer terminal, with card reading an important, but secondary, function.

The 2780 was the first IBM terminal to use the Binary Synchronous Communications (BSC or bisync) technique. All of IBM's terminals announced since 1967 have used this line control technique, which differs from the standard ASCII technique. Only in the field of typewriter and CRT terminals has the ASCII standard held its own.

The transmission technique used in the 2708 was carried over from its predecessor, the IBM 1978 Print Read Punch Terminal. Transmission is blocked in such a way that quantities of data (sub-blocks) equivalent to several print lines or punched cards are transmitted before an interruption is required to acknowledge the transmission. This concept speeds transmission in a low-error environment, in that a greater amount of information can be transmitted during a given period of time.

The 2780's capability to transmit records of varying length augments the blocking concept. With this capability, record size corresponds to the number of columns punched in an 80-column card or the number of print positions to be printed. This is in contrast to fixed-length records, where positions containing no data must be filled in with spaces.

Another interesting feature borrowed from the 1978 is the Auto Turnaround option. This feature automatically switches the 2780 to the Receive mode and readies the card punch when the reader senses a blank card following a transmission. □

The IBM 2780 is a widely used remote batch terminal that employs the IBM Binary Synchronous Communications technique. Four models provide different combinations of punched card input/output and printed output capabilities. Transmission speeds range between 1200 and 4800 bits/second.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS: Four models provide different combinations of punched card input/output and printed output capabilities:

- Model 1 provides punched card input and printed output;
- Model 2 provides punched card input/output and printed output;
- Model 3 provides printed output; and
- Model 4 provides punched card input/output.

COMMUNICATIONS: Transmission is half-duplex, synchronous at 4800, 2400, 2000, or 1200 bits/second. One of three transmission codes can be specified: 8-level EBCDIC, 8-level ASCII (with parity), or SBT (six-bit Transcode). The 2780 employs the IBM Binary Synchronous Communications technique. IBM, common-carrier, or independent modems can be used to interface the 2780 with a voice-band communications facility.

Transmission characteristics are compatible with the IBM 2701 Data Adapter Unit, 2703 Transmission Control, or 3705 Communications Controller when they are equipped with the appropriate adapters and features. Communication is also possible with an IBM System/360 Model 20 or 25, System/370 Model 135, System/3, 1130, or 1800 computer system through various optional, built-in adapters; none of these configurations supports the use of SBT, and the 1130 supports only EBCDIC.

The 2780 can operate in a multipoint arrangement with other IBM Binary Synchronous devices such as the IBM 2770, and with the IBM 1130 and System/360 Model 20 computers when the Multi-point Line Control is specified. All devices operating on the same line are limited to the same transmission code.

Automatic answering is provided as an option for operation over the dial network.

DEVICE CONTROL: Control is provided via an integral control unit and through switches on the operator panel.

Six operating modes include Off-line, Receive, Transmit, Transmit Transparent, Punch, and Print.

The Off-line mode lists punched card data; one single-spaced line is printed per card.

The Receive and Transmit modes print or punch received data and transmit data read from cards. The receiving device is program-selected. ➤

IBM 2780 Data Transmission Terminal

The optional Transmit Transparent mode performs the same operation as the Transmit mode, but with control-character recognition disabled to allow the transmission of all EBCDIC code combinations.

The Punch and Print modes allow operator selection of the receiving device. Data received in the Punch mode is limited to 80-character records; data received in the Print mode is limited to 80-, 120-, or 144-character records (as determined by the Print Line option). Each record is equivalent to one print line.

All messages are blocked. The standard 2780 accommodates two records/block, but with the Multiple Record Transmission option up to seven records/block (limited to a total of 400 characters/block) can be accommodated. (This option and 4800-bit/second transmission capabilities are mutually exclusive.)

Record length is variable up to 80 text characters for the reader, punch, and basic printer. With the extended print line, record length can vary up to the 120- or 144-character limit. Record length is defined by an end-of-media code punched into each card and entered at the end of each transmitted record. Fixed-length records are required with the Transparency feature.

The 2780 acknowledges a received message and expects an acknowledgement to a transmitted message following each message block.

With the optional Multipoint Line Control feature, the 2780 can operate in a multi-point arrangement where communication is performed by polling and selection initiated by the program stored in the remote computer. The polling and selection sequence addresses both terminal and input/output device.

The Auto Turnaround option automatically switches the 2780 to the Receive mode and readies the card punch when the reader senses a blank card.

When operating over the dial network, the 2780, its I/O configuration, features, and limitations can be identified by the remote computer under program control when the optional Terminal Identification feature is specified. Specification of the SBT transmission code precludes this feature.

The 2780 uses a pair of buffers, connected in serial fashion, to service the communications line and the input/output devices. The 400-character line buffer interfaces both the communications line and the 200-character I/O buffer. This arrangement provides overlapping operation of I/O and communication functions.

Horizontal formatting is optional and is implemented via a stored horizontal format record composed of space characters interspersed with horizontal tab characters. Operating in EBCDIC Transparency or Off-line modes precludes this feature.

Vertical formatting is implemented via a 12-channel punched tape loop. A vertical formatting command within the received print record can specify a skip of one to three vertical spaces, or to one of eight tape loop channels. Vertical formatting is performed after a line is printed.

ERROR CONTROL: Cyclic redundancy check characters (two) are generated for EBCDIC- or SBT-coded transmission; a cyclic redundancy check is performed on all received EBCDIC- or SBT-coded messages. Odd character and longitudinal parity is generated for ASCII-coded transmissions and checked on all received ASCII-coded messages.

A negative acknowledgement is transmitted in response to an incorrectly received message block. The 2780 automatically retransmits a message block up to three times in response to successive negative acknowledgements; the terminal halts and the operator is alerted both audibly and visually, that human intervention is required.

An odd/even block check is performed on all message blocks received, and the corresponding odd/even block count is generated for all transmitted blocks. This is to ensure that message blocks are not lost or duplicated.

CARD READ/PUNCH: Reads and punches 80-column cards at rated speeds of 400 and 355 cards/minute. Acceptable card codes include EBCDIC, ASCII, or SBT, as specified by the user. The input hopper holds 1200 cards, and the output stacker holds 1300 cards.

PRINTER: Prints at a rated speed of 240 lines/minute. The standard printer has 80 print positions, with 120 or 144 available as options. The printer accommodates ASCII, EBCDIC, or SBT character sets as specified by user. ASCII provides 63 print symbols, EBCDIC, 52 (39 or 63 optional), and SBT, 47 (39 optional).

Horizontal spacing is 10 characters/inch; vertical spacing is 6 or 8 lines/inch. The printer accommodates pin-fed continuous six-part forms from 4 to 16-3/4 inches wide and up to 17 inches long. Vertical tabulation is standard; horizontal tabulation is optional.

PRICING: The IBM 2780 is available for purchase or on a month-to-month lease; extended-term leases are not available. Rentals below include maintenance; a separate agreement is available for purchased units.

Component	Monthly Rental	Purchase	Monthly Maint.
2780 Model 1	$875	$38,410	$215
2780 Model 2	970	42,680	260
2780 Model 3	725	32,010	200
2780 Model 4	680	29,875	180
Options			
Automatic Answering	15	660	1
Automatic Turnaround	10	440	1
Multiple Record Transmission	15	660	2
Multi-Point Line Control	25	1,065	2.50
Printer Horizontal Format Control	29	925	1
120-Character Print Line	82	3,630	6
144-Character Print Line	44	1,920	3
Selective Character Set*	25	1,065	3.50
Synchronous Clock**	25	1,065	1
Terminal Identification	25	1,100	2
EBCDIC Transparency	15	660	0.50

*The Selective Character Set option is required for an ASCII terminal, or when one of the non-standard SBT or EBCDIC character sets is selected. Any character set can be specified if this option is installed when the terminal is first acquired. For later acquisition, additional character sets cost from $450 to $500 (one-time charge).

**For operation at 1200 bps with data sets not having an internal clock (asynchronous). ■

IBM 2721 Portable Audio Terminal

MANAGEMENT SUMMARY

Have you ever imagined using a data communications terminal that you can carry with you, tuck under the seat of any airplane, and talk to your computer by simply attaching it to the nearest telephone, which may be a phone booth at the air terminal or the corner drugstore?

The IBM 2721 Portable Audio Terminal satisfies these requirements and more. The terminal, consisting of keyboard, speaker, and internal logic, is contained in an attache-like case that measures 16 by 11 by 4 inches and weighs just 12 pounds–less than the average weight of a portable typewriter.

Operation is simple. The user places the 2721 near a phone, opens the case (the lid can be removed for added convenience), cradles the telephone handset in the terminal's acoustic telephone coupler (which also connects battery power), and, before attempting communications, checks the battery strength using the Battery Level indicator. A good indication allows the user to dial the computer and, when connection has been established, to begin communication with the computer facility. If the battery level is unsatisfactory, the user simply plugs the 2721 into a wall outlet to recharge the battery while simultaneously powering the unit for communications.

On first inspection, the casual observer will be nonplussed by the 2721's unorthodox keyboard. Its flat construction and absence of conventional keys gives it the appearance of a printed picture of a keyboard. A permanently-attached plastic overlay with printed keys is substituted ▷

The IBM 2721 provides the user with a convenient "carry-along" data communications capability for just $20 per month. Any conventional telephone puts the 2721 on-line with the user's computer facility. Queries are keyed, responses are spoken.

CHARACTERISTICS

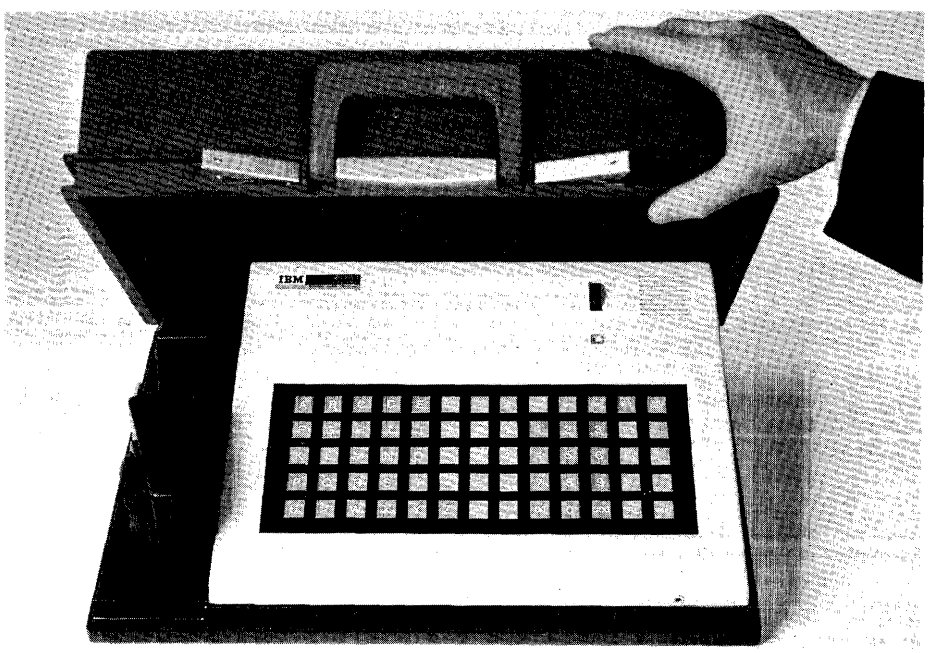
MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

COMMUNICATIONS: Transmits asynchronously in the half-duplex mode using the ABB' 3-out-of-12 transmission code. Receives voice transmission only. The 2721 contains an integral acoustic telephone coupler compatible with the Bell System Series 500 or Touch-Tone or equivalent phone.

Transmission characteristics are compatible with the IBM 7770 Audio Response Unit Model 3 equipped with the ABB' Code Line Interface feature. The 2721, via the 7770, is designed for communicating with an IBM System/360 computer, Models 25 through 85, or an IBM System/370 computer, Models 145, 155, and 165.

DEVICE CONTROL: Designed for query/response operation, the 2721 provides for data entry, via its pressure-sensitive keyboard, and for data output, via its internal speaker or external earpiece, in the form of spoken words that, under program control, have been extracted from a 32- to 128-word English vocabulary residing on the magnetic drum within the 7770 Audio Response Unit.

To use the 2721, the operator first establishes a connection to the remote computer in the conventional ▶



The 2721 Portable Audio Terminal has a highly unorthodox "flat" keyboard, as well as an unconventional key arrangement designed for convenient use by nontypists.

IBM 2721 Portable Audio Terminal

for a conventional keyboard. The key arrangement is unique and does not conform with any established convention. Keying is performed by touching the pressure-sensitive areas defined by the printed keys. Overlays tailored to specific applications can be made from paper or polyurethane sheets positioned over the standard overlay, though there are some restrictions on symbol locations.

Information retrieval is safeguarded to some extent by a unique hard-wired identification code, which is transmitted to the computer by depressing the Ident key. The code cannot be changed or generated by keyboard manipulation.

During communication with the computer, the user can have a response repeated by depressing the Repeat key or an entry verified by depressing the Verify key. The user receives a character-by-character voice response to the Verify command. If he makes an entry error, the user can also delete the keyed message via the Cancel command.

The user can elect to listen to the response either via the 2721's built-in speaker, which allows others to hear the response, or via the plug-in earpiece, which provides information security. The sound level is adjustable.

The absence of any hard-copy record of either the user's inquiries or the computer's responses will generally limit the 2721's practical applications to systems which employ audio response equipment and are limited to brief, highly structured inquiries and responses.

Customer deliveries of the IBM 2721 began during the Fall of 1970. Although it appeared to be a natural for salesmen and insurance agents, among others, the 2721 never gained a strong foothold in the market; as a result, IBM has stopped producing the unit and now offers it on an "as available" basis. Perhaps the business world is not ready to grasp the potential capabilities that this product has to offer. □

manner. Having established the connection, the operator cradles the telephone handset in the terminal's acoustic telephone coupler. The Terminal is now ready for use. The operator identifies himself by depressing the Ident key, which transmits a unique three-character sequence to the computer. Identification characters are hard-wired into the terminal and cannot be changed.

Having identified himself, the operator can now begin the query/response exchange with the remote computer. Each query keyed into the pressure-sensitive keyboard is terminated with an Execute command by depressing the Exec key. The Execute command causes a hardware interrupt at the remote computer, which is interpreted as a request for the user's program to process the query. Erroneously-keyed data can be erased by keying Cancel, which alerts the user's program to cancel all or part of the keyed message. Queries can be verified and responses repeated via the Verify and Repeat keys. The Verify function causes a spoken repeat of the keyed data, character-by-character. Having completed the exchange, the operator completes the call by keying Call End. The user's program is usually written to either disconnect the call or transmit one more response and then disconnect.

KEYBOARD: The keyboard consists of 60 flat, pressure-sensitive keys equally spaced on 0.75-inch centers and arranged in a 5-row by 12-column matrix. The keyboard, slanted 12 degrees toward the operator, can produce any of 26 alphabetics, 10 numerics, 2 special numerics (00 and 000), and 12 special characters including space. In addition, 6 Control keys provide control functions used in normal terminal operation; 5 Function keys are reserved for user assignment.

Keyboard overlays (4.5 by 10.5 inches) designed for specific applications can be made from polyurethane sheet or paper (not to exceed 0.015 inch in thickness); the overlay is fitted over the keyboard and inserted into slots at the top and bottom. The use of customized overlays must conform to the following three restrictions: (1) the user's program must accommodate the different code translations; (2) the location of the Call End, # , 000, and Exec keys cannot be changed on the overlay; and (3) the location of the number keys (0 through 9) cannot be changed on the overlay if compatibility with a Touch-Tone Pad is desirable.

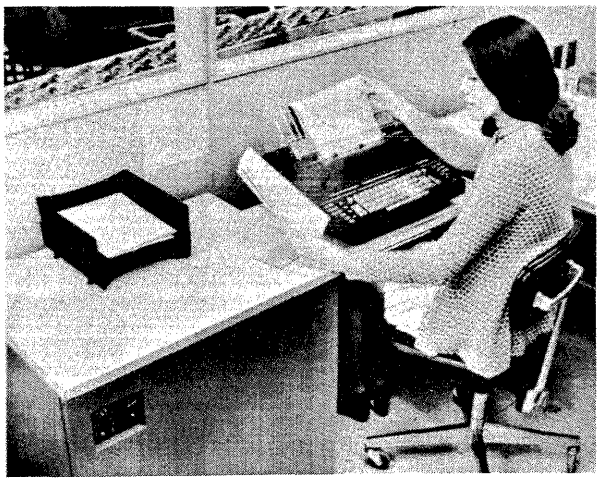
TERMINAL POWER: The 2721 is battery-powered by a rechargeable nickel-cadmium battery, which furnishes the Terminal with 6.2 + 0.62 volts. Recharging, required after 8 hours of operation, is initiated by connecting the terminal's 5-foot cord to any 110-volt AC outlet; terminal operation can continue during charging. IBM states that under normal conditions, battery life should exceed that of the terminal. However, if battery replacement is required, the terminal must be sent to an IBM Service Center. The Battery Test key, when depressed, provides a visual indication of battery condition via the Battery Level indicator located above the keyboard.

PRICING: The 2721 is available for purchase or for rental on a one-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

The 2721 is priced as follows:

Rental: $20 per month.
Purchase: $600.
Maintenance (of purchased equipment): $2 per month. ■

IBM 3735 Programmable Buffered Terminal



The 3735 is a novel intelligent terminal that must be linked to a System/360 or 370 computer. It's primarily a device for collecting data from an office, while at the same time providing the operator with assistance in the process that generates the data; i.e., filling out standard business forms.

MANAGEMENT SUMMARY

It's not really a key entry device. It's not a batch communications terminal. It's not a true interactive terminal. And it's definitely not a free-standing mini-processing system.

What the IBM 3735 is, is an intelligent terminal that is oriented toward automating, as much as possible, the preparation of standard forms used in business operations, such as invoices, checks, orders, etc. Arithmetic operations, data editing, data validation, and logical decisions can be used to expand an operator's capabilities as she is stepped through a form line-by-line, field-by-field, under control of a program stored in the terminal's integral disk unit. Data entered through the keyboard, and perhaps through the optional 5496 Data Recorder, can also be stored on the disk.

Communication with the central computer is oriented toward transmitting large blocks of data; e.g., all the data recorded during the day may be transmitted at night.

A special provision is included for interactive communication between the terminal and the computer, but the type of communications facility used may well determine the usefulness of this feature in particular installations. For example, keeping a dialed connection open would be expensive, and placing a new call for each record processed would be both time-consuming and expensive. Interactive processing with the 3735 may well be left to those installations with leased-line communications facilities. The 3735 can share a leased line with other IBM binary synchronous terminals such as the 3780, 2780, and 2770.

On to what the 3735 cannot do. The answer is very simple: it processes records but cannot process files. By controlling the disk areas that the programmer can access, ▷

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

CONFIGURATION: The 3735 Terminal consists of an IBM Selectric I/O II keyboard/printer and a desk-side control unit. The control unit houses the Arithmetic and Logic Unit, a magnetic disk drive, and the Binary Synchronous Communications Adapter.

The basic disk unit provides about 45K bytes for the Terminal Control Program and about 62K bytes for customer Form Description Programs (FDP) and data storage. One or two additional 42K increments can be added to the FDP/data storage capacity. Disk storage is reduced by 1.9K bytes when the optional 3286 Model 3 Printer and/or Operator ID Card Reader is added.

Optional attachments are available for an IBM 5496 Data Recorder, to provide 96-column punched card input and output, and for an IBM 3286 Model 3 (unbuffered) Printer, to provide faster printed output.

The Operator Identification Card Reader, also available as an option, reads data contained on the magnetic stripe of a credit card or encoded identification card. The special reader accommodates a card size of 2-1/8 by 3-3/8 inches.

COMMUNICATIONS: Transmission is half-duplex, synchronous at 4800, 2400, 2000, or 1200 bits per second. The Synchronous Clock feature is required for operation at 1200 bits per second. Either ASCII or EBCDIC can be specified as the transmission code. The binary synchronous communications (BSC) technique is employed. IBM, common-carrier, or independent modems with an RS-232C interface can be used to interface the 3735 with a voice-band communications facility. Dial or private lines can be used.

The 3735 is compatible with an IBM System/360 or 370 computer equipped with the appropriate devices for binary synchronous communications, such as a 3704 or 3705 Communications Controller, 2701 Data Adapter Unit, 2703 Transmission Control, or Integrated Communications Attachment.

The 3735 can share a private communications line with other IBM binary synchronous terminals such as the IBM 2780 and 3780 Terminals, 2770 Communication System, and 1130 computer. Other terminals on the shared line can be equipped with the Transparency feature, even though this feature is not currently available for the 3735.

The 3735 can be operated in an unattended mode to receive or transmit in response to a poll. ►

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IBM has effectively prevented this terminal from being used as a free-standing computer. In accord with this approach, the terminal programs not only must be generated at the computer site, but can only be loaded through the communications link. It is not clear at this writing whether these restrictions are due to hardware limitations or to built-in limitations of the master Terminal Control Program which is written into the terminal when manufactured.

The 3735's output printing speed was originally limited to 15.5 characters per second. This slow printing speed, combined with the slow card input/output speeds, eliminated the 3735 from serious consideration as a batch terminal (for remote job entry, for example). Since then, IBM has introduced the optional (and expensive) 3286 Printer, which can produce printed output at speeds up to 66 characters per second—still well below the printing speeds of most of the current batch terminals.

In a similar vein, the 3735's maximum transmission speed was originally limited to 2400 bits per second. IBM has since upgraded this to 4800 bits per second and has deleted the low-speed transmission capability of 600 bits per second.

The 3735 continues IBM's emphasis on 96-column cards for small business applications, a la the System/3. (The optional 5496 Data Recorder is the keypunch for the System/3.)

Provision of only one keyboard naturally limits the use of the terminal to just one operator. The 3735's disk storage and processing logic suggests the possibility of future provisions for multi-keyboard operation, albeit at some increase in hardware and software complexity. But the 3735 clearly is not IBM's reply to the shared-processor key-to-disk data entry systems.

Just what *is* the 3735, then? The two key points are *local processing* and *data communications.* The 3735 is more akin to source data recording than it is to data entry, data processing, or data communications. It provides a means for assisting the everyday business operations of an office, while at the same time collecting data for central computer applications.

Any device with real flexibility, and particularly one that is programmable, immediately excites the imagination of system designers, and our own technical staff members are no exceptions. As it stands, the feeling is that the 3735 isn't quite enough machine to do the things that its basic characteristics suggest. With a few additional options such as faster printers and card handling equipment, along with improved access to data on the disk, this unit could be a real winner. □

Data is transferred to and from the terminal over the communications lines in blocks of up to 476 bytes including field and record delimiters, but excluding line control characters.

DEVICE CONTROL: The operation of the 3735 Terminal is chiefly under the control of programs stored on the associated disk. The responsibilities of the operator are limited to selecting the task to be performed, entering data, and initiating automatic diagnostic checking in the event of malfunctions. All other functions, including loading of programs, is carried out under the control of the various programs, sometimes together with interaction with the remote computer system.

The basic orientation of the terminal is toward filling out standard business forms, such as orders, invoices, checks, etc., and storing the information for transmission to the central computer. A great deal of flexibility is provided to facilitate preparation of forms, such as arithmetic operations, data validity checking, and data editing. Other operations, such as collection of daily statistics about the office's operations, are also within the capability of the terminal.

There are two principal types of programs; user-generated Form Description Programs (FDPs) and the resident Terminal Control Program (TCP).

An FDP can specify the form format (such as location of each field, number of lines per page, etc.), editing and checking operations to be performed on each field, implied I/O operations (by specifying the source or destination of data), and any data manipulations (such as arithmetic or conditional comparisons).

The TCP executes the operations specified or implied by the FDP. There is only one TCP, but typically there will be several FDPs.

The Local Mode is the starting point for all operations. In this mode, the Selectric keyboard/printer acts like a conventional typewriter, except that other operations can be initiated.

The basic list of operations that can be entered from the Local Mode includes:

- Select an FDP.
- Initiate Enter-Form Mode.
- Enter Error-Correct Mode.
- Enter Playback Mode.
- Enter Request Mode.

FDPs are identified by a three-digit number. A message can be associated with an FDP; the operator can elect to have this printed out before beginning the data entry operation. The use of this message is to inform the operator about such things as form stock number, tab stops, and prerequisite forms.

The Enter-Form Mode allows filling out of a form under control of a specific FDP. The program automatically positions the print element and paper for each field.

If errors are made, the operator can backspace and retype the correct entry provided that the field has not been completed. If errors are discovered after a field is completed, corrections are made in the Error-Correct Mode or Playback Mode.

The Error-Correct Mode allows changes to be made in the line that is being typed. Entering this mode causes the logic

IBM 3735 Programmable Buffered Terminal

indicators and the typing element to be reset to the beginning of the line. That line can be typed out by character or by field, allowing new data to be typed where desired.

In the Playback Mode, a completed record can be recalled using the three-digit record number. The form can be typed out by line, field, or character.

The Request Mode allows the operator to select one of several auxiliary operations, including setting up the Communicate Mode. Once this mode is entered, the terminal is blocked from further operation until an exchange between the terminal and the remote computer has occurred.

Other operations that can be performed after entering the Request mode include: erase data records previously received from the remote computer, erase all operator-entered data records, type out a list of all resident FDPs, type out a list of the identifiers associated with all stored data records, and execute diagnostic tests.

The disk unit is divided into several special storage areas in addition to the space for the Terminal Control Program, user FDPs, and user/computer-created data records. These areas include 21 ten-digit counters, 236 bytes of Special Storage (byte-addressable), a 236-byte Inquiry Buffer (byte-addressable), Reader/Punch Buffers (two 96-byte buffers, byte-addressable), and a Data Directory which contains the identification and storage location of each FDP and data record stored in the terminal. Each of these areas is directly addressable, except the Data Directory, and can be used as the source for operands or the destination of a result.

In addition to these storage areas on the disk, three dynamic buffers serve as the interface between the disk and all data input to or output from the terminal. The dynamic buffers also store 105 bits of bit-addressable storage which are used to indicate the results of FDP-specified tests and thereby to control branching and other functions. The programmer has access to the logic indicators but not directly to the dynamic buffers; data can be accessed from the disk areas only.

In general, to record new data or to access data transmitted from the computer, the terminal must be operating under control of one of the customer-created FDPs. While the primary use of FDPs is to create forms, an FDP can be created for non-form-oriented operations such as transferring a card file to the disk for transmission to the computer.

Loading of the FDP programs can be accomplished only from the remote computer, and all programs must be transferred at the same time. Thus to add or modify a single program, all programs must be retransferred.

In addition to the buffering for block transmission of data, a separate Inquiry Buffer is provided for the interchange of data between the terminal and computer.

DISK STORAGE: The basic disk unit includes 45.2K bytes for storage of the Terminal Control Program and 62.8K bytes for storage of user FDPs and data records.

The disk is organized in sectors of 480 bytes each. Four identification bytes are required for each data record, so each data record can be up to 476 bytes long, including field and record delimiters but not communications line control characters.

IBM estimates that a typical FDP requires about 1000 bytes of storage. However, when FDPs are stored, half of each sector is left unused. Therefore, a typical FDP will probably take four sectors.

The basic area for user data storage will probably be insufficient to hold a full day's output from a high-volume operation, but much depends on the number and size of FDPs. However, IBM offers two additional storage increments of 41.8K bytes each. With this much storage, very extensive operations can be performed.

PROGRAMMING: To accomplish the goals of automating form preparation and data collection, the programmer has some rather impressive yet curiously restrictive facilities at his fingertips.

The sources of data for manipulation include the keyboard, the card read section of the 5496, and literals imbedded in the program. Destinations (the places where the results are output) can include the Selectric I/O II and 3286 Model 3 Printers and the card punch section of the 5496. The counter, Inquiry Buffer, and Special Storage areas can be used as the sources for data and as places for results to be stored; the last two can be effectively used for holding data to be used by successive data records or to accumulate results for a group of records. In addition, the FDP and record numbers are available to the programmer for use as operands.

Data records can be generated by the operator or received from the remote computer. Once entered, data cannot be used in the generation of other records unless it is also stored in one of the programmer-accessible areas, such as the Special Storage, Inquiry Buffer, and card input/output buffer areas. Auxiliary card files can be used in conjunction with the generation of a data record, but file-oriented processing normal to data processing functions is just not possible the way the terminal master control program is laid out now. This is not so much a deficiency as an important consideration in evaluating how the 3735 can help you implement your overall data processing functions.

Three basic types of operations can be performed on data: validation, arithmetic, and editing.

Data fields can be checked for type (alphanumeric, alphabetic, or numeric), length (maximum, minimum, or exact), value (greater than, less than, or equal to one or more constants), and/or self-check (modulo 10 or 11). A data field can be specified as optional, which suspends the checks if the operator skips the field. Batch numbers can be assigned, permitting accumulation of batch totals; up to 128 different batches can be identified.

Arithmetic operations are performed with the counters; two counters or one counter and another storage area can be involved. Clearing, addition, subtraction, multiplication, division (with or without rounding), and comparison operations are provided.

A wide range of edit options are provided. Description of numeric fields is COBOL-like. Zero suppression with blank or asterisk fill, floating dollar and arithmetic signs (plus and minus), and CR (credit)/DB (debit) insertions can be specified. Fields to be printed can be centered, right-justified with blank or zero fill, underlined, or printed with the numeric editing specifications. Output to the Inquiry Buffer and Special Storage areas can be right-justified with zero or blank fills.

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Each field that goes into the data record can be suppressed from printing and/or transmission if desired.

Specification of the processing operations for a particular form should be relatively simple. Typically, the user creates a specification in a format similar to the macro-language actually used. Fields are identified by name (including counters) and by position within the storage area (excluding counters, of course).

These specifications are converted into macro-language by the programmer, apparently using IBM System/360 Assembly language supplemented with extensive macros. After assembly, another program (Form Description Utility) formats the resulting object program for transmission to a terminal. Libraries of FDPs can be maintained at the computer site. The terminals do not have to receive the same set of programs.

ERROR CONTROL: Data transfers are checked both from the communications line and on internal movement of data. Parity is checked when the data is read from the disk, dynamic buffers, and arithmetic and logic control unit.

The facilities for making corrections in typed documents are discussed under "Device Control."

The 3735 continues the emphasis on extensive self-diagnostic capabilities exhibited by recent IBM computer systems and peripherals. Diagnostic tests included within the Terminal Control Program allow testing of the control unit electronics, disk surfaces, communications adapter, keyboard/printer, 5496 reader/punch, 3286 printer, and communications functions. Testing of the control unit is performed automatically every time the terminal is turned on and whenever a hardware error is detected. The others are run by operator request. Reports are generated for the disk surface and on-line (communications functions) tests; the results of the other tests are displayed via the indicator lights on the keyboard. In addition, a special program, the Trouble Record Form, can be processed in much the same way as a customer FDP to completely check out the terminal functions relating to processing forms.

KEYBOARD/PRINTER: The Selectric I/O II keyboard/printer is based on the familiar Selectric Typewriter, with keyboard and printing functions logically separated.

When typing automatically (called power typing by IBM), the Selectric runs at 15.5 characters per second. Character spacing is 10 characters per inch (pica), and vertical spacing is 6 lines per inch.

The basic machine is equipped with friction-feed forms movement, like a conventional typewriter. The maximum line width is 130 characters (13 inches). Optionally, the printer can be equipped with pin-feed forms movement. A wide selection of sizes is available, ranging from 5-3/4-inch form width (4-5/8 writing width) to 13-5/8-inch form width (12-1/2 writing width). IBM does not currently offer a split platen, two-color ribbon, or front-feed forms capability for the Selectric printer.

The keyboard contains many controls and indicators (lights) in addition to the alphanumeric keys. On the right-hand side of the character keyboard, a 10-key numeric pad has been overlaid (effectively a third shift) to facilitate the entry of numeric items; the layout conforms to a standard 10-key adding machine keyboard with zero on the space bar.

3286 MODEL 3 PRINTER: This optional unit prints via the matrix technique at a rated speed of 66 char/second. The printer is available with 120, 126, or 132 print positions and forms each character of the standard 64-character set of EBCDIC or ASCII symbols via a 4-by-7 dot matrix. It accommodates six-part continuous, pin-fed forms. The 3286 Model 3 is unbuffered.

5496 DATA RECORDER: This optional unit provides input and output via 96-column punched cards. It is fully described in Report 70D-491-22.

SOFTWARE SUPPORT: The software required at the central computer for operation of the 3735 includes input/output routines, the FDP generator, and the Form Description Utility.

The 3735 is supported under DOS BTAM, under DOS/VS BTAM and VTAM, under OS BTAM and TCAM, and under OS/VS BTAM, TCAM, and VTAM.

Under OS, a 128K Model 40 is required for program generation. Under DOS, a 16K Model 25 can handle the program generation—but keep in mind that 32K bytes of storage are required for telecommunications under DOS.

AVAILABILITY: First customer shipments were made in April 1972.

PRICING: The IBM 3735 is available for purchase or on a one-year lease that includes maintenance. A separate maintenance agreement is available for purchased units. The prices of the basic unit and principal options are:

	Monthly Rental	Purchase	Monthly Maintenance
3735 Model 1	$330	$13,200	$57.00
Additional 42K Disc Storage (2 maximum)	30	1,200	0.50
Multipoint Data Link Controi	15	600	0.50
5496 Adapter	25	1,000	0.50
5496 Data Recorder	155	7,600	54.00
3286-3 Adapter	15	600	0.50
3286-3 Printer	165	7,095	27.00
IBM Line Adapter (1200 bps)	15	525	2.50
IBM Line Adapter (1200 bps switched with Auto Answer)	20	700	3.00
Operator ID Card Reader	15	600	3.00
Synchronous Clock	15	600	0.50

Other features available for purchase only include the Forms Stacker ($50) and an ASCII typing element ($18). The Keylock costs $35 as a single-use charge when renting and $35 to purchase.

An attachment is required on the 5496 to permit connection to the 3735; this goes for $45 per month or $2,205 purchase ($4.50 per month maintenance). ■

IBM 3270 Information Display System

Available in both single-station and multi-station display configurations, the 3270 offers System/360 and 370 users significantly improved capabilities as compared with IBM's earlier 2260 and 2265 Displays. Higher speeds and increased functional capabilities highlight this flexible family of controllers, displays, and printers.

MANAGEMENT SUMMARY

About 18 months have passed since IBM began delivering its 3270 Information Display System, and it is fair to say that the 3270 has significantly impacted the CRT terminal market. Industry estimates place the total number of CRT terminals in use at over 200,000. It is a safe bet that at least 33 percent of this market belongs to IBM, and that IBM is replacing its existing 2260 and 2265 Display Stations with 3270 systems at a pace commensurate with System/360 to System/370 upgrades.

The 3270 system, by virtue of its inherent sophistication, obsoletes the 2260 and 2265 terminals. So why shouldn't everyone upgrade to a 3270? The kicker is that it is not just a hardware replacement. System/360 users must consider fairly extensive software conversions from 2260 BTAM or GAM to 3270 BTAM in order to accommodate the 3270. And those System/360 users who do not want to upgrade to a System/370 are not supported under IBM's latest telecommunications software. Many of these users have turned to the independent manufacturers of CRT terminals which offer 3270-like features at substantial dollar savings. Unlike IBM's 3270, most of the independent terminals accommodate IBM 2260 communications discipline; that is, they respond like the IBM 2260 or 2265 they replace, so they require no software changes or, at most, a partial sysgen to incorporate the new parameters.

In relation to the IBM 2260 and 2265 Display Systems, the 3270 provides:

CHARACTERISTICS

MANUFACTURER: International Business Machines Corp., Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

CONFIGURATION: The IBM 3270 Information Display System is designed to operate in a local environment as a multi-station, computer peripheral subsystem or in a remote environment as a single-station or a multi-station communications terminal.

Local operation requires the 3272 Control Unit, which attaches to an IBM System/360 computer, Models 25 through 195, or an IBM System/370 computer, Models 115 through 195, via a Selector, Multiplexer, or Block Multiplexer channel. The maximum data transfer rate for local operation is 800,000 char/second. Remote operation in a multi-station arrangement requires the 3271 Control Unit.

The basic control units, via a device adapter, accommodate up to four devices that can be any combination of display stations and printers; at least one display station is required. The control units can accommodate additional display stations and printers up to a maximum of 32 devices via up to seven additional device adapters, one for each four devices.

Two models of control units provide buffering for 480 or 1920 characters. Two display station and printer models provide screen and print-buffer capacities that correspond to the buffer capacities of the control units. Two printers are provided with rated speeds of 40 and 66 characters/second; both printers can be mixed on the same control unit. Displays and printers with large and small buffers can be intermixed on a control including the large buffer.

Remote operation in a single-station environment requires the 3275 Display Station, a stand-alone unit with integral control and buffering. The 3275 is also available in two models that provide buffer and screen capacities of 480 and 1920 characters. A 40-character/second bufferless printer can be attached to the 3275 Display Station.

Each device can be located up to 2,000 cable-feet from the control unit. The local control unit can be located up to 150 cable-feet from the computer channel. The 40-character/second printer can be located up to 120 cable-feet from the stand-alone display station.

The IBM 3270 System is configured as follows:

IBM 3270 Information Display System

- Faster transmission speeds–up to 600 characters per second (4800 bps).
- Larger display sizes–480 or 1920 characters (compared to 960 maximum with the 2260 or 2265).
- Faster printers–40 or 66 characters per second.
- Lower costs.
- Greatly expanded functional capabilities.
- Very flexible configurations–up to 32 devices per controller; local or remote; multistation or single station; multiple printers.
- Separate buffer for each display, and printer/screen capacity remains constant for large configurations.

The significant points for consideration boil down to cost, capability, performance, and compatibility.

Savings achieved through using the 3270 in place of the 2260/2265 can range up to 50 percent (for a stand-alone station). The pricing structure for the 3270, in relation to the 2260/2265, tends to favor small configurations more than large configurations because the newer control unit is lower-priced and the displays are higher-priced. Typical 3270 configurations may actually cost more per display unit than 2260 configurations due to the inclusion of multiple printers. The 3270 includes many features pioneered by the independent producers of CRT terminals: functions such as protected formats for fill-in-the-blanks applications and program function keys, as well as condensation of data transmitted by blank suppression, repeated character elimination, and tab control. A light pen can even be included for "finger-pointing" data entry.

The optional increased transmission speed of 4800 bits per second, the improved efficiency of using the binary synchronous transmission technique, and the faster printers, coupled with condensation of transmitted data, portend significant improvements in performance over the 2260/2265. The effect of the increased performance will show up in the capability to place more terminals on one line than was possible with the 2260/2265.

What do users say about the IBM 3270? Most rate its overall performance and ease of operation as ranging from good to excellent. Hardware reliability has been reported as good in most cases, though one user with 140 displays reports the reliability to be well below his expectations. Another user had substantial hardware installation problems; these have since been corrected, but the user feels that the quality of the IBM 2260 has not been carried over into the 3270. Other users claim technical support to be deficient in some cases.

System Operation	Control Unit	Buffer Capacity	Display Station	Printers 40cps	Printers 66cps
Local	3272-1	480 char	3277-1	3284-1	3286-1
Local	3272-2	1920 char	3277-2,-1	3284-2,-1	3286-2,-1
Remote	3271-1	480 char	3277-1	3284-1	3286-1
Remote	3271-2	1920 char	3277-2,-1	3284-2,-1	3286-2,-1
Remote	–	480 char	3275-1	3284-3	–
Remote	–	1920 char	3275-2	3284-3	–

COMMUNICATIONS: Transmission is half-duplex, synchronous at 4800 (optional), 2400, 2000, or 1200 (optional) bits/second using 8-level EBCDIC or ASCII (with parity). The 3270 employs the IBM Binary Synchronous Communications technique. IBM, common-carrier, or independent modems can be used to interface the 3270 with a voice-band communications facility.

Transmission characteristics are compatible with the IBM 3704 and 3705 Communications Controllers, 2701 Data Adapter Unit, 2703 Transmission Control, 2712 Remote Multiplexer, and Integrated Communications Attachment (ICA), each equipped for Binary Synchronous Transmission. The 3270 is designed for communicating with the System/360 Model 25 and System/370 Models 115, 125, and 135 via the ICA, and with the System/360 Models 25 through 195 and the System/370 Models 115 through 195 via the 3705, 3704, 2701, or 2703 line controllers.

The 3270 can operate in a multipoint arrangement with other IBM binary synchronous (BSC) devices such as the 2715, 2770, 2780, 3271, 3275, and 3780, and with the IBM 1130, 1800, System/360 Model 20 and System/3 Model 10 computers.

CRT DISPLAY: Via a 14-inch (diagonal measurement) CRT. Display screen arrangement is dependent on the model display station. Model 1 display screens are arranged in 12 lines of 40 characters each, totaling 480 character positions. Model 2 display screens are arranged in 24 lines of 80 characters each, totaling 1920 character positions.

A character set of 64 ASCII characters, including uppercase alphabetics, numerics, and special symbols, is displayed in green against a dark background. Each character is formed by a 7-by-9 dot matrix.

SOFTWARE SUPPORT: The 3270 System is supported by BTAM under DOS, DOS/VS, OS, and OS/VS2; by TCAM under OS; and by VTAM under DOS/VS, OS/VS1, and OS/VS2. Display console support for a 3270 System operating in a local environment is provided by DIDOCS (Device Independent Display Operator Console Support) or SDS (Status Display Support) under OS (MFT or MVT). Program products available for use with the IBM 3270 include VIDEO/370, DATA/360, IMS, IQF, CICS, and TSO.

VIDEO/370 is designed for on-line data entry and verification in a local or remote environment; it requires the use of one of the following access methods: BDAM, BSAM (DAM or SAM in DOS), or BTAM.

DATA/360 is designed for on-line data entry and verification in a local environment only via 3272/3277 Model 1 display stations operating in 2260 mode. DATA/360 operates under OS or DOS, is written in Assembler Language, and incorporates ISAM, SAM, and BTAM for DOS or BDAM, GAM, and QSAM for OS. DATA/360 does not support function keys or dual intensity and may not support protected fields.

IBM 3270 Information Display System

In general, most users feel that the 3270 offers them substantial price/performance advantages over the earlier IBM displays, but they are remaining alert to announcements by the independents–even in traditional IBM shops. □

DEVICE CONTROL: The 3270 System operates under the control of the program stored at the remote computer. Under program control, the 3270 can execute any of four types of commands: read, write, control, and sense.

Read commands initiate transfer of the contents of a device buffer, modified fields within the buffer, buffer addresses or data of fields specified by the selector pen, or the single-byte Attention Identification (AID) code generated by a Program Function or Program Access key. The 3270 responds to two read commands, Read Buffer and Read Modified.

Read Buffer initiates transfer of the contents of the addressed device buffer from the initial or current cursor address.

Read Modified initiates one of three operator-initiated functions: Read Modified, Short Read, or Test Request Read. Read Modified initiates the transfer of all fields modified by the keyboard within the device buffer. The fields are transferred in sequence beginning with the first modified field; all nulls are suppressed. However, when completion of a key-modified field is signaled by a selector pen operation, a resulting Read Modified operation will transfer only the address of the modified field. Short Read initiates transfer of the single byte AID Code generated by a Program Attention key. Test Request Read performs the same operation as Read Modified, however, a hardware-generated heading precedes the data. Nulls are suppressed as in Read Modified. Only the special heading is transferred if data has not been keyed.

Write commands condition the display or printer to receive a computer message. Two write commands–Write and Erase/Write–load, format, and selectively erase device buffer data, and can also initiate device operations such as starting the printer, resetting the keyboard, and sounding the audible alarm. Both commands are the same except that Erase/Write erases the entire contents of the device buffer before fresh data is written (beginning at the initial buffer address) and Write modifies existing buffer data.

Control commands initiate control unit and/or device operations. There are four control commands: Copy, Select, Erase All Unprotected, and No Operation. Copy, executed by a 3271 Control Unit only, transfers buffer data from one device to another. Select, executed by a 3272 Control Unit only, transfers buffer data from the selected device to the controller. Erase All Unprotected initializes the addressed device, erasing all unprotected buffer locations and repositioning the cursor to the initial position of the first unprotected field. No Operation, executed by the 3272 Control Unit only, performs no functional operation in the 3272, but can retrieve pending status.

The Sense command, executed by the 3272 Control Unit only, initiates the transfer of a single sense byte from the 3272. The sense byte defines error conditions that have occurred within the subsystem.

Program control by data field provides a flexible formatting capability. A field, identified by an attribute control code (nondisplayed) in the initial character position, can possess any one of several characteristics. The attribute control code can specify a protected or unprotected field (for fixed format operation), beam intensity or brightness (off, normal, or bright), alphameric or numeric (automatic shift) input, auto lock or skip, tab stop, or light pen selection.

The Program Tab feature automatically writes successive data fields into successive unprotected data fields defined by a fixed format.

Character Addressing permits a message to be written beginning at any screen location. Addressing can be interspersed with data throughout a message received from the computer. Character Addressing also permits the selective modification of attribute control codes.

Operator controls are provided for cursor control, editing, and program functions.

Cursor controls position the cursor up, down, left, or right, step-by-step or repetitively if the key is held depressed. The cursor can also be backspaced one character position, moved to the beginning of the next line or beginning of the next unprotected data field, tab to the beginning of the next unprotected data field, and backtab to the beginning of the previous unprotected data field.

Edit controls permit data to be inserted in or deleted from text, character by character. Following data is automatically expanded or contracted.

Program Function keys are used to initiate program functions or identify data that can be transmitted with an accompanying program function code.

The Selector Pen option permits the display operator to select any of several data fields in a displayed text.

The Numeric Lock feature restricts keyboard operation to numeric input only (or duplication of numeric data); the keyboard automatically locks if anything other than numeric data is keyed.

KEYBOARD: Three keyboards are available: typewriter, data entry, and operator console. Keyboard variations include 66- and 78-key versions. The 78-key version of the typewriter keyboard includes 12 Program Function keys. The data entry keyboard provides an IBM 29 Card Punch-style layout and contains 66 keys, including 5 Program Function keys. The operator console keyboard provides an IBM 1052 Model 7-style layout and contains 78 keys, including 12 Program Function keys. Program Function keys are defined by the application program.

PRINTED OUTPUT: Two matrix printers are available that differ only in rated printing speed. The 3284 Printer is rated at 40 characters/second and is available in three models. The 3286 Printer is rated at 66 characters/second and is available in two models. Model 1 includes a 480-character buffer; Model 2, a 1920-character buffer; and Model 3 does not have a buffer.

Both printers are available with 120, 126, or 132 print positions and accommodate pin-fed, six-part continuous forms that range from 3 to 14 inches (in 1/6-inch increments) in length.

IBM 3270 Information Display System

TYPICAL IBM 3270 SYSTEM CONFIGURATIONS*

Number of Displays	Average Cost per Display	Memory per Display	Monthly Rental	Purchase	Monthly Maintenance
4	$146/mo.	480 char.	$ 585	$ 24,900	$ 65.00
8	133	480	1,060	44,375	119.50
16	125	480	2,010	83,325	228.50
32	122	480	3,910	161,225	446.50
4	185	1920	740	29,600	98.00
8	169	1920	1,355	53,075	184.50
16	162	1920	2,585	99,825	357.50
32	158	1920	5,045	193,925	703.50

*Each configuration includes a 3271-1 or 3271-2 Control Unit and a 78-key keyboard.

The printers print from a set of 64 EBCDIC or ASCII characters. Each character is formed by a 4- by -7 dot matrix.

PRICING: The IBM 3270 System is available for purchase or on a one-year lease, which includes maintenance. A separate maintenance contract is available for purchased equipment. The IBM 3270 System components are priced as follows:

Device	Monthly Rental	Purchase	Monthly Maintenance
Control Unit –			
3271-1	$165	$6,500	$11.00
3271-2	180	7,200	12.00
3272-1	190	7,500	11.00
3272-2	205	8,200	23.00
Device Adapter*	55	1,075	0.50
4800 bps Speed (3271/3275 only)	5	200	0.50
Display Station –			
3275-1	120	5,500	9.50
3275-2	145	6,500	13.00
3277-1	75	3,400	77.00
3277-2	110	4,400	15.00
Keyboard –			
66-key (any)	15	600	4.50
78-key (operator console)	35	1,400	11.00
78-key (other)	30	1,200	6.50
Selector Light-Pen	25	1,000	1.50
Security Keylock	35**	35	–
Operator Identification Card Reader	15	600	3.00
Audible Alarm	5	200	0.50
Printer –			
3284-1	150	5,850	28.00
3284-2	160	6,560	28.00
3284-3	130	5,590	15.00
3286-1	180	7,380	28.00
3286-2	190	8,170	28.00
Forms Stand	—	50	–

*Accommodates four devices; the basic control unit contains one Device Adapter; up to seven can be added.

**Single-use charge. ■

IBM 2922 Programmed Terminal

MANAGEMENT SUMMARY

The IBM System/360 Model 20 has been called one of the best high-speed remote batch terminals ever built. But it has never been called cheap. The 2922, when announced in late April 1972, eliminated that last criticism. Well, perhaps it did not make a unit with the processing power of a Model 20 cheap, but it did at least make it more competitive. Depending on configuration and leasing plan, the 2922 is 25 to 40 percent less expensive than the equivalent Model 20.

The advantages of using a Model 20 as a remote batch terminal include the availability of a processing element that makes interleaved transmission and reception possible (under HASP), the capability for a significant amount of off-line processing, and – very significantly – the reliability of the 1403 printer for continuous high-speed operation. Within limits, the 2922 provides the same advantages at a substantially lower cost.

The limits imposed on the 2922 involve the severely restricted configuration possibilities of the 2922 in comparison with the Model 20. Magnetic tape and disk peripherals, as well as memory expansion beyond the 8K included in the basic unit, are specifically excluded. It is not difficult to figure out why. If these extensions were allowed, most users would trade in their existing Model 20's, ignore the communications interface, and leave IBM with reduced revenues.

Even in the reduced 8K configuration, IBM provides a useful complement of software. The CPS RPG compiler and Basic Assembler can be used. The addition of a card

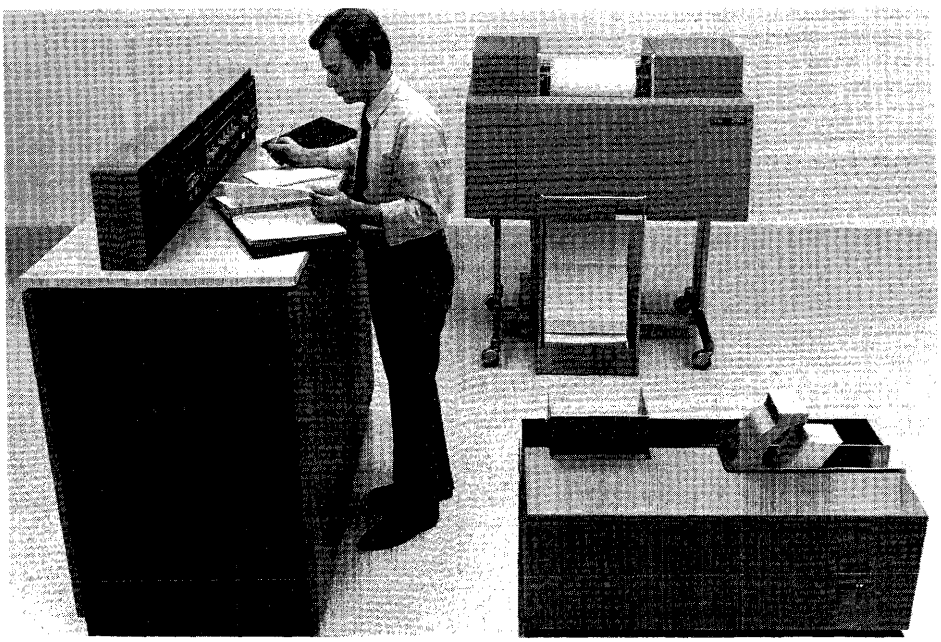
The 2922 provides the processing capability, including BSC communications, of a small card-oriented System/360 Model 20 at a substantially lower price than the equivalent Model 20. Transmission speeds range up to 7200 bps using the IBM BSC (bisync) technique.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone: (914) 696-1900.

CONFIGURATION: The 2922 terminal consists of a 500-cpm card reader, a 500-lpm line printer, a BSC communications interface, and a programmable controller (processor) with 8,192 bytes of core storage. Optionally, a 2152 Printer-Keyboard and/or a 1442 Model 5 Card Punch can be added.

COMMUNICATIONS: Transmission is half-duplex at a speed of 2000, 2400, 4800, or 7200 bits per second over the public telephone network or a leased voice-band line, using IBM's bisync (BSC) communications line discipline. Transmission code can be ASCII or EBCDIC, and transparency is available for either. The interface is the standard EIA RS-232B. IBM, common-carrier, or independent modems can be used. The 2922 can communicate with an appropriately equipped IBM System/360 or System/370 computer or point-to-point with another 2922. The specific line conditioning required for a particular speed, or the speed attainable on the switched network, is a function of the modem selected. IBM modems are available to support speeds of up to 2400 bps on the switched network and 7200 bps on a leased line with C2 conditioning. See Report 70G-500-01 (*All About Modems*) for details on these and other independent modems as well as common-carrier modems.



This view of the 2922 Programmable Terminal clearly indicates its 360/20 origins. The controller is at left, with 500-cpm card reader in the foreground and 500-lpm chain printer at rear.

IBM 2922 Programmed Terminal

punch (announced shortly after the original 2922) permits generation of object program decks.

At the reduced price, the 2922 is still not price-competitive with the many remote batch terminals offered by independent manufacturers. In its basic form, with processor, card reader, and printer, the 2922 leases for $1,370 per month under the Extended Term plan. Adding the 2152 Printer-Keyboard and 1442 Card Punch adds another $490 per month. For users who plan to run their terminal continuously or to also use it heavily for off-line processing, the 2922 may be a good choice. Users with lower transmission volumes, who are considering batch terminals mainly to reduce connect times, are likely to find other terminals more attractive, including IBM's own 3780.

The preceding discussion and the Characteristics section of this report are predicated on the limited information released by IBM on the 2922. Its status as an RPQ item hinders a full discussion. It is difficult to be dogmatic about a device whose logical existence is mostly on paper–depite the fact that units with the 2922 nameplate can be seen, touched, and used in the field. Changes, additions, and special concessions are all possible with small public evidence. This is in no way a denigration of IBM's policies. The 2922 is a specialized unit for a specialized market. It represents the way IBM responds to such specialized requests. If the 2922 follows the course of past IBM history, a more general-purpose standard unit with similar attributes can be expected in the future; how far in the future depends on user demand for a high-capacity terminal with extensive processing capability.□

DEVICE CONTROL: The 2922 executes all operations under the direction of stored programs and is software-supported by BTAM under OS or DOS and by TCAM and HASP under OS. When communicating, operator tasks are limited to the selection of a specific operation, entering data, and initiating automatic diagnostic checking in the evnt of malfunctions. The communications task fully occupies the processor, and additional concurrent data processing is not possible. However, the full facilities of a System/360 Model 20 of equivalent configuration can be used off-line. Included in these facilities are an RPG compiler, an assembler, and various utility routines. RPG programs can be compiled and executed with or without generation of an object deck. Assembly-language programs require object deck generation. The 2152 Printer-Keyboard can be used as a control console for the remote batch entry function and for output of status and error messages. Without the 2152, some error conditions are displayed only by console register readouts.

PROCESSOR: The 2922-1 Controller is a reworked IBM System/360 Model 20. (It probably started out as a Sub-model 2.) Report 70C-491-02 is an extensive discussion of the System/360 Model 20; please refer to it for additional information on the processor.

CARD READER: The 2922-3 Card Reader strongly resembles a 2501 Model B1. It operates at a peak speed of 500 80-column cards per minute. The hopper and stacker capacities are 1200 and 1300 cards, respectively. The column binary read feature is standard. In this mode, the 12 rows of a card column are treated as two 6-bit characters, which are stored in the low-order bits of 2 bytes; the 2 high-order bits are forced to zero.

PRINTER: The 2922-2 Printer appears to be a 1403 Model 2. It operates at a peak speed of 500 lines per minute with a line width of 132 positions. The character set includes the 60 graphics of the PL/1-60 set. It prints at a horizontal pitch of 10 characters per inch and can produce copy readable by any IBM OCR unit. Vertical spacing is 6 or 8 lines per inch, manually changeable by the operator. Vertical format is controlled via a 12-channel tape loop mechanism.

2152 PRINTER-KEYBOARD: This unit is an IBM Selectric I/O typewriter rated at 15.5 characters per second. It includes an 88-character set of graphics and can print up to 125 characters per line. A pin-feed platen is standard, and a friction-feed platen is also available. Attachment of the 2152 requires an adapter.

CARD PUNCH: The 1442 Model 5 Card Punch can be attached via an adapter. It operates serially at a nominal rate of 160 columns per second. This is equivalent to 91 fully punched cards per minute or 265 cards per minute if only the first 10 columns are punched. Hopper and stacker capacities are 1200 and 1300 cards, respectively. The unit cannot produce column binary punched cards.

PRICING: The IBM 2922 is available for purchase or on either a month-to-month or 24-month Extended Term leasing arrangement. All rental/leasing plans include maintenance. A separate maintenance contract is available for purchased equipment.

	Monthly Rental			
	Short Term	Extended Term	Purchase	Monthly Maint.
2922-1 Controller	$817	$695	$24,650	$ 86.00
2922-2 Printer	676	575	15,000	159.00
2922-3 Card Reader	141	120	3,875	33.00
Options				
2152 Adapter	87	74	2,650	4.50
2152 Printer-Keyboard	131	–	5,430	61.00
1442 Adapter	30	–	980	2.50
1442 Model 5 Card Punch	255	–	12,365	54.00
Transparency (EBCDIC or ASCII)	20	17	490	0.50 ■

IBM 3780 Data Communications Terminal

The 3780 consists of a 425-lpm bar printer (left), control unit (center), and 600-cpm card reader (right). It offers transmission speeds of up to 7200 bits per second.

The 3780 is the logical successor to the popular IBM 2780, though not a direct plug-for-plug replacement for it. Higher performance and lack of programmability characterize the 3780 in comparison with the older 2780 and the IBM 2922, respectively.

MANAGEMENT SUMMARY

The 3780 is the successor to the IBM 2780 (Report 70D-491-08), which is probably still the most widely used, and imitated, terminal for remote batch transmission applications. However, even though the 3780 is transmission-compatible with the 2780 under certain circumstances, the control procedures are like those of the IBM 2770 (Report 70D-491-07) rather than the 2780. The 3780 represents a response by IBM to the increased communications speeds that have recently become practical and to users' demands for terminals with higher performance than the 2780.

Announced in May 1972, with first delivery in July 1972, the 3780 is supported under DOS BTAM, OS BTAM and TCAM, ASP, and HASP II to the same extent as the 2770. (The Space Compression/Expansion feature is supported only under HASP II.) The basic specifications of the 3780 include:

- Transmission at up to 7200 bps, BSC.
- Card reading at up to 600 cards per minute.
- Printing at up to 300, 350, or 425 lines per minute. (63, 52, or 39 character set).
- Card punching at up to 160 columns per second (91 to 265 cards per minute).

This disparate set of peripheral speeds, coupled with the effect of turnaround time in switching the modem from receive to transmit and back again, makes a precise evaluation of the performance of the 3780 difficult. In addition, space compression and multipoint operation can affect the terminal's effective performance. A more detailed discussion is included in the Characteristics section, but the net effect is to make the 3780 suitable for transmitting large quantities of data from cards, receiving moderate quantities of data for printing, and receiving comparatively small quantities of data for punching. □

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone: (914) 696-1900.

MODELS: Only one model of the 3780 Terminal has been announced to date. It includes a card reader, line printer, and control unit integrated into a single terminal, but occupying two cabinets. A card punch is optional.

COMMUNICATIONS: The 3780 employs IBM's BSC (binary synchronous) communicatons technique. Transmission is synchronous, half-duplex at 1200, 2000, 2400, 4800, or 7200/3600 bits per second; the last pair of speeds (7200/3600 bps) represents a leased-line facility with the telephone network being used at the lower speed for backup. Using IBM modems, speeds up to 3600 bps can be achieved over the telephone network, up to 2400 bps over a leased voice-grade line with C1 conditioning, and up to 7200 bps over a leased voice-grade line with C2 conditioning. Other modems could require different conditioning. Operation at 1200 bps usually requires the Synchronous Clock option to provide a timing basis; if the modem has an internal clock for this speed, the option is not required.

A modem, integrated into the 3780 cabinetry, is optional. Three versions, each operating at 2400 bps, are available: one for leased-line, point-to-point operation; one for leased-line, multi-point operation; and one for switched network operation. The leased-line versions require a C1 conditioned line. Optionally, either of the leased-line versions can be equipped with the Switched Network Backup option that allows operation at 1200 bps over the telephone network. The switched network modem includes auto answer capability and automatic equalization. The Switched Network option for the leased-line versions, however, does not permit auto answer and does not include automatic equalization.

Transmission code can be either EBCDIC or ASCII. EBCDIC is an eight-bit data code; ASCII uses seven data bits and one parity bit per character. EBCDIC Transparency transmission and reception is an optional feature for 3780 terminals specifying the EBCDIC transmission code.

The 3780 BSC transmission is compatible with other IBM BSC terminals. The 3780 can share a line with such BSC terminals as an IBM System/360 Model 20, 1130, 1800, or System/3 computer operating as a terminal and with IBM 2770, 2780, 2790, 3270, and 3735 terminals. In such multi-drop configurations, an IBM System/360 (Model 22 to 195) or System/370 can act as the central control unit. Point-to-point transmission can be arranged between a 3780 and another 3780, a 2770 (requires Expanded Buffer or EBCDIC Transparency), a 2780 (requires EBCDIC Transparency), or a System/360 or System/370 computer. Communication with a System/360 or System/370 computer is accomplished through an appropriately equipped 2701 Data Adapter Unit, 2703 Transmission Contorl, 3704 or 3705 Communications Controller, or a specific Communications Adapter feature, depending on the computer system model.

DEVICE CONTROL: Control structure for the 3780 is essentially the same as for the IBM 2770 Data Communi- ►

IBM 3780 Data Communications Terminal

cation System. Basic to this structure is a pair of 512-character buffers which serve the card reader/printer/card punch and the communications line alternately to minimize delays. Variable record length is a standard feature. Spaces at the end of a card are automatically eliminated to conserve transmission. Incoming print records can be split across two blocks. Space compression and expansion is also a standard feature, but can be defeated by a switch and does not function when EBCDIC Transparency is active. Multiple records per block, a standard feature, is also inhibited in the Transparent mode.

When active, the compression feature replaces a consecutive string of spaces with a two-character sequence identifying a string of up to 63 spaces. For longer strings, multiple control sequences are used. When receiving, such control sequences are decoded and the appropriate number of spaces inserted.

Communication with another terminal is arranged manually. Communication with a computer is on a polled/addressed basis. Multi-drop operation requires the Multi-Point Data Link Control option. For operation over the public telephone network, the Switched Network Control option provides automatic answering as long as the power is left on and the modem is capable of this function; also included is provision for automatic disconnect if no data is received or transmitted for 20 seconds.

In addition to the On-Line mode for transmitting multiple blocks of data in one direction, the 3780 can operate in the Conversational mode and in the Home mode. In the Conversational mode, the remote computer can turn the communications line around for immediate return of data without the delay associated with a selection procedure. The Home mode permits transcription of data from cards to the printer or card punch.

An additional mode of operation is provided with the Multi-Point Data Link Control option. The "inquiry" mode causes the 3870 to tie up the line for only the time required to transmit or receive two blocks of data; card input or printer or card output then continues while the 3780 is off-line. Performance of the 3780 is therefore degraded to some extent, but other terminals can have access to the line on a much more frequent basis.

ERROR CONTROL: Cyclic redundancy check characters (two) are generated for EBCDIC-coded transmissions; a cyclic redundancy check is performed on all received EBCDIC-coded messages. Odd character parity and longitudinal parity checks are performed on all received ASCII-coded messages and are generated for transmission. A format check and an odd-even block check count are performed on all transmission.

Detected errors cause a negative acknowledgement sequence to be returned. In response to such a sequence, the 3780 will automatically retransmit up to three times. If desired, the control unit can be modified to permit up to 15 retransmissions before terminating communications. Data is also checked for all transfers out of the buffers.

CARD READER: The card reader is rated at 600 cards per minute. The hopper capacity is 1200 cards, and the stacker capacity is 1300 cards. Only 80-column cards can be read.

PRINTER: The printer is an oscillating bar printer with interchangeable type bars containing 39, 52, or 63 characters. The 52-character set is considered basic for EBCDIC terminals, and the 63-character bar is required for ASCII terminals. The basic printer has 120 print positions, with 144 optional. The rated speeds are 425, 350, and 300 lines per minute for the 39-, 52-, and 63-character sets respectively. Horizontal and vertical format control are standard features.

CARD PUNCH: The 3781 Card Punch operates at a nominal speed of 160 columns per second. Card columns are punched serially. Actual throughput ranges from about 91 cards per minute (all 80 columns punched) to 265 cards per minute (first 10 columns only punched). Hopper and stacker capacities are 1200 and 1300 cards, respectively. Connection of the 3781 requires the Component Selection option.

PERFORMANCE: The principal factors involved in estimating the performance of the 3780 include the number of control characters required, the mode of operation, and the limiting speed of the peripherals. Contributing factors include the amount of the buffer used and the extent to which space compression/expansion is employed. The error rate could naturally have a large effect on performance, but is not one of the terminal parameters per se. In the following paragraphs, the transmission speed in characters per second is used as the basis. This can be derived by dividing the bit rate by 8 (e.g., 2400 bps equals 300 characters per second). The result can be converted to lines or cards per minute by dividing by the record length.

The control characters cause a degradation of about 4 percent regardless of the transmission speed or mode. Block size will usually have a small effect in this area unless very short blocks are transmitted.

Turnaround times vary with the specific modems, line facilities, and operating modes employed. Using IBM modems as a basis, the effect on transmission rate ranges from nil to about 18 percent in addition to the 4 percent for control characters. The largest impact is for 2400 bps operation over a half-duplex line. The lowest impact is for operation over a full-duplex facility at any speed. Higher speeds (i.e., 4800 and 7200 bps) with IBM modems require a full-duplex facility. Even so, multipoint operation can cause a 3 to 11 percent degradation. At lower speeds, degradation due to multipoint operation can range from almost nil to 10 percent, depending on modem and arrangement.

For short records, the operating speed of the peripheral device may be exceeded even after accounting for the degradations just discussed. For example, transmission of 40-character print records or 20-character card records (reader) at 2400 bps over a half-duplex facility will exceed the capability of the printer (with 63-character set) or the card reader, respectively. Any transmission at over 1200 bps will outstrip the card punch. In such a case, transmission will not be hindered–just slowed down.

PRICING: The 3780 is available for purchase or lease. Either a month-to-month rental plan or a 24-month Extended Term Plan is offered. The monthly rentals below include monthly maintenance; a separate arrangement is available for purchased units.

	Monthly Rental			
	Short Term	Extended Term	Purchase	Monthly Maint.
3780 Terminal	$940	$800	$25,000	$235
3781 Card Punch	364	310	10,000	71
Component Selection	18	15	470	0.50
Additional Print Positions	53	45	1,350	2
Multipoint Data Link Control	18	15	450	0.50
Switched Network Control	18	15	450	0.50
Integrated Modem				
Leased Line, Point to point	82	70	2,450	11
Leased Line, Multipoint	88	75	2,650	12
Switched Network	94	80	2,800	13
Switched Network Backup	10	8.50	300	2
EBCDIC Transparency	12	10	300	0.50
Synchronous Clock	29	25	750	0.50
Keylock	35*	35*	35	–

* One-time charge. ■

IBM 129 Card Data Recorder

IBM's 129 Card Data Recorder combines the features of vintage card keypunches and verifiers with buffering and some useful new features. The 129 provides punched card installations with most of the capabilities of stand-alone key-to-tape devices without necessitating a switch to another input medium.

MANAGEMENT SUMMARY

Now that the EDP community is becoming "educated" about the more efficient techniques for preparing data for input to computers, IBM's ubiquitous 29 Card Punch and separate 59 Card Verifier look terribly dated. A growing number of card punch and verifier replacements are now available and enjoying brisk sales. IBM has countered this threat by combining keypunch and verifier functions with buffered operation (as in the UNIVAC 1700 Series). This configuration, introduced in November 1970 as the IBM 129 Card Data Recorder, is available in three models, which provide different combinations of the three basic functions: punch, print, and verify. Customer deliveries began in April 1971.

The IBM 129 looks a lot like a 29 Card Punch, but upon closer inspection there are notable differences between the controls located just above the keyboards on the two models. The keyboards themselves are the same on both models.

Here's a list of the 129's salient features:

- Combined keypunch and verifier operation (in Models 1 and 3).
- Buffered operation.
- Six program levels.
- An Interpret mode (in Models 2 and 3).

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS: Three models as follows: Model 1 punches and verifies; Model 2 punches and prints; Model 3 punches, prints, and verifies.

CARD OUTPUT: IBM 80-column cards, punched in standard 80-column card code. Hopper and stacker capacities are 500 cards each. Punching, verifying, and printing are performed from the buffer at 18 columns/second.

DEVICE CONTROL: Programs are stored in an independent buffer. Provision is made for storing six programs simultaneously, with manual switching among programs.

The program controls the format of the data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, right justification (left zero fill within numeric fields and left blank fill within alpha fields), and optional check-digit verification.

New programs are entered automatically from punched program cards on a one program-per-card basis. Any of six stored programs can be dialed, or all can be disabled to permit the operator to completely control the format of the recording. When operating under program control, the operator can select a new program (other than the one dialed) by keying the Program Select function followed by any digit from one to six. Program control will revert back to the dialed program at the end of the record. Stored programs can be punched into cards.

Modes of operation include Punch, Verify, Print, Read, and Program Load. An Interpret mode is optional for Models 2 and 3.

Punching is performed from the buffer in the Punch mode. During the punching operation, keyed data and/or data entered from prepunched cards (for duplication) resides in buffer storage. A complete record is keyed prior to releasing the card for punching. After a record is released, the operator can begin keying the next record while the just-keyed record is punched into a blank or partially prepunched card. The record is released automatically after entering the last column, or manually at any column. With the Direct Punch Control option, a switch-selectable feature, punching is performed for each keystroke, and card motion occurs in synchronism with keying. This feature permits the 129 to be operated as a 29 by an untrained or casual operator.

In the Verify mode (Models 1 and 3 only), data read from prepunched cards is read into the buffer and compared to previously-stored data (dup verify) and/or keyed data. During verification, mismatches between the keyed and stored data result in an error indication with the keyboard locked. Two additional attempts to rekey the character are required before the rekeyed character replaces the stored character and the verification process continues. Records corrected via verification must be re-

IBM 129 Card Data Recorder

- Left blank or zero insertion.
- Check digit operation.
- Automatic accumulation of production statistics.
- Automatic batch totals.

Buffered operation permits skipping, duplication, and left zero or blank insertion at "electronic" speeds and enables the operator to correct her errors, by backspacing and rekeying, prior to punching the keyed image. The 129's buffer also permits the operator to begin keying the next card while the just-keyed card image is being punched. This total overlap of keying and punching operations eliminates waiting periods between cards.

A total of six programs, read from individual program cards, can be stored and individually selected by the single-digit program number. Numeric and alphabetic fields can be right justified, with zeros punched to the left of the numeric entries and blanks to the left of alphabetic entries. Optional modulus 10 and 11 check digit verification is available for both punch and verify operations.

The IBM 129 Card Data Recorder has armed IBM with the buffered-keypunch capability that was previously enjoyed only by UNIVAC, which began delivering its 1700 Series Card Keypunches in October 1968 and now claims over 37,000 units installed or on order around the world.

There are a number of significant differences between the IBM 129 and the UNIVAC 1700 Series. The principal differences are punching speed (performed from the buffer) and independent interpreting capability. The UNIVAC units can punch at 35 columns per second, compared with IBM's 18 columns per second for a fully-punched card. IBM argues that the lower punching speed will not interfere with the operator's keypunching capability unless she is keying fewer than eight columns per card. Until recently, the 129 lacked the capability to interpret prepunched cards. UNIVAC's 1710 Verifying Interpreting Punch provides this capability as a standard feature; the feature is now optional on the IBM 129. Other differences between the two products include the 129's capability to store up to six programs (versus only two in the UNIVAC models), the 129's optional capability to provide batch totals, and the 129's lack of an auxiliary input, select stacker, and interspersed-master-card capability (all present in the UNIVAC units). Upon examining the costs and differences between the IBM and UNIVAC buffered, keypunches, each user must decide which best suits his own specific application. □

punched after a blank card has been inserted ahead of the cards in the input hopper. The blank card is automatically punched with the corrected record and notched on its trailing edge to indicate that it has been verified to be correct. Both the incorrect and corrected cards are transferred to the output stacker. Cards found to be correct during verification are notched and transferred to the output stacker. The optional Verify Read Control feature permits a card to be used as a source document (such as a turnaround card); during verification, program control halts card movement prior to entry into the read station, to allow the operator to read from the card and key the data to be verified.

Printing can be performed in either Punch or Verify mode on the Model 3. Only correct cards are printed in the Verify mode. Interpreted data is printed across the top of the card and coincides with each punched column. The printing capability cannot be performed other than in the Punch or Verify mode.

In the Read mode, data read from a prepunched card is entered into the buffer for duplicating. In the Program Load mode, programs read from program cards are entered into program storage as selected.

As an option, figures reflecting operator productivity can be recorded and punched upon demand. The Production Statistics feature records totals of keystrokes, cards processed, and verify corrections.

Accumulate, another new IBM option, accumulates totals on any of three fields and, under program control, punches the accumulated totals. Crossfooting can also be performed. Each field count can contain up to 14 digits. Programming for the Accumulate feature is restricted to program levels one and two; levels four through six can be used for this feature when the Additional Accumulate Program Levels feature is added.

The Auxiliary Storage feature (actually a "master card" feature) permits up to 80 columns of common information stored in an auxiliary memory location to be inserted into the corresponding locations of a card either under program or manual control.

Display of the current location within a record is provided by a two-digit lighted indicator.

ERROR CONTROL: Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character. The optional Modules 10 and 11 Check Digit features permit additional means for verifying numeric fields.

KEYBOARD: 49-key keypunch-style; can produce 48- or 64-character codes that include 10 numerics, 26 alphabetics, and special characters. Control keys provide for initiating functions such as manual duplication and skipping, program selection, etc.

PRICING: The 129 is available on a purchase basis or on a one-year lease which permits up to 176 hours per month of usage. The lease price includes maintenance. A separate maintenance contract is provided for purchased units. Prices are as follows:

Model/Feature	Monthly Rental	Purchase	Monthly Maint.
129 Model 1	$125	$6,125	$38
129 Model 2	140	6,860	42
129 Model 3	150	7,350	43
Accumulate Feature (1)	20	980	2.50
Additional Accumulate Program Levels (2)	5	245	1.00
Production Statistics	10	490	1.00
Check Digit Feature:			
Modulus 10 (1)	15	735	1.00
Modulus 11 (1)	20	980	1.00
Expansion Feature	10	490	–
Interpret Mode	15	550	1.50
Verify Read Control	6	295	1.00
Direct Punch Control	6	295	1.00
Auxiliary Storage	8	392	1.00
Card Input/Output Attachment (3)	75	2,625	11.00
Variable Length Feed (4)	25	1,225	6.00
Reading Board Extension	–	20	–

(1) Requires Expansion Feature.
(2) For Accumulate Feature.
(3) Peripheral interface to allow the 129 to operate as a card reader and punch when interfaced to a computer or terminal system.
(4) Required for handling 51, 60, 66, and 80-column cards; may be necessary for Direct Punch Control and/or Verify Read Control features. ■

IBM 5496 Data Recorder

Used for punching, verifying, and printing on the 96-column cards used with the IBM System/3, the 5496 Data Recorder features buffered operation at 60 characters per second, selection among up to four discrete programs, and optional check-digit verification.

MANAGEMENT SUMMARY

To assist System/3 users in preparing data for input to their computers, IBM offers the 5496 Data Recorder—a combined card keypunch and verifying unit. The 5496 is a buffered device designed for punching, verifying, and interpreting IBM's new 96-column cards. Salient features of the 5496 include:

- Buffered Operation—Data keyed or read from cards is entered in buffer storage prior to punching and printing. A record can be keyed while the previously entered record is being punched. Key and "dup" verification is performed on stored data as it is read from cards.
- Program Selection—The operator can select any of up to four stored programs, entered from punched cards (one per card), to control punch and verify operations.
- Check-Digit Verification—Numeric fields containing check digits are automatically verified using the Modulus 10 or 11 checking technique. Check-digit generation, however, is not performed.

Because the 96-column card is one-third the size of the standard 80-column card, it follows that the size of the 5496 is considerably smaller than the IBM 29 Card Punch. Although the keyboard layout of the 5496 is much the same as that of the 29, certain control functions have been changed as a result of buffered operation and the consolidation of punch and verify functions. An operator panel above the keyboard contains function controls and indicators, including the two-digit, direct-reading column indicator and the active program indicator.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

CARD OUTPUT: IBM 96-column cards punched in 6-level, 96-column card code.

The new IBM 96-column card is about one-third the size of the standard 80-column card and holds 20 percent more data. The card measures 3.25 inches wide by 2.63 inches high. The upper portion of the card can accommodate up to four printed lines, each containing up to 32 characters. The lower portion consists of three "tiers" of punching positions; each tier can hold 32 characters of data. Punched data is expressed in a 6-bit code and represented by tiny round holes.

The 96-column card is punched and printed at 20 columns/second, which is equivalent to 60 characters/second because of the three-tiered format of the card.

The single input hopper and output stacker each hold 350 cards.

DEVICE CONTROL: Programs are stored in an independent buffer. Provision is made for storing four programs simultaneously, with manual switching among the programs.

The program controls the format of the data by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, right justification (left zero fill), and optional check-digit verification.

New programs are entered automatically from punched program cards on a one-program-per-card basis. Any one of four stored programs can be manually selected, or all can be disabled to permit the operator to completely control the format of the recording.

Modes of operation include Read, Program Load, Punch, Verify, and Print.

In the Read mode, data read from a prepunched card is entered into the buffer for duplicating.

In the Program Load mode, programs read from program cards are entered into program storage as selected.

Punching is performed from the buffer in the Punch mode. During the punching operation, keyed data and/or data entered from prepunched cards (for duplication) resides in buffer storage. A complete record is keyed prior to releasing the card for punching. After a record is released, the operator can begin keying the next record

IBM 5496 Data Recorder

The basic procedure for operating the Data Recorder is as follows: (1) operator loads programs into selected program areas by placing program cards in the hopper and initiating the Program Load function; (2) operator selects format program; (3) operator keys data into the buffer, with fields automatically skipped or duplicated as specified in the program; (4) the card is automatically punched from the image residing in the buffer as the next card is entered; (5) the punched card is transferred to the stacker. The verify operation is similar. Cards that have been verified to be correct are notched; all cards are transferred to the stacker. Card path stations, in sequence from hopper to stacker, are punch, read, verify, wait, and print.

Cards are punched and verified in the same column in each of three tiers simultaneously. Thus, the rated punching and verifying speed of 20 columns per second is equivalent to 60 characters per second, and it takes only 1.6 seconds to punch a full 96-column card after the operator has keyed in all the data. Printing is performed at the top of the card in each of three rows, whose print positions correspond by number to the punch positions in the card.

Introduced in July 1969 as a strictly off-line unit, the 5496 Data Recorder assumed an important on-line role with the October 1970 introduction of the System/3 Model 6. IBM also permits on-line use of the 5496 with two of its terminals, the 2770 Data Communication System and the 3735 Programmable Buffered Terminal. As an on-line peripheral, the 5496 can serve as a card reader or punch and print unit. Rated throughput in either input or output mode is 22 cards per minute. A 5496 acting as an on-line peripheral can be switched off-line for data-preparation applications. □

while the previously-keyed record is punched into a blank or partially prepunched card. The record is automatically released after entering the last column, or the operator can release the record at any column.

In the Verify mode, data read from prepunched cards is read into the buffer and compared to previously stored data (dup verify) and/or keyed data. During key verification, non-comparisons between keyed and stored data result in an error indication with the keyboard locked. Two additional attempts to rekey the character are required before the rekeyed character replaces the stored character and the verification process continues. Card images that are corrected during verification require verification before the corrected image can be punched and the next card verified. Reverification is performed differently under program control than under manual control. Under program control, each corrected field must be reverified before the following field can be verified. Control automatically returns to the first column of the field to be reverified after the field has been corrected.

Under manual control, reverification is performed only after a complete record has been verified and corrected; control automatically returns to the first column to be reverified after the record has been corrected. The Verify Field Correct function permits an entire field to be corrected when it is known that the field contains a number of errors. The corrected field must be reverified. Records corrected via verification must be repunched by initiating the Verify Repunch function after a blank card has been inserted ahead of the cards in the input hopper. The blank card is automatically punched with the corrected record and notched on its trailing edge to indicate that it has been verified to be correct. Both the incorrect and the correct card are transferred to the output stacker. Cards found to be correct during verification are notched and transferred to the output stacker.

Printing can be performed on the cards in either Punch or Verify mode. Only correct cards are printed in the Verify mode. Print positions at the top of the card correspond by number to the positions below. Although four rows are provided for printing, only three are used by the 5496; the fourth is provided for use by other System/3 components. For printing, IBM employs a ribbon contained in a removable replacement cartridge.

Display of current location within a record, active program, and status conditions are provided by indicator lamps on the operator panel. The card column is displayed in decimal fashion by a two-digit indicator. Active program and status conditions (error, stacker full, and feed check) are displayed by individual indicator lamps.

ERROR CONTROL: Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character. Field Erase and Record Erase functions permit the operator to erase all data that has just been keyed into a field or record, respectively; duplicated data is not erased. The optional Modulus 10 and 11 Check Digit features permit additional verification of numeric fields.

KEYBOARD: 50-key keypunch-style keyboard can produce any of 64 character codes, including 10 numerics, 26 alphabetics, and 28 special characters. A total of 15 control keys provide for initiating functions such as manual duplication and skipping, field erase, program selection, etc.

ATTACHMENT: The 5496 can operate as a peripheral device on an IBM System/3 Model 6, IBM 3735 Programmable Buffered Terminal, or IBM 2770 Data Communication System via the Attachment feature. Switch selection permits the 5496 to operate on-line as part of the system or off-line as a free-standing unit.

PRICING: The 5496 is available on a purchase basis or on a one-year lease which permits usage of up to 176 hours per month. The lease price includes maintenance. A separate maintenance contract is provided for purchased units. The prices for the 5496 are:

	Monthly Rental	Purchase	Monthly Maintenance
5496 Data Recorder	$155	$7,600	$54
Check Digit feature (Mod 10 or 11)	30	900	1
Attachment feature*	45	2,205	*

* For on-line operation with a System/3 Model 6 computer, 3735 Programmable Buffered Terminal, or 2770 Data Communication System. Maintenance prices are $4.50, $11, and $15, respectively. ■

IBM 270X Communications Controllers

MANAGEMENT SUMMARY

IBM promoted the then-young concept of on-line data communications by introducing the first two members of its 270X family of communications controllers, the 2701 and 2702, as an integral part of the System/360 announcement in April 1964. As the development and application of data communications progressed, it soon became evident that the 2701 and 2702 were not adequate to completely satisfy the ever-increasing needs of System/360 users. With the announcement of the third and last member, the 2703 Terminal Control, users were offered an expanded network control capability, significantly increased transfer rates and substantially greater operating flexibility. As a result of the smashing impact of the System/360 computers, the majority of users entering computer communications have been exposed to one or more members of the 270X family.

Because the 270X controllers offered the only means of accessing the larger System/360 computers from remote terminals, they served to establish, in effect, a set of communications standards for independent suppliers of remote terminals. The viability of remote terminals produced by the independent manufacturers hinged largely on their compatibility with the transmission characteristics of the IBM 270X controllers and with the associated IBM communications software.

The 270X controllers, like other IBM peripheral devices for the System/360 and System/370, are interfaced with a user's application programs via a series of operating system I/O and file-control facilities called Data Access Methods. For data communications, IBM has evolved three access methods: BTAM (Basic Telecommunications Access Method), QTAM (Queued Telecommunications Access Method), and TCAM (Telecommunications Access Method). TCAM is a replacement for QTAM.

BTAM provides the basic I/O control routines for interfacing all IBM terminals, including provisions for polling and addressing terminals on a shared line, managing buffer queues, code translation, retransmission to correct line errors, keeping error statistics, etc. QTAM provides message control and editing routines that simplify the programmer's task of coding a program to control a large number of communications lines and terminals. QTAM's main limitation is the lack of support for many IBM terminals, particularly high-speed BSC terminals such as the 2770, 2780, 3270, 360/20, etc. TCAM incorporates the message control ideas of QTAM and the wide terminal support of BTAM, while making life easier for programmers by using communications control coding that looks more like coding for other types of file devices. Either BTAM or QTAM, or both, can be used under DOS. OS supports all three access methods, ▷

The IBM 2701, 2702, and 2703 communications controllers introduced many computer users to the concept of remote collection and dissemination of data via communications lines. Though largely obsoleted by the programmable IBM 3705, the 270X concepts will remain active because of wide support via emulation packages and systems offered by IBM and the independents.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS: The IBM 270X family of hard-wired communication-line controllers includes three members: the 2701 Data Adapter Unit and the 2702 and 2703 Transmission Controls. Each member can be connected to the multiplexer channel of an IBM System/360 computer, Models 22 through 195, or to a multiplexer, byte multiplexer, or block multiplexer channel of an IBM System/370 computer, Models 125 through 195. Each member employs modular construction, has its own unique configuration, is designed to satisfy a specific set of transmission parameters, and accommodates a different number of communication lines. The transmission parameters for each member of the 270X family are as follows:

- 2701 – Accommodates various combinations of up to four half-duplex communications lines operating asynchronously at data rates up to 600 bits/second or synchronously at data rates up to 230,400 bits/second; however, only two synchronous lines can be active simultaneously. The 2701 also supports up to four sets of parallel data connections which can be used instead of communications lines.

- 2702 – Accommodates up to 15 half-duplex communications lines operating asynchronously at data rates up to 180 or 600 bits/second, or up to 31 half-duplex lines operating asynchronously at data rates up to 200 bits/second.

- 2703 – Accommodates up to 176 half-duplex communications lines operating asynchronously at data rates up to 165 bits/ second, up to 72 half-duplex lines operating asynchronously at data rates up to 600 bits/second, or up to 24, 32, or 48 lines operating synchronously at data rates up to 2400 bits/second. Various combinations of lines are supported.

2701 CONFIGURATION: The basic 2701 Data Adapter Unit is designed for both asynchronous and synchronous operation. It contains a Channel Interface and a basic unit gate, which includes a Transmission Adapter. The basic 2701 can accommodate one communication line or direct connection. The basic unit can be expanded to accommodate up to three additional lines by adding an Expansion Feature and a Transmission Adapter for each additional line; the Expanded Capability Feature, a second unit gate, is required to accommodate a second or third Expansion Feature and Transmission Adapter. ➤

IBM 270X Communications Controllers

COMMUNICATIONS LINES ACCOMMODATED BY THE IBM 2701

Transmission Type	Maximum line Speed, bits per second	Total Lines	Transmission Adapter	Adapter Category	Line Connection	Typical IBM Terminals Supported
Asynchronous	134.5 or 600	4	IBM Terminal Adapter Type I Mod II	I	Modem	1030; 1050; 1060; 1070; 2740 Mdl. 1 or 2; 2741; System/7
Asynchronous	600	4	IBM Terminal Adapter Type II	I	Modem	1030; 1050; 1060; 1070; 2740 Mdl. 1 or 2; 2741; System/7
Asynchronous	1200 or 2400	2	IBM Terminal Adapter Type III	II	Modem	2848/2260; 2845/2265
Asynchronous	45.5, 56.9, or 74.2	4	Telegraph Adapter Type I	I	Direct	AT&T 83B2/83B3; WU 115A
Asynchronous	110	4	Telegraph Adapter Type II	I	Direct	TWX 33/35
Synchronous	1200, 2000, or 2400; 19.2K or 40.8K	4*	Synchronous Data Adapter Type I**	II	Modem	1009; 1013; 7701; 7702; 7710; 7711; 7740; 7750; S/360-20; 1130
Synchronous (BSC)	1200, 2000 or 2400; 19.2K, 40.8K, 50K, or 230.4K	4*	Synchronous Data Adapter Type II***	II	Modem	2770; 2780; 3735; 3780; S/360; S/370 S/3; 1130

* Four lines total with two Dual Communications Interface features (one per Synchronous Adapter Type I or Type II); otherwise, two lines total. Simultaneous transmission on both lines of a common interface is not supported.

** Requires Internal Clock feature for each adapter or Dual Communications Interface if external modem does not provide clock. Transmission code is 4-out-of-8 code.

*** Requires Synchronous Clock feature for each adapter or Dual Communications Interface if external modem does not provide clock. Transmission code can be specified as EBCDIC, ASCII, or Transcode; two transmission codes can be specified with the Dual Code feature.

and they can be used simultaneously for different applications programs if desired.

Although IBM periodically announced single-line controllers for smaller computer systems such as the System/360 Model 20 and 1130, the first obvious break away from the 270X concept was the microprogrammed communications control facilities provided with the System/370 Model 135, which offer a less expensive means for controlling a small number of lines. The 2703, however, remained the only means for implementing large communications networks until the March 1972 introduction of the IBM 3705 Communications Controller (Report 70D-491-31). Thus, the 270X family had an active product life span of eight years–and even now, there are certain situations in which a 2701 or 2703 will prove to be less expensive than a 3705, as described in Report 70D-491-31.

Although the 270X controllers are now largely outdated as specific products, the concepts they employ will remain an influencing factor in the communications field, as evidenced by the numerous stored-program replacements designed to emulate them. Just as there are alternate suppliers of IBM-compatible magnetic disk and tape drives and main memories for the System/360 and System/370 computers, there are alternate suppliers of

The Channel Interface is shared by all communications lines unless the optional Second Channel Interface is specified. This feature interfaces one or both communication lines supported via the Expanded Capability Feature (second unit gate) with a second channel on the same computer or a channel on a second computer.

The Transmission Adapter, designed to provide transmission compatibility with specific classes of remote terminals, is available in several models, which are divided into two categories based on space requirements and physical limitations. The 2701 can accommodate two Category I Adapters or one Category II Adapter per 2701 unit gate, for a maximum of four Category I Adapters, two Category II Adapters, or two Category I Adapters and one Category II Adapter per expanded 2701. The 2701 Transmission Adapters are listed in the accompanying table, which defines the category, transmission parameters, and IBM terminals supported by each.

The Parallel Data Adapter, not listed in the table, is a 16-bit parallel interface, expandable to 48 bits in 8-bit increments via the Parallel Data Extension. The Parallel Adapter is designed for direct attachment of user-supplied I/O devices and can be shared by up to eight devices. The Parallel Data Timeout feature (one per Parallel Adapter) provides a 20-second timeout of the response from an external device after a data transfer request from the Parallel Adapter; the Timeout feature generates an interrupt for each non-response. The Parallel Data Adapter with up to two Parallel Data Extensions is defined as a Category I Adapter; with three or four Extensions, it is defined as a Category II Adapter. The Parallel Adapter is

IBM 270X Communications Controllers

COMMUNICATIONS LINES ACCOMMODATED BY THE IBM 2702

Transmission Type	Maximum line Speed, bits per second (1)	Total Lines (2)	Terminal Control (3)	Line Adapter (4)	Typical IBM Terminals Supported
Asynchronous	75, 134.5, or 600	31 or 15	IBM Type I (5)	Data Set, LDA Type I, or LDA Type II	1030; 1050; 1060; 1070; 2740 Mdl. 1 or 2; System/7
Asynchronous	600	15	IBM Type II (5)	Data Set or LDA Type I	1030; 2740 Mdl. 2; System/7
Asynchronous	45.5, 56.9, or 74.2	31 or 15	Telegraph Type I	Telegraph	AT&T 83B2/83B3; WU 115A
Asynchronous	110	31 or 15	Telegraph Type II	Data Set	TWX 33/35

(1) Two line speeds can be specified for either the IBM Terminal Control Type I or Telegraph Terminal Control Type I.

(2) Basic 2702 accommodates 15 lines; the 31-line Expansion feature, mutually exclusive with the Speed Extension feature, which provides for operation at 600 bps, is required for operation with 31 lines.

(3) The 2702 accommodates one IBM Type I or II Terminal Control and one Telegraph Type I or II Terminal Control.

(4) LDA stands for Limited Distance Line Adapter, an IBM modem for distances up to 4.75 (Type I) or 8 (Type II) wire miles.

(5) Requires Speed Extension feature for operation at 600 bps.

> communications equipment designed to replace the IBM 270X components. These form a budding aspect of the proliferating market for programmable communications processors. (See Report 70G-400-01, "All About Communication Processors.") □

➤ not compatible with the Bell System 400 Series modems. Transmission rate between the computer and external device is governed by the device itself and is limited only by the maximum data rate of the computer channel.

The Synchronous Data Adapter Type II is available with several options:

- Transparency inhibits control-code recognition to allow the acceptance of all bit patterns of a particular code as data. The 2701 Transparency feature applies to EBCDIC, ASCII, or 6-bit Transcode (SBT) transmission codes and can be specified for each Synchronous Data Adapter Type II.
- Dual Code permits the program-controlled selection of a second code type (EBCDIC, ASCII, or Transcode), and can be specified for each Synchronous Data Adapter Type II.
- Station Selection is required for each Synchronous Data Adapter Type II that communicates with two or more remote terminals sharing the same leased line.
- The Dual Communications Interface, one per adapter, interfaces the Synchronous Data Adapter Type I or Type II with two communications lines (via a modem for each line); however, transmission is restricted to non-concurrent operation. Line selection is program-controlled. The Dual Communications Interface requires the Internal Clock or Synchronous Clock feature when a clock signal is not supplied by an attached modem. Both lines are restricted to operation at the same data rate when controlled by a common clock such as the Internal or Synchronous Clock.
- Autocall, one per adapter, supports automatic dialing over the public telephone network. This feature is available for the IBM Terminal Adapter Type I Mod II, Telegraph Adapter Type II, and Synchronous Adapter Type I and Type II.

Two clock features, the Internal Clock and Synchronous Clock, are available for the Synchronous Data Adapter Type I and Type II and for the Dual Communications Interface. Both features provide a clock signal for synchronous operation when the attached modem does not provide for clocking. The Internal Clock generates program-selected clock rates for operation at 1200, 2000, or 2400 bits/second. The Synchronous Clock generates fixed clock rates for operation at 1200 or 2400 bits/second. Each Synchronous Adapter can accommodate one clock feature.

The 2701 is available with one or two 1200-bps modems for synchronous operation over leased or switched lines, provided the 2701 does not include an IBM Line Adapter or Telegraph Adapter Type I. This feature applies only to the Synchronous Data Adapter Type II with Synchronous Clock feature and includes an IBM Line Adapter Base (one per 2701) and one or two IBM 1200-bps Line Adapters. Two versions of the Line Adapter are available: leased or switched. The switched version includes an automatic answering capability and connects to the public telephone network via the Bell System Type CBS Data Access Arrangement. Automatic dialing is implemented by combining the following features: Automatic Call Origination (one per switched line adapter) and Autocall (one per Synchronous Adapter Type II).

The IBM Line Adapter, a modem for two-wire operation at distances of up to eight wire-miles, is available for use with the IBM Terminal Adapter Type I Mod II at rates up to 134.5 or (with Speed Selection) 600 bits/second or with the IBM Terminal Adapter Type II. ➤

IBM 270X Communications Controllers

COMMUNICATIONS LINES ACCOMMODATED BY THE IBM 2703

Transmission Type	Maximum line Speed, bits per second	Total Lines	Line Base*	Terminal Control**	Line Sets***	Typical IBM Terminals Supported
Asynchronous	165	176	Start-Stop Type I or II	IBM Type I or II	Data or IBM LDA	1050; 1060; 1070; 2740 Mdl. 1 or 2; 2741; System/7
Asynchronous	600	72	Start-Stop Type II	IBM Type I or II	Data or IBM LDA	1030; 1070; 2740 Mdl. 2; System/7
Asynchronous	110	176	Start-Stop Type I or II	Telegraph Type I or II	Telegraph	AT&T 83B2/83B3; WU 115A; TWX 33/35
Synchronous	2400	48	Synchronous Type 1A	Synchronous	Synchronous	2770; 2780; 3735; 3780; S/3; S/360; S/370
Synchronous	2400	32	Synchronous Type 1B	Synchronous	Synchronous	2770; 2780; 3735; 3780; S/3; S/360; S/370
Synchronous	4800	24	Synchronous Type 2A	Synchronous	Synchronous	2770; 2780; 3735; 3780; S/3; S/360; S/370

* The Basic Expansion feature is required to attach a second Start-Stop Base. The Base Expansion and Synchronous Attachment features are required to attach one or two Synchronous Bases. Transmission code and number of lines supported differ among synchronous models. Type 1A accommodates EBCDIC or ASCII; Type 1B, EBCDIC, ASCII, or Transcode; Type 2A, EBCDIC or ASCII.

** The IBM and/or Telegraph Terminal Control Base is required to attach respective IBM and Telegraph Terminal Controls.

*** The Data and Synchronous Line Sets provide a modem interface for each line. The IBM LDA, a Limited Distance Line Adapter, is a modem designed for distances up to 4.75 (Type I) or 8 (Type II) wire miles. The Telegraph Line Set provides direct attachment to a telegraph-grade line.

2702 CONFIGURATION: The 2702 Transmission Control is designed for asynchronous operation only. It includes a basic 2702 unit, a Terminal Control Base, one to three Terminal Controls, and a Line Adapter, one per line; a modem is employed between the Line Adapter and communications line where applicable. Terminal Controls and Line Adapters are each available in four models, designed for transmission compatibility with specific classes of remote terminals. The 2702 Transmission Controls and Line Adapters are listed in the accompanying table, which defines the transmission parameters and the typical IBM terminals supported by each. The Terminal Control Expansion is required to accommodate both IBM and Telegraph terminals. The standard 2702 Transmission Control supports up to 15 half-duplex communications lines operating at speeds up to 134.5 bits/second; with the 31-line Expansion feature, the 2702 can accommodate up to 31 half-duplex lines operating at speeds up to 200 bits/second.

The following features and facilities can be added to the 2702:

- Speed Extension increases the standard line-speed capability of 134.5 bits/second to 600 bits/second for all 15 lines, but is mutually exclusive with the 31-Line Expansion feature.
- Additional Selective Speed requires the Speed Extension feature and provides program-controlled selection of a second and different specified line speed for one IBM Terminal Control Type I and/or one Telegraph Terminal Control Type I; see the accompanying table for available line speeds. This feature limits the 2702 to 15 lines.
- Auto Poll, available for the IBM Terminal Control Type I or Type II, permits polling to continue following a negative response on each line without initiating a program interrupt.
- Autocall (one per 2702) permits automatic dialing on up to eight lines; Autocall Expansion (one per 2702) expands the capability to an additional 16 lines. An Autocall Adapter and a Data Set Line Adapter are required to interface each line with an automatic calling unit; up to 8 units (or 16 with Autocall Expansion) of both types can be accommodated.
- 2741 Break (one per 2702) is applicable to IBM 2741 Communications Terminals with the Receive Interrupt feature. This feature is designed for the IBM Terminal Control Type I with Selective Speed and is mutually exclusive with Type I Terminal Interrupt. The IBM Terminal Control Type I can be used independently of the 2741 Break feature to also support terminals without Receive Interrupt; however, two speeds must be specified for the Terminal Control.
- Type I Terminal Interrupt (one per 2702) is designed for a bi-directional interrupt capability with a 1051 Terminal or a 2741 with both Transmit and Receive Interrupt, and is used with the IBM Terminal Control Type I. This feature cannot be specified if an IBM Terminal Type II or 2741 Break feature has been specified. Type I Terminal Interrupt requires an IBM Terminal Control Type I with Selective Speed.
- 1032 Attachment (one per 2702) is designed to attach a 1032 Digital Time Unit and requires an IBM Terminal Control Type II with Speed Extension.

IBM 270X Communications Controllers

- The Two-Processor Switch (one per 2702) permits the 2702 to be switched between two multiplexer channels on a System/360 or 370 computer or between two computers.

2703 CONFIGURATION: The 2703 Transmission Control is designed for both asynchronous and synchronous operation. It includes a basic 2703 unit and various combinations of three basic components: Terminal Control, Line Base, and Line Set.

Terminal Controls are available in five models designed for transmission compatibility with specific classes of remote terminals. The models are divided into three groups according to the type of terminals that each supports: asynchronous (IBM), synchronous, and telegraph.

The 2703 can accommodate a maximum of one of each model of Terminal Control with the exception of the synchronous models: the 2703 can also accommodate two Synchronous Terminal Controls–one each of any two of the four defined code types: ASCII, EBCDIC, SBT, or Transparent ASCII. If all other models of Terminal Controls are absent, the 2703 can accommodate three Synchronous Terminal Controls, one each of any three of the four defined types.

Line Bases are available in three models, each designed to support a specific number of communications lines and transmission speeds. Three versions of the Line Base designed for synchronous operation differ in the transmission codes that each supports.

A Terminal Control Base is required to interface one or two Terminal Controls with a Line Base (except for the Synchronous Terminal Control, which does not require a separate Terminal Control Base). Two Terminal Control Bases are available: the IBM Terminal Control Base, which accommodates one IBM Terminal Control Type I and/or Type II; and the Telegraph Terminal Control Base, which accommodates one Telegraph Terminal Control Type I and/or Type II. The 2703 accommodates one Terminal Control Base of each type.

The parameters of each of the three models of Line Bases are defined below.

Line Base	Total Bases	Lines per Base	Total Lines
Start-Stop Type I	3	88	176
Start-Stop Type II	3	24	72
Synchronous Type 1A	2	24	48
Synchronous Type 1B	2	16	32
Synchronous Type 2A	2	12	24

The Base Expansion (one per 2703) is required to accommodate two or more Start-Stop Bases Type I or Type II or to accommodate one or two Synchronous Line Bases, which also require a Synchronous Attachment (one per 2703).

Line Sets are available in four models and are divided into the same three classes that define the Terminal Controls. Each model is designed to interface a specific model of a Line Base with a number of communications lines. A modem interfaces each line connection on a Line Set with the corresponding communications line where applicable.

The parameters of each of the four models of Line Sets are defined below. Each Line Set or associated feature is assigned a specific weight, which is used to determine the maximum allowable configuration of a 2703. When defining the internal configuration of a 2703, the sum of the weights for the included Line Sets cannot exceed a weight of nine per Start-Stop Base Type I or Type II or a weight of six per Synchronous Base Type 1A, 1B or 2A. Because of this general limitation, three Start-Stop Base Type I's may be required for some configurations.

Line Set	Assigned Weight	Lines per Line Set	Max. Line Sets per 2703	Total Lines
Data Line Set	1	8	12	96
Data Line Set Expander	0	8	10	80
Telegraph Line Set	1	8	12	96
Telegraph Line Set Expander	0	8	10	80
IBM Line Set 1A or 1B	1	8	12	96
IBM Line Set 2	2	8	4	32
Synchronous Line Set Type 1A	1	4	6	24
Synchronous Line Set Type 1B	1	4	4	16
Synchronous Line Set Type 2A	1	4	3	12
Synchronous Clock*	1	–	–	–

* May be required for Synchronous Line Set.

All models of the three basic components of the 2703 Transmission Control are listed in the accompanying table, which defines their corresponding relationships, transmission parameters, and the typical IBM terminals supported by each.

Telegraph Line Sets require a Telegraph Attachment (one per 2703).

All lines accommodated by a Line Set (or Line Set Expander) are restricted to the same line speed (except when clocking is supplied by the modem) and line discipline.

Synchronous operation at 1200 bits/second over the switched telephone network or leased voice-band lines requires the Synchronous clock. The 2703 can accommodate up to six of these features distributed as follows: one per Synchronous Line Set and three per Synchronous Base Type 1A, 1B, or 2A. The Synchronous Line Speed Option (one per 2703) is required for one or more Synchronous Clocks. This feature generates a 1200-bit/second clock signal.

Asynchronous operation requires the Line Speed Option (up to seven per 2703), which defines the line speed for a particular class of remote terminals. Available Line Speed Options include 45.5, 56.9, 74.2, 75, 110, 134.5, and 600 bits/second.

Other features available for the 2703 Transmission Control are as follows:

- Station Selection is required for synchronous operation of the 2703 as another terminal in a multidrop environment. One Station Selection feature is required per Synchronous Terminal Control.
- Autocall (two per 2703) interfaces each line of a Data Line Set or Data Line Set Expander, or two Synchronous Line Sets, with an Automatic Calling Unit (ACU). Each Autocall feature is restricted to one Line Set or Expander.
- The Two-Processor Switch permits the 2703 Transmission Control to be switched between two multiplexer channels on the same or different System/360 and/or System/370 computers.

IBM 270X Communications Controllers

- 2741 Break (one per 2703) provides the same function as the corresponding feature for the 2703 Transmission Control. The feature is used with the IBM Terminal Control Type I, and is mutually exclusive with the Type I Terminal Interrupt feature.
- Type I Terminal Interrupt (one per 2703) provides the same function as the corresponding feature for the 2702 Transmission Control. The feature is used with the IBM Terminal Control Type I, and is mutually exclusive with the 2741 Break feature.

PRICING: The IBM 270X Series Communications Controllers are available for purchase or lease. The monthly rental prices include maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental	Purchase	Monthly Maint.
2701 DATA ADAPTER UNIT			
Basic 2701 Unit	$200	$9,130	$15.00
Transmission Adapters & Features			
IBM Terminal Adapter:			
Type I Mod II	75	3,290	6.50
Type II	75	3,290	6.50
Type III	125	5,265	8.75
Synchronous Data Adapter:			
Type I	300	13,530	19.00
Type II	300	13,530	19.00
Telegraph Adapter:			
Type I	75	3,290	6.50
Type II	75	3,290	6.50
Parallel Data Adapter	130	4,890	10.00
Parallel Data Extension	10	300	2.25
Expansion Feature	80	3,530	6.00
Expanded Capability	25	1,165	0
Internal Clock (SDA-Type I)	45	2,065	2.00
Synchronous Clock (SDA-Type II)	44	1,745	0.50
Station Selection (SDA-Type II)	39	1,260	0.50
Transparency (SDA-Type II)	73	3,275	0.50
Dual Code (SDA-Type II)	39	1,260	0.50
Dual Communications Interface:			
SDA-Type I	20	950	1.00
SDA-Type II	44	1,745	0.50
Autocall	35	1,530	2.50
Autocall (SDA-Type II)	49	1,940	0.50
Line Adapters			
IBM Line Adapter	10	500	1.75
Line Adapter Base	45	1,575	1.00
Line Adapter, 1200 bps:			
Leased	15	525	2.50
Switched	20	700	3.00
Automatic Call Origination	65	2,275	10.00
2702 TRANSMISSION CONTROL			
Basic 2702 Unit	850	38,395	46.00
Terminal Controls & Features			
IBM Terminal Control:			
Type I	35	1,530	1.00
Type II	35	1,530	1.00
Telegraph Terminal Control:			
Type I	35	1,530	1.00
Type II	35	1,530	1.00
Terminal Control Base	0	0	0
Terminal Control Expansion	20	950	1.25
Additional Selective Speed	15	700	1.00
Speed Extension	75	3,385	4.00
31 Line Expansion	100	4,425	4.00
Auto Poll	50	2,260	4.00
Type I Terminal Interrupt	30	1,200	0
Two Processor switch	75	3,385	3.50
2741 Break	10	450	1.00
1032 Attachment	40	1,560	1.00
Auto Dialing Features			
Autocall Feature	60	2,640	3.00
Autocall Expansion	15	700	1.00
Autocall Adapter	15	700	1.00
Line Adapters			
Data Set Line Adapter	20	950	3.00
IBM Line Adapter:			
Limited Distance Type 1	30	1,345	1.00
Limited Distance Type 2	23	1,050	1.00
Expansion Base (for LDA, Type 1)	0	0	0
Telegraph Line Adapter	20	900	4.00
2703 TRANSMISSION CONTROL			
Basic 2703 Unit	1,450	65,485	76.00
Line Bases & Features			
Start-Stop Base:			
Type I	75	3,385	4.50
Type II	75	3,385	4.50
Synchronous Base:			
Type 1A	145	5,820	5.00
Type 1B	145	5,820	5.00
Type 2A	267	11,640	4.50
Base Expansion	75	3,385	4.00
Synchronous Attachment	485	19,400	12.00
Terminal Controls & Features			
IBM Terminal Control Base	20	950	1.25
IBM Terminal Control:			
Type I	35	1,530	1.00
Type II	35	1,530	1.00
2741 Break	10	450	1.00
Type I Terminal Interrupt	60	2,330	0
Telegraph Terminal Control Base	20	950	1.25
Telegraph Terminal Control:			
Type I	35	1,530	1.00
Type II	35	1,530	1.00
Telegraph Attachment	45	2,025	5.00
Synchronous Terminal Control (EBCDIC, ASCII, or SBT codes)	97	3,880	3.00
Station Selection	49	1,505	0.50
Line Sets & Features			
Data Line Set	75	3,135	14.00
Data Line Set Expander	55	2,210	10.00
IBM Line Set:			
1A	94	3,805	3.75
1B	94	3,805	3.75
2	145	6,485	6.00
Telegraph Line Set	84	3,510	20.00
Telegraph Line Set Expander	65	2,590	16.00
Synchronous Line Set	390	15,520	5.50
Synchronous Clock	58	2,330	2.50
Autocall	120	5,415	8.00
Speed Options			
Line Speed Option:			
Asynchronous (45.5 bps to 600 bps)	10	475	1.00
Synchronous	15	600	0.50
Two Processor Switch	75	3,385	3.50

IBM 3705 Communications Controller

MANAGEMENT SUMMARY

IBM introduces new concepts and equipment no faster than the average user can assimilate them. Thus, IBM's March 1972 announcement of the 3705 Communications Controller marked the coming of age of several key concepts, including distributed processing, minicomputers, and data communications. Though all of these concepts have received widespread attention throughout the EDP community for some years, IBM's endorsement of them had previously been considerably less than whole-hearted. Now, the industry's unofficial but ultra-powerful sanctioning body has put its full stamp of approval upon these concepts, and rapidly increasing user acceptance is virtually assured.

In considering the 3705, several basic questions need to be answered:

- What is the 3705 and how does it relate to the earlier IBM 270X series controllers?
- What is the relationship between the 3705 and the System/370?
- Has the System/360 been forgotten?
- Are there alternate suppliers of 3705-type units, as there are for magnetic tape drives, disk drives, and main memory?

In a nutshell, the 3705 is a free-standing processing unit that is placed between the host processor and the communications lines. Its programmability is used to expand the capability for interfacing communications lines and terminals with maximum flexibility and minimum specialized hardware components. It can relieve the host processor of much of the housekeeping associated with controlling multiple, simultaneous data paths. The 3705 can be expanded to include up to 240K bytes of core memory and adapters for up to 352 communications lines. The maximum limit on lines applies to synchronous lines operating at up to 7200 bits per second as well as to slow-speed asynchronous lines. Higher-speed lines and lines using IBM Line Adapters in place of modems reduce the maximum limit, as shown in the accompanying table.

The two significant factors in comparing the 3705 and IBM's previous 270X series controllers are the related concepts of expandability and conservation of host processor resources. Cost, also an important factor for most users, is a variable comparison point. With the 270X series, the maximum number of lines that could be accommodated was limited by the number of available multiplexer subchannels. With the 3705, the maximum ▷

The announcement of the 3705 in March 1972 represented an IBM endorsement of the concept of programmable "front ends" for data communications and thus validated what many have long been advocating. The full capability of the 3705 is usable only with the IBM System/370, although there are some situations that make its cost attractive to System/360 users as well.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS: The 3705 is available in an array of 20 models, each identified by a letter and a number. The letter (A through D) refers to the maximum number of communications lines that can be attached; the number (1 through 8) refers to the amount of main memory incorporated. Both designations are related to the number of modules (1 through 4) in the system. A complete listing of the models is contained in the price list referenced at the end of this report.

CONFIGURATION: A 3705 Communications Controller is composed of:

- The basic 3705 model (A1 through D8) which includes the central control unit, main memory and space for mounting the interfaces between the central control unit and the communications lines and between the central control unit and the host computer.
- Channel Adapters (1 or 2) which provide the data path between the 3705 and the System/360 or System/370 host computer. Two types provide different levels of performance.
- Scanners (1 to 4) which interface the line attachment hardware with the 3705 central control unit. Two types provide different levels of performance.
- Line Interface Bases which provide certain control functions for particular types of lines and transmission techniques.
- Line Sets which provide the interface for data sets or directly with the communications lines.

Physically, the 3705 is configured in one to four cabinets or modules. The Base Module includes the central control unit and 16K or 48K bytes of core memory. This forms models A1 and A2, depending on memory size. Within this basic module, one Scanner and one Channel Adapter can be added. Each 3705 Expansion Module adds the capability for an additional 32K or 64K memory and one Scanner. One additional Channel Adapter can be added to the first Expansion Module. (The 3705 Expansion Module is sometimes called the 3706.)

The Base Module can contain up to four Line Interface Bases. Each Line Interface Base can accommodate up to 8 Line Sets. Each Line Set can accommodate up to 2 communications lines. For some types of lines, these maximums cannot be attained, as shown in the accompanying table. Each Expansion Module can accommodate up to six Line Interface Bases. ►

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size network that can be controlled is practically unlimited. (Software for accommodating multiple 3705's was included in the original announcement.) In addition to conserving mutliplexer subchannels, main memory in the host processor is saved—if IBM's new Network Control Program facility is chosen. More about that later.

Cost comparisons are trickier to draw. In addition to the actual hardware component costs, you must also determine the effect of the new capabilities offered by the 3705. On a hardware basis, there are several crossover points in comparing the 3705 and 270X controllers. At the low end, a 3705 will cost more than a single 2701, but may be cheaper than several 2701's. If you are using a 2703 to control multiple synchronous lines, such as those used with IBM 2780's and other BSC terminals, then the 3705 is substantially cheaper no matter what the configuration. (For reference, the 2703 can accommodate only 24 synchronous lines.) If you are using low-speed asynchronous lines, the story is different. Under the short-term lease plan, the 3705 is cheaper for *less* than about 15 lines, and under the extended-term lease plan it is cheaper for *less* than 44 lines. That's right, 2703's are cheaper for large numbers of low-speed lines. The payoff for the 3705 in such large configurations is the savings due to the reduction in host processor time and memory requirements.

For the System/370, IBM is implementing a Network Control Program (NCP) package that will allow the user to take advantage of the capability for independent processing to do much of the housekeeping. An assembler is also furnished so that you can program the 3705 to work on the data transmitted to and received from the remote terminals and further relieve the host processor. The NCP package is due in March 1973. The first 3705's were delivered in July 1972, but the supporting software delivered with them permits only emulation of multiple 2701's, 2702's, and 2703's. In the emulation mode, none of the additional processing functions are available.

The 3705 is clearly intended for the System/370, even though it can also be used with the System/360. With the System/360, the 3705 is restricted to the emulation mode only and can support a maximum of 255 lines—provided that enough multiplexer subchannels are available. For System/360 users who are using multiple BSC terminals, there is a potential cost saving as there is for small low-speed configurations. IBM has not exactly forgotten about the System/360, but it is clear that it wishes users would do so and move on to the System/370. IBM is also abandoning several terminal devices, including the popular 2260 and 2265 Display Stations, which are supported only in the emulation mode.

The announcement of the 3705 was a shot in the arm for many companies that have been marketing hardware and software for communications front ends for some time.

In addition to the limitations imposed by the basic model number, there are restrictions applying to the Channel Adapters and Scanners that affect configuration possibilities as well as performance. Both the Channel Adapters and the Scanners are available in two models. In general, Type 1 Channel Adapters and Scanners are designed for small, low-volume networks, while the Type 2's provide a higher level of performance. Within the basic limitations on number, there are only three valid base configurations:

- A 3705 Base Module with a Channel Adapter Type 1 and a Scanner Type 1. Irrespective of which letter series (A through D) is chosen, additional Scanners cannot be added, and the maximum number of Line Interface Bases accommodated is limited to the four in the Base Module. However, a Channel Adapter Type 2 can be added to all models including the first Expansion Module (B, C, and D series). This configuration requires an Attachment Base Type 1 feature to accommodate the Type 1 Channel Adapter and Scanner.

- A 3705 Base Module with a Channel Adapter Type 1 and a Scanner Type 2. This configuration can be fully expanded with an additional Scanner Type 2 in each Expansion Module. A Channel Adapter Type 2 can be added in the first Expansion Module. An Attachment Bast Type 2 is required to accommodate the first Scanner Type 2, and an Attachment Base Type 1 is required to accommodate the Channel Adapter Type 1.

- A 3705 Base Module with a Channel Adapter Type 2 and a Scanner Type 2. This configuration can also be fully expanded with Expansion Modules, additional Type 2 Scanners, and a second Type 2 Channel Adapter. An Attachment Base Type 2 is required to interface the first Type 2 Scanner.

Selection between the Type 1 and Type 2 Channel Adapters and Scanners is made on the basis of performance required. However, if more than 64 lines are to be accommodated, the selection of the Type 2 Scanner is forced. If the 3705 is to be used with the IBM System/360, only the Channel Adapter Type 1 can be used.

Timing for interpretation of data signals on the communications lines is provided by a series of Business Machine Clocks. Clocks ranging from 45 to 2400 bits per second are available and are required for all asynchronous lines; at least one clock is required in any system. Clocks are program-assigned and can be shared among several lines.

Complete configuration of a 3705 system revolves around determination of the number of Line Interface Bases required. This sets the minimum model that will suffice. Larger models can be implemented to provide additional memory. The accompanying table fully sets forth the configuration rules for determining the number and types of Line Interface Bases and Line Sets required for the types of lines that can be accommodated.

One further limitation on 3705 configurations involves the mode of operation. If the emulation mode is being used (which makes the 3705 look like a 2701, 2702, and/or 2703), the maximum number of lines is limited to 255.

CONNECTION TO HOST COMPUTERS: The Type 1 Channel Adapter provides attachment to the byte multiplexer channel of an IBM System/360 or System/370 computer system. The Type 2 Channel Adapter provides attachment to the selector, byte multiplexer, or block multiplexer channel of an IBM System/370.

The Type 1 Channel Adapter transfers data one, two, three, or four bytes at a time over the attached byte multiplexer channel. The transfer rate appears to be in the neighborhood of 16,000 bytes per second. A separate transfer control operation is required of the 3705 control unit for each data burst transferred.

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COMMUNICATIONS LINES HANDLED BY THE IBM 3705

Line Interface Base (LIB)	Communications Interface	Line Speed, bits per second	Transmission Type	Line Set	Lines per Line Set	Line Sets per LIB	Typical IBM Terminals Supported***
Type 1	External modem	Up to 1200	Asynchronous	1A	2	8	1050; 2740; 2741; S/7; TWX
		Up to 7200	Asynchronous or synchronous	1D	2	8	1050; 2740; 2741; 2260; 2265; TWX; S/3/7/370-135 ICA; 2701/3; BSC
		19,200	Synchronous	1G	1	8*	2701; 3705; S/3; S/360-20
		40,800 or 50,000	Synchronous	1G	1	4*	2701; 3705; S/3; S/360-20
	Local (IBM cables)	Up to 1200	Asynchronous; 200 feet max.	1C	2	8	Similar to 1A
		Up to 2400	Synchronous; 100 feet max.	1F	2	8	Similar to 1D
	Automatic Dialing (Autocall)	—	In conjunction with lines attached to 1A or 1D	1E	2	8	—
Type 2	Telegraph	Up to 75	20, 40, or 62.5 ma single current	2A	2	8	1050; 2740 Model 2; ATT 83B3; WU 115A
Type 3	Internal modem**	Up to 134.5	Half-duplex, asynchronous; LDLA Type 1, 2-wire, 4.75 miles	3A	2	6	2740; 2741
		Up to 134.5	Full-duplex asynchronous; LDLA Type 1, 4-wire, 4.75 miles	3B	2	6	2740; 2741
Type 4	Internal modem**	Up to 600	Half-duplex asynchronous; LDLA Type 2, 8.25 miles	4A	2	2	2740; 2741
		Up to 600	Half-duplex asynchronous; LLLA, 2-wire	4B	2	2	2740; 2741
		Up to 600	Full-duplex asynchronous; LLLA, 4-wire	4C	2	2	1050; 2740; 2741

* If at least one Line Set Type 1G is installed, this number also represents the maximum number of Line Sets of any type that can be accommodated in a 3705 system without using a software feature for altering the scanning algorithm, which may affect the maximum allowable number of lines active simultaneously.

** IBM Line Adapters included; no modems required. LDLA stands for Limited Distance Line Adapter. LLLA stands for Leased Line Line Adapter.

*** IBM 2260 and 2265 are supported in the emulation mode only.

For a look at the overall picture of Programmable Communications Processors, turn to Communications Report 70G-400-01. Much additional activity is expected in this area as IBM begins delivering 3705's with NCP. On a cost basis, many of the independents will undoubtedly be able to beat IBM. The guidelines in the referenced Communications Report will put you on the right track for dealing with the independents. □

The Type 2 Channel Adapter always operates in the burst mode, with two-byte transfers over an attached byte-multiplexer channel and multi-byte transfers over an attached block multiplexer or selector channel. It can sustain a data rate of 376,000 bytes per second. Data is transferred in blocks, and except for initiation and termination of a transfer operation, data transfers interrupt the 3705 central control unit only for the memory cycles required to access and move the data.

In configurations having two Channel Adapters, connection can be made to two channels of the same host processor or to two different host processors. In a mixed configuration (i.e., one Type 1 and one Type 2 Channel Adapter), one must be disabled during operations. This configuration is useful in allowing operation under either the emulation mode (i.e., 2701/2/3) or full 3705 mode; both modes cannot be active simultaneously. In configurations having two Type 2 Channel Adapters, only one can be active at a time, but the active channel can be designated under program control; if connection is made to two host processors, either processor can initiate a switch between Channel Adapters.

A manual two-channel switch can be added to any Channel Adapter. Thus, the 3705 (Models B through D) can be

IBM 3705 Communications Controller

connected to up to four input/output channels in up to four host processors. In all cases, only one input/output path exists at any one time.

COMMUNICATIONS: The accompanying table summarizes the capabilities of the 3705 for accommodating various types of communications lines and techniques.

DEVICE CONTROL: The program stored in memory controls all functions of the 3705. Many functions such as control character recognition and error procedures are defined and controlled by software. In previous, hard-wired controllers, such as the IBM 2701, 2702, and 2703, these functions were fixed once a particular set of adapters was selected. The 3705 is not totally independent, however. Functions are executed in response to commands issued by the host processor. Indeed, all control ultimately resides with the host processor, including program loading.

IBM is supplying two sets of programs for the 3705; one for operation under OS and one for operation under DOS. Only through the OS support package can the full benefits of front-end processing be realized.

The major elements of the OS support are the Network Control Program (NCP) and the Emulation Program (EP). NCP, when generated and loaded into the 3705, moves a great deal of the housekeeping type of processing from the host processor to the 3705. EP allows a 3705 to replace multiple 2701, 2702, and 2703 controllers with little or no program modification; operation of the host processor when EP is active is identical with activity under the previous 270X hard-wired controllers, and none of the potential benefits of "front-ending" are realized.

Both NCP and EP are supported for the System/370; only EP is supported for the System/360.

The DOS package contains only EP; NCP is not supported under DOS.

In addition to the control programs, a loader, dump routine, and macro assembler are included in both the OS and DOS packages.

NCP, like most general-purpose operating systems, requires a generation procedure to define the hardware (i.e., communications lines and terminals) configuration available and to specify which of the optional facilities will be included. IBM has implemented a macro language for specification of NCP. The language is divided into three types of macros. Systems macros define the 3705 configuration parameters, such as memory size, buffer sizes, and type of channel adapter installed, and any optional control facilities to be included, such as checkpoint/restart and on-line terminal testing. Configuration macros define the makeup of the network and supply information pertinent to each individual type of terminal, including composition of multipoint line operations. Block-handling macros specify any processing to be done in the 3705 on the blocks of data exchanged between the 3705 and the host processor. At present, the only processing macros supplied by IBM provide for insertion of data and time and for text correction involving backspaces to correct entries, but the assembler can be used to create additional macros. A framework is provided for structuring routines into symbolically named groups and sets and for controlling the point of execution of each component.

Extensive provisions can be included in NCP for accommodating transient or permanent failures of the communications lines and for gathering statistics on detected errors.

Many of the functions can be controlled dynamically through commands issued by the host processor, including specification of the network configuration by activating and deactivating devices, lines, and groups of lines. In addition, terminal ID, polling, and addressing characters can be modified, the frequency and duration of polling and transmission among the terminals or components of a multipoint line or multi-component terminal can be modified, and the block processing routines associated with a particular terminal can be switched.

The 3705 running under NCP interfaces with an IBM System/370 running under OS/MVT or OS/MFT through the Telecommunications Access Method (TCAM). The systems programs, generation procedure, assembler, loader, and dump routines require 48K bytes (MFT) or 50K bytes (MVT) in the host processor. Execution of NCP requires a minimum of 48K bytes (Model 2 series or larger) in the 3705. Execution of NCP in the 3705 when the systems programs are not being used requires only the host-processor memory space allocated to TCAM, which in general is less than with the 270X series of controllers. Exact figures are unavailable at this time, but as much as 75K bytes of main memory in the host processor may be freed in large configurations by moving the network control functions from the host System/370 processor to the 3705 via NCP. An important additional conservation of resources occurs through NCP; only one multiplexer subchannel is used, instead of one subchannel per communications line as with the 270X controllers.

The EP or Emulation Program makes the 3705 look like one or more 2701, 2702, and/or 2703 controllers to the host processor. It offers no operational benefits over the earlier controllers. User programs now written for the 270X series will work with a 3705 under EP with some restrictions. Some of the 270X features not supported include transmission with older, 4-of-8-code terminals, 6-bit Transcode, ASCII transparency, Parallel Data Adapter (2701), transmission at 230,400 bps, second channel interface, and programmable two-processor switch. However, many of the more common RPQ's are supported.

Generation of an EP requires 50K bytes (OS/MVT), 48K bytes (OS/MFT), or 16K bytes (DOS) in the host processor. It will run in the smallest 3705 configuration. The emulation mode will be supported in OS Releases 19, 20, and 21 and in DOS Releases 24 through 27.

PRICING: The 3705 can be acquired by purchase, short-term rental, or under IBM's Extended Term Lease Plan introduced with the 3705. In the System/370 price list, maintenance charges are included in the figures for both the short-term rental and Extended Term Plan; a separate arrangement is available for purchased units, and the figures are shown.

Under the short-term plan, overtime usage is charged at 10 percent of the regular hourly rates. Under the Extended Term Plan, there are no overtime charges. The initial lease period for the Extended Term Plan is 24 months and is extendable indefinitely in increments of one year or one time for less than a year. However, charges for early termination of the Extended Term Plan range from two to five times the monthly rental, depending on how long the lease has been in effect; equipment can be upgraded without incurring termination charges.

The price list is forbidding because of the many models of the 3705. A handy chart for determining the incremental cost of going from one model to another is as follows:

	Cost Increment to Add: One Expansion Module	One 32K Memory Increment
Purchase Price:	$15,375	$20,500
Monthly Maintenance:	17	32
Rental, Short Term:	376	499
Rental, Extended Term:	320	425

For detailed pricing information on the 3705 please turn to the Equipment Prices section at the end of the IBM System/370 reports 70C-491-04. ■

IBM 3704 Communications Controller

As a smaller version of the still-new IBM 3705, the 3704 should be of interest to many users who previously felt that their networks were too small to justify front-end processing. Handling up to 32 low- and medium-speed lines, the 3704 shares the sophisticated software developed for the 3705.

MANAGEMENT SUMMARY

It would be inaccurate to say that IBM has been slow about developing microcoded devices or utilizing minicomputers. The System/360 Model 30, announced in 1964, included a form of changeable control programming in the central processor. Since then there has been a parade of IBM devices that make use of stored-program processors in functions other than the classical central processor application. To hit the highlights, we can mention intelligent communications terminals (3735 and 2922), disk controllers, the System/370 Model 125 (with its extensive use of distributed processing), the System/7 (representing an early, but as yet unrealized, hope for a truly general-purpose IBM minicomputer), data entry systems (3740), and communications front ends (3705). The latest addition to this impressive list is the IBM 3704 Communications Controller, introduced on February 1, 1973 as a "little brother" to the 3705.

While the 3705 provided economic and operational relief for large data communications users, even the smallest 3705 configuration overpowered small users. Enter the 3704. Essentially a reduced version of the 3705 with the same software support and communications line and discipline possibilities, the 3704 can handle up to 32 lines operating at up to 7200 bits per second. A limited capability (two lines) is provided for accommodating high-speed lines at up to 50,000 bits per second. If you wish to draw parallels, the 3704/3705 relationship is, in effect, a modern equivalent of the 2701/2703.

Along with the 3704 announcement, additional hardware and software were introduced so that either the 3704 or 3705 could function as a remote concentrator. The two hardware additions are a full-duplex line capability (up to 7200 bps) and a facility for loading programs from the communications line. The remote concentrator capability permits multiple low-speed lines to be terminated at a ▷

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604.

MODELS: The 3704 is available in four models, which differ only in the amount of main memory they contain. Configuration possibilities for the number and type of communications lines that can be connected are the same for all models.

CONFIGURATION: A 3704 Communications Controller is composed of:

- The basic 3704 model (A1 through A4), which includes the central control unit, main memory, and space for all interfaces between the central control unit and communications and between the control unit and the host computer.
- One Channel Adapter or Remote Program Loader.
- One Scanner.
- One or two Line Interface Bases.
- Line Sets, which provide the interface for modems or directly with the communications lines.

A Two-Channel Switch feature permits the 3704 to be connected to two channels of the same processor or to two different System/360 or System/370 processors. Only one path can be active at a time; selection of the active path is made through a switch on the console.

Physically, the 3704 occupies only one cabinet in any configuration. It can be configured to serve as a front-end processor connected directly to a system/360 or System/370 input/output channel or as a remote concentrator communicating over a leased line with another 3704/3705 that is connected directly to the host processor.

The four models of the 3704 provide a main memory capacity of 16K, 32K, 48K, or 64K bytes.

The selection of the Type 1 or Type 2 Scanner is primarily a line configuration decision. The Type 1 requires the program to perform character assembly, while the Type 2 includes additional hardware to perform character assembly prior to transferring data to the controller.

Other configuration details are completely stated in the accompanying table. In general, maximum configuration possibilities can be summed up as follows: ➤

IBM 3704 Communications Controller

remote point, the data batched, and the combined data transmitted over one line to a 3704 or 3705 at the host computer site; return traffic reverses this flow pattern. Remote line concentration can provide savings in communications line costs by eliminating the need to run many low-speed lines along parallel paths.

Other software was also announced along with the 3704. A new version of the Network Control Program (NCP) was introduced for virtual storage environments. Among other new features, NCP/VS provides the capability for simultaneous operation of a single 3704 or 3705 in both the emulation mode (270X) and NCP modes. A new access method was introduced for virtual storage telecommunications environments; called VTAM, it permits dynamic sharing of the resources in a teleprocessing network among multiple application programs.

In its maximum configuration, the 3704 is significantly less expensive than an equivalent 3705. For low-speed lines, the average cost per line for an expanded 3704 is about $44 a month (Extended Term plan), whereas the cost for an equivalent 3705 is about $58 per month per line. Expanding the 3705 further to 64 lines drops its cost to about $34 per line per month. Thus, multiple 3704's are more costly than a single expanded 3705. The 3704 is cost-effective against many configurations of the 2703 and is even competitive with the 2701 for controlling a couple of medium-speed lines.

The 3704, like the 3705, is clearly intended primarily for System/370 users. When used with a System/360 computer, the 3704 can operate only in the 270X emulation mode, and its users will fall far short of gaining the full benefits of programmable front-end processing.

The 3704 is upward-compatible with the 3705, so growth from a small network into a large network should not be painful.

The 3704 is scheduled for first customer shipments in May 1973, though some features will not be delivered until October and November of 1973.□

- Up to 32 half-duplex asynchronous or synchronous lines operating at up to 7200 bits per second; or
- Up to 16 full-duplex synchronous or asynchronous lines operating at up to 7200 bits per second; or
- Up to 2 half-duplex synchronous lines operating at up to 50,000 bits per second plus up to 8 half-duplex asynchronous or synchronous lines operating at up to 7200 bits per second.

CONNECTION TO HOST COMPUTER: Used as a local unit, the 3704 can be connected to a byte multiplexer channel of an IBM System/360 Model 30 (E or F), 40, 50, 65, 75, or 195, or an IBM System/370 Model 125, 135, 145, 155, 158, 165, 168, or 195. Only one subchannel is used in the NCP mode; in the EP (270X emulation) mode, one subchannel is used for each line terminated.

As a remote concentrator, the 3704 communicates over a leased line with a local 3704 or 3705. Transmission can be full-duplex at up to 7200 bits per second, using Line Set 1H, or half-duplex at up to 50,000 bits per second, using Line Set 1G.

COMMUNICATIONS: The accompanying table summarizes the capabilities of the 3704 for accommodating various types of communications lines and techniques.

DEVICE CONTROL: The program stored in memory controls all functions of the 3704. Many functions such as control character recognition and error procedures are defined and controlled by software. In previous, hard-wired controllers, such as the IBM 2701, 2702, and 2703, these functions were fixed once a particular set of adapters was selected. The 3704 is not totally independent, however. Functions are executed in response to commands issued by the host processor. Indeed, all control ultimately resides with the host processor, including program loading.

The major elements of the OS support are the Network Control Program (NCP) and the Emulation Program (EP). NCP, when generated and loaded into the 3704, moves a great deal of the housekeeping type of processing from the host processor to the 3704. EP allows a 3704 to replace multiple 2701, 2702, and 2703 controllers with little or no program modification; operation of the host processor when EP is active is identical with activity under the previous 270X hard-wired controllers, and none of the potential benefits of "front-ending" are realized.

Both NCP and EP are supported for the System/370; only EP is supported for the System/360.

The DOS package contains only EP; NCP is not supported under DOS for non-virtual-storage System/370 computers.

In addition to the control programs, a loader, dump routine, and macro assembler are included in both the OS and DOS packages.

Details of both the NCP and EP control programs for the 3704 and 3705 can be found in Report 70D-491-31 on the IBM 3705 Communications Controller.

Additional support is provided for System/370 virtual storage environments. Special versions of both EP and NCP are provided for operation under DOS/VS and OS/VS. In addition, a new telecommunications access method, VTAM, is oriented specifically to the needs of a virtual storage environment.

NCP/VS provides all the capabilities of NCP plus some valuable additions. One of the principal benefits is the capability to operate in the EP mode and NCP mode concurrently; i.e., a portion of the lines can be operated in the 270X mode while the others operate under NCP. This capability is particularly valuable during the cutover of applications from 270X operation to front-end processing with the 3704, and is referred to as Partitioned Emulation Programming Extension or PEP. The other major expansion of NCP capabilities is the operation of the 3704 as a remote concentrator.

NCP/VS operates through the new access method, VTAM, in DOS/VS environments and through either VTAM, TCAM, or a combination in OS/VS environments. The

IBM 3704 Communications Controller

COMMUNICATIONS LINES HANDLED BY THE IBM 3704

Line Interface Base (LIB) (1)	Communications Interface (3)	Line Speed, bits per second	Transmission Type	Line Set	Lines per Line Set	Line Sets per LIB	Typical IBM Terminals Supported (5)
Type 1	External modem	Up to 1200	Half-duplex, asynchronous	1A	2	8	1050; 2740; 2741; S/7; TWX; MCST
		Up to 1200	Full-duplex, asynchronous	1B	1	8	Similar to 1A
		Up to 7200	Half-duplex, asynchronous or synchronous	1D	2	8	1050; 2740; 2741; 2260; 2265; TWX; S/3/7/370-135 ICA; 2701/3; BSC
		Up to 7200	Full-duplex, async. or sync.	1H	1	8	3704, 3705
	Local (IBM cables)	Up to 1200	Asynchronous; 200 feet max.	1C	2	8	Similar to 1A
		Up to 2400	Synchronous; 100 feet max.	1F	2	8	Similar to 1D
	Automatic Dialing (Autocall)	—	In conjunction with lines attached to 1A or 1D	1E	2	8	—
Type A1	External modem	Up to 1200 or 7200 (2)	See (2)	(2)	1 or 2	4	Same as 1A, 1B, 1D, 1H, 1C, 1F, 1E
		19,200, 40,800, or 50,000	Half-duplex, synchronous	1G	1	2	270X, 370X, S/360/370 with ICA
		Up to 50,000	Full-duplex, async. or sync.	1J	1	2	Specials
	Local (IBM cables)	Up to 1200 or 2400 (2)	See (2)	(2)	2	4	Same as 1C, 1F above
	Automatic Dialing (Autocall)	—	In conjunction with lines attached to 1A or 1D	1E	2	4	—
Type 2	Telegraph	Up to 75	20, 40, or 62.5 ma single current	2A	2	4	1050; 2740 Model 2; ATT 83B3; WU 115A
Type 3	Internal modem (4)	Up to 134.5	Half-duplex, asynchronous; LDLA Type 1, 2-wire, 4.75 miles	3A	2	3	2740; 2741
		Up to 134.5	Full-duplex asynchronous; LDLA Type 1, 4-wire, 4.75 miles	3B	2	3	2740; 2741
Type 4	Internal modem (4)	Up to 600	Half-duplex asynchronous; LDLA Type 2, 8.25 miles	4A	2	1	1050; 2740; 2741; S/7
		Up to 600	Half-duplex asynchronous; LLLA, 2-wire	4B	2	1	2740; 2741; S/7
		Up to 600	Full-duplex asynchronous; LLLA, 4-wire	4C	2	1	1050; 2740; 2741; S/7

(1) An IBM 3704 can be configured with any combination of one or two Type 1, 2, 3, or 4 Line Interface Bases; this configuration uses a Communications Scanner Type 1. Alternatively, one LIB Type A1 can be installed, which requires a Scanner Type 2. Installation of the Scanner Type 2 on Controller Model A1 requires the Expansion Feature; this feature is required on all configurations of Models A2, A3, and A4. The maximum number of Line Sets per LIB for combinations is the same as individual maximums, except for LIB Type A1; for Type A1, a combination of up to two 1G and 1J Line Sets plus up to four of the other Line Sets in any combination is permitted.

(2) Line Sets Types 1A, 1B, 1C, 1D, and 1F can be used with LIB Type A1; the number of line positions per Line Set and line characteristics are the same as listed under LIB Type 1.

(3) Line Set 1J provides a Mil. Std. 188C interface; Line Set 1G provides a digital interface compatible with common-carrier offerings for wideband services; all other external modem interfaces are EIA RS-232C.

(4) IBM Line Adapters included; no modems required. LDLA stands for Limited Distance Line Adapter. LLLA stands for Leased Line Line Adapter.

(5) IBM 2260 and 2265 are supported in the emulation mode only.

IBM 3704 Communications Controller

combination mode of operation eases conversion requirements.

VTAM is acknowledged by IBM to be the principal access method for telecommunications support under DOS/VS and OS/VS. BTAM and QTAM will not be extended, and enhancements for TCAM will be in the environment provided by VTAM under OS/VS. The chief feature of VTAM is dynamic sharing of network resources. Application programs working through VTAM have access to any terminal, line, or 3704/3705 in the network; for example, different application programs can initiate transmission and reception with terminals located on the same multipoint communications line. By the same token, multiple application programs can have access to the same data base. One component of VTAM is TOLTEP, an on-line testing program for exercising and testing the complete network.

Scheduled availability dates for the newly announced software begin in November 1973 for DOS/VS VTAM and OS/VS1 TCAM and extend through June 1974.

In general, identical software support is provided for the 3704 and 3705. Operational differences will exist primarily because of the smaller main memory of the 3704, which will limit the number of lines and programming features that can be accommodated at any one time.

REMOTE CONCENTRATION: When the 3704 is configured as a remote concentrator, the Remote Program Loader feature replaces the Channel Adapter. This feature permits loading NCP/VS into the 3704 main memory over the communications line connecting the 3704 with a 3704 or 3705 at the host computer site. The line can be a full-duplex leased voice-band line operating synchronously at up to 7200 bps (Line Set 1H) or a half-duplex wide-band facility operating at up to 50,000 bps (Line Set 1G). All data transferred between the remote and local 370X pair is transmitted over this line. The Remote feature also permits running the diagnostic aids at the remote site without involving the host computer.

Configuration of a remote concentrator arrangement follows the normal 3704 rules as long as the above requirements are satisfied. The maximum number of lines that can be connected is reduced to 30 half-duplex or 15 full-duplex low- and medium-speed lines.

Several other features are available to supplement remote location of a 3704. Enhanced Environment allows operation of the 3704 at temperatures of between 50 and 100 degrees F. Remote Power Off includes a capability for turning the power off in response to a command received over the communications line; power can be restored only from the unit's control panel. Unit Protection provides a physical locking capability for the 3704's control panel that prevents any switches except Power On and Power Off from being altered without a key.

The minimum 3704 model that can include the remote concentrator feature of NCP/VS is the A3 (48K bytes).

PRICING: The 3704 can be acquired by purchase, short-term rental, or under IBM's Extended Term Lease Plan. Maintenance charges are included in the figures for both the short-term rental and Extended Term Plan; a separate arrangement is available for purchased units.

Under the short-term plan, overtime usage is charged at 10 percent of the regular hourly rates. Under the Extended Term Plan, there are no overtime charges. The initial lease period for the Extended Term Plan is 24 months and is extendable indefinitely in increments of one year or one time for less than a year. However, charges for early termination of the Extended Term Plan range from two to five times the monthly rental, depending on how long the lease has been in effect; equipment can be upgraded without incurring termination charges.

Component	Short Term Lease	Extended Term Lease	Purchase	Monthly Maint.
3704 Controller:				
Model A1 (16K bytes)	$646	$550	$26,000	$115.00
Model A2 (32K bytes)	764	650	31,000	138.00
Model A3 (48K bytes)	881	750	36,000	161.00
Model A4 (64K bytes)	999	850	41,000	184.00
Channel Adapter Type 1	129	110	5,300	18.00
Communications Scanner Type 1	24	20	960	1.50
Communications Scanner Type 2	118	100	4,800	5.00
Expansion Feature	12	10	480	0.50
Business Machine Clock	12	10	480	1.00
Two-Channel Switch	59	50	2,400	3.50
Line Interface Base Type 1	24	20	960	1.50
Line Set Type 1A	35	30	1,450	2.00
Line Set Type 1B	35	30	1,450	2.00
Line Set Type 1C	35	30	1,450	2.00
Line Set Type 1D	94	80	3,850	6.50
Line Set Type 1E	59	50	2,400	2.50
Line Set Type 1F	94	80	3,850	6.50
Line Set Type 1H	100	85	4,100	12.00
Line Interface Base Type A1	24	20	960	1.50
Line Set Type 1G	76	65	3,100	7.50
Line Set Type 1J	82	70	3,350	3.00
Line Interface Base Type 2	24	20	960	1.50
Line Set Type 2	59	50	2,400	5.00
Line Interface Base Type 3	71	60	2,900	3.00
Line Set Type 3A	47	40	1,950	2.00
Line Set Type 3B	47	40	1,950	2.00
Line Interface Base Type 4	47	40	1,950	4.00
Line Set Type 4A	82	70	3,350	4.50
Line Set Type 4B	82	70	3,350	6.00
Line Set Type 4C	82	70	3,350	6.00
Features for Remote Concentrator:				
Remote Program Loader	176	150	7,200	30.00
Remote Power Off	12	10	480	0.50
Extended Environment	24	20	960	–
Unit Protection	–	–	35	– ■

IBM 3740 Data Entry System

Inserting a diskette into a 3741 or 3742 Data Station is as easy as inserting a tape cassette or 8-track cartridge into your stereo system. The operator is holding the protective cardboard sleeve in her left hand. The diskette itself is a mylar disk coated on one side with a magnetic material and permanently encased in an eight-inch-square plastic envelope.

MANAGEMENT SUMMARY

Punched cards may well have suffered a mortal wound when IBM announced the 3740 Data Entry System in January 1973. But IBM was not content just to settle for an attractive new data entry medium. The company continued, in December 1973, its recent trend toward putting intelligence (read "user programming capability" if you shy away from anthropomorphization) into devices removed from the central processor.

IBM's December 1973 announcements included two single-station key-to-diskette units with read/write memory for storing and executing programs written by the user in a new programming language (ACL) and translated into object code on the data entry devices themselves. In addition, a new, faster printer was announced and communications capabilities were improved. The 3747 diskette-to-tape Data Converter was enhanced, and support for the 3540 Diskette Input/Output Unit under OS/VS1 announced. All in all, it was an impressive series of announcements.

It would be fatuous to say that punched cards will die overnight (IBM states that the 3740 cannot be used to entirely supplant the requirement for a card reader on System/370 configurations, for example.) There are some applications that can still be implemented more effectively on punched cards than on magnetic media; turnaround documents for billing represent a prime example. The impact of the 3740 will be gradual. First candidates for replacement are the existing keypunch and single-station key-to-tape installations. Shared-processor key-disk systems will probably be able to maintain a good competitive posture–particularly since IBM itself has finally endorsed the shared-processor concept with its new 3790 Communication System (Report 70D-491-42). ▷

Not quite a year after introducing the key-to-diskette 3740 Data Entry System, IBM significantly enhanced its capabilities by announcing a new language for writing programs together with new models that can translate the source programs into object programs and then execute them. Clearly, the use of "floppy disks" as a data entry medium is anything but a passing fad.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corp., Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

MODELS: The basic components of an IBM 3740 Data Entry System are the 3741 Data Station, 3741 Programmable Work Station, and 3742 Dual Data Station. The 3741 Model 1 and 2 Data Stations are alike except that Model 2 includes a binary synchronous communications interface. the 3741 Model 3 and 4 Programmable Work Stations are like the 3741 Models 1 and 2, respectively, with the addition of user programming capability. All models can be equipped with a 40-character-per-second 3713 Printer or a 155-line-per-minute 3717 Printer.

A 3741 Data Station or Programmable Work Station includes a microprocessor, a CRT unit for data, control, and status display, and a cartridge disk drive; a second drive can be added. The 3742 provides two operator stations that have independent disk drives but share the CRT unit and microprocessor.

Two independent devices are provided to transfer data to a computer. A 3747 Data Converter can transcribe data from multiple diskettes to 7- or 9-track magnetic tape with recording densities of 556, 800, or 1600 bpi. The 3540 Diskette Input/Output Unit can be connected directly to an I/O channel of an IBM System/370 Model 115, 125, 135, 145, 155-II, or 158 computer System. The 3747 Converter can also be equipped to transmit data bisynchronously.

DISKETTE: Consists of a flexible, 8-inch-diameter, Mylar disk permanently housed in a plastic envelope. The cartridge (envelope and disk) is inserted into the mechanism; the envelope remains stationary while the disk is spun within the envelope. Cutouts in the envelope allow access for the read/write head and sector sensing devices. The disk is organized into 74 tracks, each containing 26 sectors of 128 characters. The first track is always reserved to hold an index to the data sets contained on the disk. The maximum data storage capacity of the disk is 1898 records. This corresponds to a maximum capacity of 151,840 bytes (80-character records) to 242,944 bytes (128-character records). Data transfer rate is 30,000 characters per second. Two spare track positions are included so that, with an optional feature (Disk Initialization), up to two bad tracks can be bypassed without loss of storage capacity.

DEVICE CONTROL: Each device–data station, converter, and input/output unit–is controlled by a microprogrammed storage unit. In all but the 3741 Models 3 and 4, the storage unit is read-only, with no user access for ▶

IBM 3740 Data Entry System

Most users will prefer to discuss the merits of the 3740 for specific data entry functions rather than to discourse philosophically on the fate of particular media. In this context, then, let us open the discussion with a flat statement; the 3740 is impressive in terms of what it can do in a data entry environment.

Each diskette (or "floppy disk") can hold up to 1898 records. If the maximum 128-character record length is used, this represents almost 243K bytes of data. Except in unusual situations, this is more than adequate to hold a full day's output from even the most productive operator. Data from up to 19 different jobs can be recorded on the same diskette as well. In some cases, control records need to be recorded as separate data sets.

The most obvious advantage that the diskettes have over punched cards is in storage volume. One diskette holds roughly the equivalent of a full box of cards—and it's only eight inches square and a fraction of an inch thick. Another advantage is that the diskette is reusable. The initial cost of the diskette is higher (about $8 apiece), but significant overall savings should be achieved. In addition, the diskettes are self-storing. Each one is mounted inside a plastic envelope and is never removed. Additional protection is achieved if the cardboard sleeve in which the diskette comes is retained.

The keyboards are buffered, and CRT units are used to display status and entered data. Search modes are available that allow any portion or all of a record to be used as the compare key to selectively locate previously recorded records for correction or other reasons. In the programmable models, ACL provides instructions for full arithmetic operations, input/output control, logical tests, and branching. The exact selection of available standard and optional features varies from model to model. The five models of the data station are:

- 3741 Model 1—single data station with basic data entry capabilities.
- 3741 Model 2—same as Model 1 with communications capability.
- 3741 Model 3—user-programmable single data station.
- 3741 Model 4—same as Model 3 with communications capability.
- 3742—dual independent data stations in a single cabinet.

The 3741 is oriented toward locations at branch offices or other places where data is originated. The 3742 is oriented toward centralized locations. Details on the specific features of each model are in the Characteristics section of this report.

Having made the points that the 3740 is superior to keypunches in terms of storage space, operational flexibility, and performance, there remains the critical question of cost.

changing the basic functions. Latitude is provided through standard and optional features for accommodating data entry in much the same fashion as a keypunch. The 3741 Models 3 and 4 include a read/write memory (in addition to read-only memory) that allows user programs to be generated; programming capabilities of the Application Control Language (ACL) developed for the 3741 Models 3 and 4 include arithmetic, input/output control, logical tests, branching, and operator guidance.

3741 DATA STATIONS: There are two non-programmable models of the 3741, which are identical in standard features and available options except that Model 2 includes a data communications interface and Model 1 does not. Both include a buffered keyboard.

The basic 3741 Model 1 and 2 includes provisions for entering and updating records, four search modes, program chaining, and operator guidance.

Data entry is controlled by format programs in much the same way as a normal keypunch. Prior to data entry, a format program is set up on a field-by-field basis to indicate alphabetic or numeric fields, duplication, skipping, and right adjust (left zero). When updating a record, fields can be designated as bypass fields, which are ignored. The format program is free-form and does not conform to the synchronized "column-for-column" layout required with keypunches; an end-of-record function has been added to delimit the record format. Up to 10 format programs can be stored in the 3741 at any one time. These are available to the operator by a manual call or through program chaining; with this facility, format programs can be automatically linked to any extent. The linkage is fixed; indicators in each format program show the next format to be called.

Record length is variable from 1 character to the limit of one sector on the disk (128 characters). Logical records of any length can be created through program chaining. When backspacing records for correction or updating, the reverse sequence of the program chain is called; a second indicator in the format program provides the number of the previous format program.

Format programs can be created and recorded on disk as a data set. Such programs can be recorded on the same disk that is to be used for data entry or on a separate disk. Entire data sets can be designated as bypass sets to prevent format programs from being transferred as part of the data recorded. Format programs can be located on disk for loading by means of any of the four search techniques.

Control of data entry requires one additional level of programming not required in keypunches. An index must be created to allow finding the data (or format control programs) on disk during a subsequent transfer or update operation. The first track of the disk is reserved for this index. It contains the name, beginning address, and ending address of the data set. Addresses are specified in terms of track and sector numbers. Although there are 26 sectors on a track, 7 are reserved for other uses, which leaves room to identify 19 different data sets. If the control programs are recorded on the data disk, each one is treated as one data set. It is possible to prerecord index information to simplify the operator's job. The beginning and ending addresses define the space reserved for a data set; the data actually keyed need not take up all this space. An end-of-data indicator can be recorded to terminate the actual data space. However, certain indicators, such as record length,

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On a straight machine-cost basis, the 3740 is more expensive than keypunches. Per-keyboard costs can range from a high of $655 per month for a programmable terminal (3741 Model 4) with printer and all options down to around $100 per month for a large 3742 complement. These figures are based on IBM's Extended Term plan, which requires a 24-month commitment; short-term rental prices are about 18 percent higher.

The 3742 price mentioned above includes a 3747 Data Converter and is achieved with a dozen dual data stations (24 operator positions). In large configurations, the 3742 compares favorably with shared-processor key-disk systems in price but offers far less in the way of data validation and preprocessing capabilities.

As a communications terminal, the 3741 Model 2 is justifiable only if substantial off-line data entry operations are required. In this configuration, the 3741 should be thought of as a data entry unit with communications capability rather than as an on-line communications terminal. With the transmission speed limited to 2400 bits per second at present, the 3740 does not represent a threat to card-oriented remote batch terminals such as the IBM 3780.

The features of the 3741 Model 3 and 4 permit substantial processing of data, using up to four independent data sets (files). Tasks such as price extensions, invoice printing, product description fill-in, and transaction code checking come to mind. Located at the site where the data originates, these models will permit many tasks to be completed at the time the data is gathered rather than when the central site gets around to processing it. They will also permit gathering data in the format most advantageous to the operator and converting it to the format most advantageous to the central computer. As a terminal, the 3741 Model 4 performs exactly like the Model 2. Any processing of data must be done prior to transmission or after all data is received. Even so, the 3741 Model 4 represents a viable alternative to the many tape cassette- and cartridge-oriented programmable terminals available from other vendors.

The 3540 Diskette I/O Unit, unlike the 2495 reader used with Model 50 Data Inscriber tape cartridges, is not a mere token concession to a concept; it truly represents a major improvement in performance over that obtainable with punched cards. The 3540 can be connected directly to an IBM System/370 input/output channel and can read up to 3630 records per minute on a continuous basis. Substantially higher computer input speeds can be achieved by converting the data from diskettes to magnetic tape via the 3747 Data Converter.

The 3740 Data Entry System will also impact System/3 users, in addition to System/360 users, System/370 users, and other users with IBM-compatible tape formats. A 3741 Model 2 Data Entry Station can be locally connected to a System/3 Model 6, 10, or 15 computer. Instead of running the cable to a modem, you connect it to a communications adapter in the System/3 processor. (This adapter excludes the possibility of using either the System/3 or the 3741 as a communications terminal.) The

bypass (skip when converting or transferring data), write-protect, multi-volume (more than one data set per diskette), and verify mark must be manually recorded in specified positions in the index track.

Four search modes are provided: by record address (track and sector numbers); by end-of-data indicator, and two by content. The end-of-data search is the simplest way to add additional data records to an existing data set. The two content searches permit setting up a mask corresponding to a partial or entrie record and looking for a record that matches all of the specified search arguments. One content search mode steps through all records sequentially until a match is found. The other content search mode takes advantage of a file that is in alphanumeric sequence to locate the target record more quickly.

The CRT display is organized as 6 lines of 40 characters each. The top line is used to display status information such as cursor position, current address (track and sector numbers), program number, mode of operation, and program shift code. The next three lines either display data as entered or display full records when a search is completed or update mode is entered. The last two lines can be used for operator guidance. In this mode of data entry, names of up to 30 characters for each field can be displayed in the fifth line of the CRT screen. A series of slashes representing the actual field length is then displayed in the sixth line. The slashes are replaced by data as it is keyed in. In this mode, data entered appears twice on the screen—once in the main display and again, field-by-field, in the bottom line. One format control program is used for each record format to hold the field names; thus, the use of operator guidance reduces the possible number of format control programs by one for each record type in which guidance is used.

Functional options are grouped together in a single package called Feature Group A. This package includes verify, production statistics, field totals, self-checking number feature, and disk initialization.

Verify mode conditions the device to read a record from disk and compare the contents character-by-character with keyed data. The record is displayed as it is keyed. A mismatch locks the keyboard and causes the entire record to be displayed. Depressing the Error Release key allows the operator to try again. Whenever a match with the previously recorded character occurs or when *two* successively keyed characters match, the verify operation continues. Production statistics include number of keystrokes, number of records processed, and number of characters corrected during verify operations. These three counters can be displayed or recorded on disk.

Field totals provide three 19-position accumulators. Under program control, the contents of any field up to 14 can be added to any of the accumulators. Non-decimal characters can be included. If the lower 4 bits have a binary value between 0 and 9, it is added in; otherwise, the character is treated as a zero. The contents of an accumulator can be recorded under program control; the total can include a field from the record in which the total is recorded. Overflows are not detected. This use of field totals is referred to as "on-line." "Off-line" totals can also be accumulated in a separate pass of previously recorded records; format programs are automatically selected. Off-line totals can also be recorded in the record.

Self-checking provides for the computation of a self-check digit for a numeric field using either modulus 10 or 11. The

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3741 in this environment can be used off-line as a data recorder and on-line as an input/output device to transfer data between the System/3 and the Data Station. The transfer rate is limited to 2400 bits per second. This corresponds to a maximum transfer rate of between 158 and 225 records per minute, depending on the record length, which is substantially faster than card input/output on the System/3 Model 6. Cards can be read faster than the above rate on the Model 10, but the available card punching speeds are slower. The cost of the necessary adapter is $153 per month or $6,630 purchase; Extended Term rates are not available.

Overall, the 3740 represents a major step by IBM in catching up to the rest of the world in data entry techniques.

Customer shipments of the 3740 components began in June 1973. Initial customer shipments of the 3741 Models 3 and 4, the new communications features for the 3741 Models 2 and 4, and the 3717 Printer are scheduled for the fourth quarter of 1974. Enhancements to the 3747 are scheduled for delivery in the third quarter of 1974. Support of the 3540 under OS/VS1 is scheduled for the second quarter of 1975.

USER REACTION

Datapro talked to several early users of IBM 3740 systems. In each case, the equipment used was the 3741 Model 2 terminal, and the users felt that the equipment worked well in terms of its ability to perform the functions its specifications called for. Two specific cases show the two ends of the spectrum of applications for the 3741 as a communications terminal.

One user provides computing services for small businesses. Customers input their data at their own locations and transmit it to the service center's System/3 computer. The customers retain their source documents at their own locations. This user likes the 3741 very much and plans expanded usage in the future. He feels that the 3741 is particularly easy to use in comparison with the IBM 5496 buffered 96-column keypunches used previously. The one thing this user strongly objects to is the use of the key-punch layout for numerics, which is reversed from the adding-machine layout the operators were familiar with. (An RPQ may be available to "reverse" the keyboard.) A few small problems cropped up in one of the two terminals originally installed in November 1973, but these were quickly remedied. (This user seemed to have prepared very thoroughly for the implementation of both the equipment and its application.)

The other user referred to, a large company with many offices, was looking for inexpensive remote job entry terminals. This user says the 3741 is overpriced in relation to the functions it can perform for his organization, although it works well. He also observed that the procedures for setting up communications between the terminal and the central computer are too complicated, with too many operator actions required. □

computed digit is compared to the one entered, and the 3741 halts if there is a mismatch.

Disk initialization provides the capability for bypassing one or two defective tracks and replacing them with spare tracks. The replacement is accomplished automatically by changing the physical addressing parameters within the disk unit itself. Without this feature, extra care must be taken to make sure that data set areas are not reserved on defective tracks; it can be done, but it is tedious and frequently would require separating data into multiple sets.

Other options for the 3741 include a second disk drive and a printer. Model 2 includes as standard a communications interface.

The second disk drive operates as a read-only unit if installed in Model 1. The principal functions of the second drive are to make a copy of a diskette, to pool data contained on several diskettes onto one diskette, and to merge records read from one diskette with records keyed from the keyboard onto a second diskette. With the Model 2, the second disk drive can be used to expand the space available to hold data to be transmitted and/or received; with communications, the second disk drive can function in a record mode.

The printer and communications capability are discussed separately in later paragraphs.

3741 PROGRAMMABLE WORK STATIONS: The 3741 Models 3 and 4 are essentially identical to Models 1 and 2, respectively, with the addition of read/write memory that permits user programming through a newly developed Application Control Language (ACL). All optional features available for Model 1 are available for Model 3, and all features available for Model 2 are available for Model 4. Models 3 and 4 can operate in either of two modes. They can function exactly like Model 1 and 2 Data Stations, or they can operate under control of the user-written sequence of instructions. Model 4 cannot include communications functions in ACL programs.

ACL includes instructions for full arithmetic operations, for input/output control (except communications), for logical tests, and for branching. Object programs are generated on the 3741 Model 3 and 4 itself through an optional ACL Translator, which can output a printed listing of the program if desired. Diagnostic messages identifying program form errors can be printed during translation.

Several hardware/microprogram restrictions have been eased during operation under an ACL program. For example, the second diskette can be written on during a data entry operation. In addition, up to four diskette data sets can be open during one program, giving, in effect, four information files to work with typically; this capability would be used to access master/data files for information not contained in the data entered by the operator.

In addition, a new access method, called key indexed, normally allows quicker access to data stored in a file than the methods provided with Models 1 and 2. With this access method, a track index table is automatically generated during file opening procedures.

Specific capabilities avaiable through the programmability of 3741 Models 3 and 4, but not provided in Models 1

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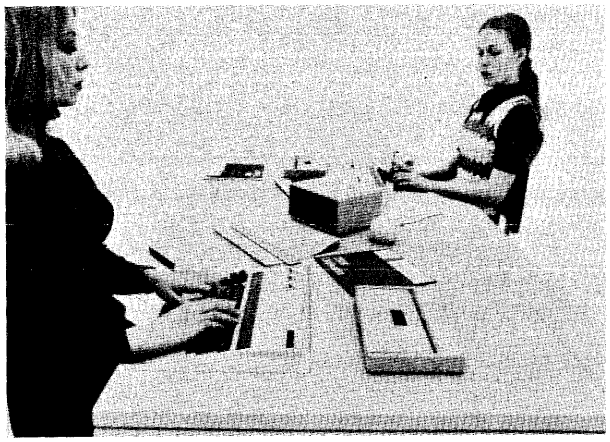

In the 3742 Dual Data Station, two operators share the same desk, CRT display, and microprocessor, but record on individual diskette units.

and 2, could include range checking, file look-up, self-check algorithms other than modulus 10 and 11, mandatory field insertion, and relational conditions among fields.

Control of diskette operations (searching and updating), display formatting, keyboard operations, and printing are provided through ACL. Control of communications functions is not.

Neither sort nor application programs will be provided by IBM.

3742 DUAL DATA STATION: The 3742 seats two operators at opposite corners of the desk enclosure and includes two independent diskette drives and keyboards. The six-line CRT display is shared by the two operators. One views three lines directly; the other views the remaining three lines through an optical arrangement. One of the three display lines is dedicated to the status information as in the 3741. The other two lines display data as entered or full records when read. Operator guidance is not provided. If the 128-character, variable record length option is included, the two data display lines are automatically scrolled as position 80 is passed; manual controls are also included to scroll the display up or down.

Standard functions included with the 3742 include data entry and update modes, verify mode, search on record address and end of data, production statistics, program chaining, and storage for six format control programs. Ten format control programs can be stored if the 128-character, variable length record option is incorporated. Feature Group A for the 3742 includes the two search-on-content modes, self-checking digit, off-line field totals, disk copy, and disk initialization. All 3742 features function identically with 3741 features, and diskettes recorded on one can be accommodated by the other. Specific 3741 features not available with the 3742 include operator guidance, on-line field totals, second disk attachment, printer, and communications interface. When the disk copy or off-line field totals features are activated, the second operator station is not operable.

3747 DATA CONVERTER: Consists of a microprocessor with read-only storage for the fixed program, disk unit, and magnetic tape unit. Four different tape controls can be installed to accommodate different tape formats and functions. The four controls are: (1) 9-track, 1600 bpi, read-only; (2) 9-track, 1600 bpi, read/write; (3) 9-track, 800 bpi, read/write; and (4) 7-track, 556/800 bpi, odd/even parity, read/write. Read/write controls permit transferring data from tape to disk and the installation of other features. The read-only control excludes the addition of other features and allows only disk-to-tape conversions.

The 3747 includes an automatic mechanism for processing multiple diskettes. The input hopper and output stacker can accommodate up to 20 diskettes each. The tape drive operates at 12.5 inches per second; rewind time for a full 2400-foot reel is about 3 minutes.

Options for the 3747 include Tape Label, Expanded Function, Storage and Blocking/Reformatting, and a communications interface with or without a built-in modem.

Without the Tape label feature, all data is transcribed from disk to tape (or tape to disk); label records, if present, are treated as separate data sets. With the Tape Label feature, data set header and trailer records (two each) are built or checked, depending on the direction of the transfer. Standard IBM lable formats are observed. Volume labels are not built or checked.

Security codes in the tape labels are honored; a cipher code can be entered through a 10-key numeric keyboard. Entry of the code requires actuation of a keylock.

A four-digit display is included with all versions of the 3747. It is used to display six items of information sequentially after an error stop or upon normal completion of a job; the items include disk number, tape data set number, input record number, input records skipped, output record number, and record address of last disk record processed. These items are displayed one at a time as a button is depressed; there is no indication of which item is being displayed. The display also has another function; the first digit indicates whether an excessive number of read retries has been required. This can indicate that a particular diskette has been worn or damaged beyond the limits of usability, that the disk read/write head needs cleaning, or that a bad communications connection was established; distinction among these three possibilities is easy to establish.

The Expanded Function feature adds capabilities for data conversion in both a local and remote environment. Specifically, the feature permits checking diskette label names during diskette-to-tape operations, writing and checking a "diskette converted" mark, and adding records to an existing file on tape.

The Blocking/Reformatting feature allows records to be combined into logical blocks on tape and deblocked when read from tape, and allows extensive manipulation of the record format. The Storage feature consists of increments of storage from 2K to 8K bytes that provide the work space for the blocking and reformatting operations. Expanded Function is required to install the Storage and Blocking/Reformatting features. Blocking size limits are governed by the amount of storage implemented. For example, 100 80-character records could be combined into 1 physical block on tape if the full 8K storage complement were implemented. Reformatting allows skipping records based on content, skipping fields, rearranging fields, inserting constants, splitting a record into multiple records, or joining multiple records into one record.

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For any task except transcription without labels, control programs are required. These can be created on a 3741 or 3742, either as a separate data set on the same diskette that includes data to be transcribed or on a separate diskette.

The communications capability is discussed under Communications.

Conversion rate is dependent on the number of records recorded per diskette. IBM gives a typical range of about 280 to 325 records per minute, including time to change diskettes.

3540 DISKETTE INPUT/OUTPUT UNIT: The 3540 consists of one (Model B1) or two (Model B2) independent drives in a single cabinet. Model B2 has separate diskette feed mechanisms for each of the two drives. The 3540 is a true I/O device for transferring data between diskettes and an IBM System/370 Model 115, 125, 135, 145, 155-II, or 158 computer system. Connection is through one control unit position on a byte multiplexer, selector, or block multiplexer channel. The units are double-buffered. The hoppers and stackers each hold 20 diskettes and can be loaded or unloaded during operation.

The 3540 is supported as a sequential direct-access device and as a system file under DOS/VS. It is supported as a spool input device under DOS/VS POWER with job control statements located either on punched cards or on diskettes. It will also be supported under OS/VS1.

Effective performance, which includes program open time and diskette changing time, depends on the number of sectors read or written per revolution of the diskette and the number of tracks written per diskette. IBM quotes performance rates of about 2250 to 3630 records per minute for reading diskettes when more than half the sectors per track and more than half the tracks per diskette are read. Writing operations for equivalent conditions proceed at about 1250 to 2210 records per minute.

3713 PRINTER: The 3713 is a serial character printer that operates at up to 40 characters per second. The print line can contain up to 128 positions, depending on the size platen selected. Horizontal spacing is 10 characters per inch, and vertical spacing is 6 lines per inch. Characters are formed by a vertical column on 7 wires that print in up to 7 possible horizontal positions for each character (e.g., a 7-by-7 dot matrix).

The 3713 can be attached to any model 3741.

Forms are pin-fed. Six-part forms can be accommodated, but IBM recommends no more than three-part forms for optimum feeding and stacking. The basic printer comes with a 12.5, 13.125, or 13.875-inch platen (distance between feed holes). The printer can be equipped with an adjustable margin stop feature that allows platens down to 7.5 inches to be used.

The 3713 operates off-line; i.e., printing cannot be overlapped with data entry or communications. Four modes of operation are provided. One mode allows printing individual records on command. A second mode allows printing whole data sets under format control. Format control for printing is similar to that for data entry, with the addition of horizontal and vertical control commands. A separate set of control programs is required, with one being reserved for vertical and horizontal format control. Formatting provisions essentially allow data fields to be spread out horizontally and line breaks to be established. The result is entirely adequate for printing invoices and other highly formatted documents. The other two print modes allow a record to be printed automatically following the successful completion of a search on content or record address operation.

Multiple diskettes can be used in a single print job.

3717 PRINTER: The 3717 is a line printer that employs a changeable engraved metal belt to print 132 character positions per line. Nominal speeds are 155 lines per minute with a 48-character set and 120 lines per minute with a 64-character set. High-speed paper advance is at 12 inches per second, and forms are advanced by tractors.

The 3717 can be attached to any model 3741.

Printer instructions are stored in the 3741 program levels and can be chained from one level to another. Disk addresses can be printed with each record for debugging assistance or updating small files. Programs prepared for the 3713 Printer can be used directly for the 3717. In addition, new editing capabilities are included, such as insertion of floating dollar sign, decimal, comma, and slash as well as automatic printing of page headings on page overflow, automatic generation of page numbering, insertion of stored constant data into a print line, and expansion of a compressed data stream.

COMMUNICATIONS: A binary synchronous (BSC) interface is standard with the 3741 Model 2 and Model 4 and optional with the 3747 Data Converter. These two interfaces are compatible, and data can be transmitted between like terminals and between a 3741 Model 2 or 4 and a 3747. Transmission to IBM computers is also possible by way of an IBM 270X, 3704, or 3705 controller or Integrated Communications Adapter equipped with appropriate features. Transmission over switched or leased lines is supported.

Transmission is half-duplex at 1200, 2000, or 2400 bits per second. The transmission code is EBCDIC. The 3747 communications option includes providisions for EBCDIC transparency, unattended answer, and terminal and far-end identification. The 3741 Model 2 and 4 provide these same facilities, but the two identification functions are provided as a single extra-cost option.

In the basic communications mode, the 3741 Model 2 and 4 can transmit, receive, or transmit and then receive during one line connection. It cannot receive and then transmit during a single line connection. Format control programs are required for each data set to be transmitted or received. Multiple data sets can be transmitted from or received on a single disk. If the second disk option is included, data sets can extend across the disk boundaries without interrupt during either transmission or reception.

Two new options, Expanded Communications and Expanded Communications/Multipoint Data Link Control, provide significant enhancements to the communications capabilities of the 3741 Model 2 or Model 4.

Expanded Communications provides additional hardware and operational features. The two communications buffers are increased in size from 128 bytes each to 512 bytes each. This allows multiple records to be received or transmitted as a block without intervening line turaround for line and error control, which add appreciably to

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transmission time. Transmission of records can be selective, based on their content; field selection is also provided. Constants or blanks can be inserted into a received compressed data stream. During unattended operation, the first data set received can be printed automatically.

The Expanded Communications/Multipoint Data Link Control option includes all features of the Expanded Communications option and also allows the 3741 Model 2 or 4 to function as a tributary station on a dedicated network (leased line) with other BSC terminals. In addition, it provides an inquiry function, using diskette storage as a message buffer and communications log; details of this function are not available at this time. The option cannot be installed with Terminal Identification.

Added security for 3741 terminals is provided through two options. A keylock can prevent the communications mode from being entered without a key. The Operator Identification Card Reader allows credit-card-size plastic cards encoded with up to 40 characters on a magnetic stripe to be entered and read. The code can be used to restrict entry into the communications mode and can be transmitted.

The 3747 transmits to and from the magnetic tape unit. Tape labels are not created or checked during a transmission operation. The 3747 operates only in either the transmit-only or receive-only mode during a single line connection.

With the Expanded Function optional feature, an operator can position the tape to a sequential file and block number rather than retransmit the whole file, multiple calls can be pooled on tape in unattended mode if the modem is equipped to answer automatically and multiple files stored on one tape can be transmitted selectively to different remote locations under operator control.

Internal modems operating at 1200 bits per second are available for the 3741 Model 2 or 4 and the 3747. Two models are available. One is for operation over a dedicated, non-switched facility (leased line), and the other is for operation over a switched facility (telephone network); the second includes provision for automatic answering of incoming calls.

Software support for all feature of the 3741 Model 2 or 4 and the 3747 as terminals is provided through BTAM under System/370 DOS/VS, OS/VS1, OS/VS2, DOS, and OS and under System/360 DOS and OS; and through TCAM (and VTAM) under System/370 OS/VS1, OS/VS2, and OS and under System/360 OS. In addition, the 3741 Model 2 or 4 is supported by the System/3 Model 6 or Model 10 Disk System under RPG II, except for multipoint arrangements.

PHYSICAL SIZE: The 3741 units are relatively small in size, measuring about 42 inches by 25 inches by 34 inches high. With service considerations in mind, a space 60 by 79 inches must be allowed. The 3742 is not too much larger, at 65 inches by 29 inches by 33 inches high; including service area, the space occupied is 73 by 89 inches. The 3713 printer occupies only a 30-inch-wide by 24-inch deep space, but an additional 30 inches must be allowed in front and back for service and the optional forms stacker. The 3747 is a box measuring 48 inches by 29 inches by 38 inches high; it opens on all sides for service and requires a total space allowance of 108 by 95 inches. When installing multiple units, service areas can generally be overlapped. Weights for the 3741, 3742, 3713, and 3747 are 240 pounds, 300 pounds, 150 pounds, and 540 pounds, respectively. All units can be obtained to operate on either 115-volt or 208/230-volt power.

PRICING: All components of the 3740 Data Entry System are available under IBM's month-to-month rental program or under its 24-month Extended Term Plan. Components can be purchased as well. Monthly rental figures below include monthly maintenance. A separate maintenance agreement is available for purchased units.

	Monthly Rental			
	Short Term	Ext. Term	Purchase Price	Monthly Maint.
3741 Data Station:				
Model 1	159	135	6,000	39.00
Model 2	194	165	7,250	50.00
3741 Programmable Work Station:				
Model 3	253	215	8,600	59.00
Model 4	288	245	9,850	65.00
Options for 3741, all models:				
Expansion Feature (for second diskette drive or printer)	12	10	430	3.50*
Feature Group A	18	15	645	1.00
Second Disk	53	45	2,000	2.50
3714 Printer (includes attachment)	165	140	5,610	63.00
Adjustable Margin	5	4	210	1.00
Forms Stand	–	–	50	–
3717 Printer	294	250	11,000	?
Options for 3741, Models 2 and 4:				
Keylock	–	–	35	–
Operator Identification Card Reader	18	15	600	3.00
Synchronous Clock	6	5	210	0.50
Terminal Identification	12	10	430	0.50
Expanded Communications	29	25	1,100	2.00
Expanded Communications/ Multipoint Data Link Control	41	35	1,550	4.50
1200 bps Internal Modem, non-switched	18	15	660	3.50
1200 bps Internal Modem, switched	24	20	880	5.50
Options for 3741, Models 3 and 4:				
Application Control Language Translator (ACL)	41	35	1,400	10.00
3742 Dual Data Station:	188	160	6,950	48.00
Feature Group A (for 80-or 128-character)	16	14	6.20	1.00
128-character Variable Length Record	18	15	660	1.50
3747 Data Converter	441	375	18,600	54.00
Communications Adapter	118	100	4,800	26.00
Synchronous Clock	24	20	960	0.50
1200 bps Internal Modem, non-switched	18	15	660	3.50
1200 bps Internal Modem, switched	24	20	880	5.50
Tape Controls –				
Write Only (9-track, 1600 bpi)	24	20	960	5.00
Read/Write (9-track, 1600 bpi)	94	80	3,800	13.00
Read/Write (9-track, 800 bpi)	94	80	3,800	19.00
Read/Write (7-track, 556/800 bpi)	123	105	5,000	22.00
Tape Label	6	5	240	1.00
Expanded Function	41	35	1,650	?
Blocking/Reformating	47	40	1,190	?
Storage Feature (2K to 8K bytes)	12 to 47	10 to 40	480 to 1900	?
3540 Diskette Input/Output Unit:				
Model B1 (one drive)	535	455	22,000	25.00
Model B2 (two drives)	805	685	33,500	35.00

*Maintenance shown is for Model 1; monthly maintenance for Model 2 costs $3.00. ■

IBM 3790 Communication System

MANAGEMENT SUMMARY

On December 27, 1973, IBM announced its long-awaited entry into the shared-processor data entry market by unveiling a minicomputer-based remote data entry system that could significantly affect future decisions concerning centralized versus decentralized data processing for many users. The 3790 Communication System represents a dramatic departure from IBM's traditional operations philosophy of centralized computer-based processing and at least a partial endorsement of the distributed processing concept.

The 3790 is a distributed processing system built around and controlled by a minicomputer that offers on-site processing capabilities for a variety of computer-based applications. Operation is primarily keyed to the concurrent servicing of multiple key-entry workstations. Data can be simultaneously keyed from as many as 16 workstations, edited, and stored on diskettes for later transmission to the host System/370 computer. As a terminal, the 3790 can serve both as a remote batch processing system and as a transaction-oriented interactive device communicating with a centralized System/370 operating under DOS/VS, OS/VS1, or OS/VS2. In addition to its principal functions of data entry and data communications, the 3790 appears to be capable of handling a variety of small-scale business data processing applications.

Primarily a remote, shared-processor data entry system for use in distributed processing networks, the 3790 supports up to 16 keystations in stand-alone fashion and operates as a communications terminal in both batch and interactive modes. The 3790 communicates with a host System/370 computer in SDLC mode under VTAM.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corp., Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

CONFIGURATION: The basic components of an IBM 3790 Communication System are the programmable 3791 Controller and its basic cluster of operator stations, including 3793 Keyboard-Printers and 3277 Display Stations. The 3791 Controller can accommodate up to three additional clusters of operator stations, including one or two remote operator stations per cluster, via one or more 3792 Auxiliary Control Units. Printed copy can be produced by one or two auxiliary line printers.

The 3791 Controller provides from 4.8 to 27.5 million bytes of disk storage plus removable diskette storage, and is available in the following four models that determine the disk storage capacity:

This typical 3790 system installation demonstrates the operating flexibility that can be derived by mixing 3277 Display Stations and 3793 Keyboard-Printers to serve various business applications. The 3791 Controller with line printer is shown at the left.

IBM 3790 Communication System

Programming of the 3790 is performed exclusively at the central System/370 site. Source programs are compiled on the host 370 computer, and the resulting object programs are transmitted to the 3790. Up to 16 disk-stored programs can serve up to 16 operators concurrently, or multiple operators can concurrently share the same programs.

IBM notes that applications suitable for the 3790, beyond the obvious multi-station data entry functions, include local file inquiry and update, arithmetic calculations, and document preparation. According to IBM, the 3790 is ideally suited for remote offices in the insurance industry as well as other industries where data entry, data inquiry, calculations, and document preparation are required. Users can expand from a 3790 with a single keyboard-printer or display station to a full complement of 16 workstations and two line printers as their applications and data volumes grow.

The key components of the 3790 system are: (1) the 3791 Controller with its user-programmable mini-computer, diskette drive, and up to 27.5 million bytes of fixed disk storage; (2) the 3793 Keyboard-Printers—newly modified IBM Selectric II typewriters; (3) the 3277 Display Stations—CRT display units with typewriter-style keyboards and screen capacities of either 480 or 1920 characters; (4) up to two 120-lpm line printers; and (5) nested 2741 typewriter terminals at remote sub-sites.

First customer shipments of the 3790 Communication System are scheduled for the first quarter of 1975. A typical system that includes a 3791 Controller with 27.5 million characters of disk storage, four CRT display stations with 1920-character screens, two 3793 Keyboard-Printers, and a line printer sells for $103,330 or rents for $2,817 per month on a short-term lease.

With the introduction of its 3790 system, IBM now offers a full range of keyboard-oriented data entry products, including buffered keypunches, key-to-magnetic tape cartridge recorders, key-to-diskette recorders, intelligent key-to-diskette recorders, and shared-processor key-to-diskette systems. Additionally, IBM offers optical readers and remote terminals that permit effective on-line entry of data directly into its System/370 computer systems. Thus, the industry giant has plugged the last obvious gap in its data entry line.

The 3790 dramatizes and confers IBM's blessing upon the industry trend toward small-scale, decentralized data processing systems that can also communicate with larger, centralized data processing systems. It should help to expand the markets for the smaller manufacturers that have long been promoting the concepts of distributed processing and shared-processor data entry systems. □

3791 Model	Disk Storage Capacity
1A	4.8 million bytes
1B	8.9 million bytes
2A	18.2 million bytes
2B	27.5 million bytes

The basic 3791 Controller can accommodate up to four 3793 Keyboard-Printers and up to eight 3277 Model 1 or 2 Display Stations via separate device attachments; in addition, the 3791 can accommodate an 80- or 132-column line printer. The 3791 Models 1A and 1B require one device attachment per attached 3793; only one device attachment is required for the Model 2A or 2B to accommodate up to four 3793 Keyboard-Printers. Up to four 3277 Display Stations can be attached to any model of the 3791 Controller via a single device attachment; two device attachments can accommodate up to eight 3277 Display Stations. The use of device attachments is defined as follows:

- 3793 Attachment (one maximum)—accommodates the first 3793 Keyboard-Printer on a 3791 Model 1A or 1B, or one to four 3793 Keyboard-Printers on a 3791 Model 2A or 2B.
- 3793 Attachment, Second (one maximum)—accommodates the second 3793 Keyboard-Printer on a 3791 Model 1A or 1B.
- 3793 Attachment, Additional (two maximum)—accommodates the third or fourth 3793 Keyboard-Printer on a 3791 Model 1A or 1B.
- 3277 Attachment (one maximum)—accommodates the first through the fourth 3277 Model 1 or 2 Display Stations. All attached 3277 displays must be of the same model and contain the typewriter-style keyboard.
- 3277 Attachment, Additional (one maximum)—accommodates the fifth through the eighth 3277 Model 1 or 2 Display Stations. All attached 3277 displays must be of the same model as those attached to the 3277 Attachment and must contain the typewriter-style keyboard.

The 3792 Auxiliary Control Unit allows additional 3793 Keyboard-Printers to be attached to the basic 3791 Controller and provides a communications capability for the attachment of remote IBM 2741 Communication Terminals.

Each 3792 Auxiliary Control Unit can accommodate up to four 3793 Keyboard-Printers and up to two communications lines as a subcluster to the 3791 Controller. Each attached 3793 Keyboard-Printer requires a separate 3793 Attachment (a maximum of four per 3792). Each attached communications line requires a separate Asynchronous Communication Control (a maximum of two per 3792) and the EIA Interface or IBM Leased Line Adapter. The Adapter Base (one per 3792) is prerequisite to the Asynchronous Communication Control.

The 3791 Controller can accommodate up to three 3792 Auxiliary Control Units via the 3792 Attachment, and each 3792 can be located up to 2000 cable-feet from the 3791 Controller.

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One or two 3792 Auxiliary Control Units can be equipped with an 80- or 132-column line printer; however, only one 3792 can be equipped with a line printer if a printer is also attached to the 3791 Controller. Line printers on the 3791 and 3792 must be equipped with the same number of print positions and the same print belt.

The Security Keylock feature, which permits power to be applied only when the key is in place, is available for the 3791 Controller and for each attached 3792 Auxiliary Control Unit.

COMMUNICATIONS: Transmission between the 3790 Communication System and its host System/370 Computer is supported by Synchronous Data Link Control (SDLC), a new IBM communication line discipline. Transmission is half-duplex at 1200 or 2400 bits per second, as determined by one of two SDLC Communications Adapters that can be specified for the 3791 Controller. Transmission at 1200 bps is clocked via the SDLC Adapter; an EIA Standard RS-232 interface for use with an external modem or an integral IBM modem can be specified. Transmission at 2400 bps is unclocked; an EIA Standard RS-232 interface is provided for an external modem, which must provide its own clocking.

The 3791 is transmission-compatible with the IBM 3704 and 3705 Communications Controllers operating under the Network Control Program (NCP) and can be used in a switched or non-switched point-to-point or a non-switched multipoint communications arrangement.

DEVICE CONTROL: Built around a minicomputer as its nucleus, the 3790 Communication System is designed to serve in a stand-alone capacity as a shared-processor data entry system, gathering and editing data from as many as 16 operator stations and storing the data on diskettes for later batch transmission to the host computer. As an alternative, the data can be transmitted to the host computer as it is edited, without being stored on diskettes.

All operations are executed under program control. The 3790 receives its operating software from the host computer via the communications facility. Following receipt of the software, the 3790 operates independently of the host system.

All 3790 programs are compiled and can be tested on the host System/370 computer prior to use on the remote 3790. The application programs are prepared by the user via a System/370 assembler and statements defined in an IBM-supplied macro library. Program debugging is performed with the aid of a utility package, Program Validation Services (PVS), on the host computer. PVS also formats 3790 programs for storage at the host computer and later transmission to the 3790. Subsystem Support Services (SSS), another utility, controls 3790 program libraries at the host site and controls the transmission of 3790 programs from the host computer to the 3790.

Data entry is performed under the control of user applications programs received from the host computer. Up to 16 programs can be active at any one time to handle as many different tasks. Each operator can use a different program, or several operators can use the same program concurrently. Programs can be accessed from the host computer as they are needed.

The programs allow byte-by-byte and field-by-field data editing and processing that is format and function oriented. The 3790 also supports the entry of data for direct file updating at the host computer. Error correction is supported at multiple levels, including field, line, and

TYPICAL IBM 3790 SYSTEM CONFIGURATIONS AND PRICES*

Number of Workstations		Disk Storage Capacity, bytes	Monthly Rental**	Purchase Price	Monthly Maint.
3277-1 Display Stations	3793 Keyboard–Printers				
2	1	8.9 million	$1,420	$50,650	$251
4	2	8.9 million	1,745	64,300	326
6	3	8.9 million	2,100	77,250	401
8	4	8.9 million	2,405	92,000	473
4	6	8.9 million	2,435	94,100	478
8	8	8.9 million	3,095	117,200	625
2	1	27.5 million	2,010	75,650	316
4	2	27.5 million	2,285	87,100	385
6	3	27.5 million	2,610	100,750	457
8	4	27.5 million	2,885	112,200	526
4	6	27.5 million	2,915	111,900	537
8	8	27.5 million	3,575	137,400	678

* Each configuration includes a 3791 Controller with 2400-bps SDLC Communications Adapter and EIA Interface, and a 132-column Line Printer.

** Rentals are based on the Extended Term Plan where available.

IBM 3790 Communication System

document. Corrections can be made immediately or at the operator's option.

SOFTWARE SUPPORT: The 3790 system is supported by VTAM under DOS/VS, OS/VS1, and OS/VS2.

3793 KEYBOARD-PRINTER: The 3793 is a modified Selectric II typewriter terminal oriented toward the functions of the 3790 system. It contains a serial impact printer that prints full characters at speeds up to 15.5 characters per second; print symbols total 88. Vertical forms movement and print positioning can be performed under program control.

The printer accommodates friction-fed or pin-fed (optional) continuous forms up to 15.5 inches wide; the printing width is 13 inches. Horizontal spacing is 10 or 12 characters per inch; vertical spacing is 6 lines per inch.

The typewriter-style EBCDIC keyboard includes operator guidance lights and switches.

3277 DISPLAY STATION: The 3277 is a CRT display unit with a 14-inch (diagonal measurement) CRT screen. The display screen arrangement is dependent on the model, as shown below.

3277 Display:	Model 1	Model 2
Characters/display:	480	1920
Lines/display:	12	24
Characters/line:	40	80

A character set of 64 ASCII characters, including upper case alphabetics, numerics, and special symbols is displayed in green against a dark background. Each character is formed by a 7-by-9 dot matrix.

Three keyboards are available for the 3277 Display Station, but only the 66- or 78-key typewriter-style keyboard can be used when the 3277 is employed as an operator station attached to the 3791 Controller. The 78-key version of the typewriter-style keyboard includes 12 Program Function keys, which are defined by the application program.

PRINTED OUTPUT: Printed copy is produced by one or two optional line printers at a rated speed of 120 lines per minute (with a 64-character print belt, or 80 lines per minute (with a 96-character print belt). The line printer is available with 80 or 132 print positions and accommodates 6-part, continuous pin-fed forms up to 8 inches (80 columns) or 14-7/8 inches (132 columns) in width. Horizontal and vertical spacings are 10 characters per inch and 6 lines per inch, respectively.

PRICING: All components of the 3790 Communication System except the 3277 Display Station are available under IBM's short-term (month-to-month) rental plan or its 24-month Extended Term Plan. The 3277 Display Station is not currently available under the Extended Term Plan. Components can also be purchased. The monthly rental figures below include monthly maintenance and unlimited usage. A separate maintenance agreement is available for purchased units.

	Monthly Rental			
Component	Short Term	Ext. Term	Purchase	Monthly Maint.
3791 Controller:				
Model 1A	846	720	31,000	155.00
Model 1B	928	790	34,000	165.00
Model 2A	1,304	1,110	48,000	180.00
Model 2B	1,622	1,380	59,000	230.00
3791 Features–				
Control Storage Expansion	47	40	1,700	5.50
Control Storage Increment:				
Type I (8K bytes)	59	50	2,400	5.00
Type II (8K bytes)	59	50	2,400	5.00
Device Attachments:				
3792 Attachment	35	30	1,300	4.00
3793 Attachment	35	30	1,300	3.00
3793 Attachment, Second	59	50	2,200	5.50
3793 Attachment, Additional	35	30	1,300	3.00
3277 Attachment	71	60	2,600	5.00
3277 Attachment, Additional	59	50	2,200	3.00
SDLC Communication Adaptor:				
1200 bps, with clock	18	15	670	3.00
2400 bps, without clock	12	10	450	2.50
EIA Interface	12	10	400	4.00
IBM Integrated Modem:				
1200 bps, non-switched	18	15	630	5.00
1200 bps, switched	24	20	860	6.50
Line Printer:				
80 columns	259	220	9,500	52.00
132 columns	288	245	10,500	55.00
Forms Stand	–	–	–	–
Security Keylock	35*	–	35	–
3792 Auxiliary Control Unit	188	160	6,900	32.00
3792 Features–				
Control Storage Increment (8K bytes)	59	50	2,400	5.00
3793 Attachment	35	30	1,300	3.00
Line Printer:				
80 columns	259	220	9,500	52.00
132 columns	288	245	10,500	55.00
Forms Stand	–	–	50	–
Adapter Base	47	40	1,700	1.00
Asynch. Comm. Control	18	15	650	3.00
EIA Interface	12	10	400	4.00
IBM Leased Line Adapter	18	15	650	5.00
Security Keylock	35*	–	35	–
3793 Keyboard-Printer	112	95	3,450	26.00
3277 Display Station–				
Model 1 (480 char.)	75	–	3,400	77.00
Model 2 (1920 char.)	110	–	4,400	15.00
3277 Keyboard–				
66-key typewriter	15	–	600	4.50
78-key typewriter	30	–	1,400	11.00
3277 Features–				
Audible Alarm	5	–	200	.50
Operator IO Card Reader	15	–	600	3.00
Security Keylock	35*	–	35	–

* Single-use charge. ■

IBM 3790/3760 Data Entry Configuration

MANAGEMENT SUMMARY

In July 1975, under the guise of enhancements to an existing system, IBM unveiled its first serious entry into the shared-processor key/disk data entry system market. The company did this by making separate, but simultaneous, announcements to introduce the 3760 Dual Key Entry Station and the 3790 Communication System/Data Entry Configuration.

Although the new system is family-related to the 3790 Communication System (Report 70D-491-42), the relationship exists only in the sense that they both use a 3791 Controller and, optionally, an 80-lpm line printer. A keynote here is the fact that the only input device used in the Data Entry Configuration is the new 3760 Dual Key Entry Station. None of the allowable input devices for the original 3790 system can be attached to a 3791 Controller configured for the 3760's; nor, conversely, can a 3760 station be attached to a 3791 being used in a regular 3790 mode.

The 3760 Dual Key Entry Station is a new addition to the family of terminals in IBM's Advanced Function for Communications category, introduced in September 1974. Use the 3760 as the data entry device, connect it to a 3791 Controller using special attachments, provide an interface to a virtual storage System/370 computer, and you have the 3790 Communication System/Data Entry Configuration. This configuration is, in all respects, a true shared-processor key/disk system that delivers what the original 3790 announcement seemed to promise.

It should be pointed out that while the 3791 Controller used in the new system is basically the same controller

A shared-processor key/disk system, the 3790/3760 configuration accepts input independently from up to 12 3760 Dual Key Entry Stations (24 operator keyboards), and operates as a communications terminal for the batched transmission of data. It can be used for centralized or decentralized data entry operations.

CHARACTERISTICS

MANUFACTURER: International Business Machines Corp., Data Processing Division, 1133 Westchester Ave., White Plains, New York 10604. Telephone (914) 696-1900.

CONFIGURATION

The 3790/3760 Data Entry Configuration consists of a 3791 Controller, 3760 Dual Key Entry Stations, and a host attachment to a virtual storage System/370 computer. The 3760 Dual Key Entry Station is available as a Model 1 and a Model 2, each providing two keying positions. The Model 1 contains logic and storage to perform control/display functions and data editing/checking. Up to eight Model 1's can be attached to a 3791 Controller. Up to two Model 2's can be attached to a Model 1. A maximum of 12 stations, or 24 operator positions, is supported. An 80-lpm line printer is an optional attachment.

COMPONENTS

3760 DUAL KEY ENTRY STATION: Consists of a desk with two keyboards in opposite corners and a single gas-panel display unit that houses a screen for each operator. The keyboard has a standard 66-character alphanumeric combination keyboard with EL character set for key entry and verifying. In addition to the standard keys, the keyboard has Record/Field/Character Backspace,

The 3760 Dual Key Entry Station consists of a desk that houses two keypunch-style keyboards and back-to-back gas-panel display units. A maximum of twelve 3760's can be used in a 3790/3760 Data Entry Configuration to accommodate up to 24 operators.

IBM 3790/3760 Data Entry Configuration

used in the 3790 Communications System, there are distinct differences for the data entry configuration. Most significant is the fact that the host System/370 is not required for program loading. Functional programs are supplied by IBM on diskettes and are loaded onto the controller's disk by the controller itself. User programs (format definitions, passwords, codes, etc.) are loaded from a 3760. Basically, the controller is now a remote stand-alone device exercising complete control over the data entry operations.

Another significant change in the 3791 Controller when used in the data entry configuration is its capability to be connected directly to a System/370 through a byte multiplexer channel. This is an important consideration for users who may want to use the system for local data entry operations in a centralized environment.

A feature of this system which adds to its versatility is that it enables the user to locate the 3760 stations, in groups of 1, 2, or 3, anywhere within 2000 feet of the 3791 Controller. Thus, while still centralized in mode of operation, the keystations may be located in, or closer to, those departments where the data is originated.

The system operates in both off-line and on-line modes. In off-line mode, data is entered, edited, checked, and stored on the 3791 disk. User storage capacity for data, formats, and job/statistical files is 3.9 or 7.8 million bytes, using a Model 1A or 1B controller, respectively. In on-line mode, batched data is transmitted to or from the host System/370. A concurrency feature enables up to nine 3760's to be active while data is being transmitted. Without the concurrency feature, no 3760 activity can go on while the system is transmitting.

It's important to note that the on-line batch data transmission link completely replaces the magnetic tape that serves as the data transfer medium in most of the competitive key/disk systems; no magnetic tape units are currently offered for the 3790/3760 system.

An 80-position line printer is an optional device which can be attached to the 3791 controller. Significant here, however, is the fact that the printer is controlled by a 3760, and while printing is taking place, the other 3760's cannot be active in any mode. Also, the printer cannot be active while data transmission is taking place.

With the introduction of this system, IBM has supplied an important missing link in its data entry line. For the first time, IBM has a product that will compete directly against the shared-processor key/disk systems from CMC, Entrex, Inforex, Mohawk, and other vendors. At the same time, the computer giant has further conferred its blessing upon the industry trend toward the distributed data processing concept. □

Field/Character Advance, Auto Skip/Dup and Auto Enter Key Switch, Display Record, Next Format, Record Position, Insert and Delete, Cursor Up and Down, Cursor Placement at Command Line, Mark Record, and Scan Next Record keys. An ASCII keyboard is optionally available.

The gas-panel screen displays up to 236 characters to each operator. There are six lines of characters, the first being the Command Line on which messages, commands, error types, and mode of operation are displayed. The last five lines display keyed data as it is entered. A fill-in-the-blanks format can be displayed, and as data is entered the cursor will automatically skip over the indicative format data. Status indicators are on the left and right sides of the screen. Left-side indicators are: Operator Attention, Auto Skip/Dup, Display Record, Auto Enter, and Verify Mismatch. The right-side indicators are Operator Attention, Station Available, Enter, Verify, Insert Mode, and Dup Not Allowed.

3791 CONTROLLER: The 3790/3760 Data Entry Configuration uses either the 3791 Model 1A or Model 1B Controller. The Model 1A controller provides disk storage of 5 million bytes, of which 3.9 million are available for user data, formats, job and statistical files. The Model 1B provides 10 million bytes, of which 7.8 million are available to the user. In both models, removable diskette storage is provided for backup of user formats and for loading the functional software from IBM-supplied diskettes.

The amount of control storage required for the system depends upon the number of 3760 Dual Entry Key Stations attached to the 3791 and the extent of the concurrency capabilities within the system. The Concurrency feature enables up to nine 3760 stations to be active while data transmission is taking place.

In using the 3791 in the Data Entry Configuration, a number of attachments may be required depending on the configuration. The use of these attachments is as follows:

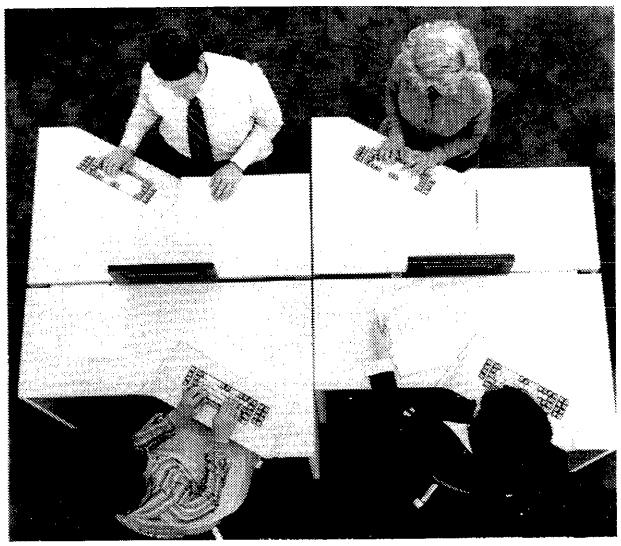
- Local Channel Attachment (one maximum)—Provides direct attachment of the IBM 3791 Controller to a System/370 byte multiplexer channel.
- Control Storage Expansion (one maximum)—Provides the capability for expanding control storage.
- Control Storage Increment (three maximum)—Provides 8,192 positions of additional control storage; required for the Concurrency capability.
- Additional Disk Heads (one maximum)—Required for use with the 3760, on either 3791 model.
- Device Attachment Type 1, Additional (one maximum)—Allows up to four 3760 Model 1's to be attached to a 3791 Controller. Each Model 1 can accommodate up to two 3760 Model 2's.

LINE PRINTER: An 80-print-position line printer can be attached to the 3791 Controller. It has a maximum speed of 80 lines per minute and uses a 96-character set. Printing is controlled by one 3760, and no other 3760 can be active in any mode during printing. The line printer can only be used when no data transmission is occurring between the 3791 and the host computer.

COMMUNICATIONS

Transmission between the 3791 Controller and its host System/370 computer is in Synchronous Data Link Control (SDLC) mode. Transmission is half-duplex at 1200 or 2400 bits per second, as determined by one of two SDLC Communications Adapters that can be specified for the 3791 Controller. Transmission at 1200 bps is clocked via the SDLC Adapter, whereas transmission at 2400 bps is clocked from an external modem.

IBM 3790/3760 Data Entry Configuration



This overhead view shows two 3760 Dual Key Entry Stations linked to form a data entry pool of four operator positions. A pool can be located in each of several user departments, such as accounting, payroll, and shipping.

➤ The 3791 is transmission-compatible with the IBM 3704 and 3705 Communications Controllers operating under the Network Control Program (NCP), and can be used in a switched or non-switched point-to-point or a non-switched multipoint communications arrangement.

SYSTEM OPERATION

Sitting at a keystation, the operator faces a keyboard similar to that of an IBM 29 Card Punch but with some additional keys to accommodate the additional functions. The gas-panel display is behind the keyboard and to the left.

As the operator keys in data, it is displayed and put into a buffer in the 3760. When the system detects an error, it alerts the operator by flashing a message on the display panel. A keying error can be corrected by backspacing and rekeying. If the error is in the source document and cannot be corrected by the operator, a Mark Record key permits the operator to mark the record for future attention. After a record is finished, the data is transferred to the 3791's disk and stored for later batch transmission to the computer. Error records discovered by a host application program can be returned to the 3791 for checking and correction.

Several file scanning modes are available which enable the operator to display previously entered records by moving backward or forward in the file one or a number of records at a time, or displaying those records previously marked. A search feature is also available which enables the operator to enter a maximum of four 30-character strings as search arguments. If the match is found, the record is displayed. If no match occurs, a message will appear together with the last record on the batch.

Under format control, balancing can be done at the record, inter-record, and batch level. Basic characteristics of each field to be entered using a specified format may be displayed. When using a fill-in-the-blanks format, each field can be preceded by a descriptor name field, which is skipped automatically and not recorded in the data batch.

Control of data being keyed is by the conventional approach of defining a control format that identifies fields, any automatic operations, and restrictions such as alphabetic or numeric only. A number of automatic operations can be defined, such as skipping, duplicating, generating a field based on a keyed code, entering the date on a record, performing arithmetic operations, and checking data to determine whether it is in a specified numerical range.

By use of an identification code, supervisory functions can be performed at any 3760. Capabilities include defining formats and jobs, displaying batch and job status, flagging batched data for extract, determining the status of the equipment, and routing messages to the computer operator. Production statistics, prepared by the 3791, can be requested by the supervisor and displayed or printed. The supervisor can also select one or more batches of a job and inspect the combined totals of all batch counters of these batches. The supervisor can also enter various codes for security purposes.

SOFTWARE

Functional programming for the 3790/3760 Data Entry Configuration is supplied by IBM and entered into the system by diskette for storage on the 3791 disk. Data transfer for both local and remote 3791's is controlled by the Batch Transfer Program (BTP), a new system control programming facility. BTP is supported under DOS/VS, OS/VS1, and OS/VS2. Data transfer is supported under VTAM.

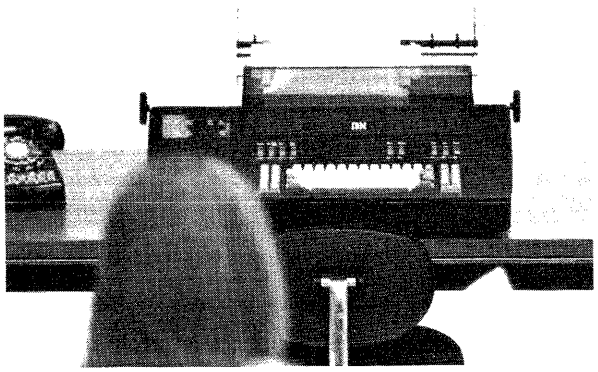
PRICING

All components of the 3790/3760 Data Entry Configuration are available under IBM's short-term (month-to-month) rental plan or its 24-month Extended Term Plan. Components can also be purchased. The monthly rental figures below include monthly maintenance and unlimited usage. A separate maintenance agreement is available for purchased units.

	Monthly Rental			
Component	Short Term	Ext. Term	Purchase	Monthly Maint.
3760 Dual Entry Key Station–				
Model 1	$258	$220	$ 9,240	$ 45.00
Model 2	141	120	5,040	32.00
3791 Controller–				
Model 1A	897	763	31,000	167.00
Model 1B	983	837	34,000	178.00
Local Channel Attachment	88	75	3,000	4.00
Control Storage Expansion	49	42	1,700	5.50
Control Storage Increment–				
Type I	62	53	2,400	5.00
Type II	62	53	2,400	5.00
Additional Disk Heads	53	45	1,800	28.00
Forms Stand	–	–	51	
Line Printer	274	233	9,500	56.00
Security Keylock	37*	37*	35	
Device Attachment Type I	24	20	800	0.50
EIA Interface	12	10	400	4.00
1200 bps Integrated Modem:				
Non-Switched	19	16	630	5.00
Switched	25	21	860	7.00
SDLC Communications feature:				
w Bus. Machine Clock	19	16	670	3.00
w o Bus. Machine Clock	12	10	450	2.50

*One-time charge. ■

IBM 3767 Communication Terminal



IBM's new keyboard/printer terminal is designed to communicate in SDLC mode with System/370 VS computers. It offers bidirectional printing at 40, 80, or 120 cps and a host of other impressive features.

MANAGEMENT SUMMARY

The IBM 3767 Communication Terminal is destined to supersede the venerable 2740 and 2741 Communication Terminals as the principal typewriter-style remote terminal in IBM's broad line of data communications equipment. Like the other terminals introduced as part of IBM's "Advanced Function for Communications" announcement on September 11, 1974, the 3767 is specifically designed to communicate with virtual-mode System/370 computers by means of IBM's new SDLC line control discipline. In addition, the 3767 can be equipped to utilize the older Start/Stop (asynchronous) line control procedures in order to facilitate conversion from the 2740 or 2741.

As compared with the 2740 and 2741 (Reports 70D-491-02 and 70D-491-03), the 3767 offers:

- Much higher printing speeds (40, 80, or 120 cps, versus 14.8 cps for the 2740 and 2741) through the use of a serial matrix printer that features bidirectional printing and high-speed tabbing.
- Faster data transmission rates (up to 2400 bps, versus 134.5 bps for the basic 2740 and 2741).
- Larger buffer capacities and improved data editing facilities.
- Compact, desk-top packaging and an optional acoustic coupler for improved mobility.
- Improved human engineering, such as the provision of machine status indicator lights, plus quieter operation.
- A novel Calculate–Scientific feature that equips the 3767 to perform a wide range of electronic calculator functions when it is not on-line to the computer.
- Several safeguards against unauthorized use, including an optional security keylock, an optional magnetic stripe reader, and standard Automatic Terminal ID and Print Suppress facilities.
- Improved reliability and serviceability through self-checking of basic terminal functions during the power-on sequence, customer-operated functional tests to aid in problem isolation, and diagnostic tests

CHARACTERISTICS

MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

CONFIGURATION: The 3767 Communication Terminal consists of a bidirectional serial matrix printer, typewriter-style keyboard, control keys, indicator lights, and logic circuitry in a single desk-top unit. Three models provide a choice of printing speed. Dual 256-byte line buffers and a buffer editing capability are standard. Two additional 256-byte buffers are optionally available. The only optional input/output device currently available is a magnetic stripe reader.

COMMUNICATIONS: Standard communications discipline for the 3767 is IBM's Synchronous Data Link Control (SDLC). Transmission is half-duplex at a minimum rate of 300, 600, 1200, or 2400 bits/second, depending upon the modem and communications facility employed. The 3767 is designed to communicate with a Virtual Storage System/370 Model 115 through 168 computer in a switched or non-switched point-to-point arrangement or as a secondary station in a multipoint or "duplex multipoint" arrangement. (In a duplex multipoint facility, multiple terminals are connected to a line in a manner that permits one station to send data back to the host computer while another station is receiving.)

The optional Start/Stop Feature equips the 3767 to operate in a asynchronous (Start/Stop) transmission mode that is compatible with the IBM 2740 Model 1, 2740 Model 2, or 2741 Communication Terminals, thereby facilitating conversion from these older terminals. An SDLC/Start-Stop switch permits operation in either mode.

The 3767 can be equipped with an integrated modem, an acoustic coupler, or an external modem. IBM offers a choice of four integrated modems, all rated at 1200 bps and capable of operating at 300, 600, or 1200 bps. The four models are Non-Switched (for 2- or 4-wire non-switched voice-grade channels), Switched with Manual Answer (for use on public telephone networks), Non-Switched with Interrupt, and Switched with Interrupt. (The latter two models include a bidirectional reverse-channel capability used to transmit an interrupt signal when the ATTN key on the 3767 keyboard is depressed while operating in the Start/Stop 2741 mode on a half-duplex line.) The IBM acoustic coupler permits communications through a telephone handset at speeds up to 600 bps. The optional EIA Interface, available with or without modem clocking, permits attachment of an external modem such as the IBM 3872. The clocked EIA interface can also be used for local attachment of the 3767 to a 3704 or 3705 Communications Controller equipped with Line Set Type 1F for operation at 600 or 1200 bps.

DEVICE CONTROL: The 3767's basic control logic provides the control for all on-line and off-line operations, including communication at up to 2400 bps and basic functions such as Automatic Terminal ID, Station Control, Internal Communication Clocking, Transmit and Receive Interrupt, End of Line Alarm, and Buffer Full Alarm. A Print Suppress facility permits selected data fields to be entered via the keyboard without being

IBM 3767 Communication Terminal

that can be run by field engineers without interference to users of other terminals in the network.

In return for all these worthwhile new features, the terminal buyer is confronted with a significantly higher price tag: $176 per month for the basic 3767 Model 1 under a short-term lease, as compared to $96 per month for a basic 2740 Model 1 or 2741.

The 3767 cannot be classified as an "intelligent" terminal because it is not user-programmable. But the impressive line control, editing, calculator, security, and diagnostic functions performed by its LSI control logic make it clear that the 3767 is far from "dumb", and may even merit a new classification. How about "intelligent but inflexible"?

IBM's new keyboard/printer terminal appears to be well suited to satisfy a broad range of applications that require substantial interaction between a computer and its users together with a printed copy of the input and output. Examples include inquiry/response, file updating, low-volume data entry, program testing and debugging, and interactive problem solving.

First customer shipments of the 3667 Models 1 and 2 were made in February 1975. First shipments of the Model 3, introduced in July 1975, are scheduled for March 1976. Delivery of the supporting software for the 3767 in its native SDLC mode will occur in November 1975 under DOS/VS, April 1976 under OS/VS1, and August 1976 under OS&VS2. Software supporting 3667's with the Start/Stop Feature and operating as a 2740 or 2741 was delivered concurrently with the hardware.

Is the 3767 worth its comparatively high price? For locations that can take full advantage of its fairly high printing and transmission speeds, the answer is probably yes. But for low-traffic locations, there remains a strong need for a slower, more economical SDLC-mode typewriter terminal. If IBM fails to fill this need in the near future, you can bet one or more of the independent terminal makers will. □

printed. When off-line, the 3767 can function as a conventional electric typewriter.

The dual 256-byte buffer feature includes a Buffer Edit function that permits correction and manipulation of data stored in the full 512-byte buffer under keyboard control. A Buffer Full Alarm sounds an audible tone when fewer than 10 positions remain unfilled.

The optional Calculate–Scientific feature equips the 3767, in off-line mode, to function as an electronic calculator capable of performing the following functions: add, subtract, multiply, divide, inverse (1/X), square root, exponential, common logarithm, natural logarithm, exponential constant, circular constant, sine, cosine, tangent, arcsine, arccosine, arctangent, and mean and standard deviation. Two memories are provided for temporary storage of totals. Numbers up to 16 digits in length can be entered and printed out.

SOFTWARE SUPPORT: Support for the 3767 operating in its native SDLC mode will be provided by a System/370 Model 115 through 168 computer equipped with: 1) DOS/VS, OS/VS1, or OS/VS2; 2) VTAM or TCAM through VTAM; and 3) NCP/VS in a locally or remotely attached 3704 or 3705 Communications Controller.

IBM 3767 terminals equipped with the Start/Stop Feature and operating as 2740-1, 2740-2, or 2741 terminals will receive extensive software support for connection through a 3704, a 3705, or the Integrated Communications Adapter (ICA) on a System/370 Model 115, 125, or 135. This support will be provided: 1) through BTAM-ICA under DOS/VS or OS/VS1; 2) through BTAM-EP/VS or VTAM-NCP/VS under DOS/VS, OS/VS1, or OS/VS2; or 3) through TCAM-EP/VS and NCP/VS or TCAM through VTAM-NCP/VS under OS/VS1 or OS/VS2.

CICS/VS and IMS/VS support will be provided for the 3767 in both SDLC and Start/Stop mode.

KEYBOARD: The standard typewriter-style keyboard consists of 44 alphanumeric data keys in either a Correspondence or EBCDIC arrangement. The optional Alternate Character Set feature permits switch selection of a second set of printer graphics (e.g., the APL set), or enables the Mono Case feature, which restricts other than upper case alpha characters from either the keyboard or communication line, regardless of key shift or line-code shift. The optional ASCII Feature provides 48 ASCII data keys in place of the standard 44 keys. In addition to the data keys, the keyboard contains function keys, operating mode switches, indicator lights, and a 3-position numeric Print Position Indicator display.

PRINTER: The bidirectional serial matrix printer is rated at 40 cps in Model 1, 80 cps in Model 2, and 120 cps in Model 3. Tabbing of more than 9 spaces is performed at 120 characters/second. Characters are formed by a dot matrix of 4 of 7 dots wide by 8 high. There are 132 print positions, spaced 10 to the inch. Vertical spacing is 6 lines per inch.

Up to 6-part forms with a maximum width of 15 inches can be used. A friction-feed platen is standard, and a Variable Width Forms Tractor for pin-feed forms is optional. Other accessories include a Paper Roll Holder for roll paper supply and a Forms Stand for feeding and stacking continuous forms. The optional Vertical Forms Control feature permits skipping to a preset page header location or vertical tab position.

MAGNETIC STRIPE READER: This compact optional device reads up to 40 A.B.A. standard numeric characters, including control characters, from a magnetically striped credit card or ID card. The reader cannot function when the 3767 is operating in asynchronous (Start/Stop) mode.

PRICING: The 3767 can be purchased or leased under either IBM's short-term (month-to-month) rental plan or its 24-month Extended Term Plan. The monthly rental figures below include maintenance service and allow unlimited usage. A separate maintenance agreement is available for purchased units.

Component	Short Term	Ext. Term	Purchase Price	Monthly Maint.
3767 Communications Terminal:				
Model 1: 40 cps	$176	$150	$5,800	$32.00
Model 2: 80 cps	223	190	6,650	36.00
Model 3: 120 cps	307	261	9,228	52.00
Acoustic Coupler–600 bps	14	12	420	0.50
ASCII Feature	12	10	350	0.50
Alternate Character Set	7	6	210	0.50
Buffer Expansion (to 1024 bytes)	24	20	700	0.50
Calculate–Scientific	19	16	560	1.00
EIA Interface–No Clock	13	11	385	1.00
EIA Interface–With Clock	13	11	385	1.00
Magnetic Stripe Reader	19	16	560	1.50
1200-bps Integrated Modem:				
Non-Switched	19	16	668	3.50
Switched with Manual Answer	19	16	668	3.50
Non-Switched with Interrupt	31	26	1,185	9.00
Switched with Interrupt	31	26	1,185	9.00
Security Keylock	35*	35*	35	...
Start/Stop Feature:				
2740-1 Line Control	6	5	175	0.50
2740-2 Line Control	6	5	175	0.50
2741 Line Control	6	5	175	0.50
Vertical Forms Control	13	11	385	0.50

*One-time charge. ■

IBM 3770 Data Communication System
New Product Announcement

On July 1, 1975, IBM significantly enhanced the capabilities of its 3770 Communication Terminals by announcing new programmable models of the 3773, 3774, and 3775 plus increased printing speeds for the 3771, 3773, 3774, and 3776.

PROGRAMMABLE TERMINALS: New models of the 3373, 3374, and 3375 Communication Terminals are functionally controllable by user-written programs. In addition to having the capabilities of the non-programmable models, the new terminals can be programmed to check data; control forms; perform logic, arithmetic, storage, and format/edit operations; and control operations with user-created indexing to data sets and relative data sets on diskettes. The non-programmable models can be field-upgraded to programmable models.

In addition to the above, user-written application programs for the 3374 and 3375 can be used to control a standard integrated diskette device with a nonremovable diskette, one or two optional storage devices with removable diskettes for storage and application programs, a new special feature that provides a 480-character display, and a 2502 or 3501 Card Reader and 3521 Card Punch.

User programs are written for the new models using a subset of 3790 Communication System programming statements plus a number of new 3770 statements which provide support for configurations with diskette storage, card I/O, and the 480-character display feature. Programs are assembled using a System/370 DOS/VS or OS/VS assembler and 3790 Host Support, including a Macro Library containing Program Validation Services (PVS). PVS is used to validate, optionally test, and format programs for the terminals.

Programs in object code are loaded from diskette storage into terminal storage for execution. User program storage capacity ranges from a basic 4K bytes to a maximum of 12K bytes in the 3773, and from a basic 6K bytes to a maximum of 22K bytes in the 3774 and 3775. The programs are selected and initiated by the operator at the 3770 terminal or by a special control command sent from the host CPU. An initiated program can also call another program from diskette storage without intervention by the operator or host CPU. The terminals also provide an operator-selectable job-control capability which enables selection and execution of a predefined series of 3770 programs. This series can be altered by the executing program.

The programmable 3774 and 3775 terminals can be equipped with a new Display Feature that provides 480 display positions (12 lines of 40 characters) and a 94-character set. This display uses gas panel technology and is swivel-base mounted on the keyboard console cabinet. User programs may be written to enable writing on the display by character, field, or line, and erasing the screen. Parameters to the statements permit vertical and horizontal cursor control. Possible applications include displaying data entered at the keyboard; creating, formatting and displaying operator guidance messages; displaying inquiry response messages from 3770 application data sets stored on diskettes; and providing for fill-in-the-blanks data entry. User programs can also use the printer or display in conjunction with a program stop and display/print capability on the 3774 or 3775 to facilitate program testing and debugging at the terminal site.

Functions of the 3770 programmable terminals which are system, not user, controlled include batch data communication between the host CPU and diskette storage, message transmission from the host CPU to the console printer, diskette data set management, setting the system date, printing the error log, and entering the communicate mode upon completion of a specific user program without operator intervention. Additional functions, applicable to the 3774 and 3775 terminals only, which are under terminal control include a CPU interrupt capability, an application program debug facility, and a data transfer capability, including card reader to console printer, card reader to card punch, keyboard to card punch, diskette copy, and data set copy.

The programmable 3773, 3774, and 3775 terminals communicate with the host CPU using BSC or SDLC at speeds up to 4800 bps over switched or non-switched communications facilities. Communication is in batched mode only, using diskette-to-line, line-to-diskette, or, under certain conditions, line-to-console printer transmission. The host CPU communicates with the terminals to add or delete 3770 application programs, create/load data sets for use by user-written application

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IBM 3770 Data Communication System
New Product Announcement

programs, erase or delete data sets, start automatic execution of a specified application program at the 3770, or specify an automatic power-down sequence. Data formatted for a non-programmable 3370 can be received and written to a system data set on diskette storage. The programming statements for a programmable 3770 provide support for transmitting this data to the printer under control of a user-written 3770 application program.

First deliveries of the programmable 3774 and 3775 terminals operating with BSC are scheduled for April 1976. Delivery of the 3773 models, operating with BSC or SDLC, and the 3774 and 3775 with SDLC is scheduled for June 1976.

NEW 3776 MODEL: The new 3776 Model 2 Communication Terminal is similar in function to the Model 1 except for printer speed. Three character set sizes are available. Maximum print speed is 230 lpm with a print belt using a 94-character set, 300 lpm with a 64-character set, or 400 lpm with a 48-character set. Spacing of 6 or 8 lines per inch is standard for both the Model 1 and Model 2; this is a new capability for the Model 1. A 4800 bps integrated modem is available as a special feature for both models. The 3776 Model 1 can be field-upgraded to a Model 2. First customer shipment of the 3776 Model 2 and of the 4800 bps integrated modem on both models is scheduled for January 1976 for BSC and April 1976 for SDLC.

NEW 3771, 3773, AND 3774 MODELS: The new 3771 Model 3, 3773 Model 3, and 3774 Model 2 Communication Terminals are identical to the earlier models in all functions, but provide increased printer speeds of up to 120 cps. The bidirectional printing capability of the slower models is retained. Accessories used with the 40 or 80 cps models also operate with the new models and have the same programming support. Current models can be field-upgraded to the 120 cps printer. First customer shipments of the new models using BSC or SDLC are scheduled for January 1976.

ADDED FUNCTION FOR 3775: Beginning with shipments in July 1975, the 3775 Communication Terminal will have a standard feature which allows the operator to select line spacing of either 6 or 8 lines per inch. Hardware to add this capability to installed terminals will be shipped automatically, beginning in August.

PRICING: All 3770 models mentioned above are available under IBM's month-to-month rental arrangement, under the Extended Term Plan (a two-year lease), and for purchase. The P1, P2, and P3 indications in the table below refer to the programmable models with printer speeds of 40, 80, and 120 lpm, respectively.□

		Short Term Rental*	Extended Term Rental*	Purchase Price	Monthly Maint.
NEW 3770 SERIES COMMUNICATIONS TERMINALS					
3771 Model 3	120 cps printer	$306	$260	$10,400	$57.00
3773 Model 3	120 cps printer	388	330	13,200	73.50
3773 Model P1	Programmable; 40 cps printer	370	315	13,200	82.00
3773 Model P2	Programmable; 80 cps printer	400	340	13,600	85.00
3773 Model P3	Programmable; 120 cps printer	447	380	15,200	95.00
3774 Model 2	120 cps printer	376	320	12,800	64.00
3774 Model P1	Programmable; 80 cps printer	476	405	16,200	106.00
3774 Model P2	Programmable; 120 cps printer	523	445	17,800	114.00
3775 Model P1	Programmable; 120 lpm printer	617	525	21,000	136.00
3776 Model 2	400 lpm printer	676	575	23,000	144.00
SPECIAL FEATURES					
4K Storage Increment (3773, 3774, 3775)		32	27	1,273	4.00
8K Storage Increment (3773, 3774, 3775)		62	53	2,545	6.00
12K Storage Increment (3774, 3775)		94	80	3,818	10.00
16K Storage Increment (3774, 3775)		125	106	5,090	12.00
Display Feature (3774, 3775)		94	80	3,200	31.50
Numeric Keypad (3773, 3774, 3775)		12	10	400	2.00
Variable-Width Forms Tractor (all models)		6	5	160	0.50
4800 bps Integrated Modem (3776 Models 1 and 2):					
Non-Switched, Point-to-Point		141	120	3,600	41.50
Non-Switched, Multipoint		141	120	3,600	41.50
Switched with Auto Answer		159	135	4,050	43.50
Switched Network Back-Up		24	20	600	1.00
Modem Fan-Out		29	25	750	2.50

*Includes maintenance; allows unlimited usage.

IBM 3800 Printing Subsystem

MANAGEMENT SUMMARY

On April 15, 1975, IBM announced a high-speed non-impact printer. Following the announcement by two years of a Xerox electrostatic page printer and by one year the announcement of a similar Honeywell unit, the IBM 3800 Printing Subsystem offers performance superior to that of the Xerox 1200 and close to that of the Honeywell Page Printing System, together with more flexibility and substantially higher cost than either of the competitive products. The IBM 3800 can be operated on-line only to a System/370 Model 145, 155-II, 158, 165-II, or 168 computer running under OS/VS1 or VS2. Both the Honeywell and Xerox units operate in an off-line mode from magnetic tape, while the Xerox 1200 can be used on-line to Xerox computers as well.

The outstanding characteristic of the IBM 3800 is its printing flexibility. It accepts conventional sprocketed, continuous computer forms (without vertical running carrier perforations) in widths from 6.5 to 14.875 inches and in lengths from 3.5 to 11 inches. Up to four different type styles and/or sizes can be combined in one printed report. A total of 18 different type styles and sizes are provided with the 3800, and additional ones can be designed by the user. Character sizes include 10, 12, and 15 characters per inch. Vertical format spacing is 6 or 8 lines per inch under program control, and can be altered at will. A form overlay capability is included to print artwork and/or table delineations. Print lines of up to 204 positions can be generated. A peak speed of almost 14,000 lines per minute can be achieved. The full capabilities of the 3800 are discussed in the Characteristics section of this report; they are truly impressive.

The Xerox 1200 (Report 70D-931-01) prints on plain 8.5-by-11-inch paper only, with a horizontal character

IBM's first non-impact computer printer, the 3800 resembles a souped-up IBM Copier II. Accompanying its high performance is a flexible printing capability closer to that of a composition house than a traditional computer printer. If you have a penchant for improved computer-produced reports, be prepared to back that desire with a lot of dollars.

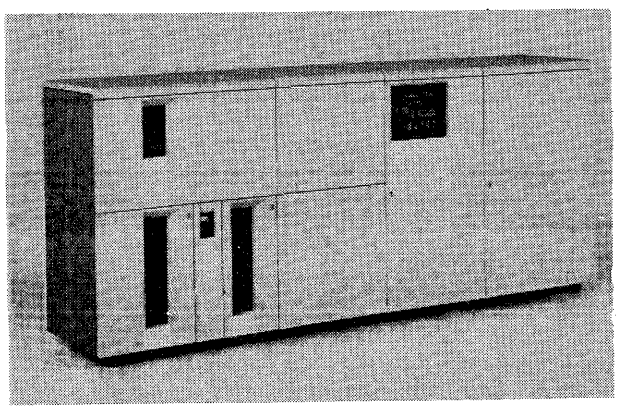
CHARACTERISTICS

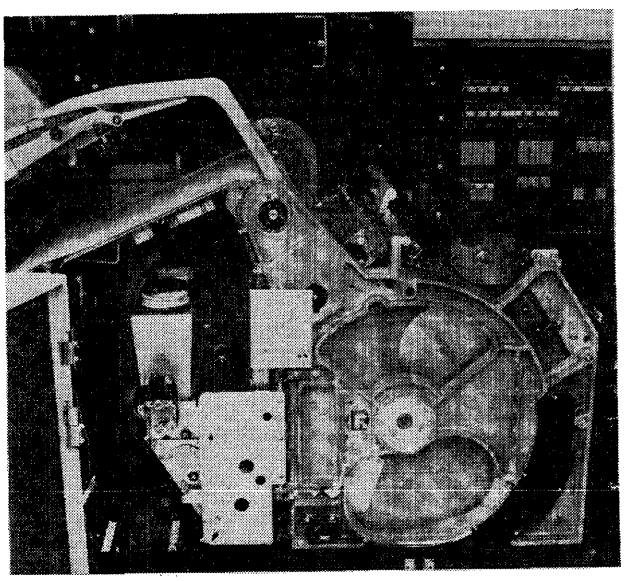
MANUFACTURER: International Business Machines Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 696-1900.

MODELS: Only one model of the 3800 has been announced to date. It attaches to a Byte or Block Multiplexer Channel of an IBM System/370 Model 145, 155-II, 158, 165-II, or 168 computer operating under OS/VS1 or OS/VS2. Attachment via a non-dedicated Selector Channel is specifically not recommended.

A manual Two-Channel Switch is available at no extra charge. A Dynamic Two-Channel Switch is an extra-cost option that permits program selection of the operating channel; it can be used with two channels of a single CPU for alternate path selection or to share the printer between two processors in a tightly coupled multiprocessing system.

PRINTED OUTPUT: Printing is accomplished by an electrostatic process, referred to as "electrophotographic" by IBM. The light source is a helium-neon laser. A revolving mirror deflects the laser beam to generate a line scan; the laser beam is deflected (modulated) away from the mirror to produce a horizontal dot pattern. A vertical dot pattern is established because the mirror is faceted. The dot resolution is 144 dots per inch horizontally and 180 dots per inch horizontally. Data characters received from the processor and stored in a buffer are encoded into the dot





It surely doesn't look like a computer printer. The exterior view at left shows the 3800's overall cabinet length of just an inch over 12 feet. The interior view at right shows the drum with photoconductive film surface. The paper path enters about mid-way up on the left, bends down to meet the drum, folds back, and exits past the fuser at the top left.

IBM 3800 Printing Subsystem

spacing of 13.3 characters per inch and a vertical spacing of 8 lines per inch. The 1200 peaks at 4000 lines per minute.

The Honeywell Page Printing System (Report 70D-480-10) prints on special 8.5- or 11-inch-wide stock in roll form. Horizontal spacing is 10 or 12.56 characters per inch, and vertical spacing is program-selected at 4, 6, 8, or 10 lines per inch. The Honeywell unit can achieve speeds up to 18,000 lines per minute. It also has four eight-tray stackers for collating copies.

The printing flexibility of the IBM 3800 provides a capability for improved report appearance, reduced physical size of reports, and very fast single-copy report production. The 3800's high printing speed, however, is matched by its price. Under ETP, the basic charge is $6,250 per month, to which is added $2.30 per month per 1000 feet of printing. And the high performance and high price are matched by the subsystem's physical size. Including service area, it occupies a space of about 16 by 10 feet.

Clearly, the 3800 is a specialized unit. The added attractiveness and flexibility of its printing will not ordinarily justify the cost difference between it and multiple 3211's. Nor is it particularly fast if you print a lot of copies of each report; copies are printed sequentially rather than in parallel as with multi-ply forms in impact printers. To justify the 3800, then, you must do a lot of single-copy printing or have an absolute need for its special printing qualities. An example of the latter is a technical publishing house. With current page composition costs ranging up to $200 for complex symbols and formulas, the 3800 would be a delight. But it would take a lot of organic chemistry papers to pay the tab for the 3800.

Initial customer deliveries of the 3800 Printing Subsystem are scheduled for July 1976. □

matrix form through one or more character set patterns stored on a flexible diskette drive.

Conventional, single-ply, continuous forms are transported from the box past the photoconductor drum, which holds an "image" of the page to be printed in the form of toner particles (a thermoplastic powder). The toner is attracted to the drum based on a pattern of electrostatic charges. The toner is transferred to the moving forms from the drum. The paper then moves past a heat fusing station and into the output stacker. The pattern of electrostatic charges on the drum is formed when the reflected light from the laser discharges the charge at the spot of contact.

In general, except for the light source, the process appears to be similar to that used in IBM's copiers. The photoconductive surface on the drum is actually a thin film; as one portion or segment of the film reaches the end of its useful life, a new segment is brought into play manually. Film not in active use is contained on supply and take-up spools inside the drum. A mark is printed on the lower left corner of each page printed; this mark is scanned and toner flow adjusted automatically to maintain proper printing darkness.

Form sizes accommodated include any combination of 10 specific widths from 6.5 to 14.875 inches and 5 specific lengths from 3.5 to 11 inches. Printing is constrained inside an area with a 0.5-inch border on all sides. For systems installed outside the U.S. and Canada, metric sizes are accommodated ranging from 165 mm to 378 mm wide following the ISO standard; lengths are specified in inches. Small forms less than six inches long are stacked by two's. Vertical perforations commonly used to separate a strip (carrier) containing the sprocket feed holes are not permitted, but interior vertical and horizontal perforations can be used with limitations.

Colored stock can be used for forms. Typical business form pastel colors of blue, buff, goldenrod, canary, green, pink and salmon are acceptable.

The 3800 comes with definitions on flexible disk for seven character styles, including Gothic (sans serif equivalent to IBM 1403 or 3211 print styles), Katakana (Japanese ideographs), OCR-A Size 1, OCR-B, Text 1 (upper case), Text 2 (lower case), and Format (special graphics for drawing form lines). The fonts are composed of from 37 to 64 characters or symbols, and, except for Katakana, include a space character. Gothic, Katakana, and Format fonts come in three sizes corresponding to horizontal pitches of 10, 12, and 15 characters per inch. The others come in 10 pitch size only. In addition, separate fonts are provided for all three Gothic sizes and for Text 1 and Text 2 for underscored characters.

In all, 18 font definitions are provided. Any font can be underscored, but unless the special fonts are used, two character spaces in the buffer are required for each underscored character. The Format fonts include graphic symbols that can be combined to form vertical and horizontal lines around the border and in the interior of printed copy. Three different line weights can be produced. Dotted and dashed vertical line elements are provided in two weights. Format symbols occupy space in the data buffer. The fonts are shown in the accompanying illustration.

In addition to the standard fonts, the user can generate his own graphic elements, including any character or symbol that can be created within the limits of the basic dot matrix pattern. Standard usage of provided fonts, substitutions, extensions, and user-created fonts are covered under the Device Control heading.

Vertical spacing is six or eight lines per inch and is under program control. Vertical format is electronically controlled.

A forms flash feature is standard and permits headings, logos, and other elements frequently associated with preprinted forms to be printed along with data. The material to be printed is represented on a photographic negative and is loaded at a special station. The drum is exposed to the image contained on the negative by means of a separate light source. Anything that can be drawn can be used, but IBM recommends the use of screening to produce a dot pattern for any solid area larger than a single character. The master copy of the artwork to be overlaid on the printed output can be prepared by the user on a polyester film (for dimensional stability) using felt-tip pen,

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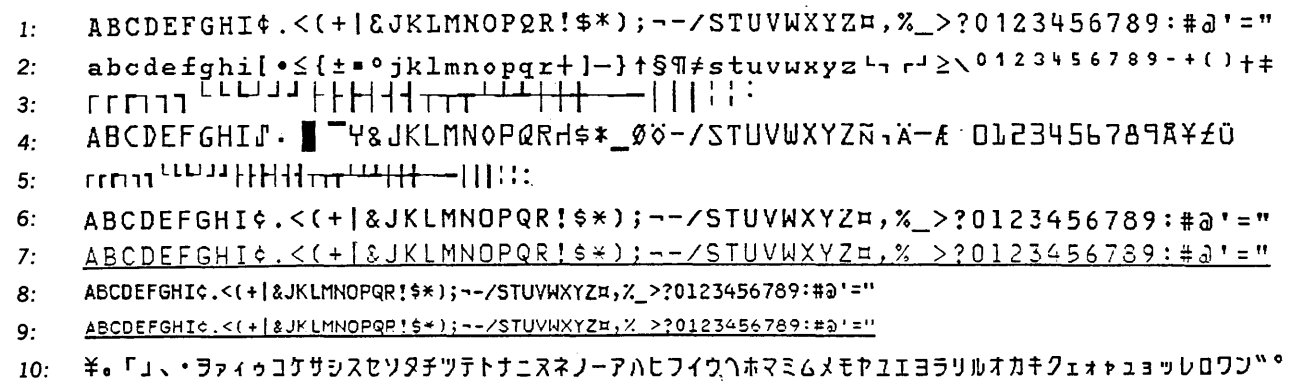


1: *TEXT 1 (10 characters/inch)*
2: *TEXT 2 (10cpi)*
3: *FORMAT-10 (10cpi)*
4: *OCR A (10cpi)*
5: *FORMAT-15 (15cpi)*
6: *Gothic-10 (10cpi)*
7: *Gothic-10 underlined*
8: *Gothic-15 (15cpi)*
9: *Gothic-15 underlined*
10: *Katakana 10 (10cpi)*

And it surely doesn't print like a computer printer. If the eight fonts above aren't enough, IBM offers eight more variations and styles as standard. There is a set of 12-pitch fonts. And if all that isn't enough, you can design your own.

India ink, chart tape, etc. A local commercial photography lab or printer can make a negative of the artwork. Alternatively, IBM will make negatives as a service. Forms flash can be used selectively when printing multiple copies.

The input station will accept a full box of forms directly from the box, if an end panel is removed to prevent the build-up of a vacuum as forms are fed out, which might cause forms to tear at the perforations. When the last form is fed, the printer stops. A new box of forms can be loaded and spliced to the previous set. If forms of a different width are to be used, rethreading of the transport path is required. The output stacker will accept a stack of forms up to 16 inches thick.

PERFORMANCE: The nominal paper speed is 31.8 inches per second. The drum revolves continuously. The paper moves continuously in synchronization with the drum as long as there are full pages in the page buffer to print and as long as certain criteria are satisfied if the forms flash feature is used. If, for some reason, printing cannot proceed, the paper is halted. Special provisions are made to ensure spatial synchronization and to prevent scorching of the paper from the fuser or preheat rollers. This is the reason for the 0.5-inch space required at the top and bottom of all forms—space to stop and start the forms so that registration can be maintained.

If the forms flash feature is not used, the only criterion for performance is the rate at which data can be delivered to the printer. If a page is not ready for printing upon the completion of the previous page, the paper stops and must be restarted after the new page is completely stored in the buffer. The effective rate, assuming no delays, is 173.5 11-inch pages per minute. Depending on the number of lines printed, the equivalent line rate can be as high as 10,410 lines per minute at 6 lines per inch or 13,880 lines per minute at 8 lines per inch. Maximum speeds for shorter forms will be somewhat less due to the greater impact of the enforced 0.5-inch border at the top and bottom. For example, the peak speed for a seven-inch form would decrease to 9,810 lpm (6 lines/inch) or 13,080 lpm (8 lines/inch).

When the forms flash feature is used, a timing interrelationship places a limit on the maximum number of characters per page that can be printed without performance degradation. In reality, this affects only the two longer form lengths (8.5 and 11 inches) out of the five permitted sizes. In normal operation, multiple page images are formed on the drum, and multiple pages are therefore printed in one revolution of the drum. If the page size limitation is exceeded, only one page can be printed per revolution of the drum. The available surface length of the drum is 77 inches. Because seven 11-inch forms fit onto this dimension, exceeding the limitation will drop the speed to one-seventh (14%) of the normal speed. In practice, these limitations will seldom be encountered. The minimum for 11-inch forms is 13,632 characters per page, and is 11,059 characters per page for 8.5-inch forms. The maximum numbers of characters that can be generated for these pages are 16,320 and 12,240, respectively, assuming 8 lines-per-inch vertical spacing and 15 characters-per-inch horizontal spacing. Repeated characters in excess of three are automatically replaced by a three-character sequence in the data buffer which reduces the requirement for buffer storage space. However, use of two-character sequences for underscoring (as opposed to using the underscore fonts) doubles the character requirement in the buffer. While performance degradation can occur due to the forms flash feature, it will be rare.

The pages-per-minute rates and peak lines-per-minute rates are listed below for all five standard form lengths:

Form length, inches	Maximum lines/page 6 lpi	8 lpi	Peak speed, lpm 6 lpi	8 lpi	Peak pages/ min.
3.5	15	20	8,180	10,900	545
5.5	27	36	9,370	12,490	347
7	36	48	9,810	13,080	273
8.5	45	60	10,100	13,470	224
11	60	80	10,410	13,880	173

DEVICE CONTROL: The 3800 is controlled by micrologic through commands issued from the processor. New JCL DD keywords have been added to OS/VS to accommodate the special capabilities of the 3800 when it is being used in the recommended manner as a SYSOUT printer. Alternatively, the 3800 can be initialized and changed dynamically by a problem program.

The four new JCL keywords are CHARS, COPIES, FLASH, and MODIFY.

CHARS permits identifying up to four character arrangements to be used by a single output run. Which of the four

IBM 3800 Printing Subsystem

is to be used is indicated by a numeral following the format control character in the data stream. (A Write Without Spacing Command is included, so character arrangements can be changed in the middle of a line.) A character arrangement is a specified grouping of characters from the standard fonts or user-created fonts; it is called by a name of from one to four alphanumeric characters. Standard IBM fonts used on impact line printers, such as AN, GN, TN, etc., carry the standard designation as their name. Standard arrangements are included in the software for most of the commonly used IBM train arrangements. As a standard feature, sufficient character generation storage is provided to store up to 128 character definitions, or two 64-character sets. A second block of storage for an additional 128 character definitions is optional.

The COPIES keyword permits specifying the number of copies of each page to be printed and how they will be ordered. Up to a maximum of 255 copies can be specified. Up to eight groups can be specified. The parameter for each group is the number of copies that will be printed of the same page before going on to the next page. If no group is specified, the output will appear in repeated sequential (collated) copies. This is equivalent to specifying a number of groups equal to the number of copies. Alternatively, pages can be repeated before continuing by using the grouping parameter. The printing speed does not differ no matter what the arrangement is, but data for each page will have to be transferred once for each group. If one group is specified, data need be transferred only once for each page, but all copies of page 1 will be followed by all copies of page 2, etc. A post-printing collation would then be required. If no groups are specified, all pages of the first copy are followed by all pages of the second copy, etc.; a special marking is printed at the perforation on the last page of each copy to facilitate separating reports. Each group, then, represents an uncollated set of report copies.

The FLASH keyword implements the use of the forms flash feature. Each form overlay negative has a name, which is used in a mounting message to the operator. A second parameter allows the programmer to specify that only the first "n" copies of the report will have the overlay printed.

The MODIFY keyword is used to identify a particular data modification record to be used. This record is used to selectively substitute constant data for variable data in a specified number of consecutive copies of a report. This provides a capability analogous to using an impact line printer to blank out a data field by overprinting or by using spot carbons in a multi-ply form set.

The Forms Control Buffer implemented in the 3800 is different from the one in the IBM 3211 line printer. User applications programs using the 3211 will need to be changed to operate with the 3800. The two chief differences are the one-inch blank space requirements between the last line on one page and the first line on the next page in the 3800 and the requirement to specify 6 or 8 lines-per-inch spacing in the program. (The programmer can intermix the two line spacings at will.) Vertical format commands are implemented to provide an immediate skip of 1, 2, or 3 lines and to skip to channels 1 to 12 after printing, as well as to print without skipping. Several 1403 and 3211 printer commands are invalid for the 3800, including the Fold command to interpret lower case data characters as their upper case equivalent. The Fold capability can be specified in a character arrangement and is provided in some standard arrangements.

PHYSICAL SIZE: The 3800 is housed in several connected cabinets. The overall size is 145 inches long, 60 inches high, and 32 inches deep. Including service area, the subsystem occupies a space 193 inches by 116 inches. A 48-ampere, 200/208/230-volt, 3-phase, 4-wire service is required; actual power consumption depends on the paper used. The high power requirement is due to the heat fusing of the toner.

PRICING: The 3800 is available on a standard month-to-month rental arrangement or on an Extended Term Plan 12-to-24-month lease arrangement. Both plans include maintenance. A separate maintenance arrangement is available for purchased units.

The rental and lease plans include basic monthly charges plus a surcharge based on the number of feet of paper printed. The monthly costs are:

	Rental	ETP
Basic 3800	$7,344/mo.	$6,250/mo.
Additional character Generation Storage	81	69
Dynamic Two-Channel Switch	213	181

The surcharge is:

$0.0023 per foot per month

Purchase prices and monthly maintenance costs are:

	Purchase	Monthly Maint.
Basic 3800	$310,000	$445
Additional Character Generation Storage	3,720	13.15
Dynamic Two-Channel Switch	8,140	10.50

Prices for supply items were not available at press time. Supply items include toner and drum photoconductor film replacement. Prototype usage of toner, according to IBM, is about 15,000 copies per pound based on 1300 characters per 11-inch page. This is about twice the typical usage of a conventional electrostatic copier. Existing toner prices for copiers range from about $10 to $30 per pound, depending on the source and quantity purchased. IBM expects the drum film to last about 9 to 12 months in normal usage.■

ICC Cor-Pak System/360-Compatible Main Memory

ICC offers replacement mainframe memories for IBM System/360 Models 22, 30, 40, and 50. These memories can extend or replace existing mainframe memory at substantial savings in cost. Step-22, an ICC enhancement package for the 360/22, provides 360/30-like performance.

MANAGEMENT SUMMARY

Information Control Corporation's CorPak memories are designed as replacements for IBM System/360 mainframe memory, Models 22, 30, 40, and 50. CorPak memories can be used to extend the storage capacity of an existing System/360 installation or (since IBM model changes can be made in the field) to replace all core memory down to the minimum storage capacity specified for the particular IBM processing unit.

CorPak memories are available in all capacities currently offered by IBM, and also in enhancement capacities that provide up to 8 times (256K bytes) the IBM-imposed maximum main storage capacity for the System/360 Model 22, up to 4 times (256K bytes) that for the Model 30, and up to 1.75 times (448K bytes) that for the Model 40.

CorPak memories are equipped with an integral power supply to satisfy their own power requirements. However, these memories are not equipped with a maintenance panel and cannot be diagnosed off-line. Diagnostic procedures must be performed on-line using a supplied diagnostic routine and IBM memory diagnostics to determine malfunctions.

Pricing, the prime consideration for dealing with an independent supplier, is well below IBM's pricing for equivalent capabilities. Rentals under a two-year lease are typically 75 percent below IBM prices. Added monthly savings are realized through unlimited usage (no extra-use charges) and extended lease terms. ICC provides lease contracts for up to five years.

Service is provided by Sorbus, which has 90 service locations in major cities throughout the U.S., with heavy concentration in the East.

CHARACTERISTICS

MANUFACTURER: Information Control Corporation, 9610 Bellanca Avenue, Los Angeles, California 90045. Telephone (213) 641-8520.

MODELS: Four models are available: CorPak 22, CorPak 30, CorPak 40, and CorPak 50. The first three models are available in standard and enhanced storage capacities, as shown in the table below.

COMPATIBILITY: ICC CorPak core memories are designed as plug-compatible add-on or replacement mainframe memories for IBM System/360 Models 22, 30, 40, and 50. CorPak memories can be used to extend the core storage capacity of an existing IBM System/360 processing unit and/or to replace all existing IBM core storage down to the minimum mainframe capacity as specified for the particular IBM model.

The CorPak memories are available in all standard storage capacities currently offered by IBM, as well as non-standard capacities designed to enhance the maximum storage capacity of a Model 22, 30, or 40. The available standard and enhanced storage capacities for each CorPak memory model are presented in the following table.

CorPak Memory Model	IBM Processor Model	Min. IBM Capacity, bytes	Standard IBM Storage Capacities bytes	Enhanced ICC CorPak Storage Capacities, bytes
22	2022	24K	24K or 32K	64K, 96K, 128K, 192K or 256K
30	2030	8K or 16K	8K, 16K, 24K, 32K, or 64K	96K, 128K, 192K, or 256K
40	2040	32K	32K, 64K, 128K, 192K, or 256K	96K*, 160K*, 384K, or 448K
50	2050	128K	128K, 256K, 384K, or 512K	–

*Additional capacities within the range of standard IBM main storage.

Cycle times of the ICC memories are the same as those of the corresponding System/360 memories: 1.5 microseconds for Model/22, 1.5 or 2.0 microseconds for Model 30, 2.5 microseconds for Model 40, and 2.0 microseconds for Model 50.

All CorPak memories contain an integral power supply that satisfies all memory power requirements; however, diagnostics must be performed on-line via a diagnostic routine. Power supply voltages can be switched to plus or minus five percent of the normal operating voltage to determine marginal operating conditions.

Physical specifications of each of the CorPak memory cabinets are shown in the following table:

Model	Maximum Storage, bytes	Depth, inches	Width, inches	Height, inches	Weight, pounds
CorPak 22	256K	25	23	28.5	125
CorPak 30	256K	25	23	28.5	150
CorPak 40	256K	25	25	28.5	150

ICC CorPak System/360-Compatible Main Memory

CorPak memories were announced by ICC in March 1971. First deliveries of CorPak 30 were made in April 1971, with CorPak 22, 40, and 50 following in June, September, and December of 1971, respectively. Currently, ICC has over 100 units installed. ICC states that all models of its CorPak memory installations have received the IBM certification for service continuance. ICC does not plan to enter the System/370 market on the grounds that it is too competitive.

ICC also offers an enhancement package for the 360/22 called Step-22, which it introduced in early 1973. Step-22 is basically a selector channel that permits the attachment of from two to nine ICC-supplied, IBM 2314-type disk drives and controller and provides the performance of a 360/30. Step-22 ranges in price from $2,245 per month under a one-year lease ($41,085 purchase) for the selector channel, a main memory upgrade from 24K to 32K bytes, disk controller and two drives to $5,333 per month ($94,516 purchase) for the selector channel, a main memory upgrade from 24K to 128K bytes, and a full complement of nine drives. Step-22 is totally transparent to the 360/22 CPU and has received IBM approval for service continuance.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 12 users reported on their experience with a total of 12 ICC replacement memories, including 8 units for the 360/30 having an aggregate capacity of 656K bytes and 4 units for the 360/22, 40, and 50 having an aggregate capacity of 456K bytes. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	9	2	1	0	3.7
Equipment reliability	9	3	0	0	3.8
Maintenance service	4	5	3	0	3.1
Ease of installation	4	7	1	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

These high scores substantiate ICC's reputation for expertise in the System/360 environment (especially 360/30's) and are consistent with last year's results. The users reported an average installation and testing time of 12.5 hours, although two said the process took substantially longer. One of these (a 72-hour installation) included removing another vendor's memory, and the other took 11 days due to the need to wait for parts. Only two users reported serious problems encountered in diagnosing malfunctions; one case had been resolved, and the other was pending. □

Model	Maximum Storage, bytes	Depth, inches	Width, inches	Height, inches	Weight, pounds
CorPak 40*	448K	25	46	28.5	200
CorPak 50	256K	25	25	28.5	150
CorPak 50*	512K	25	46	28.5	200

*A double cabinet with a maximum storage capacity of 512K is utilized where memory in excess of 256K is required.

PRICING: ICC CorPak memories are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. ICC offers lease contracts for one, two, three, four, or five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and prime-shift maintenance. A separate maintenance contract is available for purchased units. Prices for upgrading IBM System/360 Models 22, 30, 40, and 50 are presented below.

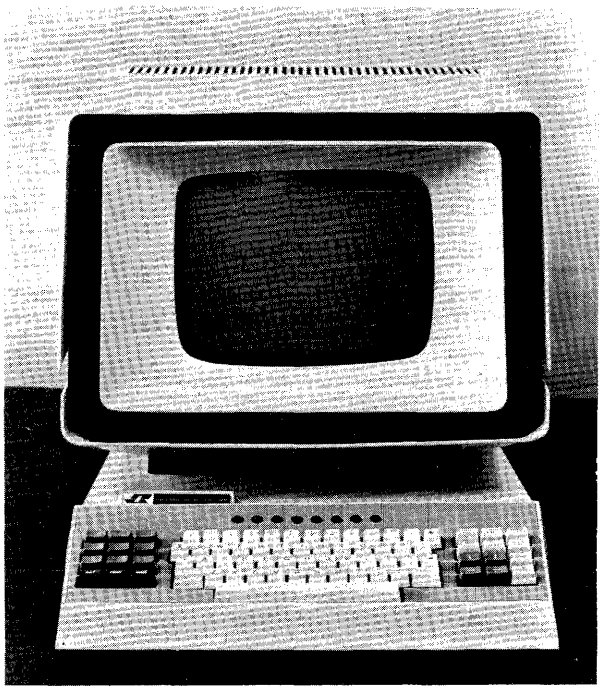
IBM Processor Conversion		Monthly Rental* 1-Yr. Lease	2-Yr. Lease	5-Yr. Lease	Purchase**	Monthly Maint.***
From 2022DC	(24K) to:					
F	(64K)	$ 643	$ 463	$ 342	$13,571	$ 50
FE	(96K)	1,111	795	589	23,323	145
G	(128K)	1,413	999	751	29,216	165
GF	(192K)	1,966	1,360	1,012	41,583	205
H	(256K)	2,542	1,751	1,318	53,784	245
From 2022E	(32K) to:					
F	(64K)	558	400	297	11,786	50
FE	(96K)	1,030	740	545	21,663	140
G	(128K)	1,327	952	706	27,888	160
GF	(192K)	1,957	1,343	1,030	41,334	200
H	(256K)	2,533	1,734	1,321	53,534	240
From 2030D	(16K) to:					
E	(32K)	410	293	212	8,632	50
F	(64K)	715	514	383	15,147	50
FE	(96K)	1,188	854	630	25,398	150
G	(128K)	1,494	1,041	787	30,461	170
GF	(192K)	2,052	1,424	1,053	43,326	210
H	(256K)	2,628	1,814	1,350	55,610	250
From 2030DC	(24K) to:					
F	(64K)	644	403	342	13,571	50
FE	(96K)	1,112	705	589	23,323	145
G	(128K)	1,413	949	752	29,216	165
GF	(192K)	1,967	1,360	1,013	41,583	205
H	(256K)	2,543	1,751	1,318	53,784	245
From 2030E	(32K) to:					
F	(64K)	558	400	297	11,786	50
FE	(96K)	1,031	740	545	21,663	140
G	(128K)	1,328	952	707	27,888	160
GF	(192K)	1,958	1,343	1,031	41,334	200
H	(256K)	2,534	1,734	1,328	53,535	240
From 2030F	(64K) to:					
FE	(96K)	716	514	383	15,478	110
G	(128K)	1,031	740	545	21,663	140
GF	(192K)	1,652	1,241	873	34,943	180
H	(256K)	2,273	1,423	1,193	48,140	220
From 2030FE	(96K) to:					
G	(128K)	558	400	297	11,786	110
GF	(192K)	1,161	808	594	24,568	160
H	(256K)	1,737	1,199	891	36,728	200
From 2040F	(64K) to:					
FE	(96K)	558	400	297	11,786	50
G	(128K)	855	612	455	17,845	80
GE	(160K)	1,269	910	666	26,643	100
GF	(192K)	1,476	1,033	756	30,212	120
H	(256K)	2,052	1,423	1,053	41,625	160
From 2040G	(128K) to:					
GE	(160K)	558	400	297	11,786	50
GF	(192K)	855	612	455	17,845	80
H	(256K)	1,476	1,033	756	30,212	120
From 2040GF	(192K) to:					
H	(256K)	853	612	455	17,845	80
From 2050G	(128K) to:					
H	(256K)	1,476	1,033	756	30,212	120
HG	(384K)	2,565	1,828	1,364	53,535	200
I	(512K)	3,690	2,635	1,967	77,356	280
From 2050H	(256K) to:					
HG	(384K)	1,476	1,033	756	30,212	120
I	(512K)	2,565	1,828	1,364	53,535	200
From 2050HG	(384K) to:					
I	(512K)	1,476	1,033	756	30,212	120

* Monthly rental includes prime-shift maintenance.

** Installation charges for purchased units range from $125 to $375.

***Prime-shift maintenance; complete maintenance for 24 hours/day, 7 days/week is priced about 1.35 times the rates for prime-shift maintenance. ■

Incoterm SPD 10/20 Terminal



One of the first of the intelligent terminals, the SPD 10/20 is still one of the most flexible. Its programmability can be used to imitate other terminals and/or to provide additional functional capabilities for the operator.

MANAGEMENT SUMMARY

With expertise gained from working with Raytheon's airline reservations activities and money from Prudential Insurance Company, a group of men started out in 1969 to build a general-purpose display terminal. They have succeeded admirably, particularly within the airline reservations area, but in other applications as well.

There are over 2000 SPD 10/20 Terminals in use today. About half of these are employed in the United Air Lines passenger reservation system. Several other airline reservation systems are also being served by SPD 10/20's. Other users include trucking companies, hospitals, and law enforcement agencies.

The first Incoterm terminal was delivered in 1970, and the unit has been extensively advertised. Thus, even though the company's marketing efforts have been concentrated on large accounts (50 is such a comforting number), the SPD terminal is well known in the data processing community. Less well known, because of Incoterm's reluctance to discuss specifics except in a contract environment, is what it is that makes the Incoterm different from other terminals. When the SPD was first announced, mentioning its programmability was sufficient. Today, intelligent terminals abound, and CRT display terminals with extensive editing capabilities are relatively inexpensive and readily available. The Incoterm terminal has thus lost some of its early glamour, and evaluations must now be based on actual capabilities.

CHARACTERISTICS

MANUFACTURER: Incoterm Corporation, 6 Strathmore Road, Natick, Massachusetts 01760. Telephone (617) 655-6100.

CONFIGURATION: The basic SPD 10/20 Terminal consists of a Terminal Processing Unit (TPU) housed in the cabinet of a CRT display and a separable keyboard. The TPU accommodates up to 8 controllers for peripheral devices and features; the basic keyboard uses one controller position.

A two-display version, called a Dual, splits the display buffer area between two independent CRT displays. A second keyboard is normally included and occupies a controller position; the second CRT does not require a controller position.

Similarly, a four-display version is available with each display having one-fourth the display capacity of the single version and with all four displays being controlled by the one TPU. This version is not actively marketed, however.

Multi-display configurations are normally constructed through the use of interconnected single or dual versions.

The SPD-M Multiplexer option is designed to permit multiple terminals to alternately share a communications line via a single modem. Up to 16 single or dual terminals can be interfaced to one SPD-M. Multiplexers can be cascaded to a maximum of four levels; this permits up to 64 terminals to share one line. Except in unusual situations, the full configurational flexibility is used primarily to provide redundant or alternate data paths to multiple central computers or among several communications lines. A terminal is connected to the Multiplexer through a Communications Controller; the Multiplexer itself is not an addressed peripheral and does not require a separate controller position. Each terminal can be located up to 1000 feet from the Multiplexer.

The Party Line Controller can be used to provide intercommunication among a group of SPD 10/20 terminals at one location. In effect, this option permits cable-connected data communications at up to 9600 bits per second. An asynchronous technique, complete with start and stop bits, is employed. Terminal-to-terminal distance can be up to 1000 feet. Each terminal connected to a party line requires a controller. The chief use for this option is to enable a group of peripheral devices to be shared among multiple terminals.

In general, each peripheral device, including auxiliary core storage, requires one controller position. Full-duplex data communications requires two communications controllers. In addition, certain features, such as Remote Program Load and Cyclic Redundancy Check, also require a controller.

Thus, an SPD 10/20 can assume a wide variety of configurations, from a display terminal to a processing terminal complete with data storage peripherals to even a multi-line communications processor.

Incoterm SPD 10/20 Terminal

The key word for placing the SPD 10/20 in perspective is not programmability but *adaptability*. Within its basic orientation as a conversational-type terminal, it can replace just about any other typewriter or CRT terminal without changing the applications programs in the central computer. New editing or data checking functions can also be added as the need occurs with minimum impact on the existing system.

Incoterm achieves this adaptability in the SPD 10/20 not just by including a programmable processor in the terminal, but also by making the display unit independent of the keyboard. There are no standard function keys that control the cursor or editing functions. There are numerous keys that can be used for this purpose, or any other, by simply coding a routine that responds to the data code generated when a key is depressed. Even the data keys are not directly linked to what is to be displayed.

Adaptability is a two-way street. It gives the user flexibility in designing the original system and in making changes as needs are changed. It also provides Incoterm with a single product that can be competitively bid in almost any conversational terminal environment.

We have talked about the advantages of adaptability. There are some drawbacks as well. One is price. Another is the amount of work required to implement a system.

The question of price is somewhat difficult to discuss because of Incoterm's reluctance to be tied down to a published price list. This is understandable to a degree. Incoterm most frequently, at the present time anyway, becomes involved in systems requiring large numbers of displays and special devices or software support. Quantity discounts and special support are a common occurrence. In addition, Incoterm seems to feel that listing the building blocks doesn't do the terminal justice, and that users will either underestimate what is required to do a particular job or will be turned off by price before the full capabilities of the terminal are explained.

In general, the Datapro staff believes the SPD 10/20 terminal is competitive in situations that require terminals with high functional capability at each location for data entry and/or conversational applications. Attractive discounts also make the terminal a contender for multiple display stations at one location. Independent units provide the advantage of redundancy compared with clustered units; if one SPD 10/20 goes down, the others will remain operational.

The question of work is the classic problem of system design. The more numerous the alternatives and approaches, the more work is required to implement the system. Such an environment offers the potential, if

DEVICE CONTROL: The program stored in the main memory of the Terminal Processor Unit controls all activities of the SPD 10/20 Terminal. The organization of the Terminal can best be summarized by calling it a minicomputer with attached peripherals. This differs from other intelligent display terminals because the keyboard is not directly connected to the display; i.e., the relationship between data keyed and data displayed is entirely controlled by the stored program. All peripheral devices are interrupt-driven and, except for the display, transfer data through the accumulator of the processor. A special Refresh Module constructed from read-only memory provides a direct interface between main memory and the display. Main memory serves as the storage area for the display and is completely available for data manipulation.

Interrupts from all external devices and internal features, including the display Refresh Module, cause the accumulator, program counter, and condition status register to be stored; values for these registers are loaded from specific locations for each type of interrupt, and further interrupts are automatically inhibited. Interrupts occurring during the period while inhibited are held pending until enabled. All interrupts can be inhibited selectively or entirely. For the Refresh Module controlling the display, this takes the form of enabling or disabling the refresh cycle.

All positions of main memory are available to the programmer; there is no automatic protection of any area at any time.

The position of the cursor in the display area is controlled by a register which is available to the programmer.

The result of this architecture is that the programmer has full control of the facilities of the equipment. Because there is no direct relationship between the contents of the display area and any input or output data stream, the display can be completely tailored to the needs of the application, whether it be imitating an IBM 2260 or a Teletype 33 or constructing edited data presentation.

The flexible architecture also means that there are few automatic answers, and applications can be tricky to implement because there are many more ways to make mistakes.

COMPATIBILITY AND SOFTWARE: Compatibility is a function of the program loaded into main memory. Both synchronous and asynchronous interfaces are provided. As long as the basic communications interface (RS-232) is met and the speeds are within the acceptable range (up to 9600 bps), problems of line discipline involving control-character sequences can be solved with appropriate programming.

Incoterm has developed about 40 to 50 routines for emulating various terminals such as the IBM 2741, UNIVAC Uniscope 100, IBM PARS (airline reservation) terminals, Teletype 33/35, IBM 3270, and many others—including the controller functions of many major computers.

In addition to the emulation routines, several assemblers are available that can be run on the SPD 10/20 itself or or any of several major computers. The assemblers that run on the big computers are written in FORTRAN, making conversion to a particular computer fairly simple. Assembled programs can be maintained on punched tape or magnetic tape cassettes. Several programming aids, such as a debug routine for selective dumping and various other utility and standard display function routines, are provided.

In general, Incoterm is willing to undertake the development of the basic terminal control package for particular system environments on a contract basis, but prefers that the user do his own application programming.

Incoterm SPD 10/20 Terminal

things are done right, for greater reward in terms of what the equipment will do in the actual application situation, but more effort must be expended to achieve this reward. Incoterm offers many basic aids in this direction in the form of routines for emulating other terminals (and not just other CRT terminals either), routines for standard editing functions, an assembler, and utilities. But significant effort still must be expended by the user, particularly in the key area of deciding just what he wants the terminal to do.

While we are on the subject of functional capability, it is important to clarify the processsing capabilities of the Incoterm terminal. Throughout this report, and in Incoterm's extensive advertising as well, the device is called just that: a terminal. Although the SPD 10/20 is a very powerful terminal, its programmability is not intended for even small, free-standing data processing activities. A system can be configured with many auxiliary devices including printers, magnetic tape cassette units, and special devices if you want. Even the small main memory limitation can be circumvented by using an auxiliary core memory module as a high-speed data store. And Incoterm is readying a "floppy disk" peripheral for demonstration in the Spring of 1973. But the SPD 10/20 is intended and suited to serve as a remote extension of a central computer; i.e., it is a terminal.

Incoterm has established its own service facilities. Although offices have been set up nearly nationwide, they are naturally centered around the major metropolitan areas. □

PROCESSOR: The Terminal Processor Unit is a rather conventional (in today's terms) 16-bit, single-address unit, specially adapted to work with a CRT display. It provides relative addressing within 256-word pages, direct addressing to any location, and indirect addressing to any number of levels. Instructions are one or two words long, depending on whether they contain a direct or relative address. Main memory capacity is 2048 words (4096 bytes), and cycle time is 1.8 microseconds per one-word access; it cannot be expanded. All I/O transfers, except to the display, are handled through the accumulator. Typical execution times are 1.8 microseconds for a one-word instruction and 3.6 microseconds for arithmetic and two-word instructions.

A real-time clock is included that, when enabled, creates an interrupt every 66.7 milliseconds. This is a relatively coarse timing increment; refreshing the display at this rate, for example, would cause the whole display to flicker noticeably.

Program loading is normally initiated by a bootstrap process from punched tape or a magnetic tape cassette. Optionally, a Remote Program Load feature (actually a separate controller) can permit the bootstrap sequence to be initiated from the communications line. Typically, the bootstrap is a simple loader sequence that loads the program from the same source as the bootstrap.

COMMUNICATIONS: The Asynchronous Controller operates in a half-duplex mode at any speed from 50 to 2400 bits per second. It is compatible with the RS-232C interface.

The code unit structure is adaptable to meet most situations with 5 to 8 data bits per character. No-cost options available with the Asynchronous Controller include the capabilities for automatic answering and automatic dialing (with appropriate common-carrier dialing units).

The Synchronous Controller also operates in a half-duplex mode at any speed from 1200 to 9600 bits per second, with clocking provided by the external modem. It is compatible with the RS-232C interface standard.

Full-duplex operation can be achieved by using two Controllers; assignment and control for using one Controller to transmit only and the other to receive only is performed by the program.

Either of these Controllers can be used up to 50 feet from the modem or 1000 feet from the SPD-M Multiplexer.

KEYBOARD: The keyboard is an important part of the overall flexibility of the Incoterm SPD 10/20 Terminal. In its standard layout, there are 52 keys arranged in an expanded typewriter layout, flanked on either side by an array of 12 additional keys. None of the keys except the shift keys causes any direct action to be performed; depression of a key causes a code to be generated which can be transferred to the processor memory. By using the shift keys, a total of 113 different codes can be generated. Optionally, one of the additional keys on the left can function as a mode key to give a total of 222 unique data codes. (The mode key causes the eighth data bit in a character representation to be set to a "one.") All functions initiated from the keyboard are a result of program action based on the data codes generated. Normal usage dictates that the middle set of keys be used as data characters and the right set as cursor controls, but this usage is not absolutely required. Above the keys is an array of eight indicator lamps that are lighted under program control.

DISPLAY: The display is a cathode-ray tube (CRT) with a viewing area 9.5 inches wide by 7 inches high. Within this area, up to 30 lines of 64 characters each can be displayed. Characters are formed by a 7-by-10 dot matrix, giving very good legibility.

With the standard character generator in the refresh module, 65 different characters can be displayed. An optional Expanded Character Set feature displays a total of 121 different characters, including lower-case alphabetics plus various symbols that provide the capability to display words from the German and Swedish languages as well.

Blinking and point plotting are standard features. The point plotting capability is based on an array of 126 points horizontally and 120 points vertically. This is adequate for bar graphs, but not for line graphs or other graphic displays.

Underlining is included in the Expanded Character Set feature.

PERIPHERALS: Standard peripherals include a punched tape reader, a magnetic tape cassette unit, two printers, and an auxiliary core memory which functions as a data storage peripheral rather than as main memory. Other peripherals have been used, and Incoterm is willing to discuss the interfacing of just about any type of peripheral device.

The punched tape reader reads standard 8-level, 1-inch-wide punched tape at up to 30 characters per second. This unit is housed in a small cabinet and is designed to handle small rolls of tape. It is normally used to load programs but can be used for data. Programs are normally prepared on a Teletype Model 33 ASR; the SPD 10/20 has no standard provision for a punch.

The SPD-T magnetic tape cassette unit is also housed in a small cabinet. It accommodates the popular Philips-type cassette. The unit is acquired from Sykes, which has an excellent reputation for its cassette drives. There are two

Incoterm SPD 10/20 Terminal

recording tracks, each capable of holding up to about 288,000 bytes of data; with inter-record gaps (0.8 inch each), the typical capacity is about 250,000 bytes. The standard model uses a wider recording band on one track than the other; with this arrangement, data is normally recorded on the wide track and track addresses are redundantly recorded on the narrow track. This technique provides a measure of random file access. Seek operations are typically accomplished in a high-speed forward or reverse direction by counting impulses provided by an optical encoder on one of the reel shafts. When the approximate location is reached, the tape is slowed to normal read/write speed and the track addresses are used to locate the desired record. Optionally, equal-width tracks can be obtained, and data can be recorded on both tracks.

The magnetic tape recording format is 800 bits per inch, phase ten coded, but is not in accordance with the ECMA standard which is pending approval for a U.S. standard; double parity bits are used by Incoterm. Read and write speed is 5 inches per second, which yields a transfer rate of 40,000 characters per second. High-speed forward and reverse speed is 100 inches per second. The cassette unit can also be used in the bootstrap mode to initiate loading.

The SPD-P10 is an impact printer, obtained from Mite Corporation, that operates at up to 10 characters per second. It prints up to 80 characters per line at 10 characters per inch. Vertical spacing is 6 lines per inch.

The SPD-P165 printer is the well-regarded Centronics 101 that operates at up to 165 characters per second. It is an impact unit using a 5-by-7 dot matrix to form characters. It can print up to 132 characters per line, and the pin feed mechanism can be adjusted to accommodate forms up to 14 inches wide. Horizontal pitch is 10 characters per inch, and vertical spacing is 6 lines per inch.

Both printers have top-of-form feed instructions and the SPD-P165 has additional vertical format control capability.

A Teletype Model 33 or 35 printer can be used in place of the other two models if desired.

The Auxiliary Memory System is available in 4K-byte increments up to a maximum size of 16K bytes. It is a core memory system with a cycle time of 1.6 microseconds. The transfer rate is 98,000 words per second. It can be configured to attach to up to four SPD 10/20 terminals with independent but not simultaneous access. The principal use for this memory unit is as buffer space for peripheral devices. It cannot function as main memory; i.e., instructions cannot be executed directly from it, but it could be used to store program modules.

ERROR CHECKING: Transfers between the TPU and external devices include a character parity check. All incoming data from a communications line is checked for character parity, and parity bits accompany outgoing data. Internal transfers are not checked for parity. In addition, a Cyclic Redundancy Check feature is available for use in conjunction with data communications; it occupies a controller position. The feature can be used with several different communications lines if desired. Several variations in the checking algorithm, including character size and check character size, are available, but once determined they cannot be changed by program. Cyclic check characters can be generated for checking received data or for transmission.

PERFORMANCE: Time and space both play an important role in evaluating the performance capabilities of the SPD-10/20 Terminal.

Of the 4096 bytes of main memory available, almost 2000 bytes are required for the full display area and reserved locations associated with interrupt servicing. Reducing the number of lines displayed opens up additional space for program storage and data manipulation. The space available is adequate for almost any grouping of routines for cursor and format control as well as data editing and validation functions; however, record-oriented processing activities are just about ruled out in the basic terminal. (The optional Auxiliary Memory provides a sizable storage area for holding data if you feel you must go this way.)

Recent modifications, applied to all installed terminals as well as new ones, have greatly reduced the demand placed on the processor by the display. If the full 30 lines are used (or both 15-line segments for a dual display), about 88 percent of the processor's time is available for other functions; any cursor manipulation functions are subtracted from the available time. Reducing the number of lines in the display provides more time, as well as space, for other activities. For example, reducing the display by 15 lines increases the processor's availability to 94 percent.

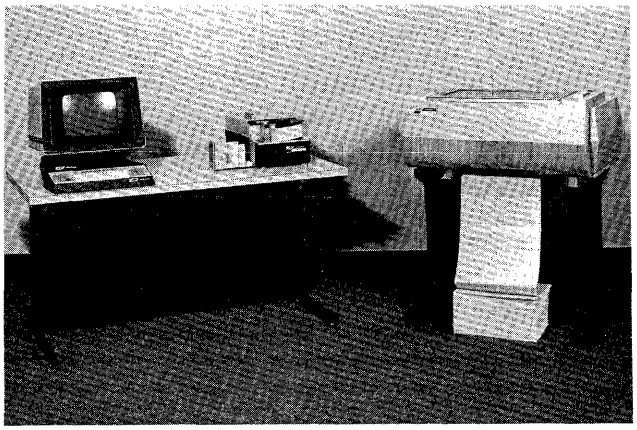
In the basic terminal, the number of characters in a line does not make any difference in the space available. The Extended Character Set option includes the capability for blanking portions of a line so that program codes or non-display data can be stored in the display area without appearing on the screen.

PRICING: Incoterm states that there is no published price list for the SPD 10/20 Terminal. The company offers the following prices as typical ones for a basic single or dual terminal with one or two displays, one or two keyboards, and a Communications Controller:

	Monthly Rental	Purchase	Monthly Maintenance
Single SPD 10/20	$195	$5,800	$30
Dual SPD 10/20	250	7,500	45
The prices of the standard options are as follows:			
Multiplexer	70	2,100	20
Party Line Controller	20	440	5
Remote Load Controller	15	350	1
Expansion Character Set	12	250	NC
Punched Tape Reader	25	650	5
Tape Cassette Unit	100	2,300	30
SPD-P10 Printer	75	1,750	20
SPD-P165 Printer	150	3,990	30
Auxiliary Memory:			
First Module, 4K bytes	94	2,990	10
Additional 4K Module	55	1,700	6
Multiplexer	20	440	5

The rental figures are for a one-year contract and include maintenance. All figures are for unit quantities; quantity discounts begin at the five-unit level. For example, in quantities of five, the basic single display costs $4,640 and the dual, $6,000. ■

Incoterm SPD 900
Remote Batch Terminal Systems



MANAGEMENT SUMMARY

Incoterm's new SPD 900 Remote Batch Terminal Systems are a family of terminals with fixed I/O configurations that serve as replacements for several of the popular remote batch terminals produced by the leading mainframe manufacturers. While their principal function is to serve as batch terminals for remote job entry, the Incoterm terminals also provide useful interactive capabilities.

The SPD 900 family includes four members; each provides punched card input and printed output, but the four models differ in I/O equipment and performance. Incoterm's SPD 10/20 Terminal, of which over 4800 units have been delivered, forms the nucleus for each of the family members and serves as both controller and operator's console. Its integral minicomputer, with supporting software, permits the SPD 900 terminals to behave as other manufacturers' terminals via software emulation. Currently, Incoterm supports the SPD 900 terminals as replacements for an IBM HASP multileaving terminal, IBM 3780, IBM 2780, IBM 2770, CDC 200 User Terminal, and UNIVAC 1004 under EXEC 8. Software emulation for any one of these terminals is included in the cost of the SPD 900 terminal, and additional emulators are priced at a one-time charge of $100 each.

But how does the SPD 900 differ from the SPD 10/20, which also offers auxiliary I/O capabilities? Incoterm is marketing its SPD 900 terminals as complete turnkey systems specifically for applications with a need for both interactive and remote batch capabilities. On the other hand, Incoterm has taken the "Tinkertoy" approach with the SPD 10/20 Terminal, which it offers with assorted software packages and auxiliary devices and markets for a wide variety of applications. Both products are software-compatible with one another. An existing SPD 10/20 user with appropriate hardware can take advantage of the SPD 900's emulation software to operate his system as a remote batch terminal. By the same token, an SPD 900 user can satisfy the requirements of some applications by loading software offered for the SPD 10/20.

The SPD 900 is available with optional punched card output (a keypunch with interpret option) and industry- ➢

The SPD 900 is a family of intelligent terminals built around the Incoterm SPD 10/20 that can serve, via software emulation, as replacements for popular batch terminals produced by IBM, Control Data, and UNIVAC. The Incoterm terminals combine batch and interactive capabilities.

CHARACTERISTICS

MANUFACTURER: Incoterm Corporation, 6 Strathmore Road, Natick, Massachusetts 01760, Telephone (617) 655-6100.

CONFIGURATION: The basic Incoterm SPD 900 includes an Incoterm SPD 10/20 Terminal, card reader, and line printer. One or two single-drive magnetic tape cassette recorders can be added as an option. Incoterm states that industry-compatible 7- or 9-track magnetic tape drives and a low-speed card punch can also be added, but detailed specifications for these units are not yet available. The SPD 900 is available in four models; all contain the same processor with 4K bytes of core memory, but the four models include different card readers and printers, as shown below.

Model	Printer, lines/min	Card Reader, cards/min
901	200	150
902	200	300
903	400	300
904	60	150

The SPD 10/20 Terminal is detailed in Report 70D-495-01.

DEVICE CONTROL: All terminal operations are executed under the direction of the operating software. The standard software consists of emulation programs that, when loaded into the terminal's main memory, enable it to duplicate the functions of the terminal that it is replacing. Incoterm currently offers five program emulation packages that emulate the following remote batch terminals:

- IBM System/360 Model 20–for communication with IBM System/360 or 370 computers as a HASP multileaving terminal. The multileaving feature of HASP is supported; this feature permits transmitting and receiving independent data streams or receiving intermixed data blocks from multiple data files being output on different terminal devices, and tacks ACKS and NACKS onto data blocks being transmitted in the opposite direction in place of using separate transmissions for them.

- IBM 3780–for communication with an IBM System/360 or 370 computer in a point-to-point or multipoint arrangement with other IBM bysynchronous terminals sharing the same facility. This package provides transmission compatibility with IBM's bisynchronous communications discipline (BSC) and supports IBM data rates of 2000, 2400, 4800, and 7200/3600 bits/second. (The 7200/3600 bps rate represents a leased-line facility with the telephone network used at the lower speed for backup.) Both EBCDIC and ASCII transmission codes are supported. EBCDIC transparency is a standard feature for reception and transmission.

- IBM 2780–for communication with an IBM System/360 or 370 computer in a point-to-point or multipoint arrangement with other IBM bisynchronous terminals sharing the same facility. This package provides transmission compatibility with IBM's bisynchro- ➢

Incoterm SPD 900
Remote Batch Terminal Systems

compatible 7- or 9-track magnetic tape. As an alternative to punched card output, the operating software supports the use of one or two single-drive cassette units produced by Sykes, which has an excellent reputation for its cassette drives. Cassette tape can be used for data or program storage.

Initial customer deliveries are scheduled for June 1973. At this writing, Incoterm has run acceptance tests on two of the five software emulators, the IBM 2780 and UNIVAC 1004 packages.

Incoterm has established its own service facilities and currently has 27 service locations nationwide; they are naturally centered in the major metropolitan areas. □

nous communications discipline (BSC) and supports IBM data rates of 2000, 2400, and 4800 bits/second. EBCDIC, ASCII, and IBM SBT codes are supported. EBCDIC transparency is supported as a standard feature. Cards can be punched in EBCDIC of Fieldata. The package also supports simulated punched card output via one or two cassette tape drives.

- Control Data 200 User Terminal–for communication with a CDC 3000, 6000, or Cyber 70 Series computer under CDC Export/Import. This package provides transmission compatibility with the CDC 200 UT at data rates of 2000, 2400, or 4800 bits/second using either 6-level BCD or 8-level ASCII transmission code. Standard CDC 200 UT features are supported.

- UNIVAC 1004–for communication with UNIVAC 1100 Series computers under the 1100 Operating System (formerly called EXEC 8). This package provides transmission compatibility with a UNIVAC 1004 at standard 1004 transmission rates of 2000 or 2400 bits/second and supports the UNIVAC XS-3 code. Cards can be punched in EBCDIC or Fieldata. Simulated punched card output is supported via one or two cassette tape drives.

Each of the program emulation packages can be used with any model of the SPD 900 family. Programs can be loaded from cards or cassette tape.

Off-line operations that are supported include media conversion and listing. Data is handled on a card image basis; i.e., 80 characters per record.

The CRT display unit is used as an operator console. The operator can display and monitor program identification, line protocol, message acknowledgment (ACK/NAK), error messages, and the first 64 characters of the incoming and outgoing buffers. Program functions can be initiated via keyed commands, and extensive editing can be performed, such as keying fields or records and inserting them in the correct sequence with respect to related data read from cards.

In addition to the program emulation packages that are available for the SPD 900 family of remote batch terminals, all software provided by Incoterm for its SPD 10/20 Terminal can also be used by the 900 Series terminals; see Report 70D-495-01.

COMMUNICATIONS: Transmission compatibility including communications line discipline and transmission parameters such as asynchronous or synchronous operation, data rate, and code type and level are a function of the program emulation package; these parameters differ among the available emulators. Hardware compatibility is provided for half- or full-duplex, asynchronous or synchronous operation at transmission rates up to 9600 bits/second. Six- through eight-level codes are accommodated. All SPD 900 terminals provide two EIA Standard RS-232C interfaces. Modem requirements are also determined by the operating software. The two modem interfaces permit switching between modems when the optional Modem Switch is installed.

CARD INPUT: Reads standard 80-column cards punched in Hollerith, EBCDIC, or Fieldata code under program control. Reader speeds are 150 and 300 cards/minute. Hopper and stacker capacities are 400 cards (150-cpm reader) and 1000 cards (300-cpm reader). Both models are produced by Documation.

PRINTED OUTPUT: Printed output is provided via one of three printers: a character (matrix) printer rated at 165 char/second (60 lines/minute) with 132 print positions (Centronics 101A), and two line printers (Control Data) rated at 200 and 400 lines/minute with 132 or 136 (optional) print positions. Each of the printers has a character set of 64 ASCII symbols. Horizontal and vertical spacing are 10 char/inch and 6 lines/inch, respectively. As an option, the two line printers are available with selectable vertical spacing of 6 or 8 lines/inch. Vertical format control, implemented via a paper tape loop, is standard in the Centronics 101A and optional in the two line printers. The Centronics printer accommodates pin-fed continuous forms from 4 to 14-7/8 inches wide; the line printers accommodate pin-fed continuous forms from 3-1/2 to 20-5/8 inches wide.

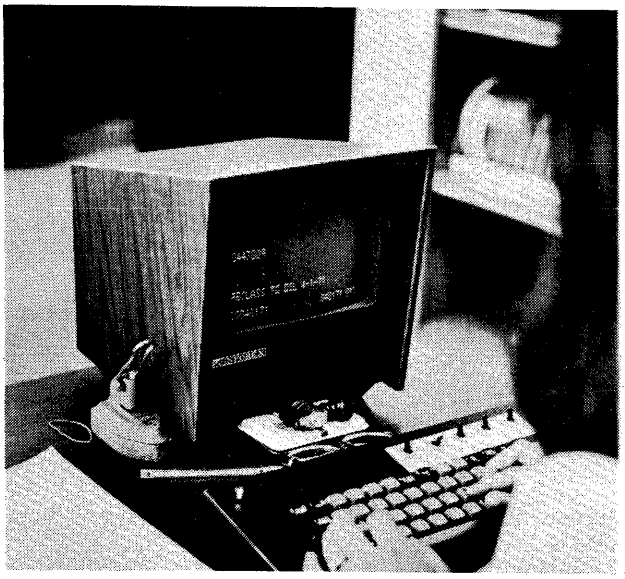
CASSETTE TAPE INPUT/OUTPUT: Provided by one or two single-drive cassette units (Sykes mechanism). Each unit accommodates a Philips-type cassette containing 300 feet of 0.15-inch-wide magnetic tape. Phase-encoded data is recorded serially at 1000 bits/inch. Two recording tracks each provide a maximum capacity of 288,000 bytes. The data transfer rate is 400 bytes/second. Tape speeds are: read/write–5 inches/second; search/rewind–100 inches/second.

PRICING: All models of the SPD 900 family of remote batch terminals are available for purchase or on a three- or five-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental (1)			
SPD 900 Model (2)	3-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.
SPD 901	$747	$571	$17,900	$150
SPD 902	863	662	20,500	180
SPD 903	951	732	22,400	205
SPD 904	572	437	13,900	110
Options				
Vertical format and 6/8 lines/inch	22	17	500	5
136 print positions (3)	4	2.50	110	0
Tape cassette (single drive)	106	85	2,300	30
Additional memory:				
1K bytes (4)	32	25	815	5
2K bytes (5)	47	36	1,265	5
Modem switch (6)	–	5	200	0

(1) Includes prime-shift maintenance.
(2) Each model includes a card reader, printer, equipment table, and one software emulation package. Each additional emulation package is priced at $100.
(3) Required for CDC 200 User Terminal emulation
(4) Required for the following emulation packages: IBM 3780, IBM 360/20 (HASP II), and CDC 200 User Terminal.
(5) Required for emulation of IBM 360/20 HASP III.
(6) Required for two or more emulation packages. ■

Inforex 1301/1302 Intelligent Key Entry Systems



Early entries in the low-cost, shared-processor key/disk marketplace, the Inforex 1301 and 1302 systems have held customer loyalty very well. The 1301 and 1302 can handle a maximum of 8 and 16 CRT keystations, respectively.

MANAGEMENT SUMMARY

The original Inforex Intelligent Key Entry System, which corresponds to the present 1301 system, was announced in early 1969 and first delivered in February 1970. From the beginning, Inforex planned to design, develop, and manufacture its own processor, memory, disk drive, and tape drive as well as develop a nationwide sales and service organization and handle its own leasing operation—an ambitious program. Ambition became reality, and the company has become the leader in the important low-cost segment of the key/disk market.

The Intelligent Key Entry System was introduced originally as a low-cost, "plain-Jane" system, but the enhancements that have been introduced since then have added considerably to the capabilities of the systems. The number of current users (3500 systems totaling 30,000 keystations) is ample justification for Inforex's philosophy.

The 1302 was introduced to relieve the pressure for lower-cost systems with more than eight keystations. Basically, the only changes are increased processor memory to handle I/O buffers, increased disk capacity, and additional hardware to interface up to 16 keystations. The operating software has also been enhanced to some degree over the 1301.

USER EXPERIENCE

During the past year, Datapro has received user ratings from a total of 28 installations of Inforex 1301 and 1302 key/disk systems, representing a total of 67 systems and 607 keystations. Most of these were in response to our key entry questionnaire that was distributed a year ago. The ratings assigned by these users are summarized below. ➢

CHARACTERISTICS

MANUFACTURER: Inforex, Inc., 21 North Avenue, Burlington, Mass. 01803. Telephone (617) 272-6470.

CONFIGURATION

An Intelligent Key Entry System consists of a control unit and multiple CRT keystations. The control unit houses a processor, memory, disk drive, and magnetic tape drive. One to eight keystations can be connected to a 1301 control unit, while 1 to 16 keystations can be connected to a 1302 control unit. All control unit components are designed and manufactured by Inforex. Either a 1402 serial printer or a 1404 line printer can be added. Two communications interfaces are available.

COMPONENTS

KEYSTATION: Consists of a desk with keyboard and CRT display. The keyboard layout is the same as that of the IBM 64-character 29 Card Punch, with a few additional keys. A 48-character subset can be switch-selected.

A CRT screen that displays 128 characters in 4 lines of 32 characters each is situated behind the keyboard. The last three positions on the bottom line give the column count. When an error or system message must be presented, the screen goes blank, the error light on the keyboard flashes, and the keyboard locks electronically. Then the message appears.

The standard distance between keystations is 15 feet; however, the last keystation in a bank of 8 can be located up to 1700 feet from the control unit at a cost of $1 per foot for the additional cable.

CONTROL PROCESSORS: Consist of a 12K-byte processor for the 1301 and a 16K-byte unit for the 1302. In the 1301, 8K bytes are read-only memory for the operational program and 4K bytes are read/write core memory that stores the I/O and keystation buffers, certain diagnostic programs, and the special editing, verification, and output features. In the 1302, 8K bytes are read-only memory and 8K bytes are read/write core.

The processors are designed to permit overlapped jobs. Keystation to memory, memory to disk, and disk to tape operations can all proceed concurrently. Communications and disk-to-tape transfers, however, are mutually exclusive, but communications and printing can proceed with the other tasks mentioned.

The processor includes a power-failure interrupt and recovery routines to allow convenient restarts in case of power failure.

DISK DRIVE: This standard system component is a fixed-disk unit that incorporates both fixed-head and moving-head read/write assemblies. The fixed-head portion holds the variable program routines and information, while the moving-head portion holds the data records. ➤

Inforex 1301/1302 Intelligent Key Entry Systems

	Excellent	Good	Fair	Poor	WA*
Overall performance	14	14	0	0	3.5
Ease of operation	17	11	0	0	3.6
Hardware reliability	13	13	2	0	3.4
Promptness of maintenance	12	15	1	0	3.4
Quality of maintenance	13	13	2	0	3.4
Software and technical support	8	15	4	0	3.2

*Weighted Average on a scale of 4.0 for Excellent.

To verify that the users still felt the same way about their Inforex systems, we called four of these users as a spot check. The ratings previously assigned by the four users indicated that they ranged from fairly happy to very happy with their systems. In each case, in the areas where dissatisfaction had existed, an improvement had been noted during the last year. In general, the users were more pleased with their systems today than a year ago.

Being happy with their systems does not necessarily mean that the users had no criticisms at all, however. One user did not feel that the operator statistics analysis program furnished was sufficient. Another user had difficulties with the communications feature, so that a separate one-station system was installed to handle communications—but the user was satisfied with this arrangement. A third user felt that Inforex maintenance had improved to adequate, but was still not outstanding.

Overall, the results of our survey clearly indicate that the Inforex 1301/1302 systems fare quite well in the critical area of customer satisfaction. □

The data portion of the 1301 disk contains space for holding over 5000 125-character records. The data portion of the 1302 disk is expanded to hold about a half to a full day's output with a maximum configuration, depending on the amount of duplication, skipping, and spacing out through reformatting.

To avoid the tendency to overload the disk when sort records are stored, the system utilizes a packing technique. Two 60-character records can be fitted into the space nominally allotted for a 125-character record, or four 30-character records can be inserted into the same space. The reformatting feature can later reassemble these short records into longer ones and rearrange the field sequences if desired.

TAPE DRIVE: This standard system component operates at 12.5 inches/second, which is adequate for the output of up to 32 operators even with backspacing for the reread check. Data is recorded on standard ½-inch tape in one of three IBM-compatible formats: 7-track at 556 bpi, 9-track at 800 bpi, or 9-track at 1600 bpi.

1402 PRINTER: This Diablo 132-column serial printer operates at 30 characters/second. It prints either from the disk or from tape, and employs the same software as the 1404 line printers.

1404 PRINTERS: Both models, M1 and M2, print lines of 132 columns at the rate of 200 lines/minute. Each printer implements a 64-character set and prints 6 lines/inch. Each has a 12-channel VFU (vertical forms unit) and can therefore use computer-formatted tape. Model 2 has a long-line driver that enables it to operate up to 500 feet from the processor. It also has a switch that permits the alternative of printing 8 lines/inch.

COMMUNICATIONS

Two communications features are available: On-Line and Off-Line (in reference to whether the system is transmitting to a computer or to another Key Entry System). The two features are similar except that the On-Line version employs IBM's BSC (binary synchronous) line discipline techniques to permit data transmission with an IBM System/360, System/370, or other computer equipped to handle BSC. An IBM 2701, 2703, 3704, or 3705 controller or a suitable adapter is required on the host IBM computer to handle data communications.

Transmission is synchronous, half-duplex at 300 to 9600 bits per second; the speed depends on timing signals derived from the modem attached. Transmission code is EBCDIC Transparent; i.e., any 8-bit code is valid.

The Inforex system checks the CRT characters, sequence number, and line continuity. Automatic retransmission is initiated for detected errors. In Off-Line operation, three retransmissions are attempted if a data error, loss of line, or no response from the remote system within 16 seconds occurs; after this, transmission is aborted. Detail error recovery for On-Line operation is determined by the remote computer; the Inforex system will respond to requests for retransmission as long as it can and the remote system requests it.

Initiation and control of the communications process is maintained from the supervisor's keystation through messages in much the same manner as other data entry operations. A status record is maintained for the communications job that includes the number of records sent and received and the number of transmission errors detected. Transmission is performed from tape.

A useful transmission restart capability is also provided. Suppose there is an interruption to transmission, such as a line failure or equipment breakdown. The system, upon restarting, queries the receiving station as to the last three records it received and compares them with the last three that the transmitting side is known to have transmitted. If the two sets agree, then the transmission resumes from that point instead of returning to the start of the batch.

SYSTEM OPERATION

Sitting at a keystation, the operator faces a keyboard very similar in layout to that of an IBM 29 Card Punch with a few extra keys and switches to accommodate the additional functions. Behind the keyboard is the CRT display.

Normally, as the operator keys in data, it is displayed on the CRT and transferred to a buffer in the memory section of the control unit. When the record is released, data is transferred from the memory buffer to the disk. On command from the keystation, data in batch form is transferred from the disk to magnetic tape.

Control of data being keyed is by the conventional approach of defining a control format that identifies fields, any automatic operations such as skipping or duplicating, and any restrictions such as alphabetic or numeric only.

The flow of records within a system is controlled by job name and batch number. For each job (identified by an 8-character label), there can be up to four formats easily accessible to the operator. Selection is controlled by two keys on the keyboard and one switch. The four record formats can also be cascaded, or chained, automatically. Because the last 3 character positions are used for chaining instructions, the maximum record length is 488 characters. A format is usually referred to as a program level, and a group of four levels as a program. The Program Library on the disk of the 1301 system holds 128 programs (equivalent to 512 formats), and the 1302 system stores 192 programs (equivalent to 768 formats). A forms feature and an auxiliary duplication format can be substituted for the second pair of recorded formats.

Inforex 1301/1302 Intelligent Key Entry Systems

If desired, the operator can display the format itself during data entry; a nondestructive underline cursor indicates the next position to be entered. At the bottom of the display, a counter keeps track of position identification within a record. The operator can also step the displayed data forward or backward by character, field, or record.

The forms feature is standard and provides a "fill-in-the-blanks" capability; field descriptors appear on the CRT with data spaces following. However, total record length including the field descriptors is still restricted to 125 characters. With the Reformatting option (available at no cost), the field descriptors can be stripped off, leaving only the keyed data to be transferred from disk to tape. This function is useful for demonstration purposes, and there is user interest in the feature despite its limitations.

A batch number is assigned to the output from each keystation. A group of records belonging to the same batch are stored as a unit on disk. Transfer of records to tape is performed from any keystation by identifying the job and the batches to be transferred.

Other functions, in addition to data entry, can also be initiated from any keystation, including data verification, format entry or deletion, job interruption and continuation, and data file interrogation and modification.

Verification is performed much as on a keypunch, with the important exception that the data is displayed. As each record comes up for verification, fields programmed for non-verification appear on the CRT screen; verified data appears as it is keyed. As in keypunch verifiers, the third time is the charm; the system assumes, when a miscompare occurs, that the third time a character is keyed it is the correct one and replaces the one previously entered. The operator can also easily modify an entire field.

The CRT display is used to notify the operator of errors within the system, be they format violations, command errors, or detected equipment malfunctions. About 80 different error messages, including a warning that the disk is almost full, are displayed on the CRT screen. Normally, the keyboard is interlocked and an error indicator lamp flashes to notify the operator that an error has occurred. However, if an operator misses these warnings and continues keying for a while, she can recover immediately by hitting the Reset key, which brings up the last valid record onto the display. If one keystation fails, the others continue to operate.

Compatible character parity and redundancy characters are written on tape and checked by backing up and rereading; the tape drive does not at present have a dual-gap head for read-after-write checking.

SYSTEM PROFILE

Unlike the disk file organization of other key-to-disk systems, the fixed-head disk files of the Inforex systems are divided into two autonomous parts, one for data storage and the other for functional programs. Since the data storage portion cannot be reduced to admit system programs, the manufacturer takes pains to ensure that any new feature fits into the assigned system management storage. The following figures give a reasonable indication of the respective capacities of the 1301 and 1302 systems.

- Keystations–1 to 8 for the 1301; 1 to 16 for the 1302.
- Record length–up to 125 characters for both systems.
- Record formats–512 for the 1301; 768 for the 1302.
- Data record storage–1301: 5,000 125-character records or 10,000 60-character records; 1302: 18,000 125-character records or 36,000 60-character records.
- Job File (system management)–1301: 119 records; 1302: 280 records.

SOFTWARE

All system operations are carried out under software control. Keyboard functions, including formatting of keyed data and transfer to the processor, skipping, duplication, left zero fill, insertions, deletions, etc., are but one example. Control of the CRT display is another. Some processes, such as editing and validation checks, are performed directly upon the incoming data and influence keying, tending to make it more accurate. Other functions, such as Expanded Tape Processing and Blocking, are performed in the background and are entirely independent of data keying. Hence, many changes can be introduced without affecting the keystations' operation.

Several additional functions have been implemented beyond those commonly found in keypunches, including automatic sequence numbering, check digit generation or checking (mod 10 or 11), verification suspension for a field, and boundary checking on alphabetic fields. In the last function, the keyboard is locked when the last position of the specific field is reached (by keying data, not by skipping); the lock-out can be overridden if the operator desires.

Another standard function, auxiliary duplication, duplicates the auxiliary drum feature on a keypunch. Common information can be held in a separate format and automatically transferred to data records.

Among the editing capabilities of the 1301/1302 systems is field checking. Specific fields can be designated for numeric-only entry, for alpha only, for mandatory entry, or for boundary checking. An especially useful editing provision is 2- and 3-position table lookup for validating entered data on the 1302. A special fixed table is provided on the 1302 for checking the two-character Post Office state abbreviations.

Batch accumulation and comparison is a widely used facility of the Inforex systems. Control sums can be entered and compared against an algebraically computed sum for specific fields within a group of records. This feature can reduce the amount of verification necessary. Sums are dynamically computed so that when an error is found in the process, the operator can see the recomputed sum each time she modifies a field entry, thus reducing the amount of checking necessary. Two registers are implemented in the 1301 software; four are supported for the 1302. Keystroke counting is available on both systems as a no-charge option.

Batch accumulation and comparison is a widely used facility of the Inforex systems. Control sums can be entered and compared against an algebraically computed sum for specific fields within a group of records. This feature can reduce the amount of verification necessary. Sums are dynamically computed so that when an error is found in the process, the operator can see the recomputed sum each time she modifies a field entry, thus reducing the amount of checking necessary. Two registers are implemented in the 1301 software; four are supported for the 1302. Keystroke counting is available on both systems as a no-charge option.

The optional Expanded Tape Processing (ETP) feature adds flexibility to Key Entry System operations. Essentially it consists of five capabilities, implemented entirely through software. The five routines are: (1) Tape Search (retrieval of any record or file on tape); (2) Tape Update in Place (modification of tape records without first transferring them to disk); (3) Tape-To-Disk Transfer; (4) Program Control Transfer (maintaining sets of program control formats on tape, with automatic transfer to the control unit when called); and (5) Tape Proofing (reading tape and counting records to verify that a valid writing operation has been performed). Program Control Transfer and Tape Proofing are standard facilities of both the 1301 and 1302 sytems.

The optional Blocking feature permits combining several logical records into one physical record on the tape for more efficient storage on tape and higher throughput when transferring data to the computer. This feature can also be used effectively to create records longer than the normal

Inforex 1301/1302 Intelligent Key Entry Systems

125-character limit. The operator can specify the length of the logical records at the time transfer is made from disk to tape. Maximum block length is 800 characters.

The optional Reformatting feature is designed to facilitate data entry operations from source records that were not originally designed for the sequence of data currently used by the computer. A program stored in the Program Library controls the operation when data is transferred from disk to tape. Fields can be rearranged or omitted. Blank fields and constant data can be added. The Blocking feature is operative. The user can specify two particular characters to be used to identify records not to be reformatted (such as header records) and whether blank records are to be deleted. In addition to the application first mentioned, this feature is of particular value when using the forms capability to perform "fill-in-the-blanks" data entry with a displayed guide to fields; with Reformatting, the forms entries can be suppressed, capturing on tape only the variable information.

Files maintained on disk contain the job status of up to 119 jobs in the 1301 or 280 jobs in the 1302. (A maximum of 8 or 16 jobs can be active at once, but allowance is made for interrupted jobs.) Contained in the library are entries for keystrokes, data entry and verification status (in process, interrupted, or completed), entry and verify operator identification, record count, number of records altered during verification, and data set transfer status (disk-resident, in process, or completed). If the optional Interval Timer is included, entry and verify operator times can be accumulated in units of minutes. On the 1302, a second Jobfile record can be recorded that contains the contents of the four balance registers and the in/out-of-balance status for the batch for either zero balancing or balance and compare. The files can be accessed from any keystation for display or transferred to tape. Inforex provides a no-charge program that will run on a minimum IBM System/360 or 370 and produces analyses in several different sequences.

The Tape-to-Tape Copy feature provides the ability to copy data from one local Inforex tape drive to another–at a transfer rate of 9600 bits per second. Back-up tapes can be thus produced, as well as pooling of the output from two systems onto one multi-file reel. Since the two tape drives need not have the same tape recording format, density and 7/9-track conversion is possible.

Another optional standard feature is the Keystation Channel Select Switch, which enables the user to transfer keystations from the control of their own processor, should it or its disk drive fail, to the control unit that governs another set of keystations. A restriction is that a control unit can never handle a greater number of keystations than its normal rating, which is 8 for the 1301 and 16 for the 1302.

Included with the Printer option is a significant set of routines to assist the user in tailoring the printed ouptut to his needs. These capabilities include line advancing, paper skipping, channel skipping, stored page headings, stored column headings, automatic page numbering, data reformatting, edit word insertion, field selection, multi-line printing of one data record, zero supression, and floating dollar sign. The ability to read IBM tapes or tapes with ANSI line control characters is also available.

PRICING

The control units and keystations in ar Inforex 1301 or 1302 key/disk system are available on a one-, two-, three-, or five-year lease arrangement. There is no discount for long-term leases for the other components of the system. The components may also be purchased. The monthly rental costs below are for a one-year lease and include prime-shift maintenance.

The Monthly Maintenance figures listed below are for prime-shift maintenance of purchased units. Extra-shift maintenance charges for all components except the control units are the same as prime-shift charges for each shift; extra-shift maintenance costs for control units are discounted from the prime-shift rates. The 1301 Control Unit can be field-upgraded to a 1302, and the 1302 can be field-upgraded to a 1303-1 (Report 70D-499-02).

	Monthly Rental*	Purchase	Monthly Maint.
1301 Control Unit	$620	$27,500	$180
1302 Control Unit	720	33,000	195
2901 Keystation	65	1,475	8
Channel Switch	20	800	3
Peripherals			
Upgrade to 1600-bpi tape	100	3,200	20
Printers–			
1402 Serial Printer	80	2,400	15
Adapter	20	800	4
Channel Select Switch	15	600	3
1404-M1 Line Printer	325	8,070	55
1404-M2 Line Printer	355	8,400	60
Adapter	48	1,440	8
Channel Select Switch (M-2 only)	40	1,600	8
Communications–			
Infosync	80	2,300	16
Bisync	100	2,800	30
Features			
Interval Timer	20	500	3
4x3 Packing	100	4,000	20
Blocking	40	1,600	4
Reformatting	40	1,600	4
Expanded Tape Processing	40	1,600	4
Tape to Tape Copy, each system	40	1,600	10

*For a one-year lease; includes prime-shift maintenance.

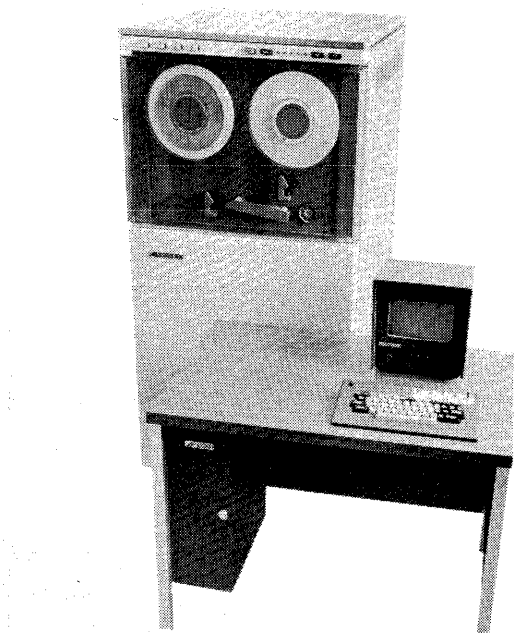
Multiple-year and multiple-system rental prices are presented below:

1301 Control Unit–
2-year lease: $594 per month
3-year lease: 576
5-year lease: 554

1302 Control Unit–
1-year multi-system lease: $670 per month, each system
2-year lease: 689 per month
3-year lease: 641
5-year lease: 615

2901 Keystation–
2-year lease: $62 per month
3-year lease: 57
5-year lease: 54■

Inforex 1303 Intelligent Key Entry System



The 1303 Model 2 Control Unit, which houses a processor, fixed disk drive, and 45-ips magnetic tape drive, is shown behind a 2901 CRT Keystation.

The 1303 represents an increase in capabilities and performance over the company's earlier 1301 and 1302 shared-processor key/disk systems, although the 16-keystation limit still applies.

MANAGEMENT SUMMARY

Inforex backed away from providing key/disk data entry systems with extensive data processing power when it delayed the ambitious In-Line System, because it found that its existing users weren't ready for that much capability. The 1303 represents a more modest expansion of the company's popular 1301/1302 systems. Announced in mid-1973, the 1303 became available for production deliveries in early 1974. Altogether, Inforex has already installed about 3500 key/disk systems worldwide, representing about 30,000 keystations. Gradually, the image of a "small-system-only" supplier is passing. Eighteen months ago, Inforex systems averaged about six keystations per system; today that average is over eight.

The 1303 is primarily an expansion of the 1301/1302 systems discussed in Report 70D-499-01. In fact, most of the software enhancements have been available in one form or another in special issues of the software for the 1301/1302. However, the rather small memory in the control processor in these systems prevented the coexistence of some of the features. The memory expansion in the 1303 will not only allow more features, but will also substantially increase the performance of the system, since more of the programming can be resident in main memory.

The most notable functional enhancement of the 1303 over the 1301/1302 systems is the provision of eight program levels and six accumulators for each data entry ➢

CHARACTERISTICS

MANUFACTURER: Inforex, Inc., 21 North Avenue, Burlington, Massachusetts 01803. Telephone (617) 272-6470.

CONFIGURATION

A 1303 Intelligent Key Entry System consists of a control unit and 1 to 16 CRT keystations. The control unit houses a processor, disk drive, and tape drive. A printer and communications interface are optional.

There are two models of the 1303 Control Unit. The 1303 Model 1 includes a 12.5-inch-per-second tape drive that can accommodate 1200-foot reels; the 1303 Model 2 Control Unit includes a 45-inch-per-second tape drive that can accommodate a full 2400-foot reel. The physical layout of the Model 1 Control Unit is identical with that of the Inforex 1301 and 1302 (see Report 70D-499-01). The 1303 Model 2 employs a new vertical packaging with the processor control panel mounted above the tape drive.

COMPONENTS

CONTROL PROCESSORS: The same control processor is included in both Control Units. It contains 24K bytes of read/write core memory. The larger memory of the 1303, as compared with the 1301/1302, provides space for holding multiple user programs (formats) resident in core, thus providing greater processor performance than the 1301 and 1302, which move the formats between disk and core for each data character entered.

CRT KEYSTATIONS: The 2901 Keystations used with the 1303 are identical with those used with the 1301/1302, except for a few key-cap changes associated with functional changes such as program level selection and cross-footing.

DISK DRIVE: The same disk unit is used in the 1303 as in the 1302 (see Report 70D-499-01).

MAGNETIC TAPE DRIVES: The low-speed (12.5-inch/second) tape unit used in the 1303 Model 1 is the same unit used with the 1301/1302. With the 1303, it is available in one of six formats: 7-track, 556 or 800 bpi, odd or even parity; 9-track, 800 bpi, odd parity; or 9-track, 1600 bpi (extra cost). The faster 45-inch/second drive used with the 1303 Model 2 is a new unit and is available in one of two formats: 9-track, 800 bpi or 9-track, 1600 bpi (extra cost). The Model 1 tape drive accommodates 1200-foot reels, whereas the Model 2 tape drive accommodates 2400-foot reels.

PRINTERS: Either the 30-character/second 1402 serial printer or the 200-line/minute 1404 line printer available with the 1301/1302 can be attached to the 1303. A separate attachment feature is required for either printer. ➢

Inforex 1303 Intelligent Key Entry System

batch. Many detail changes have also been made to streamline the data entry/verification procedures and system operation, as outlined under the Software heading in this report.

On the hardware side, the only major change, other than the memory size increase already mentioned, is the incorporation of a substantially faster (45 inches/second) magnetic tape drive into the 1303 Model 2. The 1303 Model 1 continues to use the same tape drive (12.5 inches/second) available with the 1301/1302.

Cost comparisons among the 1301, 1302, and 1303 are tricky because of the many configuration possibilities and leasing arrangements. It will cost you more for a 1303 than either of the other two systems, and the differences will range between 10 and 40 percent. For users with 8- or 16-keystation 1302 systems, the 1303 Model 1 can be acquired through a field upgrade of their 1302 at no charge. Existing 1301's cannot be upgraded to either model of the 1303, and existing 1302's cannot be upgraded to a 1303 Model 2.

The 1303 is intended to satisfy those Inforex users who wanted a modest upgrade in performance and capability. It should satisfy those needs well. But users who need substantially increased processing power, including extensive arithmetic capabilities, will have to wait for the forthcoming Inforex 3300

The 3300 is now scheduled for introduction in May 1975 at the National Computer Conference in Anaheim, California. The system is now undergoing field test. While no details have been released to date on the 3300, it will incorporate a version of the processor used in the Inforex System 5000 file management system described in Report 70D-499-11.

USER REACTION

Datapro talked with or heard from 5 users of the Inforex 1303, representing a total of 20 systems and 227 keying stations. A summary of their ratings appears below, and is eloquent in its own right.

	Excellent	Good	Fair	Poor	WA*
Overall performance	2	2	1	0	3.2
Ease of operation	2	3	0	0	3.4
Hardware reliability	3	2	0	0	3.6
Promptness of maintenance	2	3	0	0	3.4
Quality of maintenance	1	4	0	0	3.2
Software and technical support	0	5	0	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

Three of the users represented direct conversions from keypunch installations, while the other two represented upgrades from Inforex 1301 or 1302 installations. All five typically used 80-character or smaller records.

COMMUNICATIONS

Either of two communications capabilities can be incorporated. These are the On-Line (also called Binary Synchronous Communications or BSC) and the Off-Line (also called Infosync). The BSC feature allows the Inforex system to emulate an IBM 2780 under HASP or BTAM as a remote job entry terminal or remote tape drive. The print and card punch functions of an IBM 2780 are not supported. Transmission for both communications methods is synchronous, half-duplex at 300 to 9600 bits/second as determined by the attached modem. These two features, BSC and Infosync, are the same on the 1303 as on the 1301/1302. Infosync is intended for communications between two Inforex systems.

OPERATING MODES

- Key entry.
- Key verify.
- Format entry and deletion.
- Search for record and modify.
- Data transfer: between disk and tape; from tape or disk to printer; from tape to communications line.

All operations can proceed concurrently except communications and other tape-involved operations.

SYSTEM PROFILE

- CRT Keystations–up to 16; each displays 4 lines of 32 characters; 125 positions are for data; 3 positions are used for column count.
- Record Size–up to 125 characters basic. Up to eight levels of programs permit up to eight 123-character records to be chained or cascaded together. The Blocking option permits physical records of up to 1000 characters to be written to tape.
- Formats–768 stored on disk library; up to 64 resident in main memory, consisting of up to eight 8-level programs or sixteen 4-level programs; programs using less than 8 or 4 levels still count as 8- or 4-level programs in assigning memory.
- Data Record Storage–up to 322 disk tracks, each holding 47 125-character records, 94 61-character records, or 188 29-character records for a total storage of 15,604, 31,208, or 62,416 records, respectively. The JCSFILE and XFERFILE options reduce this capability by 8 and 6 tracks, respectively.
- System Storage – disk storage space is required for the program directory (formats), user programs, systems programs, and various status and statistics records; this storage is independent of the data storage area.

SOFTWARE

The software provided for the Inforex 1303 is a refinement of that provided for the 1301/1302 (see Report 70D-499-01). Numerous changes and improvements have been made in the 1301/1302 software to simplify some operations, to give increased protection against losing some statistics and data, and to provide additional functional capabilities.

Inforex 1303 Intelligent Key Entry System

The users were pleased with their 1303 systems, as attested by the ratings above. They felt the systems offered a good price/performance ratio, and, although sensitive to the software available with more powerful systems, they felt what they had was sufficient for their needs. However, the users were anxiously anticipating the next software release (as described in this report). □

The principal enhancements to the functional capabilities of earlier Inforex Intelligent Key Entry Systems include eight program levels, six accumulators with crossfooting over multiple records, Virtual Program Control, System Control, JCS File, keystroke counting, handling of tape labels, and handling of data set transfers.

The expansion from four to eight program levels provides additional flexibility. As in previous Inforex systems, two of the programs levels can be combined and used for auxiliary duplication. Eight program levels are provided not only for data entry, but also for reformatting of data during transfers between tape and disk and for print editing. An additional area of storage for 60 formats is provided for reformatting and print editing, so that these formats do not detract from overall system storage for data entry formats.

Up to six 12-digit balance accumulators can be employed with each data batch being entered. Up to five fields within each record can be crossfooted; the sixth accumulator can be used as a zero balance register. Page balancing is provided so that crossfooting can extend across multiple records. When crossfooting, accumulated balances can be compared with totals entered by the operator; out-of-balance conditions can be flagged or rekeying can be required.

Virtual Program Control causes the program level to be recorded (in position 126) along with data. This simplifies verification by making program level selection an automatic rather than manual procedure. It also permits automatic level selection when selectively transferring data records from tape to disk, which is also a new feature of the 1303.

System Control enables restricting control of the system to one designated keystation rather than enabling supervisory commands from any keystation. This feature can provide tighter control of the system.

The JCS File feature establishes a disk area for recording all supervisory statements for data transfer, communications, and printing activities. This provides an audit trail for determining what happened, in what sequence it happened, and from which keystation it was initiated.

The Jobfile records, which contain statistics on data sets entered, have been expanded to include counts of the keystrokes for data entry, verification, and error corrections. In addition, the identification of two operators for a data entry batch and for a verification data batch can be recorded in the Jobfile records. Previously, each new operator identification overlaid the previous identification for a particular batch.

Tape labels can now be transferred between disk and tape, permitting multiple sets to be stored and individually retrieved. Record and block counts can now automatically be written into a tape label if desired.

Transfer of data sets from tape to disk under program control is now a standard feature rather than a part of the Extended Tape Processing option. Selective transfer of records within a data set can be made from disk to tape, tape to disk, tape to printer, and disk to printer, all operating in the background as data keying progresses.

The Extended Tape Process (ETP), Blocking, Reformatting, and Interval Timer features available with the Inforex 1301/1302 are continued for the 1303.

Important changes in the operation of the system include forced verification of inserted records, simplified bypassing/correcting of balance fields, 3-digit batch numbers, simplified handling of signed numeric fields, and improved handling of out-of-balance records.

PRICING

The control units and keystations are available under one-, two-, three-, or five-year leases. The other system components are not discounted under long-term leases. The units are also available for purchase. The only differences between the pricing of the 1301/1302 systems and the 1303 system is in the control units. For that reason, we present only the prices of the 1303 Control Units here; please refer to the report immediately preceding this one (70D-499-01) for the prices of all features, peripherals, and software. All items available with the 1301/1302 are also available with the 1303.

Pricing for the 1303 Control Units is as follows:

1301-1–

1-year, single system:	$780 per month
1-year, multiple systems:	730 per month per system
2-year:	745
3-year:	693
5-year:	664
Purchase:	35,000
Prime-shift maintenance:	200 per month

1303-2–

1-year, single system:	$920 per month
1-year, multiple systems:	870 per month per system
2-year:	878
3-year:	816
5-year:	781
Purchase:	37,000
Prime-shift maintenance:	225 per month

All monthly rentals above include prime-shift maintenance. Extra-shift maintenance is charged at prime-shift rates for each additional shift, except for the control units, which are discounted. ■

Inforex System 3300

The System 3300 shared-processor key/disk system supports up to 16 CRT keystations with powerful editing and data manipulation software. It represents Inforex's first serious incursion into the market for sophisticated data entry systems.

MANAGEMENT SUMMARY

The System 3300 was introduced to the public in May 1975, at the National Computer Conference in Anaheim, California. It marks Inforex's commitment to and full support of large-scale key/disk systems.

Inforex shares with Computer Machinery Corporation the distinction of being a dominant force in the key/disk market. Together, these two companies have installed about 80 percent of the existing base of keystations that share processors and accumulate data batches on disk for later transcription to magnetic tape. Inforex, until recently, has primarily served the small user. A few abortive attempts were made to expand into more powerful systems, but the company's strength has traditionally been in the smaller key/disk systems.

The reference to previous unsuccessful attempts is not made to impress you with our knowledge of data processing history; nor is it intended to cast doubts on Inforex. The financial success Inforex has enjoyed and its record of user satisfaction speak for themselves. The reference is made to highlight a major change in the company that has occurred during the past 18 months. In January 1973, Timothy Cronin joined Inforex as president. Beginning then, the company evolved from a technically proficient maker of small key/disk systems that spent a lot of its technical competence in adapting a small system to the individual needs of many different users into a company with clear plans about how to maximize the technical efforts of its staff.

The System 5000, announced in the Fall of 1974 (see Report 70D-499-11) and the just-announced System 3300 are the most visible evidences of the new stability of

CHARACTERISTICS

MANUFACTURER: Inforex, Inc., 21 North Avenue, Burlington, Massachusetts 01803. Telephone (617) 272-6470.

CONFIGURATION

A System 3300 consists of a 3301 Control Unit (processor) that includes a disk unit and tape drive, and from 1 to 16 local CRT keystations. A separate adapter is required for the second group of eight keystations. Optional features include a second tape drive, a larger disk unit, one of three printers, and a communications capability.

The printer and groups of four keystations can be equipped with Channel Select features to permit switching between two 3301 Control Units. The standard data cables provide a distance of 30 feet between the processor and the first keystation and 15 feet between each successive keystation. Extra-length cables can be purchased to provide a maximum total distance between the processor and the last keystation of up to 1700 feet.

The second tape drive need not have the same format as the first. Available formats include 7-track, 556 bpi, odd or even parity; 7-track, 800 bpi, odd or even parity; 9-track, 800 bpi, odd parity; and 9-track, 1600 bpi, phase encoded.

COMPONENTS

KEYSTATIONS: Each 2933 keystation consists of a keystation and separable keyboard. Alternatively, existing 2901 keystations (1300 systems) can be field-upgraded to give the same functional layout except for the movable keyboard and 10-key numeric keypad.

The keyboard is available in keypunch or typewriter-style layouts; the two types can be intermixed on the same system. The two styles are functionally identical. The principal differences are the location of control keys. A 10-key adding-machine-style keypad is optional with either keyboard layout. With the keypunch layout, the control keys are arrayed at both sides and the top row; with the typewriter layout, the control keys are concentrated in a keygroup at the right of the keyboard.

The CRT displays 224 characters in 7 rows of 32 characters. The upper four lines are used to display data. Data is scrolled up and down automatically if records exceed 128 characters. (Up to 240-character records can be defined by one format.) The lower three lines are used to display control and status information. The fifth line displays a system-originated message or a message drawn from a user table under program control. The sixth and seventh lines display the Job Control Statement (job type), operator identification, keystation number, document count (programmed), record count, format level, start of field indicator, decrementing record length count, shift status (case), legal character set indicator, and off/on status of the automatic skip/duplicate/field generate function.

Inforex System 3300

marketing directions. But standardization of the 1300 series software (see Reports 70D-499-01 and 70D-499-02) is further evidence of the same change.

The System 3300 shared-processor key/disk system shares many components with the System 5000 file maintenance system. In fact, without the nameplates, you couldn't tell the two systems apart visually. The principal difference is in the supporting software.

The System 3300 has two outstanding characteristics: 1) it provides software for comprehensive data editing, checking, and validation; and 2) it accommodates only 16 keystations.

In the company's marketing promotional campaign, much mention is made of "parameterized" format construction by the key entry operator. The company's attitude is that this eliminates "programming" of formats, thus simplifying the job of getting the system up and running and adapting it to new data entry requirements. This style of format construction uses the CRT display to present visual cues (parameter names) to the operator, who fills in the blanks. This technique is limited to field definition and basic editing specifications such as case shift, required entry, verification required, etc.; and the parameter lists are not presented to the operator on the screen. In addition, the powerful facilities for automatic data generation and data validation based on logical and arithmetic relationships, including conditional format control, are specified in free form with no prompting to guide the operator. But the transfer of data batches to tape or printer is completely specified with a cued, parameterized specification, although the parameter lists themselves are not displayed.

The net result is that it is easy to generate simple data entry formats, whereas more complex formats using extensive data manipulation and computation require the same types of involved programming statements as other key/disk systems. It is the nature of the beast, at least so far. The software provided for the System 3300 is impressive in scope. Full table operations are provided, along with conditional format specification by field or format level.

A complement of arithmetic and logical/relational operators and addressing capabilities are provided that are sufficient to satisfy almost any data validating task you may encounter within a single data file. Multiple-file capabilities are not provided. Neither is a data sort capability. The System 3300 is intended to support a host computer, not to replace it.

The company emphasizes the data compatibility of the System 3300 with the Inforex 1300 series. Many existing customers may well install System 3300's in addition to their 1300's to upgrade their data preparation activities by adding background data reformatting and data validation. In this case, only a few keystations would be needed to keep the System 3300 busy, because all or most key entry

SUPERVISORY STATION: Any one or combination of keystations can be assigned supervisory functions. The functions reserved for supervisory initiation and control are also assigned by the user.

DISK STORAGE FACILITY: The disk unit provides a storage capacity of 10 million bytes utilizing a removable 2316-style disk pack with 20 recording surfaces. Optionally, the disk unit can be upgraded to a capacity of 24 million bytes. Average positioning time is 38 milliseconds. Data is recorded in 240-character sectors. Packing of multiple records per sector is accomplished automatically by the system software if the records are short enough. About one million bytes of storage are required to contain the system libraries, directories, and files along with non-resident portions of the system software. The remaining 9 or 23 million bytes of disk storage are allocated on demand to individual keystations.

MAGNETIC TAPE DRIVES: All models of the tape drive are similar; they can accommodate reels of up to 2400 feet and operate at 45 inches per second. Available tape formats include 7-track, 556 bpi, odd or even parity; 7-track, 800 bpi, odd or even parity; 9-track, 800 bpi, odd parity; and 9-track, 1600 bpi, phase encoded. All use single-gap read/write heads; i.e., read-after-write checking is not employed. Tape formats can be mixed in the same system.

PRINTERS: Three different models of printers are available; only one printer can be connected to a System 3300, but a printer can be shared between two systems via the Channel Select optional feature.

The 1402 Serial Printer operates at 30 characters per second and accommodates up to six-part forms that are up to 15 inches wide. Maximum print width is 80 positions.

The 1404 Line Printer is a drum printer capable of printing up to 200 lines per minute using up to six-part forms that are up to 15 inches wide. Standard IBM, COBOL, and ASA print control characters and formats are supported with the 1404 Printer to print data directly from magnetic tape.

The 1406 Line Printer uses a non-impact dry-ink transfer process and operates at up to 180 lines per minute. The 1406 is recommended where print quality is important.

PROCESSOR: The 3301 Control Unit is a 16-bit minicomputer designed and built by Inforex. It includes 64K bytes of main memory with a cycle time of 1.2 microseconds. It is similar to the processor employed in the company's System 5000 file management system (Report 70D-499-11).

COMMUNICATIONS

The communications feature for the System 3300 permits binary synchronous (bisync) transmission with another System 3300, an Inforex 1300 series, or an IBM System/360, System/370, or other computer equipped to handle bisync. An IBM 2701, 2703, 3704, or 3705 controller with appropriate adapters or a suitable integrated communications adapter is required on the host IBM computer to handle data communications. Inforex Infosync, an alternate communications discipline available with the 1300 series, is not supported for the System 3300.

Transmission is synchronous, half-duplex at 300 to 9600 bits per second; the speed depends on timing signals derived from the modem attached. Transmission code is EBCDIC Transparent; i.e., any 8-bit code is valid.

The Inforex system checks the CRT characters, sequence number, and line continuity. Automatic retransmission is initiated for detected errors.

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would be done on the 1300's. This would be the easiest way to install the System 3300 with minimum impact on existing operations and maximum short-term results. The capabilities of the System 3300 for foreground edits, and the consequent elimination of double references to the source documents when errors are discovered, would indicate the desirability of eventually moving key entry operations to the System 3300 as well. However, careful cost evaluation would be required in each installation to determine just which is the most economical approach.

The System 3300 represents a major cost jump over an Inforex 1303, for example. A 1303 system with 16 keystations, one tape drive, a serial printer, and a reasonable software complement costs about $115 per keystation per month on a three-year lease including maintenance. An equivalently configured (but substantially more powerful) System 3300 costs about $160 per month per keystation—a 39 percent cost increase. To pay for itself, that cost increase must come from reduced host processor time to perform the equivalent data checks and from the savings in procedures for correcting data entry errors. The increase in capabilities does seem, on the surface, to represent an economic advantage for the user who is willing to take full advantage of the features of the more powerful system.

First production deliveries of the System 3300 are scheduled for August 1975. The communications feature will be available early in 1976.□

Initiation and control of the communications process is maintained from the supervisor's keystation through messages in much the same manner as other data entry operations. A status record is maintained for the communications job that includes the number of records sent and received and the number of transmission errors detected. Transmission is performed from tape or disk; reception can be to tape, disk, or printer.

SYSTEM OPERATION

OVERVIEW: All operations of the System 3300 are under the basic control of an operating system. Responsibility for data control is determined by the individual user of each system by defining which functions are reserved for supervisory control and which keystations can exercise supervisory control. The basic data grouping is the data batch. Within the data batch are records, as defined by a Format level, and documents, groups of records defined by the command coding in a Format level set. Batches can be combined to build files, complete with header and trailer labels. The basic means for controlling the system's activities is the Job Control Statement, which identifies the task to be performed and the batch or group of batches involved. The Job Control Statement is always displayed at the operator's keystation; it, along with the other status information displayed at an operator's keystation, can be called up onto the screen of a supervisor's keystation.

The coding arrangements permit three basic types of operations to be performed on a System 3300: data entry, including the related subtasks of verifying, selective data retrieval, and selective data changes; reformatting; and data transfer from one medium to another. Data entry and related tasks are completely controlled by Entry Format Sets. Reformatting is established by Reformat Control Sets. Both Entry and Reformat Sets provide for data editing, checking, validation, computation, and table operations. In addition, the Reformat Controls provide for data rearrangement; records can be combined or separated to give full control over input and output data structures. Reformatting operates in conjunction with a Transfer Record, a single record identifying the input and output media and basic parameters specifying the transfer operation, and the applicable Reformat Control Set, if any.

In general, the operator enters the Entry Formats, Reformat Controls, and Transfer Records directly. Entry Formats are a combination of parameterized entries for the basic field and editing definitions and free-form command sets for data checking, calculations, table operations, and logical flow control. The Reformat Controls are entirely free-form command sets. Both need to be compiled, with the generated object code stored in a library. The Transfer Record is entirely parameterized and does not need to be compiled.

OPERATOR/SUPERVISOR FUNCTIONS: Each type of Job Control Statement can be designated as a supervisory or general task. The keystations identified by the user as supervisory stations can initiate either type; keystations identified as operator stations can initiate and execute only the general job types. Normal practice will probably reserve background processing (reformatting), data transfer operations, and communications operations for supervisory control, with key entry, verify, information retrieval, and selective modify operations permitted at all stations.

General control is exercised by batch, operator, and keystation number. Batches are both named and numbered. Format sets, reformat sets, and transfer records are named. The system maintains a number of libraries, directories, and files to record system information and statistics. The four libraries are the Format (Entry and Reformat sets), Transfer Records, labels, and tables. These contain the actual control code or information. Associated with each is a directory that provides an easy method of locating a particular data set. There are a maximum of 750 Format sets. There is no limit upon the number of Transfer Records in the system. The label and table libraries are also open-ended, but the corresponding directories provide access to a maximum of 100 and 255 data sets, respectively. In addition, a separate file is maintained that includes two 240-character records for each of up to 300 active batches.

Comprehensive statistics are recorded, including the status of all possible operations; the number of times the data batch was transferred to each of the possible destinations; counts for each operation mode including keystrokes, records, documents, error keystrokes, and elapsed time; number of fields and records flagged; and the contents of the accumulators for each batch. As data batches are deleted from the system, the status records are transferred to a separate file.

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Two additional system files are maintained. One consists of a series of records representing each function performed by an operator and forms the basis for a comprehensive operator analysis report. The second is a chronological record of each Job Control Statement executed; the user can specify which types of Job Control Statements will be represented in this file. The JCT file provides an audit trail by batch numbers and operator identification, showing what was done with each batch and when. Manual cross-referencing can be made among the four statistics files (active batches, deleted batches, operator statistics, and JCS) to fully pin down all operations. Each file can also be written to tape for processing by the host computer system.

OPERATING MODES

- Data Entry–Data is keyed into the system under control of an Entry Format set that defines fields and any checking and validating to be performed. Keying errors caught by the operator can be corrected or flagged for later correction. Data is accumulated in batches on disk. Additional processing can be performed later, with or without transfer to tape, printer, or communications line.

- Data Verification–Data is key-verified under control of the same or a different Entry Format set. Fields can be selectively identified for unconditional verification or for verification if the field is flagged. Reverification if a change is made is optional. Data verification can be performed on a batch that is also open for key entry.

- Page/Search–The operator can examine a file (data batch or system file) sequentially, record by record, or can locate specific records that match a mask of up to the full record size. Data can be modified in this mode, but format checks or arithmetic calculations are not performed.

- Modify–A data batch is presented record by record to the operator. Fields identified in the Format set can be modified, with all format checks and arithmetic computations executed. This mode presents a convenient method for making a consistent change to all the records in a data batch.

- Background–Includes all data transfers among the various components, including disk, tape, printer, and communications line. Reformatting can be performed during any transfer operation. Editing of data batches in place on disk, using Entry Format processing, can also be done in the background. Multiple background tasks can be executed simultaneously, subject to peripheral device availability; however, only one tape buffer is provided, so only one tape operation can be performed at a time.

SYSTEM PROFILE

- Keystations–1 to 16 local CRT keystations, any or all of which can function as supervisor stations.

- Record length–Up to 240 characters per Format level; logical linking between Format levels can be established.

- Formats–Up to 15 Formats can be linked into one Format or Reformat set; in addition, the Reformat set can include one level for batch-end processing. A maximum of 750 Format sets can be stored in the system.

- Output block length–Blocking factors are established independently for each transfer to tape; maximum block length is 4000 characters.

- Data storage–Typically, 1 million bytes of disk storage will be required for system files and operating system coding. The remaining 9 or 23 million bytes are available for user data. While this is a generous amount for a 16-station key/disk system, it should be noted that several of the system files are open-ended. Without some deletions, the user space could be seriously impacted over a long period of time. In addition, the powerful file-oriented operations may induce users to maintain data files on the system for operations other than data preparation; this could also affect user disk space for new data entry over a period of time. Management of the disk space is required.

SOFTWARE

All operations of the Inforex System 3300 are carried out under control of the operating system. The operating system, which includes the operational routines for the various types of logical and arithmetic functions, is directed through the user-programmed Format sets, Reformat sets, Transfer Parameter Records, and Job Control Statements (JCS). The latter are the active elements for initiating activities.

ENTRY FORMAT SETS: Data can be entered into a system 3300 only under control of an Entry Format. Multiple Formats can be linked together to form a set, which serves as the complete definition of entry operations for a data batch.

Each Format level consists of multiple field descriptors interspersed with command sequences. The field descriptors define the extent of each field and specify data checking operations, including automatic generation of field contents, accumulator control, and conditional execution of the Format. Command sequences provide logical and arithmetic control of the data entry operation. Field descriptors are entered into the system field by field in response to parameter names displayed on the screen during the Format construction mode. Command sequences are entered in free form.

The parameter list of the Entry Format is designed to accommodate key entry, key verification, and modify operations. Modify is the selective changing of fields in a previously keyed set of data records. The basic parameters identify the starting position of a field within a record and the length of the field. The case of shift is specified by a single parameter as lower, upper, international, or hexadecimal. The international shift accommodates special alphabets. Complementing the case shift parameter is a series for specifying the legal characters acceptable within the field; any combination of the following partial character sets can be specified: integers (numerics), alphabetics, blanks, special characters, and international characters. A single parameter identifies keying requirements as: skip not allowed, field must contain one or more non-blank characters, first character must not be blank, or no restrictions. A pair of parameters is used to identify verification and reverification requirements. The options for verification are: key verification always required, key verification required only if field is flagged, or no verification is required. A special option for this parameter identifies the field as a modify field for that mode of operation. The second parameter specifies whether or not reverification is required if the field is changed during verification. One parameter identifies the field as a tab stop, and another specifies the fill character along with right or left fill; both functions operate in response to key depressions by the operator. A group of parameters specifies the addition or subtraction of the field to or from up to four accumulators. Two parameters complete the definition of the field. One specifies the generation of the

Inforex System 3300

field by other than key entry; the second establishes the conditional execution of the field format.

A field can be generated by skipping or as the result of an expression, either automatically or manually in response to depression of the Generate key by the operator. The expression that identifies the data that will be recorded in the field at data entry time can be a character string from the current or previous record (even from a different format level), a character string from the save area, a numeric literal, an alphanumeric literal of any length, the contents of a specific accumulator, an entry from an indexed table, or a check digit. The index for the table or the argument for the check digit can be from the current or previous record (including a different format level) or the save area. The modulus of the check digit is also identified in the expression. Numeric quantities can be combined with arithmetic operators (addition, subtraction, multiplication, and division) to generate the field entry. In addition, the current document or record count, Julian date, or time of day from the system clock can be the result of a field generate definition. The automatic field generation facility can be used to record and display names for fields defined in the next field descriptor, thus providing prompting; the names are recorded as part of the data record but can be moved in a reformatting operation.

The applicability of the field descriptor can be conditionally based on the status of one of up to eight two-value logical indicators. In general, if this parameter is used, a pair of field descriptors must be generated to accommodate the two possible values (true or false) of the indicator. The status of the indicator is established by the command sequences between field parameter lists. Complex conditional situations can be accommodated by setting the status of the operative indicator based on the status of several other indicators.

The save area referenced as one source for a character string in a generated field is 234 bytes long. It includes the accumulators as well as a general work area. Normally, the organization is eight 12-position balance accumulators and a 134-byte temporary work area. However, the area can be reorganized at the beginning of an Entry Format set in any fashion the user wishes. The number and size of accumulators are dependent only on the overall size of the save area. The contents of the save area are controlled by the command sequences in the entry formats, and can be carried from record to record. A reorganization of the save area applies to a particular Format set only; unless the next Format set and data batch specify a particular organization, the area will revert to the normal organization mentioned above.

In the generation of an Entry Format, there is the opportunity to insert command sequences between the parametric definition of each field, as discussed above. These command sequences are also used to identify the beginning and end of each Format level and conditional or unconditional branches (chaining) to other Format levels. A maximum of 15 Format levels can be established. In effect, each Format level defines one type of record within a data batch. Alternatively, variations in the division between automatically generated and key-entered data for the same record type can be handled through different Format levels.

Other commands provided include increment document count, clear accumulator, clear or set indicator, display message or element, control cursor, move data, and flag record.

A totai of eight indicators are provided. The display message command causes a specified message to be drawn from the message table and displayed on the operator's screen, a red light to be lighted, and a tone (adjustable volume) to be sounded; for the operator to continue, the Reset key must be depressed. The display element command is similar, except that a specified data element is displayed; the element can be any expression allowed in the field descriptor generate specification discussed above. Cursor control permits moving the screen cursor backward to a specified position in the current or previous record (including format level change), and returning the cursor to the location where the last keying was performed. The move data command transfers data from any source that can be defined in the generate field descriptor or the results of an arithmetic expression to an accumulator or the save area.

Command sequences can be unconditional or conditional, excepting only Begin and End Format commands, which cannot be made conditional. Chain Format commands can be conditional, however. A conditional command sequence can be single or double. The single form follows the IF identifier with one or more expressions and one or more commands. If all of the expressions are true, the commands are executed; otherwise, they are ignored. In the double form, an ELSE identifier and a second command series follows the first command series; if all of the expressions are true, the first series of commands is executed. The two forms are complementary and provide maximum convenience in specifying logical control. The expressions which are evaluated are composed of elements and operators. The elements are character strings obtained in the same way as the character strings defined for the field generate expressions above, including literals, with one exception—table references are to non-indexed tables. Permissible operators include arithmetic (add, subtract, multiply, and divide), logical (OR, AND, and NOT), and relational (equal to, greater than, and less than). The elements and operators can be combined in any fashion as long as the result is a testable condition. Some operators can be combined to simplify expression construction; e.g., the logical NOT and the relational equal can be concatenated to form not equal.

The net result of these provisions is to permit comprehensive data checking and control of error alerting and corrective action.

REFORMAT SETS: A Reformat Control specifies the processing to be performed on the records of an existing data batch or group of batches. It is constructed of free-form command sequences similar to those in Entry Formats. There can be up to 15 levels of Reformat Controls, analogous again to Entry Formats. In addition, a sixteenth level is available for end-of-batch processing specifications. Reformat Controls include logical I/O commands such as Get and Put, but do not include physical I/O instructions. The physical I/O is included in the Transfer Parameter Records. A Reformat Control set, then, is only used in conjunction with a Transfer Parameter Record.

The available commands include begin and end reformat level, data movement, logical I/O, set and clear indicators, clear accumulators, and clear a segment of the save area. All command sequences, except begin and end reformat level, can be unconditional or conditional.

Data organization during a reformatting operation includes a current record, an output buffer area, and the save area. Access to data fields in previous data records, including those with different reformat levels, is provided without losing the current record. The save area is defined for a reformatting operation in the same way as for a data entry operation.

The data movement commands permit data to be moved from various sources to the output buffer, accumulator, or save

Inforex System 3300

area. The possible data sources are essentially the same as for generated fields in an Entry Format, and include a character string in the current or previous record, a segment of the save area, a numeric literal, an alphanumeric literal, an accumulator, an indexed table, and a generated check digit. System-generated Julian date, time of day, record count, document count, or results of an arithmetic expression are also data elements usable in a move command. A special form of the move command moves data to the output buffer after performing an edit operation such as zero suppression, floating dollar sign, asterisk check protection, conversion to zoned decimal, and conversion of an oversigned units position to a separate sign character.

A special form of the logical I/O command includes printer commands for skipping to top of form, to a specified channel, or a specified number of lines.

Conditional command sequences are created in exactly the same manner as for Entry Formats.

TRANSFER PARAMETER RECORDS: A Transfer Parameter Record is required any time data is to be transferred from one medium to another, including disk to tape, tape to disk, disk to printer, tape to printer, and tape to tape. Communications transmission and reception are controlled by a separate program facility.

The Transfer Records are created at the operator keystation by filling in parameters in response to system-generated cues. They are collected directly into the Transfer Parameter Directory; compilation is not required. Each record is named; the name can be the same as the corresponding Entry Format set without causing confusion, but the Entry Format set plays no direct part in the data transfer.

The Transfer Record identifies the operation and specifies certain parameters such as record and block length (for tape-related operations) and lines per page and page numbering (for printer-related operations). In addition, the name of the Reformat Control set is specified if reformatting is to be performed in conjunction with the transfer. If code translation is desired, the controlling table is named. If the data batch or group of batches is being transferred from disk, the transfer can be made conditional based on a number of different statuses and/or counts, including Verify and Modify status; status of a previous transfer to tape and printer; status of a previous data transmission; a count of the number of items transferred to tape or printer; or a count of the number of field and record flags.

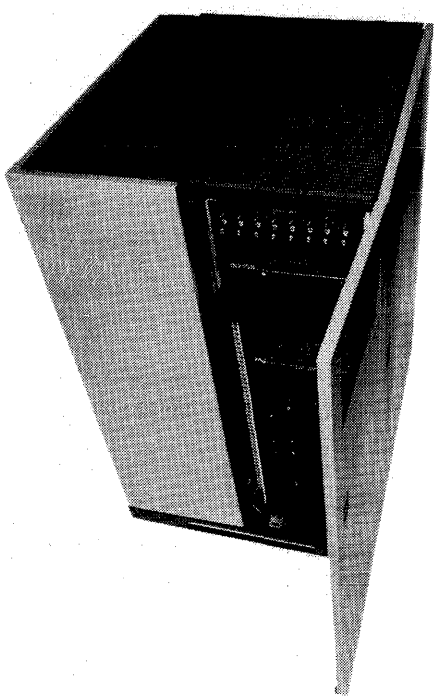
PRICING: The System 3300 is available for lease on a one-, three-, or five-year arrangement or for purchase. Separate maintenance agreements are available for leased or purchased systems. For your convenience, we have included the prime-shift maintenance costs with the system lease costs in the figures presented below. Extra-shift maintenance arrangements are available.

The three- and five-year lease costs are presented below. The monthly lease costs for a one-year arrangement range between 15 and 20 per cent more than the three-year costs excluding the maintenance charge, which is the same.

	Monthly Rental*			
	3-yr.	5-yr.	Purchase	Monthly Maint.**
3301 Control Unit (includes all software and controllers for disk, tape, and up to 8 keystations)	$920	$855	$40,150	$255
Disk Drive, 10 megabytes	350	320	16,600	60
Disk Drive, 24 megabytes	545	495	21,350	70
Tape Drive, 9-tk., 800 bpi.: 7-tk., 556 bpi; or 7-tk., 800 bpi	265	245	8,850	70
Tape Drive, 9-tk., 1600 bpi	450	415	16,225	90
Tape Drive Expansion Rack (for second tape drive)	65	60	2,250	15
Controller for expansion to 16 keystations	65	60	2,700	15
Keystations–				
2930 (field upgrade of 2901)***	60	55	1,590	7
2933 CRT keystation	49	45	1,585	7
2933 Keyboard:				
Keypunch	17	15	575	1
Keypunch with numeric keypad	21	19	720	1
Typewriter	33	30	1,155	1
Typewriter with numeric keypad	37	33	1,300	1
Desk	6	6	200	–
Printers–				
1402 Serial Printer, 30 cps	****	****	****	****
1404 Line Printer, impact, 200 lpm	355	355	8,400	60
1406 Line Printer, non-impact, 180 lpm	140	140	4,950	30
Communications Feature	****	****	****	****

* Includes prime-shift maintenance.
** Prime-shift maintenance, 8 hours/day, 5 days/week.
*** Plus one-time field upgrade charge of $90.
****Prices not firm at press time. ■

Intel Add-On Main Memory for IBM System/370



Intel's 7158 Memory, an add-on or replacement for IBM System/370 Model 158 memory, provides main memory capacities of up to 8 million bytes–twice the IBM-imposed storage limitation for the 370/158.

Intel, a leading semiconductor memory maker, recently introduced itself to end users with MOS add-ons for IBM System/370 Models 135, 145, and 158. Intel enhancements double the allowable capacity of Models 135 and 158.

MANAGEMENT SUMMARY

In May 1975, Intel, a leading manufacturer of semiconductor components and memories, announced its entry into the end-user segment of the IBM System/370 add-on memory market. Prior to its announcement, Intel had been marketing its System/370 memories on an OEM basis only; its memories reached end-users through CIG Computer Products, which continues to market Intel memories, at least for the present. Now end users can deal directly with the manufacturer instead of a third party, which could improve customer relations and result in lower prices. Intel has signed maintenance contracts with Sorbus and Telex, which will provide maintenance in geographic areas served by either maintenance organization. Intel began end-user deliveries in May 1975 with shipments of its 135 and 145 memories, and followed with shipments of its 158 memories in June 1975.

Intel's memories are add-ons or replacements for IBM mainframe memory on System/370 Models 135, 145, and 158. The Intel semiconductor memories employ MOS technology and are available in IBM-standard incremental capacities that provide up to twice the maximum IBM memory capacity for Models 135 and 158.

The Intel memories are completely compatible with IBM memory and require no hardware or software changes. IBM diagnostics can be used to locate failures within the Intel memory, or the unit can be switched off-line and

CHARACTERISTICS

MANUFACTURER: Intel Memory Systems, Division of Intel Corporation, 1302 N. Mathilda Avenue, Sunnyvale, California 94086. Telephone (408) 734-8102.

IBM SYSTEM/370 MODELS: Three models of replacement or add-on main memory are available in IBM-standard incremental storage capacities for IBM System/370 Models 135, 145, and 158 and in enhancement capacities for Models 135 and 158. The models are:

- Model 7135–for IBM System/370 Model 135.
- Model 7145–for IBM System/370 Model 145.
- Model 7158–for IBM System/370 Model 158.

COMPATIBILITY: The Intel memories are designed as plug-compatible add-on or replacement memory for IBM System/370 computers and exhibit complete compatibility with the IBM computer systems. No hardware or software changes are required to extend the storage capacity of an existing IBM processing unit and/or to replace all storage down to the minimum mainframe capacity as specified for the particular CPU model. Intel memory, combined with the mainframe storage of an existing IBM System/370 processing unit, provides the following range of standard and enhanced mainframe storage capacities:

Intel Memory Model	IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	Enhanced Intel Capacities, bytes
7135	3135	96K	96K to 512K	768K or 1024K
7145	3145	160K*	160K* to 2048K	None
7158	3158	512K	512K to 4096K	5120K, 6144K, 7168K, or 8192K

*The minimum capacity for an Intel 3145 upgrade is 256K bytes.

Effective cycle times of the Intel memories are the same as or shorter than those of the corresponding IBM memory. The cycle times of the Intel memories are:

Intel Model	Cycle Time, nanoseconds	Bytes per Fetch
7135	440 (read); 660 (write)	2 or 4
7145	540 (read); 607.5 (write)	4 or 8
7158	1035 (read); 690 (fast write); 920 (long write)	8 or 16

The 7135, 7145, and 7158 memories are semiconductor memories that employ dynamic MOS N-channel technology. The 7135 and 7145 memories feature plug-in memory cards, each containing 64 1024-by-1-bit semiconductor memory chips. The 7158 memory card contains 64 4096-by-1-bit memory chips. A cluster of 36 memory cards form a Basic Storage Module (BSM) that provides 256K bytes of data storage for the 7135 and 7145, and 1024K bytes for the 7158. The 7135 can contain up to 4 BSM's for a maximum storage capacity of 928K bytes per cabinet. The 7145 and 7158 memory cabinets are divided into two gates, each containing up to 4 BSM's, for a maximum of 7 BSM's. Total storage capacity per cabinet is 1792K bytes for the 7145 and 7680K bytes for the 7158.

Intel Add-On Main Memory for IBM System/370

Intel internal diagnostics used. Failed memory, Intel or IBM, can be interchanged with an identical segment of operable Intel memory by means of a simple dialing procedure. □

➤ **Error Checking and Correction (ECC) logic compatible with IBM's is included in the 7145 Intel memory. The Intel 7135 and 7158 memory systems make use of the ECC logic in the IBM CPU. The ECC feature detects and corrects single-bit errors; it also detects all double-bit and most multiple-bit storage errors, but does not correct them. Parity checking is also used to verify all other data and addressing within the memory.**

Storage Protection logic compatible with IBM's is also included in Intel memory models. This feature guards against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage.

Memory reconfiguration is another feature provided by the Intel memories. This feature permits the user to interchange any malfunctioning memory segment (including IBM memory) with an identical segment of Intel memory (usually high-order), simply by dialing. The interchanged memory segments are automatically assigned each other's addresses, and normal operation can continue with the remaining portion of operable memory, pending servicing of the malfunctioning segment.

The Intel memories contain an integral power supply that satisfies the memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, provides an off-line diagnostic capability to facilitate the isolation of malfunctions within the unit and supplements the on-line IBM diagnostics. The Intel memories provide full compatibility with IBM diagnostics, and Intel supplies its own comprehensive diagnostics for off-line testing.

Physical specifications and heat dissipation for each of the Intel memories are as follows:

Memory Model	Maximum Storage, K Bytes	Depth, inches	Width, inches	Height, inches	Weight, pounds	Max. Heat Dissipation, BTU/hr.
7135	928	30.5	15.0	60	850	24,250
7145	1792	53.5	31.5	60	1,400	22,400
7158	7680	35.0	40.0	60	1,700	17,060

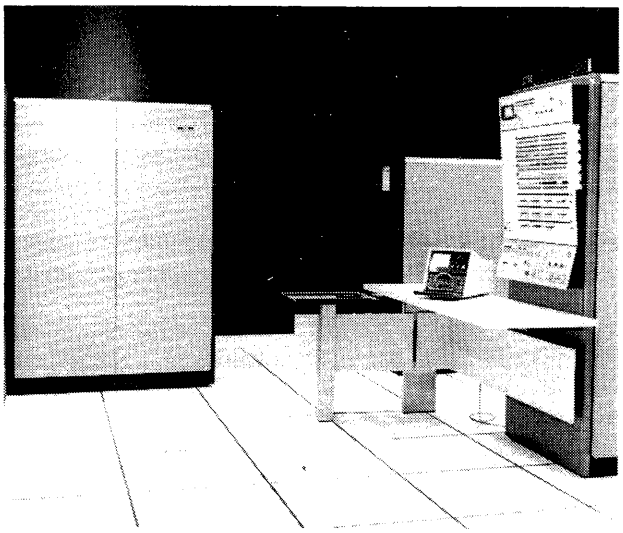
Intel memories are powered from a 208/230-volt, 3-phase, 4-wire source. They swing away from the processing unit to provide accessibility to the CPU and attached memory from all sides.

PRICING: The Intel memories are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Intel provides lease contracts for 2, 3, 4, and 5 years. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. A separate maintenance contract is available for leased or purchased units.

IBM Processor Conversion		Monthly Rental*	Purchase	Monthly Maint.**
From 3135 FE	(96K) to:			
GD	(144K)	$ 770	$ 30,000	$ 80
GF	(192K)	1,310	52,000	130
DH	(290K)	1,875	76,000	175
H	(256K)	2,085	84,000	215
HF	(320K)	2,475	95,000	275
HG	(384K)	3,080	125,200	335
I	(512K)	3,995	163,500	430
IH	(768K)	6,565	266,015	785
J	(1024K)	9,080	352,115	1,105
From 3135 GD	(144K) to:			
GF	(192K)	770	30,000	80
DH	(240K)	1,310	52,000	130
H	(256K)	1,500	54,000	150
HF	(320K)	1,915	75,500	235
HE	(384K)	2,245	85,300	295
I	(512K)	3,190	134,500	370
IH	(768K)	5,850	221,650	725
J	(1024K)	8,030	295,075	1,045
From 3135 GF	(192K) to:			
DH	(240K)	770	30,000	80
H	(256K)	1,025	38,650	95
HF	(320K)	1,390	53,500	170
HG	(384K)	2,095	80,200	240
I	(512K)	2,965	120,125	365
IH	(768K)	5,495	220,830	720
J	(1024K)	7,675	306,930	1,040
From 3135 DH	(240K) to:			
H	(256K)	1,015	34,885	115
HF	(320K)	1,455	54,345	175
HG	(384K)	2,495	104,760	320
I	(512K)			
IH	(768K)	4,915	200,460	675
J	(1024K)	7,095	286,560	995
From 3135 H	(256K) to:			
HF	(320K)	1,140	46,500	170
HG	(384K)	2,110	83,220	310
I	(512K)			
IH	(768K)	4,530	178,920	665
J	(1024K)	6,705	265,020	985
From 3135 HG	(384K) to:			
I	(512K)	1,160	47,760	170
IH	(768K)	3,585	143,460	525
J	(1024K)	5,760	229,560	845
From 3135 (I)	(512K) to:			
IH	(768K)	2,425	95,700	355
J	(1024K)	4,600	181,800	675
From 3145 H	(256K) to:			
HG	(384K)	1,300	45,000	155
I	(512K)	2,075	78,000	290
IH	(768K)	3,750	140,000	530
J	(1024K)	5,590	205,820	720
JI	(1536K)	9,895	304,245	1,330
K	(2048K)	13,720	426,920	1,710
From 3145 HG	(384K) to:			
I	(512K)	1,285	45,000	155
IH	(768K)	3,060	114,000	450
J	(1024K)	4,480	191,000	635
JI	(1536K)	9,175	286,840	1,245
K	(2048K)	13,000	409,510	1,625
From 3145 I	(512K) to:			
IH	(768K)	2,075	78,000	290
J	(1024K)	3,820	138,100	530
JI	(1536K)	8,255	314,820	1,140
K	(2048K)	12,085	412,830	1,520
From 3145 IH	(768K) to:			
J	(1024K)	2,075	78,000	290
JI	(1536K)	6,595	222,750	900
K	(2048K)	10,420	356,490	1,280
From 3145 J	(1024K) to:			
JI	(1536K)	4,445	149,500	610
K	(2048K)	8,265	284,150	990
Model 7158 for IBM 370 Model 158				
512K bytes		2,685	101,200	500
1024K bytes		5,070	190,750	800
1536K bytes		7,485	285,000	1,100
2048K bytes		9,965	392,000	1,500
2560K bytes		12,365	430,000	1,800
3072K bytes		14,680	570,000	2,100
3584K bytes		16,325	657,500	2,400

* Monthly rental under a 3-year lease, including maintenance for 24 hours/day, 7 days/week.
**Maintenance for 24 hours/day, 7 days/week.

Intermem Series 7000 Add-On Main Memory



Intermem offers replacement core memory for IBM System/360 Models 65, 65MP, 67, 75, and 195 at extremely attractive prices. Memory enhancements to 16 million bytes (16 times IBM's storage limit) are available for Models 65, 67, and 75.

MANAGEMENT SUMMARY

Since its inception, Intermem has dedicated itself to providing replacement core memory for IBM System/360 Models 65, 65MP, 67-1, and 75. In January 1974, Intermem expanded its product line to include replacement core memory for the System/360 and 370 Model 195, and the company also offers an enhanced replacement for the IBM 1052 I/O Console.

Intermem has installed about 11.5 million bytes of memory on 360/65 and 65MP computers (the area in which it has developed the most expertise) and about 2 million bytes on 360/370 Model 195 computers as of June 1975. Deliveries to 360/67 and 75 installations have not been made to date. Lead time on orders is currently quoted at 60 to 90 days after receipt of order.

Intermem offers memory enhancements for Models 65, 67, and 75 that range up to an unprecedented 16 million bytes—16 times IBM's maximum memory capacity for these models and at least four times the amount known to be available from any other independent memory vendor. What's more, Intermem packs up to 4096K bytes (in 256K-byte increments) into a single cabinet as compared with IBM's 256K-byte 2365 cabinet, yielding substantial savings in floor space, cooling, and power requirements. Each Intermem cabinet attaches to a separate memory port on the IBM Model 65, 67, or 75 processing unit, providing up to 4 million bytes of memory per port—again, 16 times IBM's per-port capacity.

Users who have a purchased IBM 2365 attached to each of the four memory ports are not precluded from adding more memory. These users can add Intermem enhancement capacities via Intermem's optional Fifth Port, which can accommodate any amount of additional memory up to an overall total of 16 million bytes. The Fifth Port option sells for $7,000 and can be leased.

CHARACTERISTICS

MANUFACTURER: Intermem Corporation, Market Street, Wappingers Falls, New York 12590. Telephone (914) 297-5996.

MODELS: Four models of Series 7000 replacement core memory. Three are available in IBM-standard incremental capacities and in enhanced storage capacities for System/360 Models 65, 65MP, 67-1, and 75; the fourth is available in IBM-standard incremental capacities only for the System/360/370 Model 195. The intermem models are:

- Model 7065 – replaces the IBM 2365 Model 2.
- Model 7075 – replaces the IBM 2365 Model 3.
- Model 7065 MP – replaces the IBM 2365 Model 13.
- Model 7195 – replaces IBM M-116 memory on Model 195.

COMPATIBILITY: Intermem Series 7000 Memory is designed as plug-compatible add-on or replacement memory for System/360 Models 65, 65MP, 67-1, and 75 and System/360/370 Model 195. It can be used to extend the existing storage capacity of an IBM processing unit and/or to replace all existing IBM main storage. Series 7000 Memory provides the following range of IBM-standard and enhanced mainframe storage capacities:

Series 7000 Memory Model	IBM Processing Unit	IBM Processor Storage*	Standard IBM Capacities, bytes**	Enhanced Intermem Capacities, bytes**
7065	2065	2365-2	256K to 1024K	1280K to 16,384K
7065	2067-1	2365-2	256K to 1024K	1280K to 16,384K
7075	2075	2365-3	256K to 1024K	1280K to 16,384K
7065MP	2065MP	2365-13	512K to 2048K	None
7195	3195	M-116	1024K to 4096K	None

* All existing IBM memory can be replaced.
** Standard and enhanced capacities are incremental by 256K bytes for Models 7065 and 7075, and by 1024K bytes for Model 7195.

The operating parameters of the Intermem 7000 Series memory are equivalent to those of the counterpart IBM memory. Models 7065, 7065MP, and 7075 have an effective cycle time of 750 nanoseconds per 8-byte fetch and provide two-way (Models 7065 and 7065MP) or four-way (Model 7075) interleaving. Model 7195 has an effective cycle time of 756 nanoseconds per 8-byte fetch and provides 8- or 16-way interleaving in the same manner as its counterpart IBM memory.

Each memory unit except the 7195 contains an integral power supply that satisfies memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, provides an off-line diagnostic capability to facilitate the isolation of malfunctions within the unit. The memory also contains semiconductor Storage Protection arrays. Off-line diagnostic capability is optional for the 7195 memory; the IBM diagnostic program is normally used. Storage Protect for the 7195 memory is located in the

Intermem Series 7000 Add-On Main Memory

Intermem also offers 360/65, 65MP, 67, and 75 users an option that permits interchanging defective memory with operable memory. The feature, which sells for $5,000 and can be leased, permits a user with up to 2 megabytes of total memory to interchange any two 256K-byte memory segments (including IBM memory) simply by dialing; interchange segments are 512K bytes for memories up to 4 megabytes. Normal operation can continue with the remaining portion of operable memory, pending service.

Intermem memory for Model 195 users is available in 1024K-byte increments, one per cabinet. No enhancement capacities are offered at this writing. To date, Intermem has two Model 195 installations, and both have been successful.

Intermem's Series 7000 memory provides complete software and hardware transparency. Intermem has received IBM certification for maintenance continuance on its Model 65, 65MP, and 195 installations.

Intermem's Series 7000 memory is available at dramatically low prices. For example, a System/360 Model 65 installation upgraded from 256K to 768K bytes with Intermem memory will provide savings of $14,520 or $15,650 per month under a two- or three-year lease, respectively, as compared to the cost of equivalent IBM memory. Further savings can be realized on extended lease terms. Intermem also offers substantial savings on its memory for the Model 195.

Intermem installs its own memory units and provides customer service by contracting personnel from Sorbus, Comma (a subsidiary of Control Data Corporation), Telex, or Itel, depending on the geographic location.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, three users reported on their experience with Intermem add-on memories, one installed on a 360/65MP, one on a 360/65, and one on a 370/195. To supplement these, Datapro contacted five more users who reported on their experience with a total of five Intermem add-ons, including three installed on 360/65MP's, one on a 360/65, and one on a 370/195. The 8 users reported on an aggregate of 9,472K bytes of Intermem memory. Their ratings are presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	6	2	0	0	3.8
Equipment reliability	6	2	0	0	3.8
Maintenance service**	4	1	1	0	3.5
Ease of installation	5	2	0	1	3.4

* Weighted Average on a scale of 4.0 for Excellent.
** Third-party maintenance; see text below.

The ratings above are indicative of well-satisfied users, and that feeling was borne out in Datapro's conversations with five of these users. One situation we ran into exemplifies Intermem's attitude toward its product and its customers.

If you total the responses above for maintenance service, you will see that only six of the eight users are represented. One user declined to provide a rating for this category. The eighth user reported serious maintenance difficulties early in the installation history; but the memory had been acquired from a third-party leasing firm, and a maintenance agreement was signed outside Intermem's direct control. The user subsequently signed with Intermem, which was still a third-party arrangement but under Intermem's control, and "things have improved dramatically." In addition, "the manufacturer (Intermem) was very cooperative in trying to assist us" during the difficult period.

Users reported installation times of 24 to 36 hours on-line. Several minor and a few major problems were reported in installation; but keep in mind that these installations frequently included processor upgrades and were in general more complex than most memory replacements. The one poor rating for ease of installation stemmed from a problem in the priority logic with a 65MP system. Installation required five days, but the memory was in daytime use during this period. The user rated the memory's overall performance as excellent.

In summary, Intermem memory clearly merits serious consideration as a cost-effective alternative to IBM memory for System/360 Models 65, 65MP, 67, and 75 and by 360/370 Model 195 users. □

processor and is part of the processor upgrade when required.

Models 7065, 7065MP, and 7075 each house up to 4096K bytes per cabinet. Model 7195 houses 1024K bytes per cabinet. Each cabinet measures 29.5 inches wide by 50 inches deep by 72.5 inches high. Cabinet weight ranges from 1,080 pounds (256K bytes) to 1,530 pounds (4096 bytes) per 70XX cabinet and is 1,500 pounds per 1024K-byte 7195 cabinet. Heat dissipation ranges from 7,160 BTU/hr (256K bytes) to 18,970 BTU/hr (4096K bytes) for the 70XX memory and is 25,000 BTU/hr per 1024K bytes of 7195 memory.

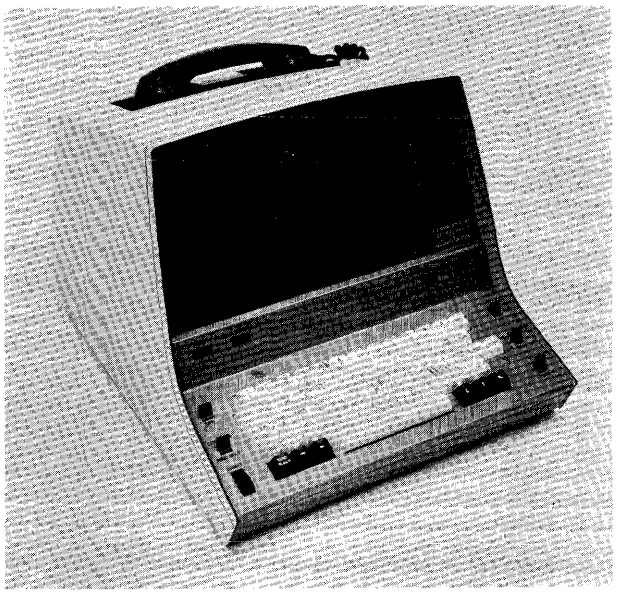
PRICING: The Intermem Series 7000 Memory is available for purchase or on a two-, three-, four- or five-year lease. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. Separate maintenance contracts are available for leased or purchased units and provide either Prime Shift (9 hrs/day, 5 days/week) or Full Coverage (24 hrs/day, 7 days/week) maintenance.

Module Capacity, bytes	Monthly Rental* 2-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
Models 70XX:				
512K	$ 5,240	$ 4,110	$125,580	$ 420
1024K	7,700	6,050	167,160	600
1536K	9,810	7,700	208,740	770
2048K	11,120	9,550	256,620	950
3072K	16,570	12,990	339,780	1,310
4096K	21,070	16,510	422,940	1,670

Model 7195: Contact vendor

*** Lease prices shown include Prime Shift maintenance.**
**** Monthly maintenance for 9 hrs/day, 5 days/week; maintenance for 24 hrs/day, 7 days/week is priced at 1.5 times the Prime Shift maintenance rate.■**

ITT 3501 Asciscope



ITT has shattered prices in the teletypewriter replacement market with the introduction of its $65-per-month Asciscope CRT terminal, which is designed as a direct replacement for the Teletype Model 33 and 35 teletypewriters.

MANAGEMENT SUMMARY

ITT's recently introduced Asciscope represents a dramatic breakthrough in CRT terminal pricing. The Asciscope's unprecedentedly low price tag of just $65 per month (including an integral modem and acoustic coupler) should make it an economically attractive replacement for thousands of teletypewriter terminals.

Designed as a direct replacement for a Teletype Model 33 or 35 teletypewriter, the Asciscope is a "bare-bones" CRT terminal that provides the essential functions of a CRT without elaborate features such as formating operations, insert and delete functions, tabbing, etc. The Asciscope is suitable for most inquiry/response and time-sharing applications, but not for specialized data-entry operations that may require the use of displayed formats with protected fields.

The 35-pound Asciscope can communicate with a remote computer, another Asciscope, or a teletypewriter. Key features include a 960-character semiconductor display memory, an integral modem with acoustic telephone coupler, a selectable line length of 72 or 80 characters, two operating modes, selective transmission, a program-controlled cursor, an I/O interface for hard-copy applications, and a self-test mode.

Operation over the dial network is performed via the terminal's integral modem and telephone coupler, which accommodates a conventional telephone handset and can operate at data rates up to 300 bits/second (30 char/sec). ➢

CHARACTERISTICS

MANUFACTURER: International Telephone and Telegraph Corporation (ITT), Data Equipment and Systems Division, East Rutherford, New Jersey 07073. Telephone (201) 935-3900.

COMMUNICATIONS: Transmits and receives asynchronously in the half- or full-duplex mode at fixed speeds of 110, 300, 1200, or 2400 bits/second. The transmission code is 8-level ASCII (including parity); the unit code structure is 11 bits/character (including one start and two stop bits) at 110 bits/second and 10 bits/character (including one start and one stop bit) at all other speeds.

Connection to a voice-band communications facility is established via any one of the following arrangements: an integral, modem and acoustic telephone coupler, which operates at speeds up to 300 bits/second, includes originate and answer modes, and can interface a communications facility via a wired or acoustic connection; or an external modem for operating speeds up to 2400 bits/second. An RS-232C interface is provided for an external modem.

CRT DISPLAY: The 12-inch (diagonal measurement) CRT screen provides a viewing area 9 inches wide by 5 inches high. The screen is arranged in 12 lines of 72 or 80 characters each to total 864 or 960 character positions. Line length is switch-selectable.

A character set of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols, is displayed in yellow-orange against a dark background. Characters are generated via a 5-by-7 dot matrix.

DEVICE CONTROL: The Asciscope operates in either of two operator-selectable modes: Character or Block.

In the Character mode, trnsmission occurs on a character basis, and data received or keyed is displayed beginning at the first character position of the first line (home). Subsequent entry continues line by line until the last line is filled. When the screen capacity is exceeded or a line feed occurs with the cursor positioned on the last line, the displayed data rolls upward by one line and the data contained on the top line is lost. The rolling action continues as subsequent lines are filled or line feeds occur. Home Cursor and Form Feed functions move the cursor to the first character position of the first line.

In the Block mode, keyed or received data is displayed as in the Character mode; however, transmission occurs only on a block or message basis, where the entire contents of the display buffer is transmitted on operator command. Selective Transmission, a standard feature, permits transmission of a portion of the displayed data–that portion bracketed by Start-of-Text (<) and End-of-Text (>) symbols. ➤

ITT 3501 Asciscope

In applications where a higher transmission speed is required, an external hard-wired modem can replace the integral modem and coupler. ITT provides an interface for speeds up to 2400 bits/second.

Terminal operation is flexible as a result of the two operating modes. Data can be transmitted on a message or character basis. A portion of the displayed data can be transmitted through use of the standard Selective Transmission feature. Scrolling of keyed or received data from bottom to top of screen can be selected when operating in a character mode. The scrolling feature, however, is limited by the screen capacity.

A self-test mode is incorporated to aid in diagnosing internal malfunctions. In this mode, keyed data is displayed to insure the integrity of the keyboard, buffer, character generator, modem, and screen.

The Asciscope is scheduled for production deliveries in November 1972. ITT plans to maintain the Asciscope on a direct replacement basis. Currently, ITT maintains 62 service centers in major U.S. cities.

ITT also markets the Alphascope Display System (Report 70D-538-02), an IBM 2260 and 2265 replacement which it began delivering in late 1970 and which has been well received.

A multiplexor designed to share a modem or printer (via an RS-232C interface) among up to six Asciscope CRT terminals is scheduled for imminent announcement. □

The cursor, displayed as a blinking underscore, can be positioned in any of four directions: up, down, left, and right. Repetitive operation and wraparound capability are provided by these four functions. The cursor can also be returned to the initial display (home) position or to the initial position of the next line. All cursor functions can be initiated manually via the keyboard or automatically via control codes within a received message.

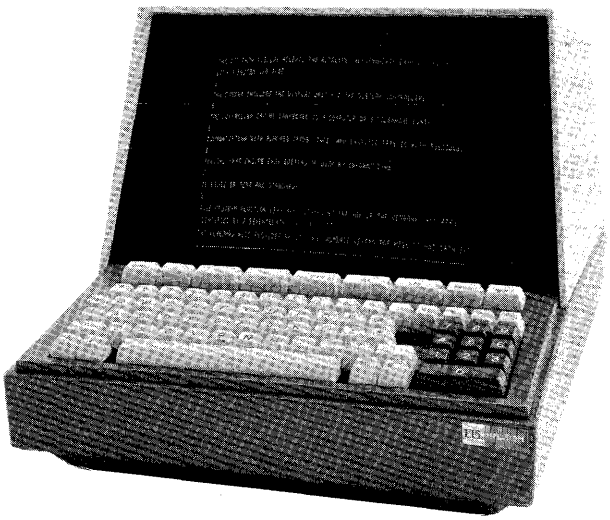
ERROR CONTROL: Parity (even, odd, or none, as specified) is generated and accompanies each transmitted character. Parity is checked on received data, and a special error symbol is displayed in place of a detected error.

KEYBOARD: 59-key typewriter style. The keyboard can generate any of 75 ASCII characters, including upper-case alphabetics, numerics, special symbols, and control codes. A repetitive-entry capability is provided.

I/O INTERFACE: An RS-232C interface provides a connection to a customer-supplied I/O device such as a printer. The interface is rated at a maximum transfer rate of 300,000 char/second. ITT offers a wide selection of printers that operate at 10, 30, 120, or 240 char/second. Printing can be initiated by the operator or by program control.

PRICING: The Model 3501 Asciscope is available for purchase or on a 3-month or 1-year lease, which includes prime-shift maintenance. The unit can be purchased for $2,195 or rented for $65/month under a 1-year lease or $85/month under a 3-month lease. Lease and purchase prices include the integral modem and acoustic telephone coupler. Installation is billed at a one-time charge of $50, or $25 when the order includes more than 10 units. Maintenance within a 20-mile radius of an ITT service center is included in the monthly rental. ITT charges $5 for each additional 20-mile increment. ■

ITT 3100 Alphascope Display System



The Alphascope Display System is a fully compatible replacement for the multi-station IBM 2260/2848 and the single-station IBM 2265/2845 Display Stations. The Alphascope features noteworthy enhancements over its IBM counterparts as well as reduced prices.

MANAGEMENT SUMMARY

The ITT 3100 Alphascope Display System offers multi-station and single-station replacements for IBM 2260/2848 and 2265/2845 Display Stations, respectively, for communication with IBM System/360 or System/370 computers. The Alphascope System is designed for operation either in a communications environment as a remote terminal or in a computer environment as a peripheral subsystem; it provides both hardware and software compatibility with the IBM terminals. Like its IBM counterparts, the Alphascope System is supported by standard IBM software and remote terminals operating under the full Operating System (OS) or the Disk Operating System (DOS) via either BTAM, QTAM, or other IBM telecommunications programs.

Besides providing all standard IBM 2260 and 2265 features, the Alphascope offers several enhancements as described in the following paragraphs.

- *Display Capacity*—Alphascope screen sizes range from 240 to 1920 characters; IBM 2260 screen sizes range from 240 to 960 characters, while the IBM 2265 has a fixed screen size of 960 characters.
- *Total Displays*—The Alphascope controller can accommodate up to 32 1920-character displays without degradation of screen capacity. By comparison, IBM's 2848 controller can accommodate a maximum of 24 240-character displays or 16 480-character displays. The Alphascope System can be expanded to 64 displays by multiplexing as many as 8 controllers on a single channel interface.
- *Display Arrangement*—The Alphascope provides ▷

CHARACTERISTICS

MANUFACTURER: International Telephone and Telegraph Corporation (ITT), Data Equipment and Systems Division, East Rutherford, New Jersey 07073. Telephone (201) 935-3900.

CONFIGURATION: The 3100 Alphascope Display System includes one of five models of display controllers; 1 or up to 4, 8, 16, or 32 display stations; and 1 or up to 32 printers.

The Alphascope System is designed either for remote operation in a communications environment, or for local operation in a computer environment as a computer peripheral subsystem.

The five controller models are listed below with the corresponding maximum number of displays and printers that each will accommodate. Multiple displays do not result in degradation of screen capacity.

Controller Model	Maximum Displays	Maximum Printers	Screen Size, Characters*
3101	1	1	960 or 1360
3104	4	1	480, 960, or 1360
3108	8	1	480, 960, or 1360
3116	16	16	240, 480, 960, 1360, or 1920
3132	32	32	240, 480, 960, 1360, or 1920

*Screen sizes cannot be mixed on the same controller.

When operating in a computer environment, the controller is directly attached to the multiplexer or selector channel of an IBM System/360 (Model 22 and above) or System/370 computer. The data transfer rate in this mode is 3300 characters per second.

Any mix of up to eight Alphascope 3101, 3104, and 3108 Controllers can share the same modem or, in a local environment, the same multiplexer or selector channel via the ITT-3134 Multiplexer.

COMMUNICATIONS: Asynchronous in the half-duplex mode at a transmission speed of 1200, 2400, or 4800 bits/second (120, 240, or 480 char/second).

The 8-level (including parity) ASCII transmission code is used; the unit code structure is 10 bits/character, including unity start and stop bits.

The Alphascope System is connected to a voice-band communications facility via a modem compatible with the ITT-2003 or Bell System 201 or 202 Data Sets. ►

ITT 3100 Alphascope Display System

display arrangements identical with those of its IBM counterparts, as well as other display arrangements not provided by IBM.

- *Printed Output*–Some models of Alphascope controllers, like their IBM counterpart, restrict the print capability to one printer, which is shared by up to four or eight displays. However, ITT's latest controllers (Models 3116 and 3132) can accommodate up to 16 or 32 printers respectively–one per display. The ITT user can specify any of several printers available from ITT, including Teletype Models 33 and 35, the GE Terminet 300, the NCR thermal printer, and a Centronics printer in addition to ITT's own product line of Dataprinters.

- *Editing*–The Alphascope features character insert and delete features not available with the IBM terminals.

- *Format Operation*–The Alphascope permits formatting to be performed the IBM way or the ITT way; the latter is a more flexible technique that permits protected format descriptors to be displayed at any screen location.

- *Keyboard Feature*–The Alphascope keyboard can include a numeric inset consisting of 10 keys arranged in an adding-machine format. This feature, not provided by IBM, is intended for high-volume entry of numeric data. The keyboard also features five program select keys that can be used to initiate specific program-defined applications; the last line of the CRT display is used by the application program to identify the program keys by name.

The ITT Alphascope System was originally designed and manufactured by ITT in Sweden and is in use throughout Europe. Domestic deliveries began four years later, in late 1970. To date, ITT boasts of 75 users within the U.S., with over 1300 units installed. The Alphascope System is currently produced in the U.S.

Service is provided by ITT, which has 62 service centers located in major U.S. cities.

A Datapro survey of installations using the ITT Alphascope System (some for over two years) found the users quite satisfied with the system's performance, reporting little or no downtime. Where service was required, it was reported as equal to or better than IBM service. Most of the installations contacted had replaced IBM 2260/2848 Display Systems with the Alphascope System. □

The Alphascope System is transmission-compatible with the IBM 2701 Data Adapter equipped with an IBM Terminal Adapter Type III at 1200 or 2400 bps, the IBM 3705 Communications Controller operating in the Emulation mode at speeds up to 7200 bps, or the ITT-3127 Data Adapter, an ITT replacement for the IBM 2701.

CRT DISPLAY: An 11-, 12-, or 21-inch (diagonal measurement) CRT provides the following respective viewing areas: 8.25 by 5.5 inches, 9 by 6 inches, or 16 by 10 inches. The 21-inch CRT is available as a monitor only (without keyboard). A character set of 67 ASCII characters, including upper-case alphabetics, numerics, and special symbols, is displayed in yellow-orange against a dark background. Characters are generated by a 5-by-7 dot matrix.

The following screen capacities and display arrangements are available:

Char./Display:	**240**	**480**	**960**	**1360**	**1920**
Lines/Display:	**6**	**12**	**12**	**17**	**24**
Char./Line:	**40**	**40**	**80**	**80**	**80**

DEVICE CONTROL: The Alphascope System is designed to operate in an addressing and polling environment under control of the program stored in the remote computer. Operation is compatible with IBM telecommunications software, including BTAM and QTAM under OS/360 or DOS/360. The Alphascope terminals are compatible with the IBM four-byte addressing sequence, command code structure, and line discipline employed by the IBM 2260/2848 and 2265/2845 Display Stations.

The cursor, displayed as a blinking full matrix, can be specified as destructive or nondestructive. Cursor control keys move the cursor right, left, up, or down by one position or to the "home" position (first screen location). A repeat function provides repetitive cursor movement. The cursor moves from the last character position of a line to the first character position of the next line, and the converse (wraparound).

Character insert and delete functions allow the insertion or deletion of characters into or from displayed text. The text expands or contracts to accommodate the inserted or deleted data. Insert and delete functions affect displayed text from the cursor to the end of the screen.

The Tab function moves the cursor to the character position following a Tab Stop character with each depression of the Tab key. Tabbing can continue line by line until the cursor moves from the last display position to the first (home) position, an automatic tab stop.

Erasure functions permit erasure of displayed data from the cursor to the end of a line or to the end of the screen, or erasure of the entire screen.

The Format mode is program-generated and can be initiated by a keyed request. The format, received from the remote computer, contains fixed and variable fields. Fixed fields are protected from inadvertent key entry and contain format descriptors. Variable fields, preceded by a displayed Tab Stop character, are used for data entry. Only variable fields are transmitted; fixed data remains displayed for the next data entry operation. Tabbing is used to skip to the beginning of the next variable field after partial entry into a variable field.

The New Line code can also be used to construct a fixed format by using the symbol to separate a variable data field (to the left of the symbol) from a fixed field containing a format descriptor. Only the variable data to the left of the New Line symbol is transmitted; the fixed data remains displayed for the following data entry operation.

The Print function initiates the execution of a printed copy of a displayed page. All displayed data is immediately transferred to the print buffer and the terminal is available for further data entry.

ITT 3100 Alphascope Display System

Program function codes can be generated by a set of five program function keys. Each of the codes can be program-defined to specify or select special applications.

ERROR CONTROL: Character and longitudinal parity generation is performed on all commands and messages transmitted to and received from the remote computer. A message is automatically retransmitted from a terminal when a negative acknowledgement to a just-transmitted message is received. An error symbol is displayed in place of a character received in error. The terminals respond to detected errors by transmitting a negative acknowledgement. A Cancel character is transmitted following text when a buffer parity error is detected.

KEYBOARD: A 66-key typewriter-style keyboard can generate any of 62 ASCII characters, including upper-case alphabetics, numerics, and specials. A 10-key adding-machine-style keyset is available as an option.

PRINTER: Several printers are available for printed output of displayed data. These include Teletype's Model 33 or 35 RO, NCR's 30-cps thermal printer (non-impact), Centronics' 101 (165 cps), GE's Terminet (30 cps), and ITT's Envoy Data Printer (20 cps).

PRICING: The 3100 Alphascope Display System is available for purchase or on a one-, two-, three-, four-, or five-year lease, which includes prime-shift maintenance. A maintenance contract is available for purchased units. A one-time charge of $100 is billed for installation.

	Monthly Rental (1)	Purchase	Monthly Maint.
CRT Displays:			
11-inch (with keyboard)	$ 40	$ 1,200	$10
11-inch (with keyboard and numeric inset)	45	1,400	10
12-inch (with keyboard and numeric inset)	45	1,400	10
24-inch (without keyboard)	75	2,500	15
Controllers:			
3101 (One display)	135	6,150	25
3104 (Up to 4 displays)	455	19,050	40
3104 (Up to 4 displays using 480 double-size chars.)	475	19,850	40
3108 (Up to 8 displays)	650	26,950	50
3108 (Up to 8 displays using 480 double-size chars.)	670	27,750	50
Print buffer (one per controller)	60	2,350	5
Local Interface (one per controller)	190	7,200	20
Remote Interface (For above controllers; up to 2400 bps)	40	1,600	5
3116 Controller (1 to 16 displays) (2)	665	24,000	65
3132 Controller (16 to 32 displays) (2)	785	28,000	85
Display Adapter (one per display):			
240 characters	20	650	2
480 characters	20	650	2
960 characters	25	900	3
1360 characters	40	1,300	4
1920 characters	40	1,300	4
Print Buffer (one per printer):			
240 characters	20	650	2
480 characters	20	650	2
960 characters	25	900	3
1360 characters	40	1,300	4
1920 characters	40	1,300	4
Printer Multiplexer (one per subsystem)	35	1,000	5
Local Interface (up to 3300 char/sec) (3)	15	425	4
Remote Interface (up to 2400 bps) (3)	10	250	3
Controller Multiplexer (4)	25	730	5
Communications Adapter Secondary (5)	15	600	5
Data Adapter (IBM 2701 replacement)	440	16,900	40

(1) For one-year lease; includes maintenance.

(2) Requires Display Adapter, one per display, and Print Buffer, one per printer; the Printer Multiplexer is required when printers are incorporated.

(3) For 3116 and 3132 Controllers only.

(4) Connects up to eight 3101, 3104, or 3108 controllers to a local or remote interface.

(5) Connects controllers 2 to 8 to the Controller Multiplexer; one per controller required. ■

ITEL 7830/7330 Disk Storage Facility

ITEL's plug-compatible replacement for the IBM 3330 Disk Storage Facility features compatibility (under OS) with the IBM System/360 Model 65 and up, the capability to add up to 16 drives, and better performance at a substantially lower price than its IBM counterpart.

MANAGEMENT SUMMARY

The ITEL 7830/7330 Disk Storage Facility is designed as a plug-to-plug replacement for the IBM 3330 Disk Storage Facility. The ITEL unit offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and operating characteristics. No hardware or software modifications to existing IBM equipment are required. Disk packs recorded by ITEL drives can be read by the equivalent IBM drives, and the converse.

ITEL, in order to remain competitive with IBM, has recently added a 16-Device Address feature, which provides the capability to add a second string of eight 7330 drives to a 7830 controller. Although the addressing scheme has not been finalized at this writing, ITEL claims it will be compatible with that of IBM.

ITEL now supports the use of its 7830/7330 Facility with IBM System/360 Models 65, 67, and 75 operating under OS. Changes to the Operating System are minor and are incorporated by means of a sysgen, using ITEL-supplied software. A Datapro interview with ITEL's initial Model 65 installation found its users to be quite satisfied. The installation, including four drives, required only two days to install and was up and running two to three hours after the initial sysgen. Some minor hardware problems were encountered, but were quickly resolved.

CHARACTERISTICS

SUPPLIER: ITEL Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 989-4220.

MANUFACTURER: Information Storage Systems (ISS), Inc. (an ITEL subsidiary), 10435 North Tantau Avenue, Cupertino, California 95104. Telephone (408) 257-6220.

DISK DRIVE: Model 7330 Disk Storage Drive.

DISK CONTROLLER: Model 7830 Storage Control Unit.

CONFIGURATION: The ITEL 7830/7330 Disk Storage Facility includes a 7830 Storage Control Unit and one to eight 7330 Disk Storage Drives; all drives can remain on-line and immediately accessible to the computer. A second string of eight drives can be added to the basic 7830/7330 Facility when the 16-Device Address feature is incorporated. This feature is completely compatible with the IBM technique for addressing more than eight drives on the same controller.

The optional Two-Channel or Four-Channel Switch features provide two or four channel interfaces, respectively, which serve as alternate data paths to the controller and its attached disk drives.

COMPATIBILITY: The 7830/7330 subsystem is designed for connection to an IBM System/360 computer, Models 65 through 195, or an IBM System/370 computer, Models 135 through 195 (via the Block Multiplexer Channel) as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 7830/7330 provides complete compatibility with the IBM 3330 command structure and, except for System/360 Models 65, 67, and 75, requires no changes to the existing software.

System/360 Models 65, 67, and 75 can accommodate the 7830/7330 subsystem via a Selector Channel, but require minor software modifications to be made to the Operating System. Modification is performed in two steps, each requiring less than a half hour to implement. The process consists of an I/O gen followed by a partial sysgen during which the necessary changes are incorporated via ITEL-supplied software. ITEL provides this capability as an extra-cost feature.

STORAGE CAPACITY: The data storage capacity of each ITEL 7330 Disk Drive is identical with that of one spindle of the two-spindle IBM 3330 Disk Storage module: 100.018 million bytes. Total on-line storage capacity of an 8-drive sybsystem is 800.146 million bytes.

ACCESS ARRANGEMENT: Each ITEL 7330 Disk Drive provides access to 404 recording cylinders (19 tracks/cylinder) via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface.

ITEL 7830/7330 Disk Storage Facility

The performance characteristics of the ITEL subsystem are slightly improved over those of the IBM 3330 Facility, offering the user a 10 (average) to 30 (track-to-track) percent advantage in rated positioning time. Rotational speed, data transfer rate, and storage capacity, however, are identical with those of the IBM units.

The ITEL 7830 Control Unit is equipped with micro-programmed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive while it is off-line. ITEL also provides its own diagnostic programs for on-line systems testing.

Like its IBM counterpart, the 7830/7330 Facility features Rotational Position Sensing (RPS), Multiple Requesting, and Command chaining.

The IBM 3330 and ITEL 7830/7330 subsystems have different physical configurations. IBM has maintained the multiple-spindle-per-cabinet design which it used for the earlier 2314 subsystem and later 2319 units. Although this packaging technique conserves floor space, it restricts the subsystem to a limited number of configurations—two, four, six, or eight spindles in the case of the IBM 3330. The one spindle-per-unit approach used by ITEL requires at least 28 percent less floor space (including service area) and allows any number of spindles, up to the maximum number per subsystem, to be used.

Like their IBM counterparts, the ITEL 7330 drives are capable of fully overlapped seek operations on any combination of up to 16 on-line drives, and of multi-track searching through a cylinder without loss of any disk revolutions.

Two- or four-channel selection is also available for the ITEL disk subsystem. The channel selection feature permits the 7830 controller to be attached to two or four computers for shared operation, between two or four controller positions on the same computer, or in a combination of both arrangements. Switching is performed under program control.

ITEL has priced its 7830/7330 subsystem under IBM's price "umbrella" for equivalent storage capacities. ITEL's prices for monthly to 5-year leases (including complete service) range from 10 to 35 percent below IBM's prices for equivalent subsystems, respectively, while purchase prices range from 15 to 20 percent lower.

The ITEL 7830/7330 subsystem was announced in January 1972, and customer deliveries began in October 1972.

ITEL provides its own service through its field service division, headquartered in Palo Alto, California with regional offices in Los Angeles, Chicago, and New York. ITEL has established over 35 service locations in most major cities. □

Each cylinder position provides access to 247,570 bytes of storage.

DISK PACK: Each ITEL 7330 Disk Drive accommodates one IBM 3336 Disk Pack or an equivalent pack. The 3336 contains 12 disk and provides 19 recording surfaces.

FILE ORGANIZATION: Identical to that of IBM; each disk pack corresponds to one logical file. Module Select (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

PERFORMANCE: The performance characteristics of the ITEL 7330 drives are compared with those of the IBM 3330 drives in the following table.

Head Positioning Time, Milliseconds

Disk Drive	Track to Track	Average (400 cyl.)	Maximum (400 cyl.)	Tracks per Inch
ITEL 7330	7	27	50	192
IBM 3330	10	30	55	192

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically by both the ITEL and IBM drives.

PHYSICAL CHARACTERISTICS: The physical arrangement of the ITEL 7830/7330 subsystem is quite different from that of the IBM 3330. Unlike the 3330, the ITEL subsystem consists of discrete components with the following cabinet dimensions:

Device	Width, inches	Depth, inches	Height, inches	Weight, pounds
7330 Drive	20	32	40*	440
7830 Controller	41	32	60	700

*Disk-pack access height is 36 inches.

Compared with a full-blown (8 spindles) channel-connected IBM 3330 Facility, which stacks its drives two-high, the ITEL 7830/7330 subsystem requires 28 percent less floor space, including the required service area.

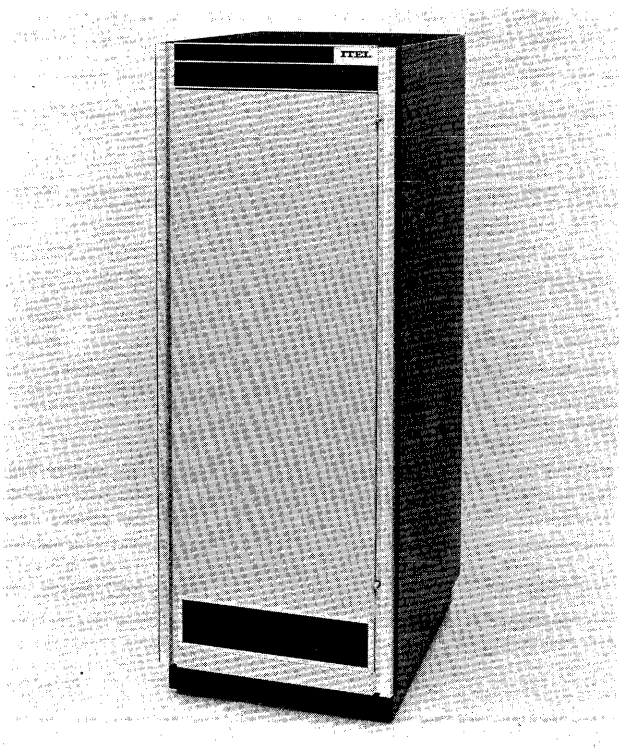
The ITEL 7830/7330 subsystem operates in the same physical environment as the IBM 3330, with slightly lower power requirements.

PRICING: The ITEL 7830/7330 Disk Storage Facility is available for purchase or lease. Leases are available on a month-to-month basis or for one to five years. Lease rates include installation, all cables, diagnostic performance checks, and unlimited usage. Maintenance is available on a 24-hour/day, 7-days/week basis, excluding holidays, for both leased and purchased units.

	Monthly Rental* 2-Year Lease	5-Year Lease	Purchase	Monthly Maintenance
7330 Drive	$490	$420	$21,060	$118
7830 Controller	1,815	1,560	77,760	191
16-Device Address	170	140	8,000	20
Two-Channel Switch	150	130	6,480	15
Four-Channel Switch	300	260	12,960	25

* Does not include maintenance. ■

ITEL 7835/7305 Fixed Head Storage



ITEL offers a replacement for IBM's 2835 Storage Control and 2305 Fixed Head Storage at a substantial reduction in price. The ITEL controller also provides the capability to connect a string of up to eight 3330-type drives, which can yield economies for users of IBM virtual storage.

MANAGEMENT SUMMARY

The ITEL 7835/7305 Fixed Head Storage is designed as a plug-to-plug replacement for the IBM 2835 Storage Control and 2305 Fixed Head Storage and the IBM 3330 Disk Storage Facility. The ITEL unit offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections and operating characteristics.

The 7835/7305 can be used on IBM System/370 Models 135 through 195 and System/360 Models 65 through 195. No hardware or software modifications to existing IBM equipment are required to incorporate the 7835/7305 on an IBM System/370 computer, but minor changes must be made to the Operating System of a System/360 computer in order to incorporate the 7835/7305 subsystem. The necessary changes are incorporated via a partial sysgen using ITEL-supplied software.

ITEL is the first of the independent peripheral manufacturers to introduce fixed-head storage for use on IBM System/370 and System/360 computers. Its 7835/7305 subsystem is more than a duplicate of IBM's expensive 2835/2305 subsystem; it also provides the user with a "3330" capability. This dual capability permits the user to share a common controller between a single fixed-head drive and a string of ITEL's 3330-type drives, described in Report 70D-546-01. This cost-cutting maneuver saves the ▷

CHARACTERISTICS

SUPPLIER: ITEL Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 989-4220.

MANUFACTURER: Information Storage Systems (ISS), Inc. (an ITEL subsidiary), 10435 North Tantau Avenue, Cupertino, California 95014. Telephone (408) 257-6220.

DISK DRIVES: 7305 Fixed Head File, Models 2 and 3, and 7330 Disk Storage Drive (see Report 70D-546-01 for 7330 details).

DISK CONTROLLER: Model 7835 Storage Control Unit.

CONFIGURATION: The ITEL 7835/7305 Fixed Head Storage subsystem can be arranged in one of three configurations: (1) a 7835 Storage Control Unit and one 7305 Fixed Head File, Model 2 or 3; (2) a 7835 Control Unit and two 7305 Fixed Head Files (models cannot be mixed); or (3) a 7835 Control Unit, one 7305 Fixed Head File, Model 2 or 3, and one to eight 7330 Disk Drives. The 16-Device Address feature is required when the 7835 is to accommodate a second 7305 Fixed Head File or a string of 7330 Drives.

COMPATIBILITY: The 7835/7305 subsystem is designed for connection to an IBM System/360 computer, Models 65 through 195, or an IBM System/370 computer, Models 135 through 195, as a plug-compatible replacement for the IBM 2835/2305 Fixed Head Storage. The 7835/7305 provides complete compatibility with the IBM 2305 command structure and, except for System/360 Models 65, 67, and 75, requires no changes to the existing operating software. The same statement is true for the 7835 and attached 7330 drives in respect to the IBM 3330 command structure. System/360 Models 65, 67, and 75 can accommodate the 7835/7305 subsystem via a Selector Channel, but require minor software modifications to the Operating System. The modifications are incorporated via a partial sysgen using ITEL-supplied software. Two controller addresses are required when both 7305 and 7330 drives are used.

STORAGE CAPACITY: The data storage capacity of each ITEL 7305 Drive, Model 2 or 3, is identical with that of an IBM 2305 Model 2: 11.25 million bytes. Total on-line storage capacity of a 2-drive 7835/7305 subsystem is 22.5 million bytes. The total on-line storage capacity of a 7835/7305 subsystem with one 7305 drive and eight 7330 drives is 811.4 million bytes.

ACCESS ARRANGEMENT: Each ITEL 7305 provides access to 768 addressable tracks via fixed read/write heads, one per track. Each track provides access to 14,660 bytes of storage.

ITEL 7835/7305 Fixed Head Storage

user from having to pay for separate controllers but will also result in lower throughput in most cases.

Virtual storage is the most significant application area for ITEL's 7835/7305 subsystem. The 7835/7305 is an important alternative to IBM's 3330 that enables the virtual storage user to upgrade his performance without paying the high IBM prices for a 2835/2305 subsystem. There is a growing suspicion that many 3330 users will fall into a performance bind brought on by paging transfers between disk storage and main memory.

Although the older System/360 computers cannot operate in the virtual storage mode, fixed-head storage is still worth considering for files which are subject to high activity.

The ITEL 7835/7305 is scheduled for first customer deliveries during the third quarter of 1973.

ITEL's 7305-2 Fixed Head File (equivalent to IBM's 2305-2) and its 7835 Control Unit are both priced 10 percent below their IBM counterparts under a two-year lease and 20 percent below them on a purchase basis. Additional savings on leased equipment can be realized through ITEL's extended lease terms.

ITEL provides its own service through its field service division, headquartered in Palo Alto, California with regional offices in Los Angeles, Chicago, and New York. ITEL has established over 35 service locations in most major cities. □

DISK ARRANGEMENT: Each ITEL 7305 contains 6 non-removable disks with a total of 12 recording surfaces.

PERFORMANCE: The performance characteristics of the ITEL 7305 drives are compared with those of the IBM 2305 drives in the following table.

Drive	Model	Access Time, Msec. Average	Access Time, Msec. Maximum	Rotation, Msec.	Transfer Rate, bytes/sec
ITEL 7305	2	5	10.25	10	1,500,000
ITEL 7305	3	8.3	16.7	16.7	900,000
IBM 2305	2	5	10.25	10	1,500,000

PHYSICAL CHARACTERISTICS: The physical characteristics of the ITEL 7835/7305 subsystem are as follows:

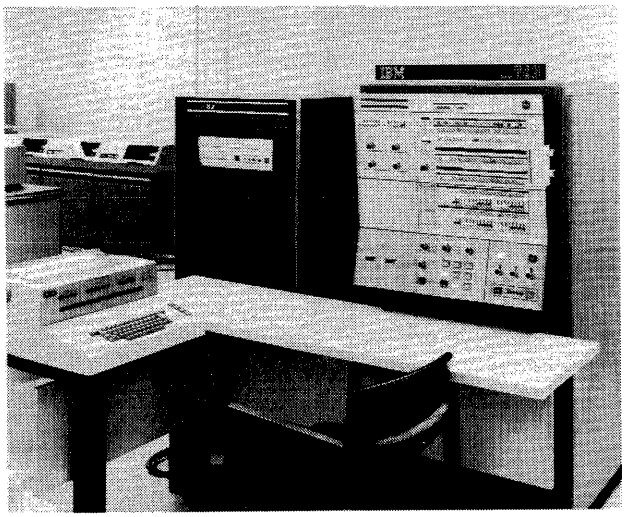
Device	Width, Inches	Depth, Inches	Height, Inches	Weight, Pounds
7305 Drive	22	30	61	350
7835 Controller	20	32	40	700

PRICING: The ITEL 7835/7305 Fixed Head Storage subsystem is available for lease or purchase. Leases are available on a month-to-month basis or for one to five years. Lease rates include installation, all cables, diagnostic performance checks, and unlimited usage. Maintenance is available on a 24-hours-per-day, 7-days-per-week basis for both leased and purchased units.

	Monthly Rental* 2-Year Lease	Monthly Rental* 5-Year Lease	Purchase	Monthly Maint.
7835 Controller	$1,890	$1,620	$81,000	$475
Drives:				
7305-2	2,945	2,530	126,000	600
7305-3	2,030	1,740	86,400	530
7330	490	420	21,060	118
16-Device Address Feature	170	140	8,000	20

*Does not include maintenance. ■

Itel Monolithic Main Memory and Hierarchical Main Memory



Using MOS technology, Itel's products replace or add on to IBM System/370 (135 through 165) and System/360 (22, 30, 40, 50, 65, and 67) main memories, offering expansion beyond IBM's limits for most models. A new product, HMM, offers 370/145 users substantial cost savings with only a small decrease in performance.

MANAGEMENT SUMMARY

Itel, one of the industry's leading independent suppliers of semiconductor main memory to end users, offers a broad line of add-on or replacement memories for IBM System/370 and 360 computers.

Itel's Monolithic Main Memory is available for System/370 Models 135, 145, 155, 158, and 165 and for System/360 Models 22, 30, 40, 50, 65 and 67. These MOS semiconductor memories are available in IBM-standard capacities for all models, as well as in enhancement sizes that extend the IBM maximum capacities for 370 Models 155 and 165 and for 360 Models 22, 30, 50, 65 and 67.

The Itel memories can replace all existing memory down to the minimum storage capacity as specified by IBM for each processing unit. Complete memory replacements can be made on the System/360 Model 65 and System/370 Models 155 and 165, where all main memory is external to the processing unit. On these processor models, Itel memory replacements offer substantial reductions in floor-space requirements. For example, a single Itel memory cabinet can contain up to 2048K bytes of storage, which is equivalent to the capacity of eight IBM 2365's or four IBM 3360 Models 3 or 5. Other benefits include a substantial reduction in power consumption and heat dissipation, which translates into significant reductions in air conditioning loads.

Itel offers an acceleration feature for the 370/155 that can particularly benefit the user of a purchased Model 155. Called Processor Speed-Up (PSU), the AMS-produced feature promises to increase the performance of a 370/155 by 10 to 20 percent, to a level equivalent to that of the 370/158. The PSU feature does not include a dynamic address translation (DAT) capability, but it does provide complete compatibility with the IBM DAT feature, which permits its use with a 370/155-II. Read/write cycle times of the PSU are identical with those for the IBM 370/158 (but not the new 370/158-3). The PSU feature is included within the Itel memory cabinet. An integral storage adapter permits the Itel memory to bypass ▷

CHARACTERISTICS

SUPPLIER: Itel Corporation, Data Products Group, One Embarcadero Center, San Francisco, California 94111. Telephone (415) 983-0000.

MANUFACTURER: Although Itel officially refuses to name its suppliers, it is common industry knowledge that the Itel memories delivered to date (except for the HMM) have been manufactured by Advanced Memory Systems, Inc. (AMS), 1276 Hammerwood Avenue, Sunnyvale, California 94086; telephone (408) 734-4330. Itel's Hierarchical Main Memory is currently supplied by National Semiconductor Corporation, Memory Systems Divison, 1177 Kern Avenue, Sunnyvale, California 94086; telephone (408) 732-5000.

MODELS: Monolithic Main Memory is available in all storage capacities currently offered by IBM for System/370 Models 135, 145, 155, 158, and 165 and for System/360 Models 22, 30, 40, 50, 65, and 67. The memories are also available for most models in "enhancement" capacities which extend main memory beyond the IBM-imposed limits. Hierarchical Main Memory is available for the System/370 Model 145.

COMPATIBILITY: Monolithic Main Memory is designed as plug-compatible add-on or replacement memory for IBM System/370 Models 135 through 165 and for System/360 Models 22, 30, 40, 50, 65, and 67. It can be used to extend the storage capacity of an existing IBM System/370 or System/360 processing unit and/or to replace all core storage down to the minimum mainframe capacity as specified for the particular IBM processing unit. The following table presents the range of IBM-standard and Itel-enhanced storage capacities available for each of the IBM processing units. Operating speed of the Itel memory matches that of the corresponding IBM processing unit.

IBM Processor Model	Min. IBM Capacity, bytes	Standard IBM Capacities, bytes	Itel Enhanced Capacities, bytes
3135	96K	96K to 512K	None
3145	160K	160K to 2048K	None
3155*	0	256K to 2048K	3072K or 4096K
3158	512K	512K to 4096K	None
3165*	0	512K to 3072K	4096K
2022	24K	24K to 32K	64K to 128K
2030	8K or 16K	16K to 64K	96K or 128K
2040	32K	64K to 256K	None
2050	128K	128K to 512K	768K or 1024K
2065 & 2067	0*	256K to 1024K	1280K, 1536K, 1792K, or 2048K

*All existing IBM memory can be replaced.

Monolithic Main Memory is constructed of MOS semiconductor modules in increments (Basic Storage Modules) of 32K, 48K, 64K, 96K, 128K, 256K, and 512K bytes that in different combinations provide per-cabinet storage capacities ranging up to 8192K bytes. The Basic Storage ►

Itel Monolithic Main Memory and Hierarchical Main Memory

IBM's Storage Adapter, providing additional savings by precluding the need for a second IBM storage adapter when both ports of the primary SA are occupied.

Itel offers its new Hierarchical Main Memory (HMM) as an alternative to its plug-compatible memory for users of the System/370 Model 145. The HMM, available in 0.5-million-byte increments from 0.5 million to 4.0 million bytes, includes 16K bytes of cache memory and offers savings of 35 to 50 percent over the lease prices of equivalent amounts of IBM main memory. Itel's HMM provides complete hardware and software compatibility with the 370/145. The HMM operates at about 90 percent of the speed of a standard 145 memory (depending on the unit's "hit" ratio) under normal operating conditions. Thus, Itel's new product offers 370/145 users a substantial increase in memory capacity at one-third to one-half the cost of equivalent IBM memory with modest performance degradation.

Error checking and correction (ECC) is featured on all Itel memories. An error light notifies the operator that maintenance is required, while normal processing continues. Maintenance is facilitated by a fault location capability, which identifies the exact card that is failing. The memory is quickly serviced by replacing the failing card.

Itel's lease prices under a two- or five-year lease range from 10 to 50 percent below IBM's monthly rental charges. Itel's purchase prices range from 10 to 60 percent below IBM's. Itel's HMM leases for 38 to 54 percent below and sells for 49 percent below IBM's rental and purchase prices.

Deliveries of Itel's Monolithic Main Memory began in June 1971 for System/360 Models 30 and 40, and in August 1971 for Model 50. Deliveries for Model 22 and 65 installations began in January 1972.

Customer deliveries of Itel memory for System/370 installations began in July 1972 with the Model 155, and first deliveries for Models 165 and 145 were made in January and August 1973, respectively. Deliveries of Itel memory for Models 135 and 155 began in March and June of 1974, respectively. Initial deliveries of the PSU feature for the 370/155 began in June 1974. Itel states that it currently has over 300 megabytes of memory at more than 400 installations and has received IBM certification for maintenance continuance for each of its System/360 and 370 installations. As of this writing, Itel has not announced replacement memory for the 370/168.

Service and installation are provided by Itel, which has service locations in about 60 major cities throughout the U.S. and Canada.

USER REACTION

In Datapro's 1975 survey of plug-compatible main memory users, 11 users reported on their experience with a total of 5 Itel replacement memories for System/360 Models 50, 65, and 67, having an aggregate capacity of 4608K bytes, and a total of 7 Itel replacement memories for System/370 Models 145, 155, and 165, having an aggregate capacity of 25,704K bytes. Their ratings are presented in the following table.

Modules are formed from storage cards, each containing 32 or more MOS chips with a capacity of 4096 bits/chip.

The Monolithic Main Memory contains an integral power supply that satisfies memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode.

Hierarchical Main Memory (HMM), currently available for the 370/145 only, ranges from 0.5 million to 4.0 million bytes and is available in 0.5-million-byte increments. HMM includes a 16K-byte cache and uses the IBM 370/158 addressing scheme. Addressing and logic changes must be made to the 370/145 CPU to attach HMM, and the 370/145 must retain at least 256K bytes of integral main memory. up to 4 million bytes of HMM can be added to up to 2 million bytes of integral main memory to provide a total of 6 million bytes of memory. HMM is composed of P-channel MOS chips with a capacity of 2048 bits/chip.

Physical specifications, heat dissipation, and power requirements for the AMS memory cabinets are as follows:

IBM Computer System	Cabinet Capacity, bytes	Depth, inches	Width, inches	Height, inches	Maximum Weight, lbs.	Power, watts
360/22, 30, 40, and 50	32K to 384K	25	25	55	485	140 to 420
360/65, 67	256K to 1048K	62.5	30	70	2,300	3,000 to 4,000
370/135	48K to 256K	25	25	55	450	300 to 600
370/145	48K to 512K	32	62	60	1,250	300 to 1,200
370/155	512K to 2048K	62	32	60	1,700	3,000 to 4,000
370/165	512K to 2048K	62	32	72	2,300	3,000 to 4,000

PRICING: Itel offers its Monolithic Main Memory and Hierarchical Main Memory for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Itel provides lease contracts for one, two, three, four, and five years.

Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and full-coverage maintenance (24-hours/day, 7-days/week). A separate maintenance contract is available for purchased units.

IBM Processor Conversion		Monthly Rental* 2-Year Lease	5-Year Lease	Purchase	Monthly Maint.
From 2022/2030E	(32K) to:				
F	(64K)	$ 960	$ 780	$ 39,593	$ 68
From 2022/2030F	(64K)				
FE	(96K)	960	780	41,250	68
G	(128K)	1,894	1,520	82,500	85
From 2022/2030FE	(96K) to:				
G	(128K)	960	780	41,250	68
From 2040F	(64K) to:				
G	(128K)	1,280	1,040	55,043	102
GF	(192K)	2,965	2,402	109,459	126
H	(256K)	4,320	3,510	184,887	150
From 2040G	(128K) to:				
GF	(192K)	1,520	1,235	54,417	102
H	(256K)	3,040	2,470	129,843	126
From 2040GF	(192K) to:				
H	(256K)	1,520	1,235	75,428	102
From 2050G	(128K) to:				
H	(256K)	3,040	2,470	129,844	150
HG	(384K)	5,768	4,687	198,075	184
I	(512K)	7,996	6,497	338,577	218
IH	(768K)	13,035	10,592	535,228	286
J	(1024K)	17,991	14,619	743,941	354
From 2050H	(256K) to:				
HG	(384K)	2,728	2,217	68,232	150
I	(512K)	4,956	4,027	208,733	184
IH	(768K)	10,557	8,578	430,871	252
J	(1024K)	15,513	12,605	639,585	320
From 2050HG	(384K) to:				
I	(512K)	2,228	1,811	140,502	150
IH	(768K)	7,996	4,027	208,733	218
J	(1024K)	13,035	10,592	535,228	286

Itel Monolithic Main Memory and Hierarchical Main Memory

	Excellent	Good	Fair	Poor	WA*
Overall performance	8	3	1	0	3.6
Equipment reliability	7	4	1	0	3.5
Maintenance service	6	6	1	0	3.4
Ease of installation	3	6	0	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

The majority of these users reported only minor problems during installation and testing and in diagnosing malfunctions and obtaining service. Judging by the high ratings they assigned to the Itel memory and the lack of comments indicating significant product disadvantages or serious problems, these users are obviously well satisfied with the products and with Itel's support. □

IBM Processor Conversion		Monthly Rental* 2-Year Lease	5-Year Lease	Purchase	Monthly Maint.
From 2050I	(512K) to:				
IH	(768K)	$ 4,956	$ 4,027	$ 208,733	$ 184
J	(1024K)	10,557	8,578	430,871	252
From 2065/2067 (zero memory) to:					
H	(256K)	4,800	3,600	160,000	336
I	(512K)	9,600	7,200	320,000	476
IH	(768K)	14,400	10,800	480,000	600
J	(1024K)	19,200	14,400	640,000	715
JH	(1280K)	24,000	18,000	800,000	854
JI	(1536K)	28,800	21,600	960,000	1,003
JIH	(1792K)	33,600	25,200	1,120,000	1,174
K	(2048K)	38,400	28,800	1,280,000	1,368
KJ	(3072K)	57,600	43,200	1,920,000	2,146
L	(2096K)	76,800	57,600	2,560,000	2,530
From 2065/2067H	(256K) to:				
I	(512K)	4,800	3,600	160,000	336
IH	(768K)	9,600	7,200	320,000	476
J	(1024K)	14,400	10,800	480,000	600
JH	(1280K)	19,200	14,400	640,000	715
JI	(1536K)	24,000	18,000	800,000	854
JIH	(1792K)	28,800	21,600	960,000	1,003
K	(2048K)	33,600	25,200	1,120,000	1,174
From 2065/2067I	(512K) to:				
IH	(768K)	4,800	3,600	160,000	336
J	(1024K)	9,600	7,200	320,000	476
JH	(1280K)	14,400	10,800	480,000	600
From 2065/2067IH	(768K) to:				
J	(1024K)	4,800	3,600	160,000	336
JH	(1280K)	9,600	7,200	320,000	476
From 3135FE	(96K) to:				
GF	(192K)	1,755	1,465	85,680	85
DH	(240K)	2,635	2,195	128,520	126
H	(256K)	2,930	2,445	130,230	156
HF	(320K)	3,545	2,955	159,435	205
HG	(384K)	4,155	3,465	188,640	259
From 3135GD	(144K) to:				
HE	(384K)	3,280	2,730	145,800	222
I	(512K)	4,500	3,750	204,210	333
From 3135GF	(192K) to:				
HE	(384K)	2,400	2,000	102,960	177
I	(512K)	3,625	3,020	161,370	296
From 3135DH	(240K) to:				
HE	(384K)	1,525	1,270	102,960	126
I	(512K)	2,745	2,290	161,370	252
From 3135H	(256K) to:				
HE	(384K)	1,225	1,020	58,410	112
I	(512K)	2,450	2,040	116,820	235
From 3145H	(256K) to:				
HG	(384K)	1,650	1,375	78,390	112
I	(512K)	2,855	2,380	137,880	224
IH	(768K)	5,265	4,390	256,860	449
J	(1024K)	7,680	6,400	375,840	606
JH	(1280K)	10,310	8,595	494,820	776
JI	(1536K)	12,945	10,785	635,310	980
JIH	(1780K)	15,355	12,795	754,280	1,163
K	(2048K)	17,770	14,805	873,270	1,367
From 3155 (zero memory) to:					
I	(512K)	5,400	4,500	198,000	449

IBM Processor Conversion		Monthly Rental* 2-Year Lease	5-Year Lease	Purchase	Monthly Maint.
J	(1024K)	$ 10,800	$ 9,000	$ 396,000	$ 673
JI	(1536K)	16,200	13,500	594,000	945
K	(2048K)	21,600	18,000	792,000	1,282
KJ	(3072K)	32,400	27,000	1,188,000	1,955
L	(4096K)	43,200	36,000	1,584,000	2,564
From 3155I	(512K) to:				
J	(1024K)	5,400	4,500	198,000	449
JI	(1536K)	10,800	9,000	396,000	673
K	(2048K)	16,200	13,500	594,000	945
KJ	(3072K)	27,000	22,500	990,000	1,731
L	(4096K)	37,800	31,500	1,386,000	2,227
From 3155J	(1024K) to:				
JI	(1536K)	5,400	4,500	198,000	449
K	(2048K)	10,800	9,000	396,000	673
KJ	(3072K)	21,600	18,000	792,000	1,282
L	(4096K)	32,400	27,000	1,188,000	1,955
From 3155JI	(1536K) to:				
K	(2048K)	5,400	4,500	198,000	449
KJ	(3072K)	16,200	13,500	594,000	945
L	(4096K)	27,000	22,500	990,000	1,731
From 3158I	(512K) to:				
J	(1024K)	2,575	2,145	113,850	449
JI	(1536K)	5,150	4,290	227,700	673
K	(2048K)	7,725	6,435	341,550	945
KJ	(3072K)	13,855	11,545	617,670	1,731
L	(4096K)	19,000	15,835	845,370	2,227
From 3158J	(1024K) to:				
JI	(1536K)	2,575	2,145	113,850	449
K	(2048K)	5,150	4,290	227,700	673
KJ	(3072K)	11,280	9,400	503,820	1,282
L	(4096K)	16,425	13,690	731,520	1,955
From 3158JI	(1536K) to:				
K	(2048K)	2,575	2,145	113,850	449
KJ	(3072K)	8,705	7,255	389,970	945
L	(4096K)	13,855	11,545	617,670	1,731
From 3158K	(2048K) to:				
KJ	(3072K)	6,130	5,110	276,120	673
L	(4096K)	11,280	9,400	503,820	1,282
From 3158KJ	(3072K) to:				
L	(4096K)	5,150	4,290	227,700	673
From 3165 (zero memory) to:					
J	(1024K)	10,800	9,000	396,000	673
JI	(1536K)	16,200	13,500	594,000	945
K	(2048K)	21,600	18,000	792,000	1,282
KJ	(3072K)	32,400	27,000	1,188,000	1,955
L	(4096K)	43,200	36,000	1,584,000	2,564
From 3165I	(512K) to:				
JI	(1536K)	10,800	9,000	396,000	673
From 3165J	(1024K) to:				
JI	(1536K)	5,400	4,500	198,000	449
K	(2048K)	10,800	9,000	396,000	673
KJ	(3072K)	21,600	18,000	792,000	1,282
L	(4096K)	32,400	27,000	1,188,000	1,955
From 3165K	(2048K) to:				
KJ	(3072K)	10,800	9,000	396,000	673
L	(4096K)	21,600	18,000	792,000	1,282
From 3165KJ	(3072K) to:				
L	(4096K)	10,800	9,000	396,000	673
Itel Memory with Processor Speed-Up for IBM 370/155					
From 3155 (zero memory) to:					
J	(1024K)	13,800	12,000	475,000	673
JI	(1536K)	19,800	17,100	700,000	945
K	(2048K)	26,400	22,800	926,000	1,282
KJ	(3072K)	37,800	32,400	1,350,000	1,955
L	(4096K)	48,000	40,800	1,725,000	2,564
Itel Hierarchical Main Memory for IBM 370/145					
0.5M bytes		3,510	2,635	142,700	405
1.0M bytes		6,875	5,155	280,875	701
1.5M bytes		10,240	7,680	419,050	1,048
2.0M bytes		13,595	10,195	557,225	1,344
2.5M bytes		16,965	12,725	695,400	1,691
3.0M bytes		20,325	15,245	833,575	1,987
3.5M bytes		23,690	17,770	971,750	2,334
4.0M bytes		27,055	20,290	1,109,925	2,630

*Monthly rental under a two- through five-year lease includes maintenance for 24 hours/day, 7 days/week.■

Keane Mini-Key System

Mini-Key is a basic electronic replacement for mechanical methods of data entry with the bonus of sight verification, a few data processing operations, and improved data recording flexibility. The stand-alone capability of the keystations allows effective source data capture. Introducing a minicomputer processor converts a Mini-Key installation into a System/4.

MANAGEMENT SUMMARY

Since its organization in 1965, Keane Associates has been noted for consulting, systems design, and software. In 1971 the company branched out into a hardware venture by reprogramming the Cogar System/4 into a data entry station and stand-alone data processor that has been marketed as the Keane System/4 (while still manufactured by Cogar).

Keane soon recognized a market for simple key-to-tape configurations, provided that they are sufficiently superior to keypunches to effect an appreciable improvement in throughput. Accordingly, the company reduced System/4 to the minimum elements of keystations and a tape converter in February 1972 and appropriately called the new system "Mini-Key."

The recent announcement of the IBM 3740 Data Entry System may focus new attention on the simpler Mini-Key system. An important implication of this event is that IBM itself has now joined the many detractors of keypunching who consider it obsolete. Hence, keypunch loyalists should be convinced at last that they can no longer ignore the benefits of electronic data entry. For the many who are content with basic data entry, unsupported by complex software controls and data processing features, and who mainly seek a modest gain in throughput while improving the professional tone of their environment, Mini-Key should prove an effective vehicle. To the EDP manager who is price/performance conscious as well, Mini-Key and its more sophisticated forebear, System/4, should have the added allure of letting him obtain only the features he wants and is willing to pay for.

Mini-Key matches or surpasses keypunches by offering a variable record length of up to 120 characters, access to two record formats at any time along with the capability of free-form entry, and such features as skipping, duplication, paging, left zero fill, standard verification, and check digit verification. Like more expensive installations, Mini-Key also has a CRT display that enables an ▷

CHARACTERISTICS

MANUFACTURER: Keane Associates, Inc., 36 Washington Street, Wellesley Hills, Massachusetts 02181. Telephone (617) 237-3041

MODELS: Mini-Key.

CONFIGURATION: A Mini-Key system consists of four or more keystations cable-connected to a tape storage unit that converts formatted data recorded on keystation cartridge tape to 7- or 9-track NRZI compatible tape. Only one station actually needs to be connected. Cables can be as long as 1000 feet. Each keystation operates independently.

KEYSTATION: Consists of a 5-inch CRT, a keyboard with either a keypunch or typewriter arrangement, a microprocessor capable of full arithmetic operations and various data entry control functions, and a dual-cartridge tape recording unit.

The CRT display exhibits up to 8 lines, with 32 characters per line. Characters are formed under microprocessor control from a 5-by-7 matrix.

The electronic keyboard is characterized by N-key rollover (clean recording of characters struck in rapid succession). A sound emitted by depressed keys improves operator keying rhythm.

The microprocessor can store two format controls at any time for immediate accessing; others are stored on cartridge tape and loaded from the tape as needed. Numerous data entry control and reformatting functions can be performed in addition to the usual keypunch operations. Three accumulators are present. The cartridge tape recorder comprises two drives, each self-threading. One is used for recording of data and the second for making format tapes and entering the formats into the microprocessor. Read-after-write, CRC, and phase checks are performed. Tapes can be read backward. Both rewind and tape search speed is 40 inches/second.

TAPE STORAGE UNIT: Performs two basic functions. One is the pooling of formatted data records present on keystation cartridges. As the data is received, the second function of conversion is automatically carried out. The resulting output is 7- or 9-track, IBM-compatible, half-inch tape spooled onto 7-inch diameter reels having a 600-foot capacity. Recording density is 550 or 800 bpi at a tape speed of 12.5 inches/second. The data transfer rate is therefore 6950 or 10,000 characters/second, respectively.

SYSTEM OPERATION: Mini-Key can operate in data entry, verification, format recording, and format entry modes. A connected keystation also transfers data to the tape converter console. Cartridge tape can be reused. ➤

Keane Mini-Key System

operator to locate her position, visually search for records or formats called up from cartridge tape, and visually discover errors when originally keyed. These features, along with the inherent advantages of electronic keying and moving tape rather than cards, invariably raise average keystroking rates by 30 to 50 percent. Users say that 12,000 to 13,000 strokes per hour at keystations are typical, compared with 8000 to 9000 strokes at keypunches. Mini-Key operator statistics help reveal the operator's strengths and weaknesses. Other features, such as batch totaling and field definition, are useful in validating recorded data. The foregoing characteristics identify Mini-Key as a basic keypunch replacement that is, nevertheless, distinctly more powerful than even buffered keypunch/verifiers.

Although the manufacturer's literature implies that all keystations should be cable-connected to the tape converter console, only one such connection is really essential. Actually, the purpose of the cable is to permit unloading of data recorded on cartridge tape to the tape converter. At other times the connected station is used for data entry in the usual way. All other stations can be located anywhere rather than limited to the specified 1000-foot cable length provided that each station's cartridges can be hand-carried to a connected station.

Conversation with various users has confirmed the impression that many data entry environments have relatively modest volume requirements; for them, Mini-Key is definitely attractive. Its adherance to fundamental operations and lack of sophisticated features are actually advantageous to many installations accustomed to using host computers for all format restructuring and data processing. Even those installations that perform some data processing before committing data to the computer find a place for Mini-Key in combination with System/4, which includes a minicomputer capable of much useful processing. Thus, the users interviewed represented various gradations of small- and medium-scale data entry operations, and their attitude toward Mini-Key was significantly positive. Ease of operation was a frequently cited advantage.

We point out that these users were satisfied to replace tape cartridges rather frequently and to accept the simplicity of this system. Others with similarly modest requirements should also find Mini-Key a cost-effective means of upgrading outmoded keypunch installations. Then, as input needs grow more complex, Mini-Key can be elevated into a System/4 configuration by adding components to those already in use.

At present, Mini-Key is available from Keane Associates branch offices in Boston, Worcester, Providence, Hartford, and Westport in New England and from offices in Philadelphia and Detroit. The Westport office in Connecticut serves the New York metropolitan area as well as its immediate locality. Installations are serviced by Keane field engineers from these offices. □

Records can be 120 characters long. The system offers sight verification, batch totaling, and numeric and alphabetic field validation. Another parallel with keypunches is that each station is under the sole control of its operator. Each station records operator statistics consisting of output records written, the number of valid keystrokes, and the number of error keystrokes.

In data entry, the operator keys information onto two-track cartridge tape in a serial binary code. Each cartridge can hold 600 records. In terms of 120-character records, this volume is equivalent to a day's work if the average keying rate is 12,000 strokes per hour and total keying time is 6 hours. A capable operator will key more data per day than can be held by a single cartridge.

Verification is accomplished in several ways. One is the standard procedure of keying the same data already recorded in a cartridge and correcting when a mismatch ensues. (It is immaterial which station originally recorded the cartridge.) The CRT display enables visual editing and immediate correction of errors during the entry process. It also lets the operator make visual searches of data records and formats. (No automatic search modes are provided in Mini-Key.) The combination of visual checking, check digit verification, field controls, and batch totaling can obviate standard verification in many instances.

Useful editing can be improvised by using the second tape drive. After a record already in a cartridge is verified, it can be transferred to the second cartridge. A record can be deleted simply by omitting its transfer. Similarly, a record can be inserted at some point by reverting momentarily to the data entry mode and keying it into the second cartridge.

Although each station's output is binary-encoded cartridge tape, the system's ultimate output is computer-compatible tape. Each cartridge is discharged from a cable-connected station to the tape converter, which then produces the desired computer tape. Only one station can transmit to the console at a time. A full cartridge discharges in 2.5 to 3 minutes.

Mini-Key also provides a "gang-punching" utility that enables corrections to be made in some systematic way to a large mass of recorded data. One example is account numbers to be changed by a fixed amount; another is a fixed change in dates, like May to July.

Other features still in development, but not yet available, are off-line totaling and record reformatting. A system printer is also under development.

PRICING: The Mini-Key system is available for outright purchase or for rental on a 1-year lease. The indicated monthly rental prices include prime-shift maintenance. Keane's standard maintenance contract provides prime-shift service between 8 a.m. and 5 p.m. every weekday. Extended service coverage is available through special arrangement.

	Monthly Rental	Purchase	Monthly Maint.
Mini-Key System (4 entry units plus 7-track, 556-bpi converter)	$783	$49,700	$135
Mini-Key System (4 entry units plus 9-track, 800-bpi converter)	775	49,480	135
Mini-Key Entry Unit (Single)	155	10,070	25
Mini-Key Converter (single, 9-track, 800 bpi, 7-inch reel)	155	9,200	35
Mini-Key Converter (single, 7-track, 556 bpi, 7-inch reel)	163	9,500	35 ■

Logic LC-720 KeyDisc System

MANAGEMENT SUMMARY

A quick way of describing the LC-720 is to call it the largest, most powerful key entry system on the market, capable of supporting up to 72 data entry stations, but at the same time the most expensive. But can this description be fully justified? After all, other excellent key-to-disc systems advertise practically all of the standard features of the LC-720. One might wonder, therefore, in what respect the 720 is really more powerful than the others. One can also question whether total installation cost is a reliable cost criterion. These considerations must be resolved in order to understand the LC-720 and assess its potential for a particular environment.

A listing of capabilities alone does not provide adequate insight into how a system will perform under specified conditions. Instead of total costs, a prospective user should concentrate on determining the productivity gain relative to system cost per data entry station. The first step in this determination is to look at the cost per station itself.

The user needs to determine the practical limit of keystations at which the system he is considering becomes "software bound"; that is, slowed down by software implementation. He needs to decide whether the system has sufficient storage to implement all the functions he requires. He needs to find out whether he will be compelled to empty the disc more frequently than is convenient. He also needs to list special functions that he ▷

The LC-720 is a multi-keystation shared-processor data entry system that produces IBM-compatible 7- or 9-track magnetic tape. A disc provides intermediate storage, and software routines can perform extensive processing and validation checks upon the keyed data. Numerous I/O options include line printers, card readers, and paper tape readers.

CHARACTERISTICS

MANUFACTURER: Logic Corporation, 21 Olney Avenue, Cherry Hill Industrial Park, Cherry Hill, New Jersey 08003. Telephone (609) 424-3150.

CONFIGURATION

An LC-720 installation consists of up to 72 LC-720 Data Stations (keystations) a supervisory station, a Varian minicomputer, one or more magnetic disc drives, and magnetic tape drive(s). A card reader, paper tape reader, and a line printer are optional. Other options include a CRT data station and communications interfaces.

LC-720 STANDARD DATA ENTRY STATION: Has a movable keyboard and a 10-inch-high display panel, both resting on a single-pedestal desk. The keyboard is patterned after the IBM 64-character 29 Card Punch, except for the use of control keys instead of switches. A 48-character subset can be selected. "Touch-tone" entry encourages good operator rhythm.

The recently upgraded display panel utilizes both LED arrays and indicator lights. The LED section usually forms ▶

The powerful LC-720 system is most cost-effective in large installations with 40 to 72 keystations.

Logic LC-720 KeyDisc System

wants, other than standard operations, and determine what special software the manufacturer will furnish and when he will provide it.

We have direct confirmation from users that the LC-720 operates efficiently with at least 64 stations. A Logic configuration can be equipped with exactly as much disc storage as an installation requires. Processor core storage capacity is ample. Furthermore, Logic is ready to write any new software and make any system modification that the user wants. Some recent LC-720 software packages appear to be unique in the industry. These considerations justify the impression of the LC-720's inherent power.

At high station multiples, moreover, the cost of the LC-720 per station is definitely competitive with other systems. It is hard to say exactly when this condition sets in, but 40 is certainly not too low a figure to suggest. Logic claims to be competitive at a much lower number of keystations. The user will want to make his own determination in any case.

We believe that the LC-720 should be evaluated carefully for high-production installations–particularly if the combined use of several systems is under consideration.

Unfortunately, multiple-system operation is less cost-effective than a single system with a high number of stations per processor/disc drive. Instead of adding additional systems, the EDP manager might consider adding supervisory consoles to a single system. We make this suggestion because, in view of the sophistication of the LC-720, we suspect that it will pay off fully only when configured and operated in a highly sophisticated way. That way is to approach the limit of 72 stations as closely as possible and employ as much software data validation as is feasible.

Hence, Logic tests the mettle of the EDP manager. In offering so many features, the LC-720 obligates the user to determine carefully what he needs. After installing his system, he has the further obligation to profit from all that he is paying for.

In order to service medium-production installations economically, Logic has adapted the LC-700 KeyDisc system from the LC-720. Essentially, the LC-700 is a version of the 720 that employs a 4.4-megabyte disc drive, the Varian minicomputer, and less extensive software than that of the 720. Logic cites one installation of the LC-700 that employs only 8 data entry stations.

Logic has made 61 LC-720 installations to date. This number should expand as appreciation of the system's capabilities grows and economic pressure requires even greater price/performance than at present.

the last four characters keyed, but under some conditions it also displays special messages, four characters at a time, indicating an error condition or the next step to be taken. The remainder of the panel is backlit by lamps that illuminate particular error and status information when switched on by the system.

LC-720 CRT DATA ENTRY STATION: Has same keyboard as the standard station and is interchangeable with it. Up to 20 lines, each 40 characters long, can be displayed on the screen. During data entry or verification, keyed data is displayed. In addition, data records can be recalled from the disc and displayed on the screen. The bottom is reserved for error messages and keyboard status information. The station features format prompting, which is characterized by the printing of the field name, or tag, of each field just before it is filled. Up to 30 fields can be displayed. (Prompting differs from other presentations serving the same purpose, as represented by the Entrex 480, wherein all field names flash on together before any data is keyed.) A special station capable of displaying 1920 characters is available.

SUPERVISORY STATION: Can be a Teletype ASR Model 33 teleprinter or a new terminal consisting of an electronic keyboard and a 30-char/sec, 132-column printer housed in a system console.

CONTROL PROCESSOR: Consists of a Varian 620 minicomputer with a 1.8-microsecond cycle time, a 16-bit word length, and a 4,096-word storage capacity that is expandable to 32,768 words in 4,096-word increments.

Addressing is facilitated by indexing from two registers and by multilevel indirect addressing. Data is transferred at rates of over 200,000 words/second. A real-time clock with selectable time base is instrumental in the generation of job and operator statistics. The processor also has memory protection circuits and power failure/restart capability. The latter interrupts the unit upon power failure and automatically restarts it upon power recovery.

DISC DRIVES: Can be any of several models, depending on the required storage capacity, and more than one unit can be incorporated. All the drives issue supervisory warning messages when they are 90 and 100 percent full.

Large installations employ the ISS Model 714 Disk Storage Drive, which is plug-compatible with the IBM 2314 drive and uses the IBM 2316 Disk Pack (11 discs with a total capacity of 29.17 megabytes). The 714 data transfer rate is 312,000 bytes/second, and its average access time is 32 milliseconds (compared with 60 milliseconds for the 2314). Start-up and shut-down times are 20 seconds each (compared with 60 seconds)

Exceptionally large installations can employ the equivalent of a double-density IBM 2314 disc drive, such as the ISS 715 drive, which has a 58.34 megabyte capacity. Its data transfer rate is also 312,000 bytes/second, and its average access time is 29 milliseconds. Start-up and shut-down times are 20 and 25 (max.) seconds, respectively.

Medium-size installations employ the ISS Model 701, which is plug-compatible with the IBM 2311 drive and uses the IBM 1316 Disk Pack (6 discs with a total capacity of 7.25 megabytes). The 701's data transfer rate is 156,000 bytes/second and its average access time is 30 milliseconds (compared with 75 milliseconds for the 2311). Start-up and shut-down times are 15 seconds each (compared with 60 seconds).

Logic LC-720 KeyDisc System

SOFTWARE

Because of Logic's willingness to write special programs, the LC-720 has become known as a "customized" system. LC-720 software is structured into functional modules so that a new program can be readily incorporated into the library of existing software.

Programs that carry out data station operations and those that perform supervisory functions are blended into a fully interactive and cohesive software unit. Data station service routines operate in what is called the foreground partition. These routines execute data transfers between the stations and the processor and between the processor and the disc data storage area. Such functions as editing, skipping, duplication, current mode control, four-character display, error condition display, etc., are also performed by foreground routines.

Supervisory programs are segregated into the background partition. These routines implement data manipulation, such as totaling, comparing, and balancing, and exert output control. As the term background implies, these routines cannot lower throughput by reacting with foreground operations. Ultimately, the net effect of the error controls and editing functions applied by the two partitions is production of a data file remarkably free of discrepancies that would eventually cause wasted computer time and impose costly checking procedures. Data, when transferred from disc to tape, is recorded in formats designed to facilitate subsequent computer processing.

Another purpose of LC-720 software is that of relieving the operator of almost all responsibility except keying. Hence, the ultimate achievement of software in shared-processor/disc systems, and especially of LC-720 software, is the production of reliable data at an extremely high throughput rate.

Logic also supplies supplementary software for straight data processing during off-shift hours when data entry is suspended. To the many application programs that allow the Varian 620 minicomputer to operate under its own identity, Logic has recently added a simulator that accepts programs written for the IBM System/360 Model 20. We cannot directly verify Logic's claim that in this simulation mode a throughput gain is realized, but comparison of the minicomputer with the older Model 20 shows that the claim is not implausible despite the additional routines that must be executed.

USER REACTIONS

Datapro found that the attitude of users toward the LC-720 was surprisingly uniform. About concrete matters they were consistently positive. Yes, the system is extremely reliable and does not fail more than 1 percent, or maybe 2 percent, of the time. Logic Corporation's maintenance is prompt and efficient. There is

MAGNETIC TAPE DRIVES: Can be one or more of a number of Pertec drives, depending on the characteristics specified by the user. Output is 0.5-inch IBM-compatible 7- or 9-track tape. The density of 7-track tape is 200, 556, or 800 bits per inch; parity can be odd or even. For 9-track tape the density is 800 or 1600 bpi; parity is odd. In addition, LRCC parity is employed for all recording densities. CRCC parity is generated for all but phase-encoded tapes (1600 bits/inch). Each reel has a capacity of 2400 feet.

PRINTERS: Can be selected from a group of five printers, including a matrix printer, that print 80 or 132 characters/line. The printing rate of the Centronics table-top matrix printer varies from 165 char/sec to 1100 lines/min. The Data Products 80-column drum printer, which produces upper case only, operates at the rate of 350 to 1100 lines/min. Another option is a 132-column model, either a drum or chain printer, that prints 300 lines/min. The drum printer prints upper case only, while the chain printer provides both upper and lower case. Another chain printer option prints 132 columns at 600 lines/min. both upper and lower case. The final option is either a drum or chain printer that prints 132 columns at 1100 lines/min, both upper and lower case.

CARD READER: Reads 51, 80, and 96-column cards at a rate of 400 cards/min for 51 and 96-column cards and 300 cards/min for 80-column cards.

PAPER TAPE READER: Reads 600 char/sec.

OPERATING MODES

- Data entry.
- Verification (subsequent rekeying of data by the same or a different operator for comparison with the original entries).
- Dual verification (a second operator keys the same data a record or two behind the first operator; corresponding entries are then compared).
- Format entry (formats can be entered in interactive or batch modes).
- Search (each operator can retrieve selected information from disc storage by keying descriptors that the desired record contains; e.g., batch or job number, date, account number).

SYSTEM OUTPUT

- IBM-compatible tape as described under Magnetic Tape Drives, above.
- IBM-compatible discs. (A disc pack may be removed from the drive and used in place of tape to supply data directly to a computer as long as the computer in programmed to access the data records. Logic provides such a disc dump program for IBM 360/370 computers.)
- Edited text (prepared text can be stored and later printed upon demand, including name, address, and variable text insertions).

Logic LC-720 KeyDisc System

no interaction between data entry stations. Software, despite its scope, does not inhibit keying in any way. Yes, productivity has shot up and average keying rates have risen substantially. Data validation has been effective and sifts errors from the output tape extemely well. (It is worth noting that this kind of affirmation has been given by users of most of the competitive systems as well.) In addition, LC-720 users credit software for attracting them to the system originally, and they express satisfaction with its performance.

When the issue passes on to price/performance, however, the responses are less clear. Productivity has increased all right, but managers imply that they are wondering whether their system operation is optimal. It seems reasonable to conclude that as experience with the LC-720 accumulates, it will become even more cost-effective.

The number of data stations per installation usually lies between 40 and 60. Users say that administrative problems have discouraged them from increasing the number of stations. Logic says that there are smaller installations as well, including some with LC-700 components.

To our previous suggestion of incorporating a second supervisory console, we offer another thought: perhaps Logic should organize a users' association to help them pool their combined experience. □

SYSTEM PROFILE

- Record length–variable from 1 to 320 characters. Blocking of up to 4096 characters is possible.
- Formats–over 4000 stored in disc library; up to 99 or, in some cases, 120, as selected by the supervisor, can reside in the processor. As many operators as necessary can use a particular format.
- Data record storage–42,000 80-character records on a 1316-type disc pack and 133,000 112-character records on a standard 2316-type pack. Up to 9999 records can be grouped within a batch.
- System management storage–no practical limit to the magnitude of disc file storage available for software and system management functions.
- CRT Data Entry Station – can display 20 lines of up to 40 characters each.

SOFTWARE

Functions performed by LC-720 software include control of data station operation, supervisory service, job statistics, I/O device control, data transfer between system components, reformatting of data records and blocking on output tape, tape-to-disc transfer, error checking, editing, format entry, totaling, balancing, extensions, searching, communications, etc.

The first three packages described below have been introduced recently and are novel in the data entry field.

IBM SYSTEM/360 MODEL 20 SIMULATOR: This interesting package, which Logic calls SM-20, enables the Varian minicomputer to accept IBM 360/20 programs written in any suitable language, such as RPG or BAL, and generate an object deck that can then be run on the minicomputer. Logic's strategy is to substitute the LC-720 minicomputer during off hours for 360/20 computers that are used exclusively for pre-mainframe data processing; indeed, SM-20 cannot run during normal data entry operation. Logic asserts, furthermore, that the simulator effects approximately a 10 percent throughput gain over a 360/20 computer. SM-20 also enables the LC-720 configuration to operate as a remote communications station under control of RJE HASP.

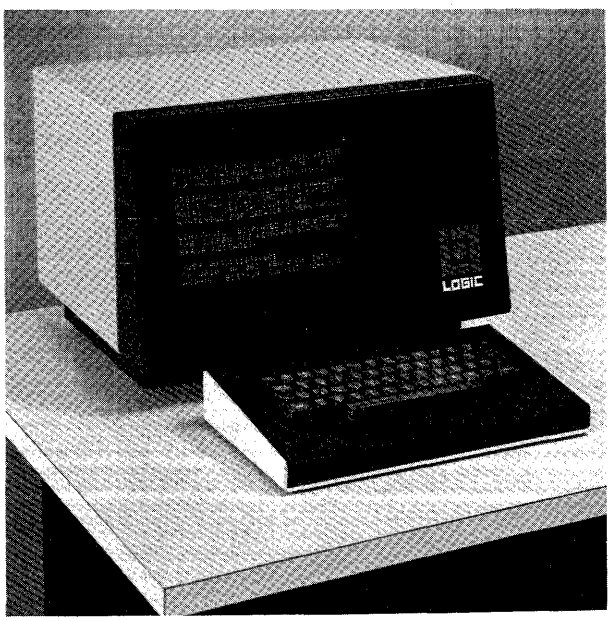
LOGIC II: This innovation is a high-level language similar to the BASIC time-sharing language. It enables the user to write his own editing programs and add them to the existing library. One possibility is end-of-batch editing, which would be incorporated into the background partition (performed after keying). The user could also enter special foreground editing (executed during keying). Hence, Logic II will lessen user dependence on the manufacturer to effectuate changes in the software repertoire. According to the manufacturer, an outstanding property of the language is its simplicity, which enables persons without programming background, such as the system supervisor, to enter most new editing routines into the LC-720 system. Similar user programming capabilities announced by both Computer Machinery and Cummins-Chicago use RPG II, which requires some programming experience to implement.

TAPE PRINT SYSTEM: Using the basic key-to-disc configuration without change, this new software operates several tape drives and printers concurrently, all performing a different operaton. The system does not operate while any keying takes place. Since mnemonics serving as the commands are similar to those used in standard LC-720 operation, a data station operator can quickly learn to operate the Tape Print System.

ERROR CORRECTION: Standard error correction procedures are employed, such as backspacing, character insertion, sequential insertion of missing records, and record deleting. Dup field errors can be automatically corrected after the correction is keyed into the system. Corrections can be made while verifying as well.

EDITING: When an editing condition is violated, the keyboard locks and appropriate indicator lights illuminate. One type of editing in the LC-720 is field definition; examples are alpha only (only alphas or symbols can be entered), must enter (field cannot be skipped), numeric only (numerics only permitted), left blank (right justifies by left blank fills), and max/min and valid/invalid value (characters validated according to parameters entered during format entry). There are check digits of modulo 7, 10, or 11, special check digits (for chemical compounds), product codes, employee numbers, limit and range checks, table lookups (comparing an entry with a table of acceptable values), and special batch totaling and balancing modes. Zero balancing, cross-footing, and extension checking are also performed.

Logic LC-720 KeyDisc System



The LC-720 CRT Data Station presents multiple-record displays and direct status and error messages.

TAPE OPERATIONS: In addition to the usual functions, record reformatting on output is performed. This feature enables any character or field to be interchanged with others within the record. Consequently, an operator can key data from source documents without regard to its ultimate format. Not only can the data be reorganized into a particular format when recorded on tape, but it can be structured into as many other formats as required as well.

In addition, record lengths can be manually or automatically specified. Variable record lengths within a batch are also permissible.

OPERATOR AND JOB STATISTICS: Consists of such items as operator code, productive time, unproductive time, total keystrokes, total errors, keystroke rate/hour, time utilization efficiency, and others. The supervisor can have this information printed by the teleprinter or by the optional line printer, or she can have it recorded on tape. One use of statistics is the drawing of operator fatigue curves and the calculation of work distribution figures.

FORMAT ENTRY: Can be entered in batch mode from a tape drive or, as is more usual, in an interactive (conversational) entry mode from the supervisory console. Here the operator keys the format, character by character. This mode is also used to modify formats already stored.

AUTOMATIC PROGRAM SELECT: Enables a data station operator to make a rapid selection manually from up to 20 program levels or to cycle through them automatically. This feature is known as format chaining in other systems. In manual selection, only two keystrokes suffice to call up a program.

SYSTEM MANAGEMENT: Performed at the supervisory console, where total system control is centered. Some of the supervisor's responsibilities are setting date and start time; specifying job status filed in the system; interrupting an on-going job entry operation; searching for designated batches, jobs, and formats; erasing obsolete data individually or by job type; printing any information stored on the disc or tape, such as job status, batch totals, operator statistics, formats, format numbers, and data files (either before or after reformatting by the system); transferring formats to core; and determining available disc space. The operator override feature allows the supervisor to override temporarily the integrity of a data file and thus permit either an operator in data entry mode to reenter a closed batch or a second operator in verify mode to enter a batch still assigned to another operator. Hence, verification concurrent with entry can be conducted as long as the second operator is a record or two behind the first.

STANDARD DATA PROCESSING: Software is also provided to support the Varian minicomputer in conventional data processing operations when the system is not used for data entry. The Tape Print System should be a useful adjunct to these applications.

SYSTEM OPERATION

The supervisor assigns job and batch numbers, allocates them to the data station operators, enters new formats and modifies existing ones, prints status reports, transfers data files from the disc to tape, and performs other functions described under System Management, above. Essentially, the data station operator keys or verifies data. She can use any of 99 formats in core, concurrently with other operators if necessary, and has discretionary access to 20. In some installations she and the supervisor can both access any format in the disc library.

Verification is significantly aided or even made unnecessary by the validation techniques of the system, as described under Software. Sometimes visual verification at a CRT station is acceptable, but this method is better used in support of standard procedures.

ERROR CONTROL: Parity generation and checking is performed on data transferred between the computer and disc and between disc and tape or to other output devices. Longitudinal and cyclic redundancy characters are created and written on disc and tape. A read-after-write check is performed on both tape and disc. Data written on a disc is read during the next revolution and compared with the original data in core; erroneous data is immediately rewritten. Data written on tape is subjected to all parity checks. Other measures are described under Editing. A validation error locks the keyboard and notifies the operator by sounding a warning tone and displaying the questionable character. An incorrect character can be rekeyed; records can be deleted and sequentially inserted.

COMMUNICATIONS: The LC-720 interface operates synchronously at up to 9600 bits/sec using IBM's Binary Synchronous (BSC) line control protocol. It transmits and receives in either transparent or nontransparent EBCDIC code.

PRICING

The LC-720 KeyDisc System can be acquired by purchase or lease. Lease terms range from one to five years, with maintenance included. Logic provides servicing during the user's prime shift at normal rates and during off hours at an extra charge.

Logic LC-720 KeyDisc System

➤ The following pricing information lists charges for LC-720 installations according to their incorporated number of standard data stations. Charges for the Varian mini-computer with appropriate storage, an IBM-2314-compatible disc drive, and other components are included. Storage capacities are 16K, 20K, 24K, and 28K for the systems with 15, 24, 48, and 64 data stations, respectively.

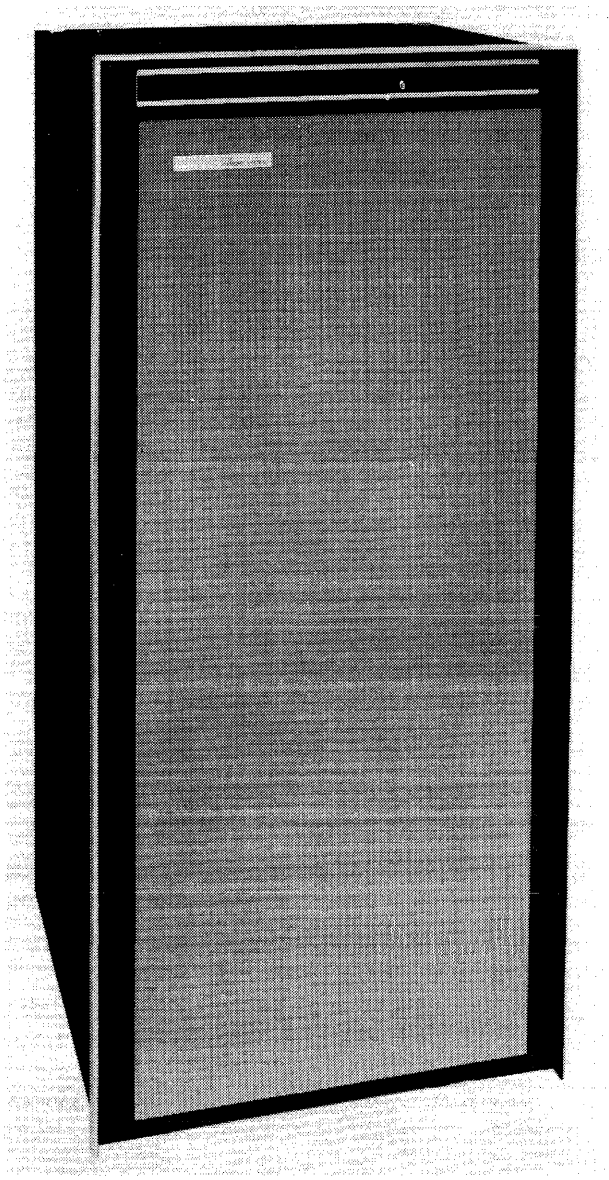
Data Stations	Cost per Data Station	Rental (2-yr. lease)	Purchase	Monthly Maint.
15	$281/mo.	$4,204/mo.	$182,400	$382/mo.
24	210	5,048	218,900	459
48*	150	7,222	312,900	657
64*	132	8,472	366,900	781

*Includes two disc drives.

Individual components and additional I/O devices are priced as follows:

Device	Rental (2-yr. lease)	Purchase	Monthly Maint.
Low-Speed Console	$ 58	$ 2,500	$ 8
High-Speed Console	150	6,500	14
Non-CRT Data Station	58	2,500	8
CRT Data Station	81	3,500	8
Card Reader	125	6,000	13
Matrix Printer (132-col)	299	13,000	27
Drum Printer (80-col.)	368	16,000	34
132-Col. Line Printer (300 lines/min.)	575	25,000	52
132-Col. Line Printer (600 lines/min.)	690	30,000	63
132-Col. Line Printer (1100 lines/min.)	1,288	56,000	117
Communications Interface	345	15,000	31 ■

Memorex 6000 Monolithic Memory



Memorex offers MOS semiconductor replacement memory for the IBM System/360 Model 65 and System/370 Models 135, 145, 155, 158, and 165. Besides price/performance advantages over IBM, the Memorex 6000 offers enhancements for some models that extend their storage capacities beyond the IBM-imposed limits and an acceleration feature for the 370/155.

MANAGEMENT SUMMARY

On January 13, 1975, Memorex announced its entry into the highly competitive plug-compatible memory market. Memorex, a leading manufacturer and supplier of IBM 3330-compatible disk subsystems, now offers MOS memory for IBM System/360 and 370 users as a natural extension of its peripheral product line. The 6000 Series memory, manufactured by Advanced Memory Systems, is available for the System/360 Model 65 as a direct replacement for the IBM 2365 and for System/370 Models 135, 145, 155, 158, and 165. The Memorex replacement memory is completely compatible with its IBM counterpart memory and and with the IBM processing units, and provides error checking and correction (ECC) and Storage Protect features compatible with those of the IBM memory. Memorex will install and maintain its memory via its worldwide service organization.

CHARACTERISTICS

SUPPLIER: Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-1000.

MANUFACTURER: Advanced Memory Systems, Inc., 1276 Hammerwood Avenue, Sunnyvale, California 94086. Telephone (408) 734-4330.

MODELS: The Memorex 6000 Series add-on semiconductor memory currently includes six models. Each model is available in standard IBM incremental sizes, and enhancement capacities are available for some models. The Memorex 6000 Series includes:

- Model 6065–for System/360 Model 65; a replacement for the IBM 2365 Model 2.
- Model 6135–for System/370 Model 135.
- Model 6145–for System/370 Model 145.
- Model 6155–for System/370 Model 155.
- Model 6158–for System/370 Model 158.
- Model 6165–for System/370 Model 165.

COMPATIBILITY: The 6000 Series memory is designed as plug-compatible add-on or replacement memory for the IBM System/360 Model 65 and for IBM System/370 Models 135, 145, 155, 158, and 165. They can be used to extend the storage capacity of an existing IBM processing unit and/or to replace all existing storage down to the minimum mainframe capacity as specified for the particular IBM models. Memorex 6000 Series memory, combined with the mainframe storage capacity of an existing IBM System/360 or 370 processing unit, provides the following range of standard and enhanced mainframe storage capacities:

Memorex 6000 Model	IBM Processing Unit	Min. IBM Capacity, bytes	Standard IBM Capacity, bytes	Enhanced Memorex capacities, bytes
6065*	2065	0	256K to 1024K	1280K, 1536K, 1792K, 2048K
6135	3135	96K	96K to 512K	None
6145	3145	160K	160K to 2048K	None
6155*	3155	0	256K to 2048K	3072K, 4096K
6158	3158	512K	512K to 4096K	None
6165*	3165	0	512K to 3072K	4096K

*All existing IBM memory can be replaced.

Memorex 6000 Monolithic Memory

The 6000 Series memory is available in IBM-standard capacities for all models, as well as in enhancement capacities that provide up to twice the IBM maximum capacity for the 370/155 and 360/65 and 1.3 times the IBM maximum capacity for the 370/165. The Memorex memory can replace all existing memory down to the minimum storage capacity as specified by IBM for each processing unit. Complete memory replacements can be made on the System/360 Model 65 and on System/370 Models 155, 155-II, 165, and 165-II, where all main memory is external to the processing unit. On these processor models, Memorex memories offer substantial reductions in floor-space requirements. Other benefits include a substantial decrease in power consumption and heat dissipation, which translates into a significant reduction in air conditioning loads.

Memorex also offers an acceleration feature for the 370/155, a key enhancement that can particularly benefit the user of a purchased Model 155. Called Processor Speed-Up (PSU), the AMS-produced feature promises to increase the performance of a 370/155 by 10 to 20 percent, to a level equivalent to that of the 370/158. The PSU feature does not include a dynamic address translation (DAT) capability, but it does provide complete compatibility with the IBM DAT feature used on the 370/155-II. Read/write cycle times of the PSU are identical with those for the IBM 370/158. The PSU feature is included in the Memorex memory cabinet. An integral storage adapter permits the Memorex memory to bypass IBM's Storage Adapter, providing additional savings by precluding the need for a second IBM Storage Adapter when both ports of the primary SA are occupied.

Memorex began deliveries of its 6000 Series memory in late December 1974. Six units have been installed to date.

Memorex provides substantial price breaks below the cost of equivalent IBM memory. For example, Memorex memory for a System/370 Model 135 or 145 leases for 25 or 40 percent (under a two- or four-year lease, respectively) below IBM's monthly rental charge, and sells for 35 percent below IBM's purchase price. Memorex memory for a Model 158 leases for 18 or 34 percent (on a two- or four-year lease) below IBM's rental charge and sells for 25 percent below IBM's purchase price.

Users have generally been satisfied with the AMS memory as marketed by Control Data and Itel; see reports 70D-263-05 and 70D-546-03. □

Effective cycle times of the Memorex 6000 memory are the same as those of the corresponding IBM memory, with the exception of Memorex memory for the 370/155 with the Processor Speed-Up (PSU) feature:

IBM Model	Cycle Time, nanoseconds	Bytes per Fetch
360/65	750	8
370/135	770 (read); 935 (write)	2 or 4
370/145	540 (read); 607.5 (write)	4 or 8
370/155	2,070 (read/write)	16
370/155*	1,150 (read); 690/920 (write)	16
370/158	1,035 (read); 920 (partial write); 960 (write)	8 or 16
370/165	2,000 (read/write)	8

*Memorex 6000 memory with PSU feature.

The Memorex 6000 is a semiconductor memory composed of 1024-bit or 2048-bit (Model 6165 only) MOS chips. On the Model 6065 memory, 32 1024-bit chips are contained on each storage card. The storage cards are combined into Basic Storage Modules (BSM's) which contain 256K bytes of storage each. This is equivalent to the capacity of the IBM 2365.

Error Checking and Correction (ECC) logic compatible with IBM's is included in all models of the Memorex 6000. The ECC feature detects and corrects single-bit errors and detects all double-bit errors and most multiple-bit storage errors, but does not correct them. Parity checking is also used to verify all other data and addressing within the memory.

Storage Protection logic compatible with IBM's is included in all models of the 6000 Series memories. This feature guards against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage.

Models 6155 and 6165 are fully compatible with the IBM DAT feature included in System/370 Models 155-II and 165-II, and also with Model 155 and 165 without the DAT feature.

The Memorex 6000 Series memories are fully compatible with IBM diagnostics.

Physical specifications and heat dissipation for each of the Memorex 6000 Series memories (per cabinet) are tabulated below.

Memory Model	Maximum Storage, bytes	Depth, inches	Width, inches	Height, inches	Weight, pounds	Max. Heat Dissipation, BTU/hr.
6065	2048K	62.5	30	70	2,300	38,700
6135	384K	36	36	36	500	6,400
6145	768K	32	49	60	1,600	20,800
6155	2048K	32	62	60	2,300	20,800
6158	3072K	64	32	60	2,200	29,000
6165	4096K	65	33	70	2,300	39,500

PRICING: The Memorex 6000 Series memory is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Memorex provides non-cancelable lease contracts for 3, 4, and 5 years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and complete maintenance (24 hours/day, 7 days/week). A separate maintenance contract is available for leased or purchased units.

Memorex 6000 Monolithic Memory

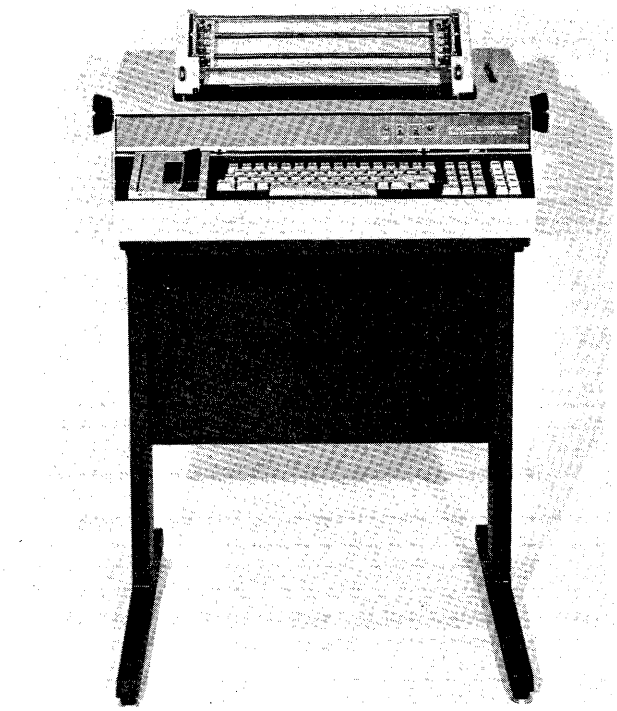
IBM Processor Conversion		Monthly Rental* 3-Year Lease	5-Year Lease	Purchase	Monthly Maint.**
From 2065	(0K) to:				
H	(265K)	$ 3,264	$ 2,283	$ 90,000	$ 440
I	(512K)	4,379	3,087	118,500	660
IH	(768K)	5,917	4,167	160,500	880
J	(1024K)	7,078	5,002	190,500	1,100
JH	(1280K)	8,915	6,315	238,500	1,430
JI	(1536K)	10,586	7,463	286,500	1,595
JIH	(1792K)	12,258	8,611	334,500	1,760
K	(2048K)	14,117	9,882	388,500	1,925
From 2065H	(256K) to:				
I	(512K)	3,264	2,283	90,000	440
IH	(768K)	4,379	3,087	118,500	660
J	(1024K)	5,917	4,167	160,500	880
JH	(1280K)	7,078	5,002	190,500	1,100
JI	(1536K)	8,915	6,315	238,500	1,430
JIH	(1792K)	10,586	7,463	286,500	1,595
K	(2048K)	12,258	8,611	334,500	1,760
From 2065I	(512K) to:				
IH	(768K)	3,264	2,283	90,000	440
J	(1024K)	4,379	3,087	118,500	660
JH	(1280K)	5,917	4,167	160,500	880
From 2065IH	(768K) to:				
J	(1024K)	3,264	2,283	90,000	1,100
JH	(1280K)	4,379	3,087	118,500	1,430
From 3135FE	(96K) to:				
GF	(192K)	1,463	1,170	61,880	120
DH	(240K)	2,194	1,755	92,820	155
H	(256K)	2,441	1,953	94,055	195
HF	(320K)	2,951	2,361	115,147	245
HG	(384K)	3,461	2,769	136,240	300
HGF	(480K)	4,481	3,585	164,700	350
From 3135GD	(144K) to:				
DH	(240K)	1,463	1,170	61,880	120
HG	(384K)	2,730	2,184	105,300	265
I	(512K)	3,750	3,000	147,485	330
From 3135GF	(192K) to:				
HF	(320K)	1,489	1,191	53,267	150
HG	(384K)	1,999	1,599	74,360	215
I	(512K)	3,019	2,415	116,645	325
From 3135DH	(240K) to:				
HG	(384K)	1,268	1,014	74,360	155
I	(512K)	2,288	1,830	116,645	275
From 3135H	(256K) to:				
HG	(384K)	1,020	816	42,185	150
I	(512K)	2,040	1,632	84,370	280
From 3145H	(256K) to:				
HG	(384K)	1,373	1,098	56,615	145
I	(512K)	2,378	1,902	99,580	265
IH	(768K)	4,388	3,510	185,510	485
J	(1024K)	6,398	5,118	271,440	660
JI	(1536K)	10,785	8,628	458,835	1,000
K	(2048K)	14,805	11,844	630,695	1,200
From 3145HG	(384K) to:				
I	(512K)	1,005	804	42,965	145
IH	(768K)	3,015	2,412	128,895	415
J	(1024K)	5,025	4,020	214,825	585
JI	(1536K)	9,413	7,530	402,220	900
K	(2048K)	13,433	10,746	574,080	1,300
From 3145I	(512K) to:				
IH	(768K)	2,010	1,608	85,930	265
J	(1024K)	4,020	3,216	171,860	485
JI	(1536K)	8,408	6,726	359,255	800
K	(2048K)	12,428	9,942	531,115	1,100
From 3145IH	(768K) to:				
J	(1024K)	2,010	1,608	85,930	295
JI	(1536K)	6,398	5,118	273,325	660
K	(2048K)	10,418	8,334	445,185	1,000

IBM Processor Conversion		Monthly Rental* 3-Year Lease	5-Year Lease	Purchase	Monthly Maint.**
From 3145J	(1024K) to:				
JI	(1536K)	$ 4,388	$ 3,510	$ 187,395	$ 485
K	(2048K)	8,408	6,726	359,255	800
From 3145JI	(1536K) to:				
K	(2048K)	4,020	3,216	171,860	485
From 3155	(0K) to:				
I	(512K)	3,790	2,646	105,000	495
J	(1024K)	6,199	4,352	169,500	880
JI	(1536K)	9,323	6,543	255,000	1,320
K	(2048K)	11,646	8,212	315,000	1,760
KJ	(3072K)	16,589	11,667	451,500	2,420
L	(4096K)	19,132	13,556	511,500	3,080
From 3155I	(512K) to:				
J	(1024K)	3,790	2,646	105,000	495
JI	(1536K)	6,199	4,352	169,500	880
K	(2048K)	9,323	6,543	255,000	1,320
KJ	(3072K)	–	–	RPQ	–
L	(4096K)	–	–	RPQ	–
From 3155J	(1024K) to:				
JI	(1536K)	3,790	2,646	105,000	495
K	(2048K)	6,199	4,352	169,500	880
KJ	(3072K)	11,646	8,212	315,000	1,760
L	(4096K)	16,589	11,667	451,500	2,420
From 3155JI	(1536K) to:				
K	(2048K)	3,790	2,646	105,000	495
KJ	(3072K)	9,323	6,543	255,000	1,320
From 3158I	(512K) to:				
JI	(1536K)	4,690	3,775	189,750	840
K	(2048K)	7,036	5,663	284,625	1,040
KJ	(3072K)	12,620	10,157	514,725	1,440
From 3158J	(1024K) to:				
K	(2048K)	4,690	3,775	189,750	840
KJ	(3072K)	10,275	8,270	419,850	1,240
L	(4096K)	14,965	12,045	609,600	1,640
From 3158JI	(1536K) to:				
KJ	(3072K)	7,929	6,382	324,975	1,040
L	(4096K)	12,620	10,157	514,725	1,440
From 3158K	(2048K) to:				
KJ	(3072K)	5,584	4,495	230,100	840
L	(4096K)	10,275	8,270	419,850	1,240
From 3165	(0K) to:				
J	(1024K)	5,399	3,829	144,000	880
JI	(1536K)	7,581	5,406	199,500	1,320
K	(2048K)	9,621	6,890	250,500	1,760
KJ	(3072K)	14,471	10,285	384,000	2,420
L	(4096K)	17,862	12,727	471,000	3,080
From 3165I	(512K) to:				
JI	(1536)	5,399	3,829	144,000	880
From 3165J	(1024K) to:				
K	(2048K)	5,399	3,829	144,000	880
KJ	(3072K)	9,621	6,890	250,500	1,760
L	(4096K)	14,471	10,285	384,000	2,420
From 3165K	(2048K) to:				
KJ	(3072K)	5,399	3,829	144,000	880
L	(4096K)	9,621	6,890	250,500	1,760

* Includes maintenance for 24 hours/day, 7 days/week. Monthly rental charges under a 4-year lease are priced 10 percent below those under a 3-year lease for Models 6135, 6145 and 6158, and 15 percent below for Models 6065, 6155, and 6165.

**Maintenance for 24 hours/day, 7 days/week. ■

Memorex 1200 Series Communication Terminals



The top-of-the-line Model 1280 Communication Terminal features a magnetic tape cassette recorder (at left). This unit also includes the optional 15-key Numeric Keypad (at right). The other Memorex 1200 Series terminals are generally similar in appearance.

The Memorex line of high-performance teleprinters now consists of three models that provide print speeds ranging from 10 to 60 characters per second, data transmission speeds of 10 to 120 characters per second, magnetic tape storage, full ASCII keyboard, and Teletype compatibility. An IBM-compatible communications controller is also available.

MANAGEMENT SUMMARY

The Memorex 1200 Series family of high-performance teleprinter terminals now consists of three models. The family traces its inception to early 1970 when the first member, Model 1240, was announced and exhibited at that year's SJCC. The terminals boast a wide range of printing speeds up to 60 characters per second (four times the speed of the Teletype Model 37), 120 print positions on standard units (about 1.5 times the line width of standard Teletype units), 94 ASCII symbols including upper and lower case printing, pin feed on standard units with adjustable tractor width up to about 15 inches, a full ASCII keyboard complemented with an optional adding-machine keygroup, and switch-selectable transmission speeds up to 120 characters per second.

Common to all members of the 1200 family is the printing mechanism, a Memorex innovation, which employs a belt-driven arrangement similar to the printing technique of the IBM 1403 chain printer. The Memorex arrangement consists of a print cartridge that contains the print belt and attached print symbols totaling 94. This printing arrangement presents an alternative to carriage or print-head movement. As standard equipment, the printer includes a removable tractor for pin-feed forms to enhance print quality. Vertical forms control is available as an option.

CHARACTERISTICS

MANUFACTURER: Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-1000.

MODELS: Three Models: 1240, 1242, and 1280. The 1240 Series models are KSR configurations (keyboard and printer). Model 1280 includes keyboard, printer, and integral magnetic tape cassette recorder. The table describes the differences among the models.

COMMUNICATIONS: See table (next page).

DEVICE CONTROL: Primarily manual. Except for Models 1242 and 1280, data is printed and transmitted as it is keyed and printed as it is received. Model 1242 is a buffered unit that transmits and receives at 120 char/second, although the printer operates at 30 or 60 (optional) char/second. Buffering also allows a block or line of data to be prepared and edited prior to transmission. The basic buffer capacity, which can be doubled as an option, is 256 characters. An alternative option provides a split buffer, which employs two 256-character buffers. During transmission, a keyed block is transmitted while the next block is being keyed. When receiving, the split buffer allows a block to be printed while the next block is being received. Model 1280 records keyed data on magnetic tape in an off-line mode for later transmission. Data can also be received at high speeds up to 1200 bits/second and recorded directly on magnetic tape for printing in an off-line mode.

On all models, received control codes initiate functions such as space, carriage return, line feed, and horizontal tabulation, which is optional on all models.

Model 1242 is designed for operation in a multidrop environment where individual units, connected to a common leased or private line, are polled or addressed by the remote computer.

Model 1280 provides edit functions for its integral magnetic tape recorder. Manual edit controls permit the operator to advance or reverse one record or character, insert or delete a single character or a complete record, and expand a record by up to 16 additional characters.

ERROR CONTROL: Character parity is generated and accompanies each transmitted character; and on some models, character parity or character and longitudinal parity are checked on received data (see table). For manual operation, the operator is alerted to detected errors via an indicator lamp.

KEYBOARD: A 60-key typewriter arrangement. All 128 graphics and control codes of the ASCII character set can be generated from the keyboard. Control codes are generated by depressing the control shift key in conjunction with the key that identifies the particular control code to be transmitted. Control codes are engraved on the respective keys. A repetitive entry capability and a break function are also provided.

Memorex 1200 Series
Communication Terminals

MEMOREX 1200 SERIES MODEL DIFFERENCES

Model	1240	1242	1280
Transmission Speed, bps	Fixed at 110, 150, 300, or 600 (opt.); switch selection is optional	1200	Fixed at 110, 150, 300, 600, or 1200; switch selection is optional
Operating Mode	Half- or full-duplex	Half- or full-duplex	Half- or full-duplex
Transmission Code	7-level ASCII; 10- or 11-unit code includes parity, start, and one or two stop bits	7-level ASCII; 10-unit code includes parity and unity start and stop bits	7-level ASCII; 10- or 11-unit code includes parity, start, and one or two stop bits.
Synchronization	Asynchronous	Asynchronous	Asynchronous
Interface	EIA RS-232C	EIA RS-232C	EIA RS-232C
Integral Modem	Bell System 103-compatible with auto answer, 202C-type compatible, or 600-bps unit with 150-bps reverse channel; integral acoustic telephone coupler is available with above modems	Bell System 202C-compatible or 1200 bps unit with 150-bps reverse channel	Bell System 103-compatible with auto answer, 202C-type compatible, or 600-bps unit with 150-bps reverse channel; acoustic telephone coupler is available with above modems
Print Speed, cps	Model 1240 is fixed at 10, 15, 30 or 60; switch selection is optional at 10, 15, 30 or 60	Fixed at 30 or 60 (optional)	Fixed at 10, 15, 30, or 60; switch selection is optional at 10, 15, 30, or 60
Buffering	Unbuffered	256-char. buffer; options include second 256-char. buffer or toggle buffer with 256 chars. each	Magnetic tape cassette (256-character buffer)
Error Detection	Optional; odd, even, or disable parity-check switch settings	Std; character and longitudinal parity checking	Optional; odd, even, or disable parity-check switch settings and longitudinal parity checking
Unattended operation	Optional	Std.	Optional
Horizontal Tab	Optional; local/remote set and clear	Optional; local/remote set and clear	Optional; local/remote set and clear
Multipoint Line Control	Not provided	Standard	Not provided

The horizontal tab option (available for a small additional charge) permits the user to create any print format at the computer end. All tab settings are cleared by one command. This feature also increases line efficiency by eliminating the need to transmit spaces.

One member of the 1200 Series family, the buffered Model 1242, is designed for use in a multistation arrangement where a number of terminals attached to a common leased or private line can be addressed or polled via a remote computer. The standard version of the buffered model provides buffering for up to 256 characters (two full print lines); as an option, this model is available with a second 256-character buffer to provide up to four full lines of print or a split buffer, which allows the printer to print a line while the next line is in the process of being received. The buffered unit transmits at 120 characters per second.

A numeric keygroup (in addition to the main keygroup), with keys arranged in an adding-machine format, is available as an option.

PRINTER: Prints any of 94 ASCII symbols, including upper- and lower-case alphabetics, numerics, punctuation marks, and special symbols. The printing mechanism accommodates a readily interchangeable print cartridge that contains the 94-symbol set attached to a moving belt. The unit prints up to 120 characters per line, spaced at 10 char/inch. Vertical spacing is 6 lines/inch. Models 1240 and 1280 are available with upper-case letters only as an option.

The impact printer accommodates 6-part continuous forms or single sheets up to 14-7/8 inches wide. The standard Series printers provide friction feed with removable tractor feed, adjustable up to 14-7/8 inches wide. Form feeding is performed at 15 lines/second. Vertical forms control, skip over perforation, and an upper and lower forms stacker stand are optional for all models. The printer uses a 1/2-inch fabric ribbon which Memorex says is readily obtainable.

Memorex 1200 Series
Communication Terminals

A conventional "Philips-type" magnetic tape cassette recorder, promised by Memorex while the Model 1240 was still young, is incorporated in the Model 1280. Operation using tape cassettes not only provides a convenient buffer, but adds flexibility to the terminal.

Memorex also offers a variety of integral modems for its terminals that provide compatibility with existing Bell System models. Besides hard-wired modems, Memorex offers an acoustic telephone adapter that allows the user to couple the terminal to the line via a conventional telephone handset.

Model 1242 was announced in May 1971, with first deliveries in the third quarter of 1972. Model 1280 was announced in November 1970, with first deliveries during October 1971. Lead time on orders for existing models is quoted at 90 days.

Memorex maintains a diagnostic center at Santa Clara to provide free on-line service for customers with 1200 Series terminals. With this service, any 1200 Series terminal and associated modem can be tested via diagnostic routines to determine the cause and/or location of a failure by dialing the INWATS number of the diagnostic center. (No charge for the telephone call, either.) Simple problems such as incorrect switch settings or operator misadjustments are handled by two-way conversations between the operator and the diagnostic center. For more serious failures that require the attention of a service man, the diagnostic center will dispatch a local serviceman who will be armed with the diagnostic findings; this usually means that he will have any required replacements with him.

To control its own terminals as well as those of other manufacturers, Memorex also markets communications controllers which are compatible with the IBM 2701, 2702, and 2703 (and also with the IBM 3704 and 3705 operating in the 270X emulation mode). The Memorex Model 1270 Terminal Control Unit, initially delivered in April 1971, is a hard-wired controller for up to 8 (Model 2) or 96 (Model 1) communications lines. The Model 1270 has achieved a substantial penetration of the IBM market and may represent as many as one-third of all the IBM-compatible communications controllers in the field today.

USER REACTION

In a recent DATAPRO 70 survey of typewriter terminal users (Report 70D-010-21), responses were received from 12 users of the Memorex 1200 Series, representing 24 Model 1240 units, 30 Model 1242 units, and 7 Model 1280 units. The properties of these terminals that were commended most consistently were their speed and overall performance. Most of the users were also pleased with the terminals' ease of use, keyboard feel, print quality, and reliability. A user of the 1240 felt that its flexibility in accepting continuous forms or single sheets up to 14-7/8 inches wide was especially convenient. Another 1240 user was pleased that the printer utilizes standard paper and ribbon. The "Philips-type" cassette recorder and the numeric keyboard of the 1280 drew favorable comment.

Unfavorable comments were received as well. A common user complaint about the impact-style typewriter terminals as a class concerned their noisiness, and the Memorex 1200 Series did not escape this criticism. In addition, the quality of maintenance service for the 1200 Series appears to be spotty, as indicated by a vote of seven users who rated it good to four who called it no better than fair. □

CASSETTE TAPE RECORDER: For Model 1280 only. Accommodates a "Philips-type" cassette containing 300 feet of 0.15-inch-wide magnetic tape. The unit records data serially by bit and can record up to 180,000 characters (90,000 char/side) on a cassette. Fast forward and rewind are each performed at 40 inches/second.

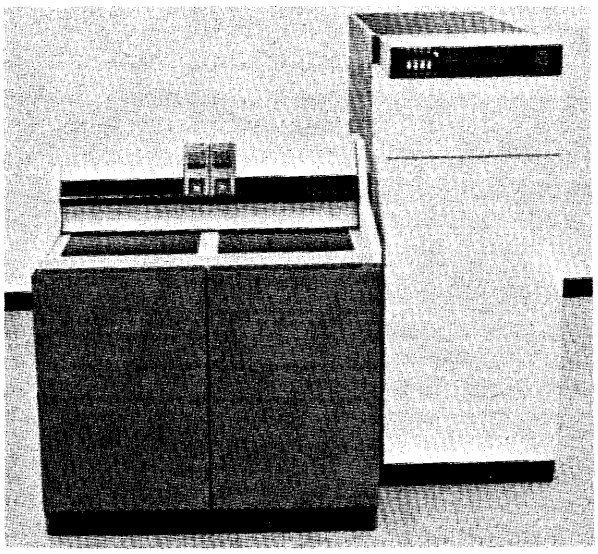
MODEL 1270 TERMINAL CONTROL UNIT: This hard-wired, IBM-compatible unit replaces the IBM 2701, 2702, or 2703 communications controllers. It attaches directly to an IBM System/360 or 370 Byte Multiplexer Channel to provide interface and control logic for as many as 96 data communications lines. These lines can be asynchronous at transmission rates of 110, 134.5, 150, 300, 600, and 1200 bits/second; synchronous at various rates up to 9600 bits/second; or wideband synchronous at 19,200, 40,800, and 50,000 bits/second. Interfaces are provided for Bell System 103 and 202 asynchronous modems or their equivalents; for Bell System 201, 203, and 208 synchronous modems or equivalents; and for Bell System 301 and 303 wideband synchronous modems or equivalents. In addition, support is provided for the Bell 801A and 801C Automatic Calling Units. Memorex also provides a line of integral modems: The Memorex 1220, a Bell 103 equivalent; the Memorex 1222, with a dual-speed, switch-selectable, 600-1200 bps primary channel and a 150 bps reverse channel; the Memorex 1224, a Bell 202 equivalent; the Memorex 1221-LD1, an IBM Limited Distance Line Adapter Type 1 equivalent; and the Memorex 1221-LD2, an IBM Limited Distance Line Adapter Type 2 equivalent.

PRICING: The 1200 Series Communication Terminals are available for purchase or on a one-year lease, which includes complete maintenance (24 hours/day, 7 days/week). A maintenance contract is available for purchased units. The Memorex 1200 Series is priced as follows:

Model	Monthly Rental*	Purchase	Monthly Maintenance** (prime shift)
1240	$145	$4,200	$40
1242	195	8,775	46
1280	215	6,575	55
1270 TCU:			
Model 1 (96 lines)	1,000-2,500	40,000-100,000	150-350
Model 2 (8 lines)	300-1,400	13,500-50,000	150-200
Options for Terminals:			
60-cps Speed	25	875	1
Speed Select	5	175	–
Horizontal Tab	10	350	2
Unattended Operation	10	450	3
Numeric Keyboard	5	175	1
Vertical Forms Control	16	720	4
Additional Buffer (256 chars.)	15	675	2
Split Buffer (256 chars. each)	10	450	–
Upper and Lower Forms Stacker Stand	–	40	–
Upper Case Only	3	135	–
Parity Check	5	175	0.50
1220 Modem (equivalent to Bell System 103A)	10	350	4
1222 Modem (dual speed 600/1200 bps)	20	900	4
1227 Acoustic Adapter	15	450	1.50
1224 Modem (equivalent to Bell System 202C)	15	525	4

*Includes 24-hr./day, 7-day/week maintenance.
**For purchased units. ■

Memorex 3670 Disc Storage Subsystem



This replacement for the IBM 3330 Disk Storage Facility includes up to 16 spindles in any mix of 100M-byte and 200M-byte drives, operates on System/370 Models 135 through 195 and on System/360 Models 65 through 195, and offers price/performance advantages over its IBM counterpart.

MANAGEMENT SUMMARY

The Memorex 3670 Disc Storage Subsystem is designed as a plug-to-plug replacement for the IBM 3330 Disk Storage Facility. The Memorex system offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and operating characteristics. Disk packs recorded by Memorex drives can be read by the equivalent IBM drives, and the converse.

On October 26, 1973, Memorex announced the 3675 Disc Storage Module, a plug- and media-compatible equivalent to IBM's double-density 3330 Model 11 Disk Storage module. Like its IBM equivalent, the Memorex 3675 contains two spindles and accommodates Memorex Mark XI or IBM 3336 Model 11 disk packs to provide a storage capacity of 200 million bytes per spindle and 400 million bytes per drive module.

Like its IBM counterpart, the 3670 subsystem can intermix 3670 and 3675 drive modules on the same 3671 Control Unit, which can accommodate a second string of up to four drive modules via the Eight Module Attachment feature.

Installed 3670 Disk Storage Modules can be field-converted into the 3675, but Memorex states that initial conversions will be by replacement. Changes to the control unit required to support the 3675 can also be performed in the field. Memorex says that customers on lease may upgrade without penalty.

The 3670 Subsystem with standard- or double-density disk storage is available for use on IBM System/370 Models 135 through 195 and System/360 Models 85 and 195, and is supported under OS/VS1, OS/VS2 Release 2, and VM/370. Memorex also supports its 3670 Subsystem, equipped with standard-density disk storage only, for use with IBM System/360 Models 65, 67, and 75 operating under OS. Changes to the Operating System are minor and

CHARACTERISTICS

MANUFACTURER: Memorex Corporation, Equipment Group, San Tomas at Central Expressway, Santa Clara, California 95052. Telephone (408) 987-1000.

DISK DRIVES: Model 3675 Disk Storage Module, a double-density drive, and Model 3670 Disk Storage Module, a standard-density drive. Both models contain two independent spindles.

DISK CONTROLLER: Model 3671 Storage Control Unit.

CONFIGURATION: The Memorex 3670 Disc Storage Subsystem includes a 3671 Storage Control Unit and any mix of one to four dual-spindle 3670 (standard-density) and/or 3675 (double-density) Disc Storage Modules; all drives can remain on-line and immediately accessible to the computer. A second string of four dual-spindle drive modules can be added to the basic 3670 subsystem via the optional Eight Module Attachment feature.

The optional Two-, Three-, or Four-Channel Switch features provide two, three, or four channel interfaces, respectively, which serve as alternate data paths to the controller and its attached disk drives.

COMPATIBILITY: The Memorex 3670 Disc Storage subsystem is designed for connection to an IBM System/360 computer, Models 65 through 195, or an IBM System/370 computer, Models 135 through 195 (via a Block Multiplexer Channel), as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 3670 provides complete compatibility with the IBM 3330 command structure and, except for System/360 Models 65, 67, and 75, requires no changes to the existing software.

System/360 Models 65, 67, and 75 can accommodate the 3670 subsystem via the optional 2860 Selector Channel Attachment feature, which operates under OS/MFT or MVT. Because of microprogramming support within the 3671 Controller, the 2860 feature requires only minor software modifications to the Operating System. The process consists of a partial Sysgen during which the necessary changes are incorporated via Memorex-supplied software.

The 3675 Disk Storage Module, a replacement for IBM's 3330-11 Disk Storage and 3333-11 Disk Storage and Control, is restricted to use on System/370 Models 135 through 195 and on System/360 Models 85 and 195 only. The Memorex 3675 is supported under OS/VS1, OS/VS2 Release 2, and VM/370.

3670 STORAGE CAPACITY: The data storage capacity of each Memorex 3670 Disc Storage Module is identical with that of the dual-spindle IBM 3330 Model 1 Disk Storage module: 200.036 million bytes (100.018 million bytes per spindle).

3675 STORAGE CAPACITY: The data storage capacity of each Memorex 3675 Disc Storage Module is identical with that of the dual-spindle IBM 3330 Model 11 Disk Storage module: 400.072 million bytes (200.036 million bytes per spindle).

Memorex 3670 Disc Storage Subsystem

are incorporated by means of a Sysgen, using Memorex-supplied software.

The performance characteristics of the Memorex 3670 Subsystem are modestly improved over those of the IBM 3330 Facility, offering the user a 10 (average) to 30 (track-to-track) percent advantage in positioning time over the IBM drives. Rotational speed, data transfer rate, and storage capacity, however, are identical with those of the IBM units.

The Memorex 3671 Control Unit is equipped with microprogrammed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive in the off-line mode. The diagnostics, in addition to the operating microprogram and any additional programs stored on a disk cartridge, are loaded into a monolithic read/write memory during the subsystem's power-up sequence.

Like its IBM counterpart, the 3670 Subsystem features Rotational Position Sensing (RPS), Multiple Requesting, and Command Chaining. The 3675 drives are also equipped with Write Format Release, a new feature introduced with the IBM 3330-11 and 3333-11.

The Memorex 3670 Subsystem is currently limited to a maximum of 16 spindles and provides a maximum subsystem storage capacity of 1.6 or 3.2 billion bytes. By contrast, IBM's 3330 subsystem permits up to 32 spindles. When queried about this limitation, Memorex commented that most current prospects can be satisfied within the 16-spindle limitation. Memorex plans to respond to the demands of the market as it becomes necessary.

Pricing for the Memorex 3670 Subsystem falls just below IBM's price "umbrella" for leased subsystems, while the Memorex list purchase prices fall 25 percent below those of IBM Memorex's two-year and three-year lease prices (including maintenance) are about 5 and 10 percent, respectively, below IBM's two-year lease prices for equivalent subsystems.

First deliveries of the Memorex 3670 Subsystem were made in October 1972. First deliveries of the 3675 are scheduled for the fourth quarter of 1974, with volume production in early 1975.

Memorex provides service through its worldwide organization, including over 70 sales and service offices, and promises a two-hour service response time.

USER REACTION

Datapro queried several Memorex 3670 users about the equipment performance and reliability and about the service provided by Memorex. Users' comments in all these areas were highly favorable; remarks included "minimal downtime," "good to excellent service," "smooth installation," and "I've got an order in for more drives." □

ACCESS ARRANGEMENT: Each spindle of a Memorex 3670 or 3675 Disc Storage Module provides access to 404 or 808 recording cylinders, respectively. The 3670 and 3675 drives provide 19 tracks per cylinder (like their IBM counterparts); each cylinder is accessed via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

DISK PACK: Each spindle of the Memorex 3670 Disc Storage Module accommodates one Memorex Mark X, IBM 3336-1, or an equivalent disk pack. Each spindle of the Memorex 3675 Disc Storage Module accommodates one Memorex Mark XI, IBM 3336-11 or an equivalent disk pack. All of these packs contain 12 disks and provide 19 recording surfaces; however, the Memorex Mark XI and IBM 3336-11 packs are equipped with a mechanical interlock to prevent inadvertent use of the double-density packs on standard-density units, and the converse.

FILE ORGANIZATION: Each 100M-byte or 200M-byte disk pack corresponds to one logical file, as in the IBM 3330. Module Select (file identification) plugs, one per spindle, are interchangeable and specify the logical address of each spindle.

PERFORMANCE: The performance characteristics of the Memorex 3670 and 3675 drives are compared with those of the IBM 3330 drives in the following table.

Head Positioning Time, msec

Disk Drive	Track to Track	Average	Maximum	Tracks per Inch
Memorex 3670	7	27	50	192
IBM 3330	10	30	55	192
Memorex 3675	7	27	50	384
IBM 3330-11	10	30	55	384

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically in both the Memorex and IBM drives.

PHYSICAL CHARACTERISTICS: The physical arrangement of the Memorex 3670 subsystem is quite different from that of the IBM 3330. Unlike the 3330, the Memorex subsystem consists of discrete components with the following cabinet dimensions:

Device	Width, inches	Depth, inches	Height, inches	Weight, pounds
3670/3675 Drives**	44	32	47*	1,100
3671 Controller	24.5	60	60	825

*Disk-pack access height is 35 inches.
**Each drive module contains two spindles.

PRICING: The Memorex 3670 Disc Storage Subsystem is available for purchase or lease under the Memorex Fixed Term Plan, which provides leases for one, two, and three years. Conversion from lease to purchase is available through a purchase-credit arrangement. Lease rates include installation, all cables, diagnostic performance checks, unlimited usage, and maintenance, which is provided on a 24-hours/day, 7-days/week basis, excluding holidays.

	Monthly Rental*				
	1-Yr. Lease	2-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
3671 Control Unit	$2,020	$1,920	$1,825	$75,250	$200
3670 Disc Module	1,100	1,040	990	38,000	170
3675 Disc Module	1,535	1,400	–	54,140	–
Options					
2860 Selector Channel Attachment	250	250	250	10,000	50
Eight Module Attachment	285	270	270	13,060	30
Channel Switches:					
Two Channels	175	165	155	7,990	15
Three Channels	263	248	233	11,985	20
Four Channels	350	330	310	15,980	25
Disk Packs:					
Mark X	30	30	30	725	NA
Mark XI	NA	NA	NA	990	NA

* Monthly rental charges under a 1-, 2-, or 3-year lease include maintenance for 24 hours/day, 7 days/week. ■

Memory Technology 370-Compatible Monolithic Main Memory

Memory Technology currently provides replacement memory for IBM System/370 Models 145, 155, and 165. The MTI units deliver substantial reductions in floor space, power requirements, and cost compared with equivalent IBM memory.

MANAGEMENT SUMMARY

Memory Technology, a major supplier of read-only memory to the computer industry, also offers add-on or replacement semiconductor memory to IBM System/370 computer users. MTI's Monolithic Main Memory is currently available for System/370 Models 145, 155, and 165 in IBM-standard capacities, as well as in enhancement capacities of up to 4096K bytes for Models 155 and 165 only. Enhancement capacities are not currently available for the Model 145. MTI replacement memories for System/370 Models 135, 158, and 168 are currently under consideration.

MTI has received IBM certification for maintenance continuance on its 370/155 installations and IBM acceptance for its 165 installations on a "best efforts" basis. MTI says IBM certification is imminent for its MT-145.

MTI's Monolithic Main Memory employs the MOS semiconductor technique, in contrast to IBM's use of conventional magnetic core memory in the 370/155 and 165 and the rival bipolar semiconductor technique in the ▷

CHARACTERISTICS

MANUFACTURER: Memory Technology, Inc., 83 Boston Post Road, Sudbury, Massachusetts 01776. Telephone (617) 891-8465.

MODELS: Three models are available: MTI-745 for the IBM 370/145, MTI-755 for the IBM 370/155, and MTI-165 for the IBM 370/165.

COMPATIBILITY: MTI's Monolithic Main Memory employs semiconductor construction and is designed as plug-compatible add-on or replacement main memory for IBM System/370 Models 145, 155, and 165. The MTI memory can be used to extend the storage capacity of an existing IBM System/370 processing unit and/or to replace all of the unit's existing storage down to the 160K-byte minimum for the 145; Models 155 and 165 can be stripped of all IBM memory. MTI's memory product line includes all storage capacities that are currently available from IBM; enhancement capacities (storage capacities above the IBM-imposed maximum capacities) are also available for the 370/155 and 370/165, in capacities up to 4096K bytes.

Effective cycle times of the MTI memories are the same as those of the corresponding IBM units: 540 nanoseconds per 8-byte fetch for Model 145, 2.07 microseconds per 16-byte fetch for Model 155, and 2.0 microseconds per 8-byte fetch for Model 165.

The MTI-745 cabinet contains up to 896K bytes of storage, measures 30 inches wide by 31.5 inches deep by 60 inches high, and weighs up to 450 pounds. Power consumption and heat dissipation per 896K bytes of storage are 1.8KVA and 6,000 BTU/hr., respectively.

Physical, electrical, and environmental specifications are the same for both the MTI-755 and MTI-765. A standard upright cabinet containing up to one million bytes of storage measures 30 inches wide by 31.5 inches deep by 60 inches high and weighs up to 975 pounds. Power consumption and heat dissipation per one million bytes of storage are 2,500 watts and 10,500 BTU/hr., respectively.

The MTI-755 and MTI-765 semiconductor memories are constructed from 16K-byte memory cards; each card contains 72 monolithic integrated circuit modules, each capable of storing 2,048 bits of information. Therefore, a one-million-byte memory contains 64 memory boards. The MTI memories include "bump" storage and require only five types of circuit boards.

The MTI memories contain an integral power supply that satisfies the memory power requirements, a power sequencing/desequencing unit, and a maintenance panel that provides an off-line diagnostic capability to facilitate isolation of malfunctions within the memory. The MTI memories are powered from a 115-volt, single-phase source. ➤

Memory Technology 370-Compatible Monolithic Main Memory

smaller 370/135 and 145. (IBM itself employs MOS in its newer Model 158 and 168 main memories.)

Current LSI semiconductor memories fall into either the bipolar or MOS category. The chief advantage of the bipolar technique over both core and MOS is higher potential operating speed, but this is currently achieved at the expense of substantial increases in power consumption and higher costs.

The MOS technique, which MTI uses, is currently regarded by many as a more cost-effective main storage method than either core or bipolar semiconductors, but its commercial development has lagged somewhat behind that of the bipolar technology. Although MOS memories can operate at somewhat higher speeds than core, their prime advantage in many situations is a substantial reduction in power consumption, which translates into significant reductions in heat dissipation and air conditioning loads. Still other advantages include smaller floor-space requirements, non-destructive readout, and simplified maintenance. A single card containing 16K bytes of MOS memory (the MTI card capacity) can be slipped out and replaced in short order.

The semiconductor memories' only noteworthy disadvantage seems to be their volatility, which means that when the power is interrupted, the stored data is lost. However, this characteristic does not pose a serious problem for most installations, since it is a normal operating procedure to reload all data after a power failure when using core memory, too.

MTI's MOS memories offer the user substantial reductions in cost, power consumption, air-conditioning loads, and floor space. System performance is unchanged. Cost savings of at least 20 or 25 percent below IBM's prices for equivalent storage capacities can be realized on leased or purchased units, respectively. Power consumption of the MTI memories is about 50 percent below that of the IBM memories, with corresponding reductions in heat dissipation. Floor space requirements range from 23 to 50 percent of that required by IBM. Like their IBM counterparts, the MTI memories connect directly to the IBM Storage Adapters associated with the processors and also provide for the storage of error correction and control (ECC) bits.

MTI also offers an accelerator for the 370/155 that promises a substantial improvement in performance, which should make the 155's processing speed essentially equivalent to that of the 370/158. Other features available from MTI for the 370/155 include the Uniport and Shared Port features. Uniport permits attaching up to 2 megabytes of MTI memory to a single port on IBM's Storage Adapter, as compared with 1/2 megabyte of IBM memory. The Shared Port feature permits 1/2 megabyte of IBM memory to be combined with up to 1-1/2 megabytes of MTI memory on a single port of IBM's Storage Adapter.

MTI began deliveries of its semiconductor memories in September 1972, when it shipped its initial MT-755. The MT-765 followed in August 1973, and the MT-745 in September 1973. To date, MTI has installed about 40 megabytes of semiconductor main memory.

Service is provided exclusively by MTI, which currently has about 20 customer engineers and locations in 11 major cities, including New York, Washington, D.C., Dallas, Chicago, Los Angeles, and San Francisco.

USER REACTION

The results of a recent Datapro survey of users employing add-on main memory from independent suppliers (Report 70D-010-60) showed all three of the responding MTI users to be well satisfied, as indicated by unanimous ratings of excellent or good in all four of these categories: overall performance, equipment reliability, maintenance service, and ease of installation. The users reported few or no problems during or since installation. Reported installation times ranged from 8 to 12 hours for installations of up to 1 megabyte of MTI memory. One user expressed dissatisfaction with the MTI memory's inability to correct double-bit errors and said that "though these errors are occasional, the operator is not alerted via the console typewriter." □

PRICING: MTI-745, MTI-755, and MTI-765 memories are available for lease, purchase, or on an installment purchase plan, which provides full ownership. Conversion from lease to purchase is available through a purchase credit arrangement. MTI offers lease contracts for two, three, four, and five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and full service on a 24-hour/day, 7-day/week basis. A separate maintenance contract is available for purchased units.

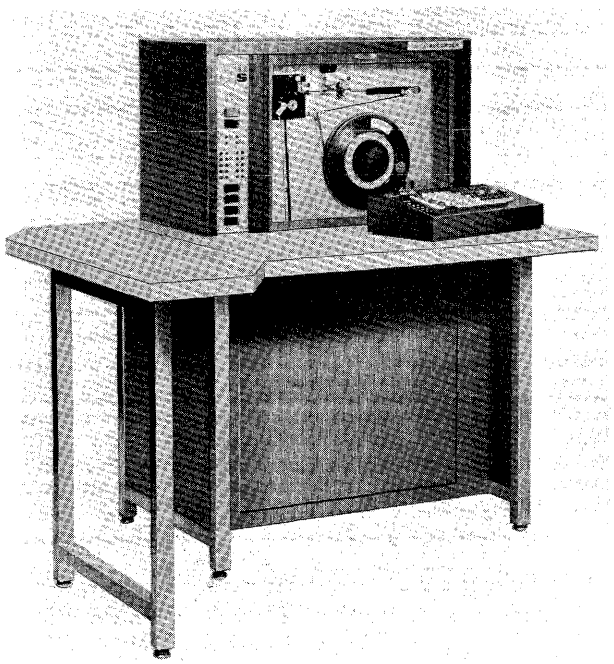
MTI-755/765 Capacity, bytes	Monthly Rental 2-Year Lease	Monthly Rental 5-Year Lease	Purchase	Monthly Maint.**
512K	$2,900	$1,760	$85,000	$ 580
768K	4,415	2,695	130,000	670
1024K	5,775	3,520	170,000	750
1536K	8,660	5,280	255,000	1,100
2048K	11,550	7,045	340,000	1,400
3072K	18,300	11,100	530,000	2,100
4096K	24,200	14,600	700,000	2,800
MTI-745 (per 256K increment)***	2,000	1,200	100,000	250
Features				
370/155 Accelerator	700	400	20,000	–
Shared Port	350	200	10,000	–
Uniport	N/C	N/C	N/C	N/C

*Monthly rental under a 2- through 5-year lease includes maintenance for 24 hours/day, 7 days/week.

**Prime shift.

***For 370/145 upgrades to 1024K bytes maximum. ■

Mohawk 1100 Series Data-Recorders



Mohawk, the innovator of the keyboard-to-tape concept, provides a wide line of data recorders for preparing input to computers. Data is recorded directly on a 1200-foot reel of magnetic tape in 7-track IBM 729-compatible format. Many models include auxiliary I/O devices.

MANAGEMENT SUMMARY

The Mohawk Data-Recorders are individual, self-contained units designed for direct transcription of data from a keypunch-stype keyboard to computer-compatible magnetic tape. They are a logical substitute for keypunches and verifiers for magnetic tape-oriented installations. Many models, combining one or two auxiliary devices with the basic reader, permit flexibility in the design of an input preparation system.

Mohawk achieved almost instant success with its keyboard-to-magnetic tape innovation, introduced in April 1965 as the 1101 Data-Recorder. This unit was the first member of a now well-established and expansive product line. Mohawk had the field pretty much to itself until January 1968, when Honeywell introduced Keytape. Honeywell's move strengthened the keyboard-to-tape concept because it represented endorsement by a major manufacturer of computers.

The 1100 Series is no longer in production. In all, some 30,000 units were produced, including those sold under NCR's label. A significant number of units on rent are being converted to sales through a liberal allowance program. However, 7-track Data-Recorders are still readily available from Mohawk, and probably will be for some time to come. The 9-track 6400 Series Data-Recorders are still in production; see Report 70D-642-02. □

CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, P.O. Box 630, Herkimer, New York 13350.

MODELS: The 12 models of the 7-track Mohawk Data-Recorders are shown in the following table. All are some combination of the basic 1101 Data-Recorder and an input device, an output device, and a communications interface.

All models are completely self-contained, single-station units designed to permit recording of keyed data onto computer-compatible magnetic tape.

MOHAWK 1100 SERIES MODELS

Auxiliary Device	Model Numbers Without Communications	With Communications
Key Entry Only	1101	1103
Pooler	1102	–
Adding Machine	1104	1112
Paper Tape Reader	1105	1115
Punched Card Reader	1116	1119
Output Typewriter	1118	1183
Input/Output Typewriter	1181	–

Additional models, such as 7/9-track converters and units with a different card reader than the 1116/1119, may be available depending on inventory. A buffered line printer is available for models 1101, 1103, 1105, 1115, 1116, and 1119.

TAPE OUTPUT: Fully compatible with IBM's 729 Series tape units. Character and longitudinal parity are written. Recorded tape is collected in a bin; only one half of a full 10.5-inch, 2400-foot reel can be recorded.

Recording density is 200 bits/inch.

Record length is fixed at 80 characters in the standard model; buffers up to 180 characters are optional.

Various options, some free when ordered, others for a charge, permit code compatibility with IBM, Burroughs, GE, and CDC even-parity and Honeywell, NCR, RCA, and UNIVAC odd-parity data codes. ►

Mohawk 1100 Series Data-Recorders

The magnetic tape handler is a single reel, pinch-roller unit that employs a tape bin in place of a take-up reel. A take-up reel is optional. Tape speed is 15 inches/sec.

DEVICE AND ERROR CONTROL: The 1100 Series functions essentially the same as the Mohawk 6400 Series; see Report 70D-642-02.

AUXILIARY DEVICES: The auxiliary devices available in the various 1100 Series models are essentially the same as in the 6400 Series models, although there are some minor differences in operation. See Report 70D-642-02 for a description of communications, card reader, paper tape reader, adding/listing machine, buffered line printer, pooling, and check digit devices. Devices unique to the 1100 Series are described below.

KEYBOARD: 47-key or optional 64-key keypunch-style keyboard can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters. Up to 13 control keys provide for initiating function such as tape movement, manual duplication and skipping, error correction, etc. key modules can be interchanged, at the user's discretion, without changing the character bit configuration produced by the key.

TYPEWRITER: Permits data previously recorded on magnetic tape to be selectively printed as specified by program codes in memory. Horizontal tabulation can be initiated by program codes. Printing can be initiated automatically for each record or manually for selected records. The typewriter (IBM 735) can be used independently of the Data-Recorder.

In the 1181 Data-Recorder, the typewriter replaces the keyboard and is used directly for data entry. Many of the standard options, such as Alternate Program, Programmed Left Zero, Check Digit, etc., are not available for the 1181.

PRICING: The Data-Recorders are available for purchase or on a one-year lease for unlimited usage. The lease prices shown below include maintenance. A separate maintenance contract is provided for purchased units.

	Monthly Rental	Purchase	Monthly Maintenance
1101	$140	$ 7,200	$20
Incrementing Block Counter (standard in all except 1101, 1104, 1105, 1116, and 1118)	5.50	200	0.50
Decrementing Block Counter (for models without standard block counter)	11	400	1
Decrementing Block Counter (instead of standard block counter)	5.50	200	0.50
1320 Interface	9	280	2
1320 Buffered Line Printer	500	21,000	80
Take-Up Reel	12.50	400	2.50
Alternate Program	6.50	240	0.50
Self Check (modulo 10 or 11)	25	990	5
Self Check (universal)	30	1,200	5
Programmed Left Zero	–	150	–
Keyboard (64-character)*	3.50	120	0.50
90-Character Buffer	5.50	200	0.50
100-Character Buffer	10	300	–
120-Character Buffer	20	600	–
140-Character Buffer	30	900	–
160-Character Buffer	40	1,200	–
180-Character Buffer	50	1,500	–
Selective Record Limit	2	100	–
1102	195	8,400	35
1103	232.50	9,750	37.50
High-Speed Communications Interface	30	450	–
1104	215	9,250	35
1105	260	10,500	35
Spooler and Unwinder	9.50	420	0.50
1112	300	11,025	45
1115	357	13,000	52
1116	307	10,800	42
Two Cards per Block	3	125	–
Face Up/Down Read Control	10	400	–
1118	295	12,000	35
NCR or Honeywell to IBM Translation	21	600	1
1119	390	13,300	55
1181**	240	10,200	60
1183	375	13,000	60

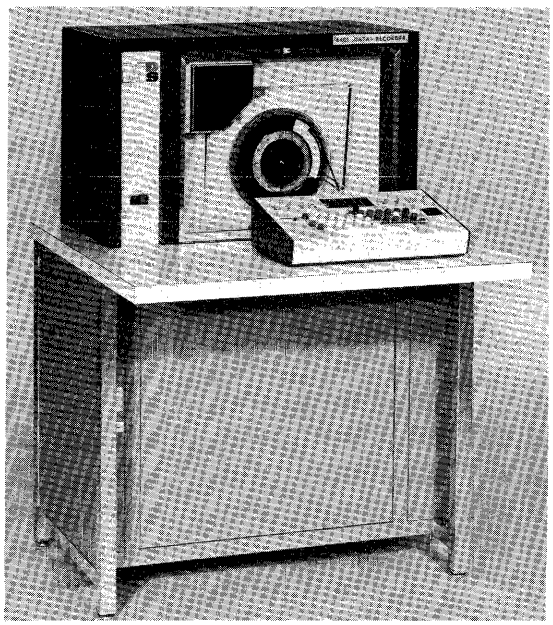
*This entry represents several different keyboards adapted to be compatible with particular computer families. All are the same price except for the models for NCR and Honeywell; for these, the rental is waived.

**None of the 1101 options can be used except buffers.

In general, options available for a single-use Data Recorder are available for the models incorporating that function with others, but there are some restrictions. There are also some restrictions about combinations of options.

The maintenance figures presented above are for the basic contract, which covers installation within 15 miles of a service area for normal business hours (9 am to 5 pm weekdays). Currently there are a total of about 90 service locations spread across the U.S. A graduated scale is applied to additional hours of coverage and for locations outside the basic service limit; additional maintenance charges are reduced in proportion to the number and type of units installed. ■

Mohawk 6400 Series Data-Recorders



The 6401 Data-Recorder is the basic model in the 6400 Series.

The leader in the field of non-punched-card preparation of input for computers, Mohawk offers many models of the 6400 Series Data-Recorders for recording data entered via a keyboard onto magnetic tape in a format compatible with IBM 9-track, 800-bpi magnetic tape units. A host of auxiliary devices increase the versatility of the input preparation process.

MANAGEMENT SUMMARY

Analyzing the rousing success of the key-to-tape concept pioneered by Mohawk is a chancy undertaking at best. Perhaps computer users became psychologically unable to appreciate new advances in computer mainframe speeds, became disillusioned about the capability for "operating systems" to solve their computer throughput dilemma, and were ready for a new solution to their problems. In any event, the key-to-tape concept has caught on in a big way. This is attested to by the host of imitators and innovators competing today for the opportunity to replace the estimated half-million key-punches installed. Many of the competing companies hasten to add that there are many markets and applications for these units outside the traditional one of computer input preparation.

The one outstanding advantage Mohawk has at present is a proven track record. Mohawk 1100 Series units have been installed and working since 1965, and the first delivery of a 6400 Series model was made in 1968. This puts Mohawk in the position of being chased by the others.

Mohawk states that keypunch replacement and data communications are the two primary application areas for the 6400 Series units.

Competitors have challenged Mohawk on several points, such as the use of a bin instead of a take-up reel, the use of a full 10.5-inch supply reel, the use of a binary data display instead of a direct read-out, economies of large-scale installations, and aesthetic appearance.

CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, P. O. Box 630, Herkimer, New York 13350.

MODELS: The models of the 9-track Mohawk Data-Recorders are shown in the following chart. All are some combination of the basic 6401 Data-Recorder and an input/output device and/or communications interface.

MOHAWK 6400 SERIES MODELS

Auxiliary Device	Model Numbers Without Communications	With Communications
Key Entry Only	6401	6403
Adding Machine	6404	6412
Paper Tape Reader	6405	6415
Card Reader	6406	6409
Pooling	6402	–

A buffered line printer can be added to all models except the 6404 and 6412.

TAPE OUTPUT: Fully compatible with IBM's 2400 Series tape units. Character parity and cyclic redundancy are written. Recorded tape is collected in a bin; only one-half of a full 10.5-inch, 2400-foot reel can be recorded.

Recording density is 800 bits/inch.

Record length is fixed at 100 characters in the standard model. The user can specify 80- or 90-character buffering at no additional cost from the factory. As an option, record length can be dial-selected in 10-character increments from 10 to 180 character positions.

The magnetic tape handler is a single-reel, pinch-roller unit that employs a tape bin in place of a take-up reel. (A take-up reel is now available as an option.) Tape speed is 15 inches/sec.

DEVICE CONTROL: Programs are stored in an independent core buffer. Provision is made for storing two programs simultaneously, with manual switching between basic and alternate programs.

The program controls format of the data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or optional right justification (left zero fill). The program also controls the operation of input/output devices and the check-digit function.

Mohawk 6400 Series Data-Recorders

Mohawk stoutly defends the use of a bin, maintaining that it has not been a problem in the many thousands of installations now operating. Nevertheless, some customers have complained, and Mohawk offers a take-up reel as an option.

The use of a full 10.5-inch reel seems wasteful, especially since the bin can only hold 1200 feet; but, more significantly, the full output from one girl is at most 300 feet per day. Since most installations pool at the end of one day, short tapes are sufficient. Indeed, Mohawk says that many installations use 300- or 600-foot mini-reels. Using this approach, the inventory costs for supplying a many-station Data-Recorder installation with reels of tape are sharply reduced. After all, just because the unit can accommodate the big reel doesn't mean that the customers have to use them. Naturally, the big-reel capacity is convenient when pooling.

The binary data display is a moot point. Units such as the Data-Recorder are intended for high-volume applications. The necessity to read out recorded characters seems a minor concern. Looking at a display to see what has been recorded is often less efficient than just rekeying a field. Sight verification also seems a risky operation on a character by character basis. However, many users are unwilling to give up the security of being able to read what has been recorded, especially since magnetic tape cannot be read visually as punched cards can.

Aesthetics? You'll have to work that out for yourself.

The basic Data-Recorders have changed little since they were first introduced, although many models, options, and arrangements have been added over the years. One significant omission has been the lack of 1600-bpi recording.

In addition to incorporation of the Data-Recorders into other Mohawk product configurations to give a key entry and/or magnetic tape recording capability, three specialized products use the Data-Recorders as building blocks to end up with an IBM BSC-compatible terminal, an input unit for an IBM System/360 computer, and a multi-station key entry system.

The *7201 BSC Adapter* provides a communications interface for an 1101, 1116, 1118, 6401, 6405, or 6406 Data-Recorder that is compatible with IBM's bisynchronous transmission technique at up to 2400 bits/second. Point-to-point transmission compatibility with the IBM 2780 is provided, although not all 2780 options are supported. The basic 7201 Adapter rents for $115 per month (including maintenance) and sells for $5,300. Numerous options are available, including provisions for connecting two Data-Recorders to the Adapter, which,

New programs are entered manually from the keyboard or automatically from a short strip of magnetic tape—usually no longer than two feet. Several programs can be recorded on the tape and selected via the search function; constant information can also be recorded and entered following program entry. The program can be locked out, which permits the operator to completely control the format of recording.

Modes of operation include Entry, Verify, and Search; Send and Receive modes are included with models that incorporate a communications interface. In the Entry mode, all data for a complete record is accumulated in a data buffer prior to writing on tape. In the Verify mode, a complete record is read from tape into the buffer memory and compared character for character with the data rekeyed by the operator from the source document. The Search mode allows the operator to find a record with the same identifier as that keyed in; any portion of a record can be used as an identifier.

ERROR CONTROL: Conventional read-after-write checking as tape records are written, plus several additional provisions.

Character parity is produced along with character generation for each data key depression, and is checked when transferred to the buffer. Character parity is also checked when read from memory.

Following the writing of each record, the tape is backspaced and the record is read and compared bit for bit with the data retained in the buffer. This feature applies equally in the Verify mode when a record is corrected.

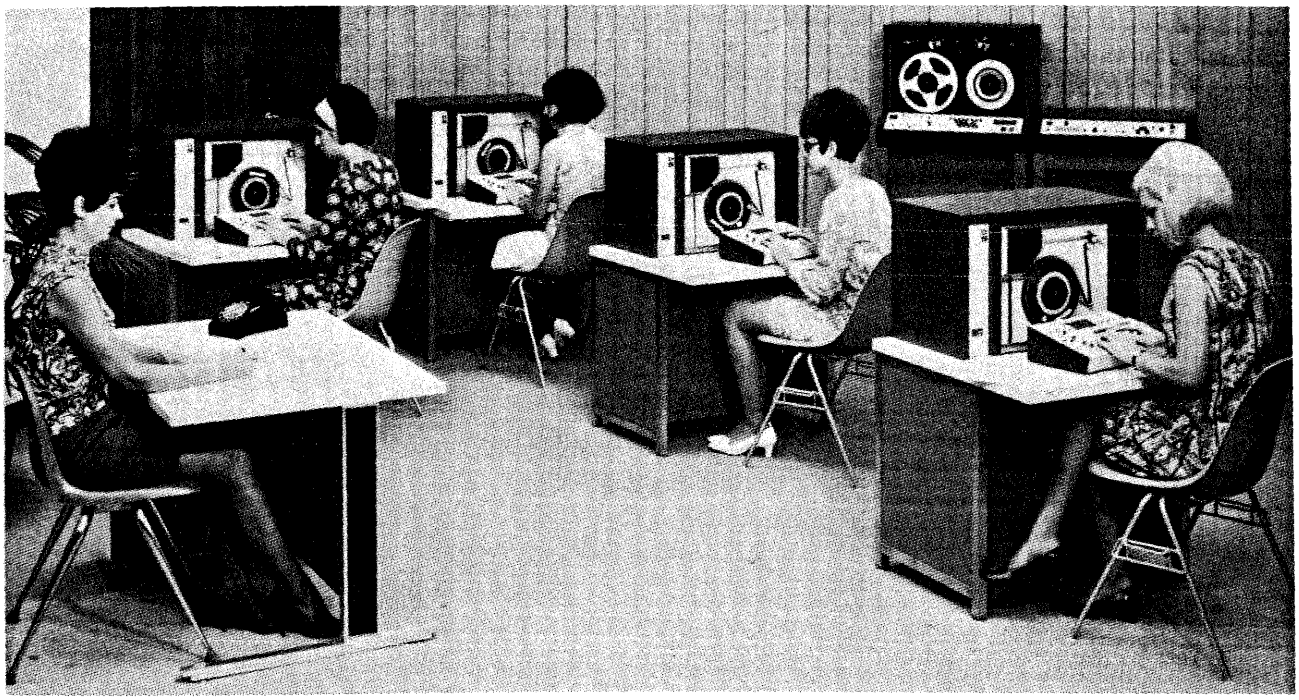
Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character.

KEYBOARD: 49-key keypunch-style keyboard can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters including space. Up to 14 control keys provide for initiating functions such as tape movement, manual duplication and skipping, correction, etc. Key modules can be interchanged, at the users' discretion, without changing the character bit configuration produced by each key.

COMMUNICATIONS: Capability is provided by several models. Data is transmitted synchronously in the half-duplex mode, using a modified BCD code. Alpha characters are transmitted as an eight-unit code, numerics as four-unit code. Character parity is not included, but, built-in redundancy allows for error checking. Alternatively, an image mode can be used that includes no translation; all characters are transmitted as 8 bits. A medium-speed interface that operates at 1200 or 1600 bits/second is standard. Optional high-speed interfaces operate at up to 4800 bits/second.

Data sets must be equipped with a reverse-channel feature or a full-duplex facility must be employed to accommodate error signaling. Messages are transmitted in fixed-length records which can include 1 to 100 data characters (as specified by the program) or, optionally, up to 180 data characters. Each record is preceded by an odd/even message code. Longitudinal parity accompanies each record and is checked when received.

Mohawk 6400 Series Data-Recorders



Four 6401 Data-Recorders are included in this 9200 System, with multiplexer and central magnetic tape handler in right background. A 9200 System can include up to 16 Data-Recorders (Series 1100 or 6400) and 7 tape handlers.

in conjunction with automatic turnaround options, permits transmitting and receiving from independent tapes (but not simultaneously). Several different printers can be incorporated into a 7201/Data-Recorder configuration.

The *3600 Controller* is an interface for connecting an 1101, 1103, 6401, 6403, or 6405 Data-Recorder to the Multiplexer Channel of an IBM System/360, Model 25 or larger. (It can also be used with a Model 20.) The Data-Recorder operates under DOS or OS as a low-speed tape drive. Off-line operation can be used to generate a tape from key entry, data communications, or paper tape, depending on model. The Controller rents for $100 per month (including maintenance) and sells for $5,000. The Data-Recorder interface rents for $30 and sells for $1,000.

The *Mohawk 9200 System* assembles Data-Recorders into a multi-station key entry system capable of controlling the output of up to 32 operators. A single or dual controller is available that buffers the output of individual stations and transfers the data to up to seven 7-track (800 or 556 bpi) or 9-track (800 bpi) tape units. The dual controller is, in effect, two controllers in one; either section can be operated independently of the other to give continued operation in case of malfunction in one of the controller modules. Either 7-track (1101, 1102, 1103, 1104, 1105, 1116, or 1118) or 9-track

Normally, two programs are used at the transmit or receive terminal to control data format. The first program controls the data format of the first record of a block, and the alternate program controls succeeding blocks. This arrangement allows constant information to be transmitted in the first record and duplicated in succeeding records to reduce the amount of data that must be transmitted.

Message acknowledgement is performed bia the reverse-channel technique. A tone transmitted by the receiving station via the reverse channel signals the transmitting station to transmit the next record–or to retransmit the previous record in the case of a detected transmission error.

The transmitting station will automatically repeat a message over a 20-second duration before an error condition is signaled and operator intervention is required.

CARD READER: Permits data to be transferred from punched cards to the magnetic tape at 160 cards/minute. An option permits reading two cards and transferring the data to one tape block. With this option, throughput is 220 cards per minute. Data fields on the card can be selectively interspersed (but not rearranged), with data entered from the keyboard under control of none, one, or two programs. The reader can be adapted to handle 51-column cards.

Data-Recorder models including a card reader can also be used to perform off-line card-to-tape transcription. Records can be modified under control of the stored programs. Card code is automatically translated to EBCDIC code.

Mohawk 6400 Series Data-Recorders

(6401, 6402, 6403, 6404, 6405, or 6406) Data-Recorders can be connected to the controller. Full off-line functions can be performed. A lower-priced version of the Data-Recorder is available that cannot be used off-line. The 9200 System appeals to those users who have purchased Data-Recorders previously and/or those who want the added flexibility represented by the various auxiliary devices included in some Data-Recorder models. It also appeals to users with an extreme need for reliability, because all Data-Recorders could be used independently in the system controller went down. A typical 9200 System with single controller and five output tape drives rents for $1,250 per month (including maintenance), exclusive of Data-Recorders; the corresponding sale price is about $50,000. About 100 of the 9200 Systems have been installed. □

PAPER TAPE READER: Permits data to be transferred, without translation, from a strip of punched tape to the magnetic tape at 400 characters/second. Punched tape data can be selectively interspersed with data entered from the keyboard under control of program codes in memory and codes in the data from paper tape. The reader can accommodate 11/16-, 7/8-, or 1-inch paper tape punched in any 5- to 8-level code. Throughput ranges from about 80 records per minute for 180-character records up to over 300 records per minute for very short records (under 10 characters).

ADDING/LISTING MACHINE: Permits data fields entered from the keyboard or read from tape to be entered into the adding machine accumulator and listed. Printing of a total can be initiated from either the keyboard or the adding machine; the total is not entered into the memory or recorded on magnetic tape. The adding machine can be used independently of the Data-Recorder.

BUFFERED LINE PRINTER: The 1320 Line Printer permits off-line tape-to-print transcription or printing of data received directly from a remote Data-Recorder via a communications facility. Both operations are controlled by the stored programs. A drum printer rated at 250 lines per minuts (minimum printing speed) to 375 lines per minuts (numerics only) produces up to 132 characters per line. Vertical spacing is manually selected at 6 or 8 lines per inch; the character set includes 63 characters plus horizontal space code. Printing is performed from a 132-character print buffer.

Data can either be printed in the same format as on tape or, in a special format-control model, form advance and spacing control characters included in the record can be used to position data fields. Forms from 4 to 20 inches wide can be used; maximum form length is 22 inches.

POOLING: Allows short tapes to be consolidated onto one longer tape. Up to three pooler models can be interconnected. In a three-station pooling system, the operator can be reloading one station while the second is transferring data. A moderate amount of editing can be performed via the main and alternate stored programs through the automatic skip and duplicate functions.

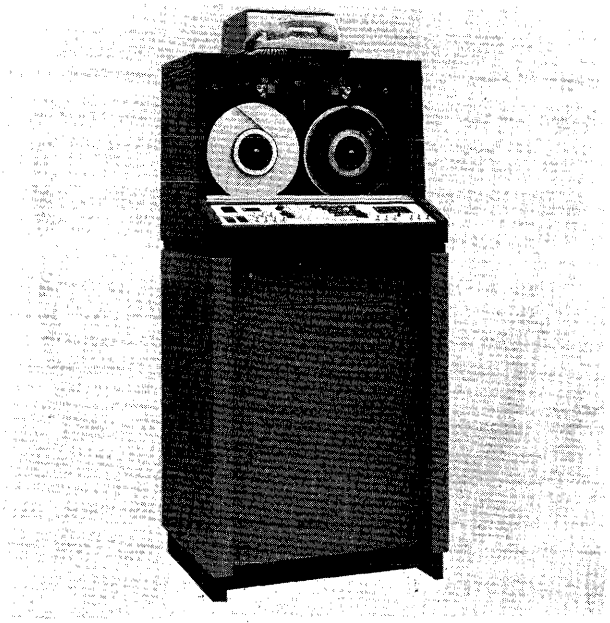
CHECK DIGIT: Allows validation and, in one case, generation of check digits for numeric fields. Check digit models are equipped to handle either modulo 7, modulo 10, or modulo 11 check digit validation; modulo 10 models include check digit generation. This check digit function is identical with that performed by the IBM keypunches.

PRICING: The Data-Recorders are available on a purchase basis or on a one-year lease for unlimited usage. The lease price includes maintenance. A separate maintenance contract is provided for purchased units.

Device	Monthly Rental	Purchase	Monthly Maintenance
6401	$169	$ 8,000	$24
Decrementing Block Counter	5.50	200	0.50
Interface for 1320 Line Printer	9	280	2
1320 Line Printer	500	21,000	80
Take-Up Reel	12.50	200	0.50
Self-Check (Module 7, 10, or 11)	25	990	5
Self-Check (universal)	30	1,200	5
Single Run Entry/Verify	2.50	115	0.50
180-Character Buffer (selectable length)	15.50	600	1
6402	217	9,200	37
6403	259	10,550	39
High-Speed Interface	30	450	–
6404	262	10,050	37
6405	292	11,300	37
Spooling and Unwinding Device	9.50	420	0.50
6406	340	11,600	50
Two Cards per Block	3	125	–
Face Up/Down Read Control	10	400	–
6409	430	14,100	65
6412	335	11,825	50
6415	405	13,800	60

In general, options available for a single-use Data-Recorder are available for the models incorporating that functions with others, but there are some restrictions. The most significant restriction is the non-availability of the 1320 Line Printer for the 6404 and 6412. There are also some restrictions about combinations of options. ■

Mohawk 7500 System



The 7505 Controller, central component of the 7500 System, contains the system control logic, magnetic tape drive, keyboard, and optional communications interface.

The 7500 System is designed for off-line media conversion applications and supports transcription between magnetic tape, punched cards, and paper tape. Printed copy can be produced during and in addition to the transcription.

MANAGEMENT SUMMARY

Users who are currently using a costly computer system for the trivial task of media conversion should take a good look at an alternative technique for performing a variety of media conversion operations in off-line fashion—the Mohawk 7500 System.

The 7500 is a media conversion system that converts data from computer-compatible magnetic tape, punched cards, or punched tape to computer-compatible magnetic tape, punched tape, or punched cards and can simultaneously provide a printed copy. Besides its media conversion capabilities, the 7500 System can also provide a half-duplex communications capability using the Mohawk Synchronous Communications (MSC) technique.

Centered around a controller with integral magnetic tape drive and keyboard, the 7500 System can include a paper tape reader, paper tape punch, card reader, card punch, printer, and communications interface. One each of two card-reader models that read 1000 or 400 cards per minute and two printer models that each print 300 lines per minute can be specified. One printer is a drum type and the other is a chain type.

The controller is buffered. It receives data from a manually selected input device, intermediately stores the ▷

CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, World Headquarters, P.O. Box 362, Utica, New York 13503. Telephone (315) 792-2202.

CONFIGURATION: The 7500 System is centered around the 7505 Controller, which contains system control logic, a magnetic tape drive, a keyboard, and an optional communications module. System I/O components can include any of the following: 7516 or 7517 Card Reader, 7515 Paper Tape Reader, 7525 Paper Tape Punch, 7526 Card Punch, and 7520 Buffered Line Printer or 7530 Buffered Chain Printer.

TAPE INPUT/OUTPUT: 7- or 9-track, fully compatible with IBM's 729 or 2400 Series tape units. Recording density is 800 bits/inch for either 7- or 9-track drives; 556 bits/inch is optional for 7-track drives. A second selectable recording density of 200 bits/inch (read only) is available with either of the 7-track recording densities. Block length can be dial-selected from 10 to 190 characters in 10-character increments.

The magnetic tape drive is a double-capstan, pinch-roller unit that handles tape in reel-to-reel fashion and accommodates standard 10.5-inch, 2400-foot tape reels. The read/write speed is 15 inches/second, and the rewind speed is 75 inches/second.

Standard tape codes are BCD (7-track), ASCII and EBCDIC (both 9-track).

DEVICE CONTROL: Provided through switches on the operator panel and I/O device panels and through stored programs (record formats). Programs are stored in an independent core buffer. Provision is made for storing two programs (input and output) simultaneously, with automatic or manual switching between the two programs.

Except for the magnetic tape unit and the printer, programs control the format of the data transferred between the controller and an input device (including keyboard) or output device or the communications interface by delimiting alphabetic and numeric fields and by initiating field skipping or duplicating.

Programs can be entered from any of the input devices. Eight program codes, used to control specific functions, constitute a code set. Each input or output device responds to its own unique code set, which is not interchangeable with that of other devices. The magnetic tape unit is not programmable, but program control over magnetic tape records can be established indirectly through the device that is communicating with the ▶

Mohawk 7500 System

data, then transfers the stored data to a selected output device. A printed copy of the transcribed data can be produced during the transcription.

Transcription is performed under program control. Two stored record formats control data input and output between the controller and the selected input and output devices. Either program can be selected at the keyboard. These record formats are much the same as those used with the Mohawk Data Recorders to delimit alpha and numeric fields and to initiate duplicate and skip functions. The programs can be entered via the keyboard or any input device.

The 7500 System, through its communications interface, is compatible with other Mohawk devices such as the 1103 and 6403 Data Recorders. Communications can be performed in one of two modes: BCD or Image. The BCD mode is used for communications between a 7500 System and an 1100 Series Data Recorder because the 1100 Series units are limited to a 64-character set. Image mode transmits any eight-level code and can be used when communicating with a 6400 Series Data Recorder. It is important to note that when communicating between units that employ different code levels, the character set is restricted to that of the unit having the lower number of bits per character.

The 7500 System was initially delivered in January 1970 and the number of systems delivered to date is over 100. Delivered systems have varied from a configuration with communications and printer only to a full-barreled configuration with communications, printer, paper tape, and card I/O. The current lead time on orders is 28 weeks, except for the 7530 printer, which takes 26 weeks. □

magnetic tape unit. The tape unit operates in one of two modes: Read Tape, in which complete data blocks are read into the buffer memory, and Entry, in which the entire contents of the buffer memory are transferred to tape.

The 7517 Card Reader provides an additional programming capability via a group of Field Select Switches. These switches allow the user to select any of up to five card fields to be read and transferred to buffer memory; any number of columns can be selected. The field-selection technique provides the capability to pack information sequentially from several cards into one data block of up to 190 character positions. The actual transfer of data to memory is governed by the input program, which can reject or accept data transferred under the control of field selection.

Input/output device selection is performed manually via on-line switches located on each I/O device. One input device and two output devices, provided the second is a printer, can be active simultaneously; selection of additional I/O devices is inhibited through system interlocking. Any of 41 I/O combinations can be selected.

Translation between the media code and the internal EBCDIC code used by the controller is performed within each I/O device.

Manually-initiated functions via switches on the operator panel provide for tape and keyboard selection, tape operation, data communications, program loading, skip and dup code recognition, record search, etc. Tape operation controls also permit the deletion of incorrectly entered data blocks by reversing the tape one block while erasing; the tape can also be reversed without erasure. Block length is established via thumb-wheel switches on the operator panel.

Display of current location within a record, data character stored in the current buffer location, program code stored in the current buffer location, and status conditions are provided by indicator lamps on the operator panel. The buffer address is displayed in decimal fashion by three groups of lamps (units, tens, and hundreds). Data is displayed as a single character in an 8-bit EBCDIC form and requires interpretation. Program codes are displayed in three-bit binary form. Status information displayed includes type of error, end-of-file, controlling program (input or output), and communications status. A block counter indicates the number of blocks transferred from memory to an output device.

ERROR CONTROL: Conventional read-after-write checking as tape records are written, plus several additional provisions. Character parity is produced along with character generation for each data key depression; character parity is also generated and accompanies each character transferred to memory from an input device. Character parity is checked prior to writing data in the buffer memory and when reading from memory.

Data recorded incorrectly on magnetic tape can be corrected through manual initiation of tape backspace and rewrite functions, in which three inches of tape including the error block is erased before the block is rewritten. Data read in error from magnetic tape can be reread through manual initiation of tape backspace and reread functions, which backspaces the tape to the beginning of the block and rereads the block. An error indication during a search operation indicates a parity error or blank tape.

Tape records found to be in error when reading from tape can be manually corrected from the keyboard. Through key-verification, data read from tape is compared to keyed data; a mismatch between the characters halts the operation and alerts the operator who can then correct the character or re-enter a field of up to 190 characters.

Errors that occur during media conversion automatically halt the operation and require operator intervention.

KEYBOARD: 49-key keypunch-style keyboard can produce any of 64 character codes: 10 numerics, 26 alphabetics, and 28 special characters including space. Fourteen control keys provide for initiating functions that include manual duplication and skipping, correction, and field modification, memory backspace, tape backspace, program selection, clearing errors, alpha and numeric shift, and resetting the memory to the initial location. All data keys are repetitive when held depressed. A Multiple Code key permits the construction of any 8-bit character.

Mohawk 7500 System

COMMUNICATION: Data is transmitted synchronously in the half-duplex mode. One of two transmission modes can be selected manually: BCD and Image. BCD mode transmits alpha characters as eight-unit codes and numerics as four-unit codes. Image mode transmits all characters in the internal 8-bit EBCDIC code, which is not compatible with the Mohawk 1103 LDC Data Recorder. Character parity is not included in either transmission mode, but built-in redundancy allows for error checking.

A medium-speed interface that operates at 1200 or 1600 bits/second is standard. An optional high-speed interface operates at 2000, 2400, or 3600 bits/second.

Data sets must be equipped with a reverse-channel feature or a full-duplex communications facility must be employed to accommodate error signaling. Messages are transmitted in fixed-length records which can include 1 to 190 data characters. The record size of the transmitted message is dependent on memory capacity of both the sending and receiving device. Each record is preceded by an odd/even message code. A validity check character accompanies each record and is checked when received.

Normally, messages are transmitted under control of an output program and received under control of an input program. Sending and receiving terminals are not required to use identical programs, but all data transmitted must be accounted for by the receiving terminal. Skip codes can be used by the sending terminal to delete non-wanted fields or to eliminate transmission of spaces. Skip codes in the receiving program can be used to space out fields. Dup codes can be used at the sending and receiving terminals to eliminate repeated transmission of common data by transmitting it in a header record, using an alternate program; dup codes at the receiving terminal can be used to repeat common information input at the receiving terminal. The format of the record can be altered to the extent of spacing and duping operations, but data cannot be resequenced. Naturally, accurate coordination of sending and receiving programs is vital; normally this is done on a timed schedule basis or by voice conversations prior to switching to data mode.

Message acknowledgment is performed by the reverse-channel technique. A tone transmitted by the receiving station via the reverse channel signals the transmitting station to transmit the next record—or to retransmit the previous record in the case of a detected transmission error.

CARD READER: Permits data to be transferred from punched cards to buffer memory.

The 7516 Card Reader reads 51- and 80-column cards at a rated speed of 400 cards/minute; its hopper and stacker hold 500 cards each.

The 7517 Card Reader reads 80-column cards at a rated speed of 1000 cards/minute; its hopper and stacker hold 1000 cards each.

Translation from Hollerith code is performed by both readers.

PAPER TAPE READER: Permits data to be transferred, with optional translation, from a strip of punched tape to buffer memory at a rated speed of 400 characters/second. The reader can accommodate 11/16-, 7/8-, or 1-inch paper tape punched in any 5- to 8-level code. A tape winder/unwinder is optional to accommodate spooled tape.

CARD PUNCH: Permits data to be transferred, with translation to Hollerith code, from buffer memory to 80-column cards at a rated speed of 200 cards/minute. The punching speed can be increased to 300 cards/minutes when a minimum of 16 columns are punched per card. The hopper and stacker hold 1000 cards each.

PAPER TAPE PUNCH: Permits data to be transferred, with optional translation, from buffer memory to paper, Mylar, or Mylar/foil tape at a rated speed of 300 characters/second. The punch can accommodate a 1000-foot reel of 11/16-, 7/8-, or 1-inch tape and can punch any 5- to 8-level code.

PRINTER: Permits printing of data from buffer memory.

The 7520 Buffered Line Printer is a 132-column drum printer with a rated print speed of 300 lines/minute. It provides a 64-symbol set compatible with IBM, NCR, Honeywell, Burroughs, GE, UNIVAC, or RCA. Vertical spacing is 6 or 8 lines/inch. Accommodates 6-part forms from 4 to 20 inches wide and up to 22 inches long.

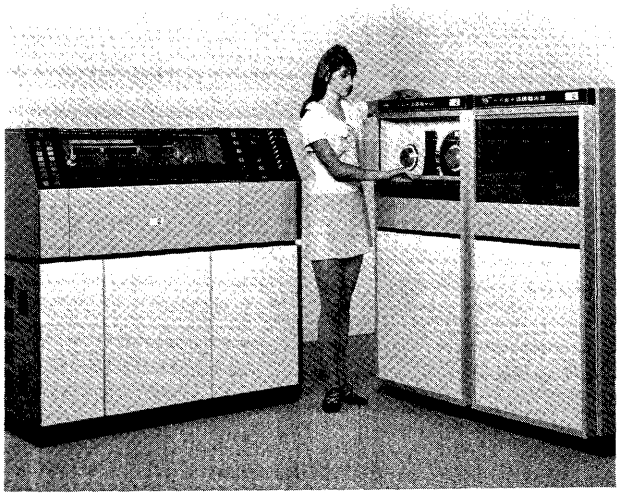
The 7530 Buffered Chain Printer is a 100- or 132-column chain printer with a rated print speed of 300 lines/minute. It provides a standard 64-symbol set, with options of 16, 48, 96, and 128 symbols. Vertical spacing is 6 or 8 lines/inch. Accommodates 6-part forms from 4 to 20 inches wide and up to 14 inches long.

PRICING: The 7500 System is available either on a purchase basis or on a one-year lease for a usage of 176 hours per month. Overtime charges are billed at a rate of 30 percent over the base rental rates. The rental prices include maintenance. A separate maintenance contract is provided for purchased units.

The 7500 System is priced as follows:

Device	Monthly Rental	Purchase	Monthly Maint.
7505 Controller (without communications)	$212.00	$ 9,000	$33.00
7505 Controller (with communications)	288.00	11,550	38.00
7515 Paper Tape Reader	91.50	4,050	16.50
7516 Card Reader	91.50	4,050	16.50
7517 Card Reader	173.50	7,650	38.50
7525 Paper Tape Punch	338.00	14,000	58.00
7526 Card Punch	532.00	21,500	93.50
7520 Drum Printer	497.00	21,000	92.00
7530 Chain Printer	534.00	23,625	99.00

Mohawk 2501 Programmable Print Station



This off-line tape-to-printer station features universal code compatibility, flexible forms control, 160 print positions, and rated speeds up to 1250 lines per minute; 7- or 9-track tapes recorded at densities up to 1600 bits per inch can be accommodated via one or two tape drives.

MANAGEMENT SUMMARY

Mohawk's 2501 Programmable Print Station, announced in October 1970, is the successor to the now dated and discontinued 6170 and 9160 Off-Line Printer Systems. Having descended from these earlier Mohawk product lines, the 2501 has inherited many of their features that characterize both print and tape operations and promote compatibility between the 2501 and the earlier printer systems. Besides its inherited features, the 2501 incorporates enhancements that provide greater operating flexibility and compatibility with virtually any of the computer systems currently in use.

Mohawk has augmented the original 2501-1 and its 1250-lpm drum printer by introducing an additional model, the 2501-2, that combines the basic 2501 controller with a 900-lpm drum printer and one of four available tape drives. Mohawk has also discontinued the availability of the 400-cpm and 1020-cpm card readers that were formerly offered with the 2501.

Salient features of the 2501 include:

- Buffer storage—4096-character buffer memory is standard; an 8192-character buffer is available as an option.
- Translation—any computer code can be translated to the 2501's internal code by means of a table look-up technique. The translation table is part of a stored program that is loaded from magnetic tape.
- Tape input/output—one or two computer-compatible tape drives can be used on a 2501-1 Print Station; 7- and 9-track drives can be mixed.

The 2501 can accommodate fixed- or variable-length tape records through the use of end-of-line codes or space codes that can be interspersed with or added to a ➤

CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, World Headquarters, P. O. Box 362, Utica, New York 13503. Telephone (315) 792-2000.

MODELS: Models 2501-1, a 1250-lpm print station, and 2501-2, a 900-lpm print station.

CONFIGURATION: The 2501 Programmable Print Station combines a programmable controller with a line printer and one or two read-only magnetic tape drives Model 2501-2 is limited to a single tape drive, while Model 2501-1 can accommodate any mix of two of the four models of available tape drives. Both models contain a 4096-byte memory, which can be expanded to 8192 bytes.

TAPE INPUT: The following read-only magnetic tape drives are available for use on the 2501: a 7-track drive with switch-selectable density pairs of 200/556, 556/800, or 200/800 bits per inch (Model 2501-1 only); a 7-track drive with switch-selectable densities of 556 and 800 bits per inch (Model 2501-2 only); a combined 7- and 9-track drive with switch-selectable densities of 200, 556, and 800 bits/inch for 7-track operation and 800 bits/inch for 9-track operation; a 9-track NRZI-encoded drive for operation at 800 bits/inch; and a 9-track phase-encoded drive for operation at 1600 bits/inch. All models are fully compatible with industry standards. The 9-track drives equipped for operation at 1600 bits/second read phase-encoded tapes; all others read NRZI-encoded tapes.

The magnetic tape drives accommodate standard 10.5-inch tape reels and feature vacuum-column tape loops with a single-capstan tape drive. Tape read and rewind speeds are 45 and 180 inches/second, respectively.

PRINTER OUTPUT: Printing is performed by a drum printer. The standard 3-inch print drum provides 160 print positions and a 64-character set of IBM A/H print symbols. An optional 6-inch drum provides 160 print positions and a 97-character set of symbols. The rated print speeds for these drums (based on a subset of 48 characters) are as follows:

Model	64-Character Drum	97-Character Drum*
2501-1	1250 lpm	625 lpm
2501-2	900 lpm	425 lpm

* Rated speed is double that shown when printing numerics only.

A speed selection option is available for the 64-character drum which permits operator selection of full- or half-speed operation.

Horizontal spacing is 10 char/inch; vertical spacing is selectable at 6 or 8 lines/inch. The printer accommodates ➤

Mohawk 2501 Programmable Print Station

data record to produce a full print line of 160 characters. Maximum block length is determined by buffer capacity minus the size of the stored program and translation table; minimum block length is eight characters.

Through the use of the standard File Search feature, the user can locate a specific file on tape. Then, if the File Select option is incorporated, he can locate a specific record to be printed within the selected file.

The 2501 incorporates many functions that are useful for off-line printing. Some of these functions include single-line printing, reversing or advancing tape by one block, skipping to the end of a file, etc.

Currently, a Mohawk customer engineer loads the 2501's control program at the time of installation. However, if the user requires more than one program, the option is available for him to load his own from Mohawk-prepared tapes. Mohawk provides a number of standard programs oriented toward general off-line printing applications, but will tailor programs for special user applications for a "nominal" charge.

First deliveries of the 2501-1 were made in December 1970. Deliveries of the 2501-2 began in May 1973. Current lead time on orders is 12 weeks.

Service is provided by Mohawk through some 90 sales and service offices throughout the U.S.

Users' experience with the Mohawk 2501 has been mostly good. In most cases, users report satisfactory equipment reliability and overall performance. However, one installation where two 2501's receive heavy usage (24 hours per day, 6 to 7 days per week) reported repeated printer failures within the feed mechanism, such as paper runaway and forms alignment problems; this installation reports that repeated attempts to resolve the problems have been unsuccessful. Service is also reported as satisfactory in most cases, except for the installation with the printer problems, which reports downtimes of up to three days as a result of parts delivery time and slow service response. □

up to 6-part, pin-fed, continuous fanfold forms up to 20 inches wide and 22 inches long. Paper skipping speed is 25 or 75 inches/second, as determined by the vertical format tape and slow-rate control. The speed of 75 inches/second can be maintained from 9 lines after the beginning until 9 lines before the end of each skip at 6 lines/inch. Vertical formatting is standard and is implemented by a 12-channel tape loop.

DEVICE CONTROL: Provided manually through switches on the printer and tape-drive operator panels and automatically through vertical formatting and a stored program.

Under program control, data is read from magnetic tape on a block-by-block basis, stored in a block buffer, and translated to printer code. Printing and translation are performed from the buffer on a line-by-line basis. Tape blocks can vary in length from eight characters to available buffer storage. Standard buffer capacity is 4096 characters; an 8192-characters buffer is optional.

Code translation is performed by a table look-up technique, using a stored translation table that is loaded as part of the program from magnetic tape. The controller interprets each tape code as an address of a location in the translation table which contains the corresponding printer code. Printer codes read from the translation table fall into one of three categories: graphic, control, and vertical format codes.

The printer operates in one of two modes: Edit or List. The Edit mode provides vertical formatting via the punched tape loop and interprets the first character of each print line as a vertical format control code, which initiates a space or skip operation as defined by the tape loop. The List mode prints data without vertical formatting; vertical format codes are treated as data and vertical spacing is manually established as a single- or double-line space. Paper movement to the top of the next form is initiated via the tape loop.

Variable print-line length is a standard capability and requires an end-of-line code to define the print line. Fixed-length lines of 132 or 160 characters are printed when the Auto Print function is enabled. This function treats end-of-line codes as data. An end-of-line code is not required at the end of a block.

File Search, a standard feature, permits tape to be searched for a recorded file mark. Printing is inhibited during the search, which is terminated when a file mark is detected. Operator intervention is then required to initiate a tape-to-printer operation or another file search.

File Select (optional) permits selection of a specific record or print line within a block. The file select character is recorded in the first or the second character position of a record when operating in the List or Edit modes, respectively. The file select character is determined by setting a group of selector switches on the operator panel.

Manual controls provide functions such as printing a single line, skipping to end-of-file, reversing or advancing tape by one block, positioning paper to the top of the next form, printing a test pattern, selecting vertical spacing, etc.

ERROR CONTROL: Character and longitudinal parity (odd or even) checking is performed on all data read from tape. A detected parity error causes the tape to automatically backspace to the beginning of a block, and the block is reread. This operation is performed up to seven consecutive times before the operation halts and operator intervention is required.

PRICING: The 2501 Programmable Print Station is available either on a purchase basis or on a one-year lease. Rental prices include maintenance. A separate maintenance contract is available for purchased units. Reduced rates are available on extended leases of 3 or 5 years.

Device	Monthly Rental*	Purchase	Monthly Maint.
Model 2501-1 (printer and controller)	$1,140	$57,000	$294
Tape Drives:			
7-track**	210	7,500	40
7- and 9-track***	320	11,000	55
9-track, 800 bpi	210	7,500	40
9-track, 1600 bpi	425	15,000	75
8192-Byte Memory	120	4,000	20
Model 2501-2 (includes one tape drive):			
7-track, 556/800 bpi	920	43,000	280
9-track, 800 bpi	920	43,000	280
7-/9 track, 200/556/800 bpi	1,005	44,500	295
9-track, 1600 bpi	1,040	47,000	320

* For 1-year lease; includes maintenance.
** 200/556, 556/800, or 200/800 bpi.
*** 200/556/800 bpi (7-track); 800 bpi (9 track). ■

Mohawk 2400 Systems

MANAGEMENT SUMMARY

In 1965 Mohawk introduced key-to-tape recording. Adding a communications and printer interface to the basic Data-Recorder, Mohawk established and maintained a leading position in the data entry field. The next related innovation, multi-station systems, was not made by Mohawk. The company's 9000 and 9200 systems trailed the products of other manufacturers. Neither of these systems was based on a minicomputer, and thus lacked the glamour and flexibility of computer-based systems. Meanwhile, through acquisition and internal development, Mohawk built itself into a strong contender in the manufacture of peripheral devices, in foreign as well as domestic markets.

In February 1971, Mohawk introduced the 2400 System, built around the just-acquired Altron minicomputer. The announcement was a significant one. Mohawk was promising a system that could do just about everything for a data processing operation except the central processing of data files. However, there were some questions. The concepts of multiprogramming and on-line processing had been heavily touted by the mainframe vendors. The economies of off-line processing were provable logically, but there was a sizable emotional attachment to overcome. In addition, virtually all data processing personnel had finally been convinced, through bitter experience, that a computer system, large or small, needed working software to achieve the magical promises of the hardware specifications.

Mohawk had more than one string in its bow. In addition to peripheral processing applications, such as media conversion, sorting, and elementary file processing and ➢

Mohawk's versatile 2400 Systems can be configured to perform effectively in any of three basic applications: shared-processor data entry via up to 24 CRT keystations, off-line peripheral processing in support of a central computer system, or emulation of a variety of remote batch terminals.

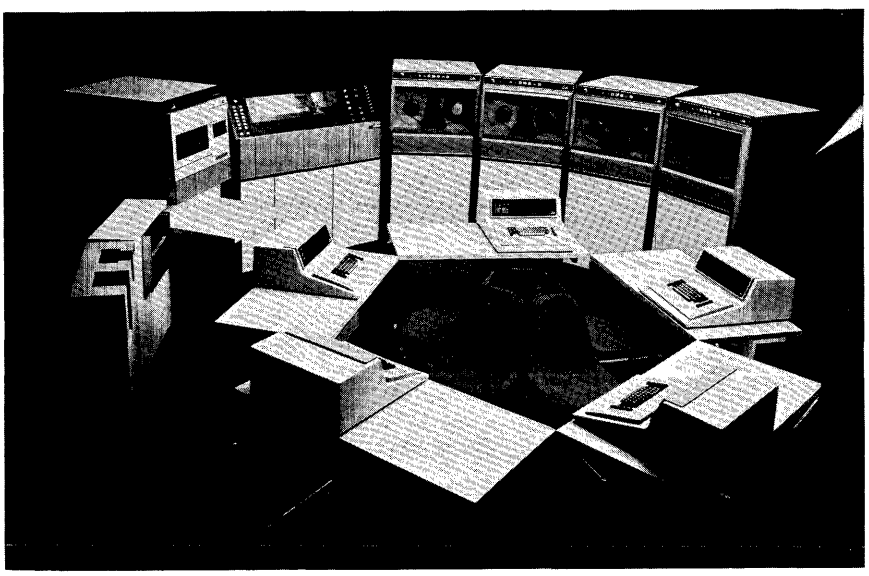
CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, Corporate Headquarters, Utica, New York 13503. Telephone (315) 792-2222.

SYSTEM MODELS: Mohawk 2400 Systems are built around one of three processors, for three basic application areas: off-line data manipulation, key-entry, and data communications. There is much overlap in the configurations marketed. Several names have been associated with 2400 Systems in Mohawk's promotional activities; Peripheral Processors, Data Communicators, and Key Display Systems are the most common. Actually, the Data Communicator is usually a Peripheral Processor with one or more data communications capabilities. Under the Peripheral Processor System title, Mohawk also offers Peripheral Processors with a reduced capability for CRT key-entry stations. The configuration rules associated with all 2400 Systems are more a result of specific Mohawk marketing and application support policies than of the hardware interconnection capabilities of the equipment.

For the purposes of this report, we will distinguish between the Peripheral Processor Systems, which are built around the 2405/2408 Processors and the Key-Display Systems, which are dedicated to key entry and are built around the 2409 Processor. Overlapping of application areas will be pointed out in specific discussions of the two types of systems.

CONFIGURATION: The 2405 Processor (Peripheral Processor Systems) is a minicomputer of unique architecture. Main memory ranges from 8K bytes to 32K bytes in increments of 8K bytes; the memory cycle time is 2 microseconds. ➤



Oriented toward peripheral processing in support of a central computer installation, this System 2400 includes a medium-size processor, 7- and 9-track tape drives, a 1250-lpm printer, a card reader, a disk drive, and five input keystations.

Mohawk 2400 Systems

maintenance, the early announcements of the 2400 emphasized data communications. And while computer users may not be quite ready to abandon multiprogramming and on-line processing and return their processing centers to the dual nature of the late 1950's and early 1960's, they were definitely interested in powerful, programmable remote terminals.

The puzzling lack of emphasis on data entry functions in the early 2400 announcements was clarified in November 1971 with the introduction of the Key Display System. This is the system users were expecting all along. Mohawk had finally responded to the many competitive key-disk systems with its own shared-processor, 24-keyboard system. The Key-Display System comes in two versions: the 2409-I, which has a 30,000-page capacity, with 125 characters/page, and the 2409-II, which can store over 100,000 pages.

The 2400 Systems, as presently supported and as expected to develop, cover a wide range of capabilities. The primary discussion areas required to get an appreciation of what the 2400 systems are and what they can do for you as a data processing user are *configuration* and *software support.*

A discussion of configuration possibilities is really a discussion of application areas. The full modularity of the minicomputer serving as the central element of a 2400 System is not exercised. Mohawk carefully controls the allowable peripheral expansion as well as the software provided to remain within the limits of usage it is capable of supporting.

The basic application areas supported by 2400 Systems configurations include peripheral processing, data communications, and key entry.

Peripheral processing is one of those ambiguous names that sounds good but doesn't really call specific applications to mind. Basically, as implemented by Mohawk, it refers to any manipulation of data required before or after the central computer gets down to the principal business of processing the data. It includes such jobs as pooling short tapes into one long one, converting unblocked low-density tapes into blocked high-density tapes, printing reports from tape, sorting, etc. The theory is that the main computer is too expensive to burden it with such operations. (A similar concept is the use of front-end processors to relieve the central computer of the load of managing multiplexed low-speed data streams from many remote points transmitting data to the central site. Mohawk accomplishes the same function off-line with its Communications Line Concentrator.)

Mohawk contends that to get throughput, high-performance printers, card readers, tape drives, etc., are always required whether they are attached to the main

The 2408 Processor replaces the 2405 when operational functions need to be expanded and accelerated. Some outstanding characteristics are a 1-microsecond memory that is expandable from 16K to 65K bytes in increments of 4K bytes; a minimum of 2 and a maximum of 8 I/O channels, each of which accommodates up to 16 controllers; and a 500,000-byte/second transfer rate on I/O channels. This rate confers the ability to employ higher-speed peripherals than those of the other processors. Options available for the 2408 Processor include operator panel expansion switchbars, a printer controller, a special data recorder controller, 4K memory modules, a communications controller, a second communications controller for Telpak speeds, and an asynchronous communications controller. From 1 to 8 tape drives can be operated from the same or from several I/O channels. Tape drive models can be mixed, and reading, writing, and rewinding can be performed concurrently by different units.

The basic 2405 Processor comes with one I/O Selector Channel, and three more can be added optionally. Each channel can accommodate up to 16 peripheral control units. All I/O channels can be active concurrently with each other and with central processor execution, but only one input or output transfer can be active on each channel at a time. The maximum permissible data rate per channel is 250,000 bytes per second. The configuration limits are a function of software support rather than physical connection. The limits are: 1 half- or full-duplex communications interface (2401/2402 or 2403 Communications Controller); 1 to 8 magnetic tape drives (any combination); 1 or 2 printers (any combination); 1 card reader and punch or 1 card reader/punch; 1 paper tape reader; 1 to 4 disk drives; 1 Teletypewriter; 1 to 4 Data Recorders.

The high-performance 2408 Processor can be equipped with from 2 to 8 I/O channels, including a mix of Selector and Direct Memory Access types. Compared with the 2405 Processor, the 2408 provides System 2400 users with double the memory capacity, half the memory cycle time, expanded software capabilities, and increased throughput.

The 2409 Processor in a Key-Display System employs a one-microsecond main memory that ranges from 24K to 65K bytes in increments of 8K bytes. The basic configuration includes a control unit and one disk storage drive (2 million bytes). This configuration can be expanded to include 1 or 2 magnetic tape drives (2430's or 2480's in any combination), 1 to 24 Keystations, 1 printer (2443 or 2444), 1 Teletypewriter, and one 2401 or 2401/2402 Communications Controller. A larger disk drive is required to support over 12 Keystations.

The 2405 or 2408 Processor can also be used in a Key Display System, but is limited to a maximum of 10 Keystations. As this usage is on an alternate basis (i.e., data entry or peripheral processing, but not both simultaneously), the other configuration possibilities described above still apply.

One magnetic tape drive is required for the Key-Display Operating System to function; it serves to collect the output of data entry operators for computer entry. Keystations and tape drives are priced separately.

DEVICE CONTROL: All operations are executed under program control.

The architecture of the Mohawk 2400 System processors is unusual in that machine instructions refer to operands in terms of records and buffers rather than specific bytes of memory. Two levels of tables identify specific segments of memory that are referenced. In essence, an instruction can reference up to three records. Fields within a record are referenced by item number. The first-level table contains pointers to three entries in the second-level table, which contains the beginning address and a listing of item numbers and sizes in bytes; these are the three records that are available for processing at any

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computer or operate as off-line peripheral processors. And their cost is about the same wherever they are used. The cost justification for peripheral processors, then, must be in that a minicomputer costs less than the equivalent time on the main computer. This is not a simple evaluation because more than just the computer time is involved. Personnel time must also be included for the operations, as well as the effect of scheduling and managing two systems. Because of the inefficiencies of the major mainframe operating systems, it is probable that a peripheral processing system can be cost-justified. In fact, Mohawk has already convinced over 2000 users that it is cost-justified, even though these users had just gone through several years of supposedly proving that centralized operations are preferable.

Data communications has long been a strong market for Mohawk. With its Data-Recorders equipped with communications interfaces, the company has done very well in the off-line communications field. The communications capabilities implemented for the 2400 Systems follow the trend set by other vendors—that of emulating popular batch terminals produced by the mainframe vendors, such as IBM and UNIVAC. Mohawk's strong points for this application include high-speed peripherals to support almost any transmission speed and software support to permit peripheral independence (such as using a tape drive as a logical card reader).

Key entry is supported in two fashions. One is by interconnecting Mohawk Data-Recorders, and the other is the Key-Display System, which uses CRT Keystations.

Up to four Mohawk Data-Recorders can be interfaced directly to the System 2400 for dumping verified tapes into the processing mainstream. A further enhancement, the 2429 Communications Line Concentrator in combination with the MSC Network Controller software package, allows the System 2400 to communicate with two remote Data-Recorders simultaneously.

The Key-Display System is very well thought out in terms of maximizing operator throughput. It is not intended for a "fill-in-the-blanks" approach to data entry. The CRT is used to assist the operator in setting up operations and making corrections. The Key-Display System uses disk storage to buffer entries, and the output is to computer-compatible magnetic tape.

The three application areas seem separate, but they really are not. A Key-Display System can be configured for up to 24 Keystations and dedicated entirely to data entry. A peripheral processing system can be configured for up to 24 Keystations and can also include enough peripherals to accomplish the other functions. Any 2400 System can include the communications capability to emulate an IBM 2780, 2968, or System 360/22; a Control Data 200 User Terminal; a UNIVAC 1004 or DCT 2000; or a Honeywell G-105 or G-115. Part of the

one time. Records can be up to 256 bytes long and can be composed of up to 64 items; full freedom exists for overlapping item boundaries so that individual or multiple fields can be manipulated with one instruction. In addition to accessing data as records, buffers of any length can be defined for input and output areas and for temporary storage. Buffers are handled in one block. A maximum of 64 record and buffer definitions can be established at one time. The facilities described are the machine-level operations. The purpose of this organization is to simplify machine-level programming.

Supporting Software is provided in three areas: peripheral processing, communications, and key entry via display.

PERIPHERAL PROCESSING: This group of programming facilities currently consists of a compiler for Mohawk Data Language (MDL), RPG II, a collection of transcription and operation utility routines, a Sort/Merge routine, and a Correspondence Composer.

The Mohawk Data Language (MDL) is a simple business-oriented language. Coded statements combine algebraic symbols and English words to define each operation to be performed. These operations include: data transfer, logical branching, the comparison of two fields or characters, test and decision functions, arithmetic calculations, editing, translation, I/O control, and miscellaneous functions.

Statements coded in MDL fall into two categories: set-up and executable.

Set-up statements define the format of the data to be handled, the constants, and the I/O units to be used. Format statements, referenced by name, define the formats of the records to be processed by specifying label and size for all fields within the record. A special statement is used to specify constants. Input/output statements link the peripheral devices used in a specific program run to the related processing operation. I/O operations are handled by user-identified parameters. In general, the user only calls for records by name. All detailed coding functions, such as handling multi-record blocks on tape, status testing, etc., are handled automatically.

Executable statements are commands that initiate processing of specific data records. Any of three records can be accessed by an executable statement. Two of the accessible records can be processed, but the third contains predesignated data (constants) and cannot be altered by the user program.

Programs written in MDL are compiled and punched into cards or written on magnetic tape. A syntax scanner pass can be executed to check the source program for coding errors and format correctness prior to the compilation pass. During compilation, MDL statements are translated to machine-level instructions, memory locations are assigned, address tables are prepared, and the object program is written. Compilation, using the Mohawk-supplied MDL compiler, requires a System 2400 configuration including two tape units, an 8K memory, a printer, and a card reader or third tape unit.

The RPG II package is compatible, in source form, with IBM's RPG and RPG II. It is oriented toward producing printed reports calculated from data input from cards, magnetic tape, and (eventually) disk.

Several data transcription routines are provided to transcribe data from one medium to another. The complete range of peripheral devices is supported. One package permits simultaneous data transcriptions within the availability of peripheral devices. Transcriptions can be made with or without format changes, such as tape density or blocking factor, and printed listings can be made from tape or disk. Another package, the Report Processor, permits formatted, selective listings of a file contained on tape; a second tape drive or card reader is required for inputting the control directives. Some of these media

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configuration complexity is due to the fact that Mohawk uses two different types of processors; one is twice as fast as the other and can be expanded more in terms of main memory size. The high-performance model can be configured much more flexibly in terms of peripherals, to support the full range of 2400 applications.

The *software support* provided by Mohawk is indicative of the application areas the company is stressing. The support falls into four main groupings: user programming, data communications, utility packages, and data entry via CRT's.

Mohawk announced a mating coupler that interconnects its Key-Display System and the 4400 System in September 1973. The 4400 System is an integrated data collection system for gathering information at its source, for example, in factories, hospitals, or libraries. A typical 4400 System consists of a number of interconnected numeric keyboards, card readers, and badge readers whose input is channeled through a central controller to a magnetic tape unit or directly to a central computer. Application areas for the 4400 System include time/attendance reporting, production/material control, and automated circulation monitoring for college and university libraries. The 4400 System is designed for non-clerical and non-EDP personnel. By gathering data directly at its source and immediately channeling it to a Mohawk 2409 Processor, the user can eliminate many costly intermediaries, such as keypunches, skilled operators, and media conversion.

The 4400 Central Controller polls up to 64 input stations for source data and transfers it directly to the 2409 Processor. The 4400 data is then edited and merged with keyed data on the same output tape. The KDS supervisor can review and change 4400 input records at will through her keystation CRT. Hence, she can monitor the status of jobs scattered throughout an entire facility.

For user programming, Mohawk furnishes a compiler for its own language, Mohawk Data Language (MDL), and an RPG II that is compatible with IBM's. MDL is a business-oriented language designed to permit simple programming tasks to be implemented quickly. It is structured along the lines of the minicomputer's unique internal architecture and is sufficiently powerful to permit convenient programming of selective file extraction, report generation, and basic arithmetic operations. This supports the thrust into peripheral processing by relieving the main computer of not only the tape- or disk-to-print run, but the production of simple reports as a whole. RPG II is an extra-cost option. Its orientation is obvious, since most data processing users already have people on their staff with knowledge of this facility. If you really want to do some fancier programming on the 2400, the record-oriented architecture of the mini-

transfer and print utilities can be run concurrently with data communications.

Utilities called IOCS (Input/Output Control System) are provided for performing a gamut of I/O functions without the burden of coding these functions individually. Two levels are available. Basic IOCS effects all channel-level I/O functions, automatic recovery procedures, code translations, and device status checking. Full IOCS adds to these capabilities the blocking and deblocking of data records, printer format control, and dynamic allocation of buffer space within unused memory. Full IOCS requires that programs be written in MDL.

Subroutines required for a particular System 2400 installation are abstracted by the System Generator (SYSGEN) from the IOCS package and linked to the appropriate application program. A change in the system configuration usually necessitates only a rerunning of SYSGEN and no rewriting or recompiling of application programs. SYSGEN performs two basic functions, namely, normal software generation and system software reconfiguration. The following files are reference sources for SYSGEN or among its outputs:

- Configuration Specification File–describes such equipment configuration data as core storage, channel and device code assignments for peripheral devices, required translation codes, etc., for which a software set is to be constructed.
- Basic Program Tape (BPT)–holds such software support as the MDL Compiler, Loader, utility programs, etc., that are supplied by the company.
- User System Tape (UST)–a tape that the user constructs via the Librarian from software supplied by the company and/or his own application programs; it is similar in format to an MPT.
- User Object Tape (UOT)–any output tape resulting from a compilation and containing one or more object programs.
- Master Program Tape (MPT)–produced by a normal SYSGEN run, it contains the Loader and a selection of software subroutines that are appropriate for the particular configuration as described to SYSGEN through the Specification File; MPT also contains other configuration specifications for reference by operational programs.
- Print Files–consist of a Master Program Tape Index Listing, which contains a listing of the contents of the newly generated MPT, and a System Configuration Description Listing, which specifies the equipment configuration on which the MPT and the object programs were based.

SYSGEN is employed for normal system software generation when originally producing an MPT for a new installation and when updating an MPT pursuant to changes in system specifications, such as core storage changes and substitutions of peripheral devices.

SYSGEN is also employed for system software I/O reconfiguration when one or more programs compiled for a configuration different from that of the present system are to be run or when other changes in the I/O sector have taken place.

The sort/merge routine employs a user-prepared set of specification records that describe the data and stipulate the process to be performed to construct a specialized sort or merge program from the supplied parameters. The resultant program can be stored on magnetic tape and run as often as necessary. Its important features are an ability to utilize up to 64 sort keys (control fields), each of which contains up to 256 bytes; an ability to classify each key according to an ascending or descending order of sorting and according to whether it contains an alphanumeric, binary, decimal, packed decimal, or floating

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computer simplifies machine-level programming. Mohawk supplies an IOCS package to assist you, but does not furnish a symbolic assembler.

The communications software consists of the packages for emulating the remote batch terminals mentioned above.

A number of utility packages are provided for media conversion, simple file maintenance, program library maintenance, sorting, etc.

The Key-Display Operating System (KDOS) is designed only for the data entry application and for certain data communications packages and print utilities that can run concurrently with keying.

Except for KDOS, use of disk storage is not supported to a large extent. Development of disk-based software has been fully implemented by Mohawk's acquisition of Marshall Data Systems, a manufacturer of IBM-compatible disk drives. As soon as Mohawk fully resolves the manner in which these products fit into the 2400 picture, you can expect to see such things as full-fledged operating systems for the 2400.

All software is not available on all configurations. The specific limitation is that the programming facilities, MDL and RPG II, cannot be used on a dedicated Key-Display System. The purpose behind this restriction was to provide the data entry user with a bundled system at the lowest possible cost. The Key-Display System is equipped with sufficient capabilities and available options to accommodate virtually any data preparation task. One of the most significant options for the Key-Display System is the recent addition of Concurrent Processing. With this feature, the supervisor can use the system for background data communications or printing without disturbing normal keying operations.

Overall, the 2400 Systems come in three basic configurations: shared-processor data entry and editing, intelligent communications terminal, and satellite business computer.

To date, Mohawk has installed around 2000 non-display 2400 Systems. About 75 percent of these include the communications capability. About 1000 Key-Display Systems have been installed and accepted.

Perhaps the most impressive feature of the 2400 Systems is the care that Mohawk has put into making them easy to use by the operator, with such features as extensive English-language console displays and elimination of toggle switches from the display stations.

Mohawk is dedicating a major portion of its resources to the 2400 Systems. The company now has in-house all the peripheral capabilities to manufacture the complete system. At present, the company is purchasing CRT

point data value; an ability to run on various equipment configurations with from 16K to 32K bytes of core storage and from 3 to 8 magnetic tape drives; and an ability to accept fixed- or variable-length blocked or unblocked records. Other characteristics are nonstandard label checking on header and/or trailer labels, nonstandard blocking and unblocking of records, error routines, modification of input data (including additions and deletions) before entering it in the sort/merge process, modification of output data (including additions and deletions) of output from the sort/merge process before it is written to the output file, and optional simulation of IBM-compatible OS/DOS label processing. Sort/merge also maintains a checkpoint/restart capability in the event that unrecoverable errors are detected.

A considerable number of utility programs are provided. An example is the Loader, which enables a user to position a program tape in the proper format in core and load object programs from it. The Tape Update program enables a user to effect changes in a data or source program file by inserting records into or deleting records from the file; the current version of Tape Update is restricted to files composed of unblocked 80-character records. The Media Converter is a general-purpose utility package for transferring data files from one peripheral device to another; the possible functions are tape-to-tape, card-to-tape, tape-to-card, tape-to-print, card-to-card, card-to-print, and print used in conjunction with any of the previous nonprint functions. The Tape Pooler/Spooler program combines batches from several tapes onto a single tape (pooling), distributes batches from a single tape to several tapes (spooling), and copies batches from one or more tapes onto a single tape or several tapes (copying) The File Utility transfers data from one device to another and can change the record size, blocking factor, and/or recording mode of the data if required. The Report Processor produces formatted listings from punched card or magnetic tape input; changes in format according to user specifications and such options as page numbering, space control, and page headings can be introduced. Librarian is a facility for maintaining any library tape of source or object programs, provided that the tape conforms to standard formatting; it can update a Basic Program Tape, Master Program Tape, or User System Tape. Tape Dump reads a magnetic tape file and produces a printed listing of its contents in EBCDIC only, hexadecimal/EBCDIC, or trioctal/EBCDIC code. Two programs, Full Edit Mode Conversion and Full Edit Mode Print, convert print-image tape files to the Full Edit mode format and print them.

The Correspondence Composer package is designed to generate form letters with personalized information included both in the heading and in the body of the letter, in the fashion made popular by mail-order houses.

The Configuration Check program verifies that the generated I/O device tables obtained from a SYSGEN run validly represent the actual hardware configuration with respect to device types, channel assignments, and device select codes. As a daily check, the program exercises the peripheral devices and determines their operability.

The Print Utility package executes off-line printing of data files stored on magnetic tape. It comprises a control (monitor) program called PISTON and a collection of print utility subprograms. Each subprogram processes data file records of a particular format type, e.g., IBM System/360 DOS Power II, Honeywell 200, etc. If one printer and one magnetic tape unit are employed in the 2400 configuration, the print utility processes one data file; when two tape drives and two printers are incorporated, the print utility can process two separate data files, which can have the same format or different formats. In the latter case, each utility subprogram is independent of the other. Both 7- and 9-track tape inputs are available.

DATA COMMUNICATIONS: Nine different software packages are provided to emulate an IBM 2780, 2968,

Mohawk 2400 Systems

displays from OEM sources. All other components are manufactured in-house.

The main thrust of the 2400 System is in a support role for a central computer installation. However, users have been writing their own application programs for functions such as payroll, accounts receivable, inventory control, etc. Under user pressure, Mohawk is beginning to implement and support small stand-alone, general-purpose computer systems.

Field support of Mohawk systems is accomplished through some 116 sales and service offices spread across the U.S. Early users experienced difficulties with the software, but most of these problems have been solved; and with the experience gained from the installed systems, Mohawk is in a much better position to handle the new bugs which inevitably crop up in the software from any vendor. Mohawk's self-discipline in restricting itself in the applications market also bodes well for the establishing of good software.

The Key-Display System is capable of competing on its own merits with other key-disk data entry systems, particularly in configurations with a large number of Keystations. The other forms of the 2400 are effective as batch terminals, with the auxiliary functions providing a strong added attraction. □

System 360/20, or 360/22; a Control Data 200 User Terminal, a UNIVAC 1004 or DCT 2000, a Honeywell G-105 or G-115 under GERTS, or a Mohawk Data-Recorder. In general, the emulation programs provide the same capabilities as the terminal they imitate, plus additional flexibility in the use of peripherals (such as using a tape drive in place of a card reader). A main memory size of 8K bytes will support a punched card terminal, and 12K or 16K bytes are required to support a magnetic tape terminal. Support of terminal operations is under the various mainframe vendors' remote batch communications software, such as IBM's HASP.

KEY DISPLAY: The CRT key entry stations and the software, the Key-Display Operating System (KDOS), are based on the premise that the display capability is for guiding the operator in setting up an operation, in making corrections, and in exchanging certain system and status information, but is not looked at during the actual data keying operations.

In general, operators enter information via the keyboard. Records are accumulated on disk until a batch is completed; the batch is then dumped to tape. Multiple operators can be involved in the preparation of one batch by using different batch names. The system accommodates up to 300 batch names.

On an operational level, data entry centers around the amount of data—125 characters—that can be displayed at one time on the screen of a display station; this is referred to as a page. Data is entered under the control of a sub-format, which specifies field definitions, functions, editing operations, and arithmetic operations in much the same manner as the formats for key punches or key-to-tape recorders but in a greatly expanded scope. A total of 64 different field types can be specified, including duplicating, skipping, shift control, left zero fill, range checking, extension checking, batch accumulators, and check digit validation. The left zero fill definition checks that the left zero fill operation was performed by the operator. Extension checking performs simple field arithmetic to verify the entries keyed in by the operators from the source documents. Batch accumulators allow the accumulation of specified fields over the entire batch for control purposes. All of these functions are implemented through software, and some are optional at extra cost.

A great deal of flexibility is included for formatting records. Up to four (eight optionally) sub-formats can be linked together to form the format for a record. Operations are initiated via a job (batch) name which identifies a particular record format. Progression from one sub-format to another is automatic, but can be initiated manually. The maximum record length is 500 characters (1000 characters optionally). The record format is really a naming convention because it is created in the control code linking sub-formats. A total of 256 record formats can be actively stored on the disk at one time. If the 8-sub-format per record option is elected, the maximum is decreased to 169 record formats. The operator cannot access sub-formats directly, but only record formats through a six-character job name. The sub-formats associated with this job are then used to control key entry.

The functions provided by KDOS are strongly operator-oriented. All functions are initiated or controlled by key depressions; there are no toggle switches. A total of eight different primary functions can be performed by an operator. These are entered by selecting from a "menu" which is always accessible by depressing a special function key. Four of the functions are oriented toward data entry: start, end, intermediate end, and restart batch. The last two allow the operator to suspend data entry for a particular batch and pick it up later. The other four functions include format creation, searching for a particular record within a batch not yet released to tape, supervisor operations, and return to last mode. The latter function is required in case the operator accidentally hits the menu key; all other operations are format-controlled. Formats can be created from an individual keystation, but can only be deleted from the supervisor's station. Formats can also be modified by the supervisor.

When starting a batch operation or any other function, a fill-in-the-blanks approach is used to ensure proper entry of control information. In addition, key verification is required for all control entries, including format creation.

In the Supervisor mode, batch statistics and status are available, as well as initiation of transfers to tape, start of day opening, end of day closing, and other control functions.

MAGNETIC TAPE: Nine models are available, as listed below:

Model:	2480	2481 and 2437/2437-I	2438/2438-I	2482 and 2439/2439
Density (bits per inch	200, 556 or 800	800	200, 556, or 800 (7-track); 800 (9-track)	1600
Speed	18.75 ips	18.75 ips (2481); 45 ips (2437); 75 ips (2437-I)	45 ips (2438); 75 ips (2438-I)	18.75 ips (248) 45 ips (243) 75 ips (243)
Tracks	7	9	7/9, operator selectable	9
Operating mode	Read/write	Read/write	Read only	Read/write
Parity	Odd or even	Odd	Odd or even	Odd
Recording mode	NRZI	NRZI	NRZI	Phase encoding
Interrecord gap size (inches)	0.75	0.6	0.75 (7-track) 0.6 (9-track)	0.6
Transfer rates (characters/second	3750 10,425 or 15,000	15,000 (2481); 36,000 (2437); 60,000 (2437-I)	9,000/15,000 25,020/41,700, or 36,000/60,000	30,000 (2482) 72,000 (2439) 120,000 (2439)

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The drives are fully compatible with industry standards, accommodate standard 10.5-inch tape reels, and feature vacuum-column tape loops with a single-capstan tape drive. Rewind speed is 180 inches/second.

PRINTED OUTPUT: Five printer models are available for use on the System 2400, as listed below:

Printer Model	Printer Type	Print Positions	Character Set	Rated Speed, lines/min*
1310	Matrix	132	64	100 cps
2443	Chain	100/132	16/48/64/ 96/128**	350/280/200/ 200/150
2444	Chain	132/136	16/48/64/ 96/128**	450/380/300/ 210/160
2445	Chain	132/136	16/48/64/ 96/128**	900/760/600/ 470/370
2446	Drum	132/160	64/97	1250***

*Rated speeds are presented in the same sequence as the character sets.

**A 48-character print set is standard, others are optional. Many different fonts, including foreign languages, are available.

***Based on a contiguous 48-character print set.

Horizontal spacing is 10 characters/inch; vertical spacing is selectable at 6 or 8 lines/inch. The printers accommodate up to 6-part, pin-fed, continuous fanfold forms up to 18.75 inches wide (Models 2443, 2444, and 2445) or from 4 to 20 inches wide (Model 2446) and up to 22 inches long (all models).

Paper skipping speed is 17 inches/second for Models 2443, 2444, and 2445, and 25 and 70 inches/second for Model 2446. The speed of 70 inches/second can be maintained up to 9 or 14 lines before the end of each skip at 6 or 8 lines/inch, respectively. Vertical formatting is standard and is implemented via a 12-channel tape loop.

PUNCHED CARD UNITS: The exact units available for 2400 Systems has fluctuated somewhat since original announcement; the models currently available are shown below:

Model	Function	Speed
2453	Reader	400 cpm
2455	Reader	1000 cpm
2457	Punch	160 columns/sec
2458	Reader/Punch	400 cpm/160 columns/sec
2459	Punch	200 cpm

Model 2453 can be equipped to read 51-column cards. Model 2458 incorporates a single card path and can read and punch the same card; it includes two 1300-card radial stackers. Models 2453 and 2458 can be equipped with an option called Code Image Read, which reads a binary image of the 12 card rows into the lower six bits of two memory bytes; this is a way of compacting data on a card, but prevents it from being read by other card readers or conventional EAM equipment. Normally, these cards are the output of a computer rather than key-punched.

PUNCHED TAPE UNITS: The 2467 Reader and 2468 Punch read or punch 11/16-, 7/8-, or 1-inch, 5-, 6-, 7-, or 8-level paper tape. The reader operates at 750 char/sec (optionally at 2000 char/sec) and can read in either direction; it accepts reels and includes a winder and unwinder. The punch operates at 150 char/sec and includes a spooler.

MAGNETIC DISK UNITS: The 2470 Controller handles up to four disk drives and is housed in the cabinet of the first drive. Each 2471 Disk Drive incorporates a single disk cartridge with two recording surfaces. The disk is organized into 200 cylinders; each cylinder consists of two tracks (top and bottom surface). Each track is arranged in 24 sectors of 256 bytes per sector (which is equal to the maximum "record" length of the processor as described under Device Control). Maximum capacity of one drive is 2,457,600 bytes. Positioning time ranges from 15 to 135 milliseconds. The average access time (including rotational delay) is 119 milliseconds. The data transfer rate is 195,250 bytes per second.

The 2475/77 Controller/Disk subsystem is also available with the 2400 System for Key-Display operation and other random-access applications. The 2475/77 is a medium-capacity subsystem with a 29-million-byte storage capacity. Performance factors are significantly greater than those of the 2471 Disk Drive.

DATA RECORDERS: Up to four Mohawk Data-Recorders can be connected to one I/O channel in any mix of Models 2411, 2413, 6401, and 6403. The 2411 and 2413 are essentially equivalent to Models 1101 and 1103. Data can be transferred in either direction between the processor and the Data-Recorders, but only one can be on-line at a time. Using the MSC Network Controller software package, 2400 processors can now communicate directly with remote Data-Recorders. Full off-line use is possible, including the communications capability of Models 2413 and 6403. See Reports 70D-642-01 and 70D-642-02 for a full discussion of the 1100 and 6400 Series Data-Recorders.

SYSTEM 9000 TAPE UNITS: Up to two tape units from a Mohawk System 9000 can be shared between a 2400 System and a System 9000. The 2400 processor can read the tapes, but cannot write on them. The System 9000 cannot read the tapes. The System 9000 is a multistation key entry arrangement for high-volume data preparation. It can pool the output of up to 32 keystations onto up to 7 tape units.

COMMUNICATIONS CONTROLLERS: The 2401 Controller operates in a synchronous, half-duplex mode at from 600 to 50,000 bits/second. By itself, it can operate over a four-wire facility via an optional feature, but the 2402 Controller is required for wideband rates and full-duplex operation. All communications line discipline is established through software; the controller performs character assembly and parity checking only. Optional features include automatic dialing, automatic answering, dual modem interface, special codes such as the IBM Transcode, and an internal clock for operation with asynchronous data sets. Both of the 2401/2402 Controllers require a dedicated I/O channel.

The 2403 Asynchronous Communications Controller is for operation at 50 to 2400 bits/second and also requires a dedicated I/O channel.

DISPLAY STATIONS: The 2491 Keystation includes a CRT that can display 240 characters in 8 lines of 30 characters each. In the standard implementation of the KDOS software, the first two rows are used for control information, the third row is blank, and the last five rows are used for data (last 25 characters unused). For operations other than data entry, the full display is used. The 2428 Multiplexer, included in Key Display Systems and available for other 2400 Systems, includes provision for attaching 8 Keystations. The maximum of 24 is achieved in increments of 4 keystations through expansion modules.

PRICING: Mohawk 2400 Systems and components can be purchased outright or leased under two plans: the Variable Term Plan or Fixed Term Plan. The Variable Term Plan offers 1-year, 2-year, or 3-year leases, with a 10 percent discount offered under the 3-year lease. The customer may cancel after one year (with 90 day's notice). The Fixed Term Plan provides for 2-, 3-, 4-, or 5-year leases with no option of cancelling, but a 10 percent, 15 percent, or 18 percent discount is available, depending on the length of the lease. These discounts apply to rental prices only, not to maintenance. The following table shows the basic monthly rental on a 1-year lease. Prices shown include maintenance. The separate maintenance column is for purchased units only and covers prime-shift service; full-time service is also available at extra cost. ■

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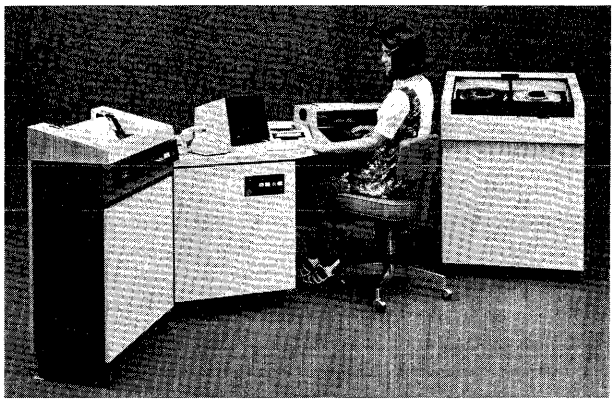
EQUIPMENT PRICES

	Monthly Rental	Purchase	Monthly Maint.
2405 Processor (includes 1 I/O channel, but no memory)	$ 320	$11,840	$ 48
2408 Processor (with no memory or I/O channels)	440	16,280	63
4K Memory Module	60	2,220	8
I/O Channel	20	740	3
Data Recorder Controller	25	925	5
16 Additional Sense Switches (2 sets max.)	25	1,000	4
2401 Communications Controller (includes 1 I/O channel)	100	3,700	15
2402 Communications Controller	90	3,330	15
2403 Asynchronous Communications Controller (does not include I/O channel)	100	3,700	15
2406 Systems Console (optional)	50	1,850	7
2409-1 Key-Display System (includes control unit with processor, memory, I/O channels, and disk drive)	840	33,600	185
Expansion Modules -- (1)			
For Keystations 9-12	65	2,600	14
For Keystations 13-16	65	2,600	14
For Keystations 17-20	65	2,600	14
For Keystations 21-24	65	2,600	14
2491 Keystation	45	1,800	7
Table (includes convenience drawer)	5	150	–
Keystation Multiplexer (for connection of up to 24 Keystations)	–	–	–
Magnetic Tape–			
2437 (9-channel, 800 bpi)	230	8,510	–
2438 (7- or 9-channel, read only)	280	10,360	56
2439 (9-channel, 1600 bpi)	405	14,985	81
2480 (7-channel)	200	8,000	45
2481 (9-channel, 800 bpi)	200	8,000	45
2482 (9-channel, 1600 bpi)	275	11,000	55
Disk Storage–			
2470 Controller	100	3,700	15
2471 Drive	260	9,620	60
2473 Drive	150	5,550	30
Printers–			
1310 Matrix Printer	185	7,400	42
2443 Chain Printer	330	12,210	80
2444 Chain Printer	450	16,650	105
2445 Chain Printer	700	25,900	140
Chain Font (2)	45	1,665	–
132 Print Positions (for 2443; prerequisite for 136-position option)	50	1,850	15
136 Print Positions (for any chain printer)	15	600	4
2446 Drum Printer	1,150	42,550	270
160 Print Positions	50	1,850	5
1-Speed Shifter	25	1,000	4
Punched Card Units–			
2453 Card Reader (400 cpm)	120	4,400	30
Code Image Read	8	250	2
2455 Card Reader (1000 cpm)	210	8,400	45
2457 Card Punch (160 col/sec.)	380	14,060	95
2458 Card Reader/Punch (400 cpm/160 col/sec)	400	14,800	100
Code Image Read	8	250	2
2459 Card Punch (200 cpm)	525	21,500	85
Code Image Punch	8	250	2
Punched Tape Units–			
2467 Paper Tape Reader (750 cps)	180	7,200	40
2000-cps Read	30	1,200	5
2468 Paper Tape Punch (150 cps)	240	9,600	60
2493 Teletypewriter (interfaces through 2401/2/3 Communications Controller not being used for communications)	85	3,125	25
2494 Teletypewriter (heavy-duty)	135	4,995	40
Data-Recorders–			
2411 (7-channel)	95	3,515	20
2413 (7-channel, communications)	182.50	6,750	37.50
6401 (9-channel)	170.20	8,000	25.20
6403 (9-channel, communications)	265	10,550	45
Software–			
RPGII	11	325	–
KDOS Options–(1)			
Range Check, Extension Check, Second Check Digit	60	2,400	4
Accumulators	60	2,400	4
4 Additional Sub-Formats	60	2,400	4
Multi-Batch Selection	60	2,400	4
Check Digit	–	–	–
Reformatting	60	2,400	4
Auxiliary Dup	30	1,200	2
Multi-Records/Page	60	2,400	4
Table Handling	60	2,400	4
Subtotaling	30	1,200	2
Concurrent Processing	60	2,400	4
Advanced Operator Statistics	30	1,200	2
List Batches	60	2,400	4
List Formats	–	–	–

(1) On Peripheral Processing Systems equipped with the designated memory capacities, Expanded Modules and all KDOS options are offered free of charge.

(2) One chain font, IBM-compatible, is included with the basic printer; many other fonts are available for compatibility with other computer systems and for foreign languages.

Mohawk 2300 Document Processing System



The basic 2307 Control Unit at center, with its CRT display and keyboard/printer, is flanked by the optional 100-cps matrix printer at left and a 9-track magnetic tape drive at right. Also housed in the compact control unit are a 4K-byte minicomputer and disk drive.

The 2300 DPS is an intelligent, standalone terminal that collects keyed data at its point of origin and produces various business forms from this information. It also transmits the data to an IBM System/360 or 370 or to a Mohawk 2400 System for processing. The 2300 can directly replace the IBM 3735 and uses the same programming language.

MANAGEMENT SUMMARY

Over two years ago IBM introduced the 3755 Programmable Buffered Terminal. Now MDS proposes to deliver essentially the same system, but with expanded capacities and capabilities. Hence, the 2300 DPS will be capable of doing nearly everything the 3735 can do, and a few things more. MDS says, moreover, that the 2300 is the forerunner of a family of terminal systems that will be geared to still other remote data entry functions.

Report 70D-491-10 describes what the IBM 3735 is. The MDS 2300 system, which is plug-compatible with the 3735, has the same objective of capturing source data before it passes through a succession of human hands and processes, and then converting this data into a formatted, stored image that can be transformed directly into a desired document and/or transmitted to a central computer. Of critical application importance is the fact that this procedure takes place at the source-data site and is performed by an on-site terminal. The system can communicate not only with an IBM System/360 or 370 computer, but also with a Mohawk 2400 System. In either case, communication with the central computer usually consists of the transmission of large blocks of data. It is expected that the data recorded during the day will be transmitted at night over a voice-grade line in unattended operation; however, other transmission modes, such as interactive inquiries and program loading, are also fundamental to the sytem's operation.

Like the 3735, the 2300 can share a leased line with other terminals that also employ Binary Synchronous Communications (BSC) protocol, as the 2300 does, such as the IBM 3780, 2780, and 2770 terminals. This kind of operation can help to keep the cost of leased lines within practical bounds.

Essentially, the 2300 DPS is an intelligent source-data recording station that employs a single keyboard, a 9-inch CRT display, a minicomputer with 4K bytes of memory, a ▷

CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, Corporate Headquarters, Utica, New York 13503. Telephone (315) 792-2222.

CONFIGURATION

The 2307 Control Unit consists of a desk-height cabinet that houses a minicomputer with 4K bytes of main memory, a disk drive, a keyboard, a CRT display, a serial character printer, and associated controllers. Optional components of the control unit are a Binary Synchronous Communications adapter and a modem. Other optional components of the 2300 system are 9-track magnetic tape drives, a cartridge tape drive, a matrix printer, and additional disk storage.

KEYBOARD: Has a pattern similar to that of a typewriter, with the addition of control keys and indicators. A special numeric pad is included. Optional keytop layouts are available. The keyboard implements a set of 64 upper and lower case characters.

CRT DISPLAY: The 9-inch CRT screen acts as a data, message, and general information display medium for system/operator communication. The presentation consists of 4 lines of 32 characters each. A 5-by-7 matrix forms the characters. The top line displays the operating mode, the second line displays guidance messages, the third line presents error messages, and data keyed by the operator appears on the fourth line. A cursor in the form of an underscore indicates the operator's position in the field. When the field is complete, the cursor vanishes.

CHARACTER PRINTER: Prints at 30 characters/second. A set of up to 96 upper and lower case characters is provided. Print-head tabbing speed is 33 inches/second, and line advance speed is 4 inches/second. The maximum paper width is 15 inches. Column spacing is 10 characters/inch; 132 columns can be printed. Vertical spacing is 6 lines/inch. All data transfers are checked for correct parity.

DISK STORAGE: Basic unit has a 230.4K-byte head-per-track disk, with 115.2K bytes available to the user. The drive is interfaced to the system by an associated controller. It holds all the software for operating the system except for a small control and handling program in main memory. In particular, the Terminal Control Program (TCP), Forms Description Programs (FDP), and system diagnostic programs are stored on the disk. Over 115K bytes of storage are allotted for FDPs (application programs) and for data input to cover a day's operation.

MAGNETIC TAPE DRIVES: Either a Model 2481 or 2482 tape drive can be attached to the 2307 Control Unit. Both drives have a 2400-foot reel capacity and a forward speed of 18.75 inches/second. Model 2481 operates at 800 bits/inch and Model 2482 operates at 1600 bits/inch. Both are 9-track units.

CARTRIDGE TAPE DRIVES: One or two Mohawk 2330 tape drives can be mounted within the operator's desk. ►

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230K-byte head-per-track disk storage unit, and a 30-character/second, 132-column printer with a 96-character font. An optional data communications controller is available and will almost always be included. Disk capacity can be expanded in two increments, one of 230.4K bytes and a second of 460.8K bytes, to provide a maximum of 806.4K bytes of storage available to the user and an overall total of 921.6K bytes.

In typical operations, the operator keys data and, after performing arithmetic operations, data editing, data validation, conditional comparisons, and formatting, the system prepares standard forms such as customer invoices purchase orders, contracts, tax statements, payroll checks, or insurance policies. As mentioned, it also transmits data at day's end to the central computer. It then receives instructions and programs from the CPU for the following day.

Like the IBM 3735, the 2300 DPS cannot be employed as a free-standing computer. Through its standard File feature it can, however, perform simple file lookup and file update functions. An equivalent feature is optional in the IBM 3735.

Another limitation is that only one keyboard can be connected to the 2300, as is the case with the 3735. If the user wants to replace an IBM MTST at his location, he should also be aware that a Forms Description Program can be written for certain basic MTST functions, but not all.

One respect in which the 2300 DPS does not currently outdo the 3735 is that of transmission speed. At present, both transmit at a maximum rate of 4800 bits/second, but Mohawk states that it is preparing a 9600-bps capability.

On the other hand, the 2300 CRT display exhibits tutorial instructions and system messages in English. The 3735 has no CRT, and the indicator lamps on its panel, in contrast, provide only part of this information.

Perhaps the most important superiority of the 2300 is its much larger disk storage capacity. A full day's work can readily be accumulated by the standard disk, and much more can be stored on an expanded disk file, such as names, addresses, part numbers, and prices.

Another advantage of the 2300 system is the ability to incorporate a computer-compatible magnetic tape drive or a cartridge tape drive. Output data can be written on the tapes, which can then be hand-carried to another location. For example, the tape reels or cartridges could be transported to the central computer facility for loading into the CPU, so that the need to transmit the data would be eliminated. Next, the CPU could record the FDP's and other instructions needed by the 2300 DPS for its next day of operation on the tape, which would now be carried back to the 2300 site and entered into the system via the tape.

When communications are employed, data is compressed and efficiently transmitted under the disciplines of BTAM, TCAM, or QTAM, whichever is installed.

The typing and printing speeds of the 2300 are higher than those of the 3735. Other advantages of the 2300 are

These units utilize 3M Data Cartridges that hold 300 feet of 1/4-inch tape and have a capacity of 1740 80-character records/track. Serial recording on 4-track tape is standard.

MATRIX PRINTER: The optional Model 1310 matrix printer connects to the standard I/O channel of the 2300, operates at a nominal speed of 100 characters/second, and prints a 132-column line. Up to 6-part forms can be used. The printer accommodates standard fan-fold forms in sizes from 4 to 20 inches wide and up to 22 inches long.

ADDITIONAL DISK STORAGE: The first increment of storage adds 230.4K bytes, providing 345.6K bytes to the user. A second increment of 460.8K bytes brings the total capacity to 921.6K bytes, with 806.4K bytes available to the user.

COMMUNICATIONS

Transmission is effected in half-duplex, synchronous mode at 4800, 2400, 2000, or 1200 bits/second. Communications at 1200 bits/second uses a nonsynchronous modem. MDS supplies modems for rates up to 2400 bits/second, but for the higher rate the user must obtain a suitable modem from another source. MDS supplies an appropriate controller for all of the specified rates. Binary Synchronous Communications (BSC) protocol is used, with either ASCII or EBCDIC selected as the transmission code. Voice-grade lines are employed on dial-up or private facilities.

The 2300 is compatible with an IBM System/360 or 370 computer equipped for BSC. It can operate under QTAM, BTAM, or TCAM. The 2300 can share a private communications line with other IBM BSC terminals, such as the 2770, 2780, and 3780 terminals and the 1130 computer. Transparency is not available for the 2300.

The 2300 can be operated in an unattended mode to receive or transmit. Transmitted data is always in 476-byte blocks, including field and record delimiters, but excluding line control characters. As an alternative to employing the disk for collecting data that is later transmitted in Remote Batch mode, the user can write the output file on cartridge magnetic tape or computer-compatible tape. This information can not only be transmitted if desired, but mailed or hand-carried to the CPU site as well.

DEVICE CONTROL

The application thrust of the 2300 terminal is toward producing standard business forms, such as orders, invoices, checks, contracts, purchase orders, tax forms, etc. As the operator keys data from source documents, the 2300 control processor generates the required output data, performing any of the four arithmetic operations when necessary, and under program control it formats this information as desired.

Another basic output of the 2300 system is communications. Usually, formatted data will be transmitted to the central computer for processing. A reverse flow, from the computer to the terminal, supplies the 2300 with updated file information and data to be printed. If print data overflows the disk storage, it can be stored on magnetic tape for later runoff.

More generally, the IBM 360 or 370 central computer is used to assemble Forms Description Programs that are coded in macro statements, and a utility program formats this material into a program that is ultimately transmitted to the 2300 system.

Forms Description Programs (FDP's) act as one level of program control in the 2300 system; the other is the Terminal Control Program (TCP). Both programs are stored on the 2300 disk and together control the operation of the 2300 system. The FDP is specified by the user in a forms description using either macro statements, as previously mentioned, or code assembler statements. These programs

Mohawk 2300 Document Processing System

clearly shown in the accompanying comparison table. In a very real sense, then, the 2300 can be regarded as an updated and expanded version of the 3735.

Pilot installations of the 2300 DPS are scheduled for November 1973, and production models are scheduled for the first quarter of 1974. □

COMPARISON WITH THE IBM 3735

Feature	IBM 3735	Mohawk 2300
System printer	15.5 cps	30 cps
Character set	84 chars.	96 chars.
Columns	130	132
Cartridge ribbon	Yes	Yes
Electronic tab setting	No	Yes
Keyboard	2-key rollover	n-key rollover
Overlapped keying/ printing	No	Yes
CRT display	No	Yes
User disk storage (std.)	62.8K bytes	115.2K bytes
User disk storage (max.)	314.1K bytes	806.4K bytes
File storage	Optional	Standard
Communications (max.)	4800 bps	4800 bps
Means of loading FDP's	Communications	Communications or mag. tape
Cartridge tape drive	No	Yes (option)
Dual-density tape drive	No	Yes (option)
Reader/punch	Yes (option)	No
Line printer	66 cps (opt.)	100 cps (opt.)
Console keylock	Optional	Standard

specify the functions desired for processing a specific form type. The TCP, which is transferred from the disk to the control unit as needed, interprets the FDP and provides detailed control. Hence, the operator need only select the task to be performed, enter data, and initiate automatic diagnostic checking in the event of malfunction. All other functions are performed under this two-level program library.

In particular, an FDP specifies the form format (such as location of each field, number of lines per page, etc.), editing procedures, and checking operations to be performed on each field. The FDP also implies I/O operations by specifying the source or destination of data and calls for data manipulations, such as arithmetic or conditional comparisons.

OPERATING MODES: *Local Mode* enables the operator to employ the keyboard/printer as a standard typewriter and thus acts as the starting point for selecting other operating modes. Information keyed in Local Mode is not recorded on the magnetic disk.

Enter-Form Mode transfers control of the system to the FDP selected by the operator. FDP's are identified by a three-digit number. An FDP can have an operator message, which the operator can print, display, or bypass before starting the data entry operation. Messages typically include setup instructions, application name, form number, etc. The operator can also elect to set tabs manually or to have tabs set automatically by the system.

Under FDP control, the following internal functions are executed to effect processing of the form as desired: statement of data source (e.g., keyboard, special storage, central computer, etc.); destination (e.g., printer, cartridge tape, or special storage); class of data (numeric, alphabetic, self checking, etc.); processing (arithmetic, testing, or branching operations); and editing (defines the format of the output data). Each form processed in Enter-Form Mode is stored on the disk with a unique record serial number that provides identification for later recall.

In *Playback Mode,* records recorded in Enter-Form Mode can be retrieved from the disk for updating or correcting or to produce additional copies of the form records. Modification of records entered into the control processor from an external source cannot be modified by the system without the File feature.

When in Playback Mode, the operator can cause the system to print a character, a field, or a line at a time or order continuous printing of the records. This mode, like Enter-Form Mode operation, is under FDP control.

The 3-digit record number associated with each form record is automatically encoded as each record is created on the system. Records received from the control processor are assigned record numbers when received.

Request Mode enables selection of one of the many auxiliary operations of the system, such as: Communicate Mode (causes records to be compressed and transmitted in IBM 3735 BSC mode); Erase CPU Data (causes ecords received from the CPU to be erased from the system disk); Erase Operator Data (deletes records that were created by the 2300); FDP listing (effects a printed listing of the FDP's currently available in the 2300 terminal); Data Listing (effects a printed listing of the records currently stored in the 2300 terminal); Diagnostics (enables one of the system diagnostics to be executed as selected); Cartridge Utility (used on systems employing the cartridge tape drive); Tape Utility (used on systems having an IBM-compatible tape drive); and Data Compression (used to compress the size of records stored on the 2300 disk).

Communications is initiated to transmit the operator's output of the day to the CPU, to obtain new FDP's (a new complete set must be received for each day's operation), or to receive a message from the CPU.

SYSTEM OPERATION: Generally, FDP programs are assembled by the remote CPU and loaded into the 2300 terminal via a transmission line. Because all programs must be transferred at the same time, the task of adding or modifying a single program imposes the need to retransfer all programs. An alternative procedure is that of assembling FDP's on a Mohawk 2400 system and transmitting them to the 2300 terminal; or the user can elect to write assembled FDP's on cartridge or standard magnetic tape at the central site, and then transport the cartridge or tape reel to the 2300 site for local loading.

The operator fills out a form under control of a particular FDP in the Enter-Form Mode. The program automatically positions the paper form and the print mechanism for each field. As the operator proceeds, the CRT displays the fields currently being entered and thus enables the operator to sight-verify and correct the keyed information before it is printed on the form and written on the disk. If constant information is pulled from storage under FDP control and automatically printed, the operator continues without interruption to key the next field.

Should the system or the operator detect errors during form processing, the operator can respond with one of several correction procedures, depending on the location of the error in relation to the field currently being entered. See "Error Control" below.

The end of the form can be handled automatically under FDP control or manually by the operator. After completing a form, the operator can continue processing another form under control of the operative FDP, select a different FDP for processing another form type, or enter another operating mode.

Mohawk 2300 Document Processing System

The TCP executes the operations specified by the FDP. In most application environments there will be several FDP's to draw from on the disk, but there is only one TCP.

The three basic operations that can be performed on data are validation, arithmetic, and editing. Data fields can be checked for types (alphanumeric, alphabetic, or numeric), length (maximum, minimum, or exact), value (greater than, less than, or equal to), and/or self-check (modulo 10 or 11). A data field specified as optional causes checks to be suspended if the operator skips the field. Batch numbers can be assigned, with provisions for identifying up to 128 different batches. Hence, accumulation of batch totals is made possible. Arithmetic operations are performed with counters; two counters or one counter and another storage area can be assigned.

ERROR CONTROL: Checks are made on data transfers over the communications line and within the 2300 system. Parity is checked when the data is read from the disk, dynamic buffers, and arithmetic and logical control units.

If errors are made while in the Enter-Form Mode, the operator can backspace and retype the correct entry provided that the field has not been completed. Corrections to errors that are discovered after completion of a field are usually made in the Playback Mode, which permits a completed record to be recalled using the three-digit record number. The printing element and logic indicators, including the cursor, are reset to the beginning of a specified line. That line can be printed by character or by field, and new data will thereby be produced where desired. In the Request Mode, data records keyed by the operator can be erased. Now an entirely new form can be entered and printed.

Like the IBM 3755, the 2300 emphasizes extensive self-diagnostic capabilities. Tests included within the TCP implement testing of the control unit electronics, disk surfaces, communications adapter, keyboard/printer, and communications functions. Testing of the 2307 Control Unit is performed automatically each time the terminal is turned on and whenever a hardware error is detected. Other tests are conducted upon operator request. Reports are generated for the disk surface and on-line (communications functions) tests; the results of the other tests are displayed by means of indicator lights on the keyboard and by error messages on the CRT.

SOFTWARE

There are three categories of software that relate to the 2300 system: IBM System/360 and 370 system software, Mohawk 2400 system software for 2300 support, and Mohawk 2300 system software.

The IBM computer assembles Forms Description Programs and supports BSC communications under OS for TCAM and BTAM and under DOS for BTAM. The minimum IBM systems that can support the MDS 2300 are a System/360 Model 22 with 32K bytes of storage and a System/370 Model 125.

The Application Package, supplied by IBM for its 3735 and also usable with the MDS 2300, is a series of programs that permit the DOS user to specify, assemble, and store for later transmission application programs for the 2300 system. Application programs can be specified in a language that resembles RPG in format and can be coded on RPG statement sheets.

If the user has a Mohawk 2400 system, the 2300 File Manager and Communications programs can be installed in the 2400 system. The File Manager program makes it possible to generate FDP object programs suitable for transmission to a 2300 terminal in the 2400 system. The File Manager also permits initial creation of an FDP file and other functions. The Communications program enables the Mohawk 2400 to emulate the communications characteristics of the IBM 360 or 370 with respect to 2300 terminal communications.

The Terminal Control Program supplied by Mohawk is located in a write-protected area of the disk drive of the 2300 system. It incorporates the following functions: Hardware Control, FDP Interpretation, Utility Programs, Communications Programs, and Hardware Diagnostics. The TCP also implements operation of the CRT display, controls printing and carriage and platen motion, performs a test on all surface areas of the disk, and includes a write/read on open areas of the disk.

PRICING

Production models of the 2300 Document Processing System will be available during the first quarter of 1974. The 2300 is available for purchase or on a one-year lease that includes maintenance. A separate maintenance agreement is available for purchased units.

Description	Monthly Rental	Purchase	Monthly Maint.
2307 System Controller	$305	$15,000	$70
Cartridge magnetic tape drive (4 track)	20	1,000	5
9-track, 800-bpi tape drive	155	8,000	45
100-cps matrix line printer	143	7,400	42
Basic externally mounted modems:			
1200 bps non-synchronous	22	1,000	5
2000 bps synchronous	45	1,980	10
2400 bps synchronous	48	2,160	12
File feature	–	–	–
Selector channel (required for 9-track tape drives)	20	1.000	5
Cartridge drive controller	20	1,000	5
1310 matrix printer controller	8	400	2
Forms tractor for system printer	5	150	2
230.4K bytes additional disk storage	30	1,400	5
460.8K bytes additional disk storage	60	2,800	10
Synchronous communications controller	15	1,000	5
Synchronous clock	8	320	2
Alternate modem select	9	400	1
Voice/data switch	2	80	–
Select/standby switch	2	80	–
Data-rate select	2	80	–
Multi-point data link control	8	400	2
1200 bps internal non-synchronous modem	20	920	5
2000 bps internal synchronous modem	42	1,860	10
2400 bps internal synchronous model	45	2,040	12

Mohawk 1200 Key-Display System

This 1200 KDS configuration includes five CRT keystations, a chain printer, and the 1204 Control Unit (left rear), which houses a processor, disk drive, tape drive, and control panel.

The Mohawk 1200 KDS provides most of the operating features and options of the larger Mohawk 2400 KDS. It sacrifices peripheral flexibility, some performance options, and disk storage capacity in the interests of reduced cost and size.

MANAGEMENT SUMMARY

With sales of its 2400 peripheral processing/communications terminals and its 2400 Key-Display Systems perking along quite well, Mohawk found time to turn its attention to the smaller end of the shared-processor, key-disk spectrum.

The brand new Mohawk 1200 Key-Display System (KDS) introduces still another version of the Atron mini-computer (the 1204 Control Unit) the company acquired several years ago. This time the design emphasis was on reduction in size and production costs. Consequently, the company has been able to mount the processor, disk drive, and tape drive in a single cabinet that, although still fairly large, is considerably smaller than the three-cabinet arrangement of the 2400's. In addition, the price in a fully expanded basic system (12 keystations) is tantalizingly close to the $100 per month per keystation that everyone seems to regard as the ideal ($102, to be more precise).

Adding communications, printer, software goodies, and more disk storage for extended-play data entry sessions raises the price considerably – to around $150 per month per keystation for a "typical" fully equipped 12-keystation layout, or to $232 per month per keystation for an all-out system with 1600-bpi tape drive and the highest-speed chain printer.

The 1200 KDS uses the same KDOS software provided for Mohawk's 2400 KDS, with a few changes and restrictions. The control panel on the 1204 processor has been reduced and support for a system teletypewriter eliminated, so that some supervisory functions, such as initiation and ▷

CHARACTERISTICS

MANUFACTURER: Mohawk Data Sciences Corporation, Corporate Headquarters, Utica, New York 13503. Telephone (315) 792-2222.

CONFIGURATION

A 1200 Key-Display System (KDS) consists of a Model 1204 Control Unit and 4 to 12 Model 2491 CRT Keystations; a printer and communications controller can be added. The control unit includes a processor, disk drive and controller, magnetic tape drive and controller, keystation multiplexer, and operator's control panel in a single cabinet. Individual models of these components and configuration rules are discussed in the following paragraphs.

Two switching devices add reconfiguration capabilities to installations using multiple Mohawk 1200 systems. The Peripheral Switch allows the printer to be manually switched between two 1204 Control Units located up to 100 feet apart. The Keystation Switch allows any connected group of 1 to 12 keystations to be manually switched between two 1204 Control Units located up to 2000 feet apart. Overall configuration rules cannot be violated by switching arrangements. Reconfiguration adds flexibility for sharing one printer between two systems and for continuing production during maintenance of one processor or during operations, such as keying large data batches or printing, that fully occupy one processor without fully occupying all the keystations normally attached to that processor.

2491 CRT DISPLAY STATION: Displays 240 characters in 8 lines of 30 characters each. Under the standard KDOS software, the first two rows are used for control information, the third row is blank, and the bottom five rows (except for the last 25 characters) are used to display the keyed data record. The multiplexer included in the 1204 Control Unit allows connection of up to 8 keystations. An Expansion Module is required for connection of the additional 4 keystations allowed in a system.

1204 CONTROL UNIT: This unit is built around a new, physically smaller processor. In the basic system, 32K bytes of 1-microsecond memory is provided. Storage size can be expanded to 65K bytes. In general, required storage expansion is provided as part of software options. The architecture of the 1204 processor is similar to that of earlier Mohawk processors in the 2400 Systems (see Report 70D-642-05), but the 1204 cannot directly execute programs written for those processors. Limitations on peripherals and systems software prevent the 1200 KDS from being used for applications other than data entry and communications.

DISK STORAGE: Disk storage sufficient for systems residency requirements and up to 8K 125-character data pages is included with the basic system. A fixed-disk drive is provided in the basic system; this can be converted to a removable-cartridge disk drive at extra cost. Either the fixed or removable-cartridge drive can be expanded to provide storage for an additional 6K data pages. The drive is similar to the 2471 and 2473 drives used with the Mohawk 2400 Systems. The reduced 8K capacity is achieved at ►

Mohawk 1200 Key-Display System

control of communications, had to be moved to a CRT keystation. Concurrent key entry, communications, and printing was not implemented. And only one tape drive is supported. Otherwise, the full facilities of KDOS, including most of the options, are supported on the 1200 KDS.

The 1200 is more cost-effective than the 2400 KDS in environments that do not require a large amount of storage for keyed records and do not require some of the performance options such as concurrent operations. A basic 12-station 2400 KDS system comparable to the 1200 KDS costs about $120 per keystation per month, but it includes disk space for 30,000 125-character records or pages. The expanded storage is valuable if you run a high-volume shop, such as multi-shift operation. For single-shift operations, particularly where some of the key entry locations are established in the areas where data is generated rather than in a "keypunch" room, the 1200 may well prove adequate at a price that is competitive with the offerings of other vendors.

First deliveries of the 1200 KDS are scheduled for mid-summer 1974. Between now and then, systems will be delivered – at 1200 system prices – using Mohawk's supply of the retired 2404 processors that were formerly used in 2400 systems and are still in use in Europe. □

reduced cost by eliminating some of the electronics associated with creating disk sector addressing.

MAGNETIC TAPE: One of three tape drives with different recording formats, each operating at 18.75 inches per second, is provided with each of the three models of the 1204:

- The 1204-1 provides a 7-track tape format with switch-selectable recording densities of 200, 556, and 800 bits per inch.
- The 1204-2 provides a 9-track format with a recording density of 800 bits per inch.
- The 1204-3 provides a 9-track format with a recording density of 1600 bits per inch.

These drives correspond to Mohawk's 2480, 2481, and 2482, respectively. All employ industry-standard recording formats, accommodate standard 10.5-inch tape reels, and feature vacuum-column tape loops with a single-capstan tape drive and a rewind speed of 180 inches per second. Only one tape drive can be included in a 1200 KDS.

PRINTERS: Any one of four printers can be attached to a 1200 KDS via an optional I/O Channel. The four printers are the serial 1310 Matrix Printer and the 2443/2444/2445 Chain Printers.

The 1310 prints at up to 100 characters per second on multi-part, pin-fed forms from 4 to 14.875 inches wide. The print line contains 132 positions at 10 characters per inch. Vertical spacing is 6 or 8 lines per inch, as specified at the time of order.

The 2443, 2444, and 2445 constitute a family of interchangeable chain cartridge printers with a broad performance range. The 2443 has a standard print line of 100 positions, while the other two provide 132 positions. All can be expanded to 136 positions. Various fonts ranging from 16 to 128 characters per set can be installed by the operator; a 48-character font is standard. Performance for different-size character sets is as follows:

	Nominal Speed, lines per minute		
	2443	2444	2445
16-character set	350	450	900
48-character set	280	380	760
64-character set	200	300	600
96-character set	170	210	470
128-character set	150	160	370

All of these printers include provisions for switching between 6 and 8 lines per inch vertically and include a 12-channel vertical format unit. The printers accept 6-part, double-sprocketed, fan-fold forms from 6 to 18.75 inches wide. High-speed skipping rate is 17 inches per second.

COMMUNICATIONS

The optional 1221 Communications Controller enables half-duplex, synchronous communications at up to 9600 bits per second. All communications line discipline is established through software. The 1200 can specifically use the emulation packages developed for the IBM 2780 and 2968 terminals; the 2968 is a special IBM terminal for transmission of data in large blocks of 4K characters or so. Mohawk will provide later a package for emulating its own MSC discipline as used on its Data-Recorder terminals. Communications and data entry cannot be performed concurrently; neither can communications and printing. Received data must be printed in a separate tape-to-printer operation.

OPERATING MODES

- Key entry of data in batches.
- Key verification of data in batches.
- Key entry and immediate key verification by same operator of data by page.
- Key entry and parallel key verification by a different operator, with a system-enforced 3-page lag.
- Key entry and key verification of job formats.
- Search for selected record with updating if desired.
- Communications.
- Printing a listing of job formats or a data batch.

The first six operations can be performed concurrently; this group and the last two operations are all mutually exclusive.

SYSTEM OUTPUT

- IBM-compatible tape as described under Magnetic Tape, above.
- Communications, as described above.

SYSTEM PROFILE

- Record length – variable, with options, from 15 to 1000 characters long. The basic displayed and stored data segment is 125 characters, which Mohawk calls a page. In the basic system, up to four 1-page subformats can be linked to form logical records of 125, 250, 375, or 500 characters. Optionally, up to eight subformats can be linked to form records up to 1000 characters long. Another option allows multiple short records of 15 or more characters to be blocked within one 125-character page for storage on disk. ➤

Mohawk 1200 Key-Display System

- Formats – up to 256 can be stored on disk storage for access by the operators. If the optional linking of up to eight formats is employed, the number of active formats that can be stored decreases to 169. Multiple operators can access the same format simultaneously.
- Data storage – up to 8,000 125-character records or pages in the basic system; up to 14,000 pages optionally.
- System storage – the basic system includes 32K bytes of main memory for the processor and about 250K bytes of disk storage for systems functions. Processor memory can be expanded to 65K bytes; expansion is normally included as part of software options within the price of those options.
- CRT keystation – displays 8 lines of 30 characters each. Under standard software for data entry, 125 positions are used to display keyed data, 60 characters are used for control information, and the rest are unused.

SOFTWARE

Only two types of software are available with the 1200 KDS: Key-Display Operating System (KDOS) and communications terminal emulators.

KDOS for the 1200 is essentially identical with KDOS for the Mohawk 2400, with a few exceptions. The restrictions include non-support of multiple tape drives, non-concurrent communications/printing/key entry, and non-support of a teletypewriter for systems procedures. Elimination of the teletypewriter and changes in the control panel for the new 1204 processor caused some of the suprevisory functions to be moved to an assigned CRT keystation; this is the only change in operational procedures. See Report 70D-642-05 for a more complete discussion of KDOS.

Of the various emulators available for the Mohawk 2400 System, only the IBM 2780 and 2968 emulators are available for the 1200 System at present. Mohawk has announced intentions to provide an emulator at a future date that will enable data communications between the 1200 and Mohawk Data-Recorders using Mohawk's MSC transmission method.

PRICING

The Mohawk 1200 is available on a conventional 1-year lease, a variable 3-year lease, and on a 2-, 3-, 4-, or 5-year fixed-term lease. The prices shown below are for the 1-year contract. Rental prices include prime-shift maintenance. The maintenance cost column is for purchased units and covers prime-shift service. Full-time service is available at extra cost. The variable 3-year lease carries a cancellation provision after 1 year with 90 days' notice. Arrangements other than the 1-year contract carry various discounts on the equipment rental portion of the monthly rental prices shown below. These discounts are:

3-year variable contract – 5% discount;
2-year fixed-term contract – 7% discount;
3-year fixed-term contract – 10% discount;
4-year fixed-term contract – 12% discount;
5-year fixed-term contract – 15% discount.

To figure the actual rates for leases other than the 1-year contract, subtract the monthly maintenance, apply the discount, and add the monthly maintenance back in.

Costs of a basic system that includes 4 to 12 keystations, basic fixed-disk storage for 8,000 pages, and a 9-track, 800-bpi tape drive, but no options, are as follows:

Monthly Charges*

Number of Keystations	Per Keystation	Total System	Purchase	Monthly Maintenance
4	$201	$805	$32,200	$168
8	123	985	39,400	196
12	102	1230	49,200	238

* Monthly costs include maintenance.

	Monthly Rental*	Purchase	Monthly Maint.
1204 Control Unit:			
Model 1 (7-track, 200/556/800 bpi)	$625	$25,000	$140
Model 2 (9-track, 800 bpi)	625	25,000	140
Model 3 (9-track, 1600 bpi)	700	28,000	150
8K-page removable-cartridge disk (in place of standard fixed disk)	80	3,200	20
6K-page Disk Storage Expansion (fixed or removable)	25	1,000	5
I/O Channel for printer	20	740	17
Expansion Module (for Keystations 9-12)	65	2,600	14
Peripheral Switch	65	2,500	5
Keystation Switch	8	150	2
1221 Communications Controller (includes I/O Channel)	100	4,000	15
Interface to 4-wire modem	***	100***	–
Automatic Answer	8	250	2
Internal Clock	5	150	1
Dual Modem Select	8	250	2
GPO Interface (international only)	8	320	2
MSC Adapter (for communications with Mohawk Data Recorders)	15	600	3
1491 Keystation	45	1,800	7
Table	5	150	–
1310 Matrix Printer	195	7,400	52
2443 Chain Printer	330	12,210	80
2444 Chain Printer	450	16,650	105
2445 Chain Printer	700	25,900	140
KDOS Options:**			
Range Check/Extension Check/Second Check Digit	45	1,800	3
Accumulators	45	1,800	3
Check Digit	–	–	–
Four Additional Subformats	45	1,800	3
Multi-Batch Selection	–	–	–
Reformatting	30	1,200	2
Auxiliary DUP Fields	–	–	–
Multiple Records per Page	30	1,200	2
Subtotaling	30	1,200	2
Field Escape/Character Override/ Selective Verify	–	–	–
Advanced Operator Statistics	30	1,200	2
List Batches	–	–	–
List Formats on Printer	–	–	–

* Monthly rental prices include prime-shift maintenance.

** Software option prices include expansion of processor memory if required. Only these KDOS features have been announced for the 1200 KDS.

***One-time charge. ■

Mohawk 8830/8330 Disk Storage System

Mohawk's plug-compatible replacement for the IBM 3330 Disk Storage Facility features compatibility (under OS) with IBM System/360 Models 65 and up, the capability to add up to 16 drives, and better performance at a substantially lower price than its IBM counterpart.

MANAGEMENT SUMMARY

Mohawk recently announced its entry into the IBM 3330 replacement market with the introduction of its 8830/8330 Disk Storage System, which is manufactured by Information Storage Systems (ISS) and acquired from Telex. Mohawk decided to purchase its 3330-type subsystem from an outside source instead of producing a Marshall-developed drive that it acquired along with Marshall Data Systems.

The Mohawk 8830/8333 is designed as a plug-to-plug replacement for the IBM 3330 Disk Storage Facility. The Mohawk unit offers full compatibility with its IBM counterpart, with identical interface logic, power and signal cable connections, and operating characteristics. No hardware or software modifications to existing IBM equipment are required. Disk packs recorded by Mohawk drives can be read by the equivalent IBM drives, and the converse.

The performance characteristics of the Mohawk subsystem are slightly improved over those of the IBM 3330 Facility, offering the user a 10 (average) to 30 (track-to-track) percent advantage in rated positioning time. Rotational speed, data transfer rate, and storage capacity, however, are identical with those of the IBM units.

CHARACTERISTICS

Supplier: Mohawk Data Sciences Corporation, World Headquarters, Box 362, Utica, New York 13503. Telephone (315) 792-2202.

MANUFACTURER: Information Storage Systems, Inc. (an Itel subsidiary), 10435 North Tantau Avenue, Cupertino, California 95104. Telephone (408) 257-6220.

DISK DRIVE: Model 8330, a single-spindle upright module.

DISK CONTROLLERS: Model 8830-1, which accommodates up to 8 drives, and Model 8830-2, which accommodates up to 16 drives. Both controller models feature microprogramming.

CONFIGURATION: The Mohawk 8830/8330 Disk Storage System includes an 8830-1 or 8830-2 Disk Controller and one to eight or sixteen 8830 Disk Drives, respectively, in single-spindle increments.

The optional Two-Channel or Four-Channel Switch features provide two or four channel interfaces, respectively, which serve as alternate paths to the controller and its attached disk drives.

COMPATIBILITY: The Mohawk 8830/8330 subsystem is designed for connection to an IBM System/360 computer, Models 65 through 195, or an IBM System/370 computer, Models 135 through 195 (via a Block Multiplexer Channel), as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 8830/8330 provides complete compatibility with the IBM 3330 command structure and, except for System/360 Models 65, 67, and 75, requires no changes to existing hardware or software.

System/360 Models 65, 67, and 75 can accommodate the 8830/8330 subsystem via a Selector Channel, but require minor software modifications to be made to the Operating System. Modification is performed in two steps, each requiring less than a half hour to implement. The process consists of an I/O gen followed by a partial sysgen during which the necessary changes are incorporated via Mohawk-supplied software (360 Mode feature) at extra cost.

STORAGE CAPACITY: The data storage capacity of the drives is 100.018 million bytes per spindle, which is identical with the per-spindle storage capacity of the IBM 3330. Total on-line storage capacity of an 8- or 16-drive subsystem is 0.8 or 1.6 billion bytes, respectively.

ACCESS ARRANGEMENT: Each spindle provides access to 404 recording cylinders (19 tracks/cylinder) via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

Mohawk 8830/8330 Disk Storage System

The Mohawk 8830 Control Unit is equipped with micro-programmed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive while it is off-line. In addition to the IBM diagnostic routines, Mohawk also provides its own diagnostic programs for on-line systems testing.

Like its IBM counterpart, the 8830/8330 subsystem features Rotational Position Sensing (RPS), Multiple Requesting, and Command Chaining. The Mohawk 8330 drives, like their IBM counterparts, are capable of fully overlapped seek operations on any combination of up to 16 on-line drives, and of multi-track searching through a cylinder without any loss of disk revolutions. The 8830/8330 subsystem also features Secondary Disconnect, an enhancement not available from IBM, which disconnects the controller from a drive during the erase portion of a Formatted Write operation, allowing the controller to become engaged with another drive.

Mohawk supports the use of its 8830/8330 subsystem with IBM System/360 Models 65, 67, and 75 operating under OS via isolated software changes to the Operating System and an additional section of coding. The software support for attachment of the 8830/8330 subsystem to System/360 Models 65 through 75 was originally developed by ISS and has been acquired by Mohawk from Telex.

Two- or four-channel selection is also available for the Mohawk disk subsystem. The channel selection feature permits the 8830 controller to be attached to two or four computers for shared operation; between two or four controller positions on the same computer; or in a combination of both arrangements. Switching is performed under program control.

MDS has priced its 8830/8330 subsystem substantially below IBM's prices for equivalent storage capacities. Under a two-year lease, a 16-drive 8830/8330 subsystem is priced 18 percent below its IBM channel-attached equivalent and 10 to 20 percent below IBM's integrated equivalent. Further discounts can be realized through extended lease terms.

MDS announced the 8830/8330 subsystem in March 1973, and customer deliveries began in April 1973.

Service is provided by Mohawk through some 90 sales and service locations nationwide. □

DISK PACK: Each Mohawk 8330 drive accommodates one IBM 3336 Disk Pack or an equivalent pack. The 3336 contains 12 disks and provides 19 recording surfaces.

FILE ORGANIZATION: Identical with that of IBM; each disk pack corresponds to one logical file. Address (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

PERFORMANCE: The performance characteristics of the Mohawk 8330 drives are compared with those of the IBM 3330 drives in the following table.

	Head Positioning Time, Milliseconds			
Disk Drive	Track to Track	Average (400 cyl.)	Maximum (400 cyl.)	Tracks per Inch
Mohawk 8330	7	27	50	192
IBM 3330	10	30	55	192

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/ second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically by both the Mohawk and IBM drives. Start-up and shut-down times for the Mohawk drives are 15 seconds each, about the same as those of the IBM 3330 drives.

PHYSICAL CHARACTERISTICS: The physical arrangement of the Mohawk 8830/8330 subsystem is quite different from that of the IBM 3330. Unlike the 3330, the Mohawk subsystem consists of discrete components with the following cabinet dimensions.

Device	Width, inches	Depth, inches	Height, inches	Weight, pounds
8330 Drive	20	32	40*	440
8830 Controller	41	32	60	700

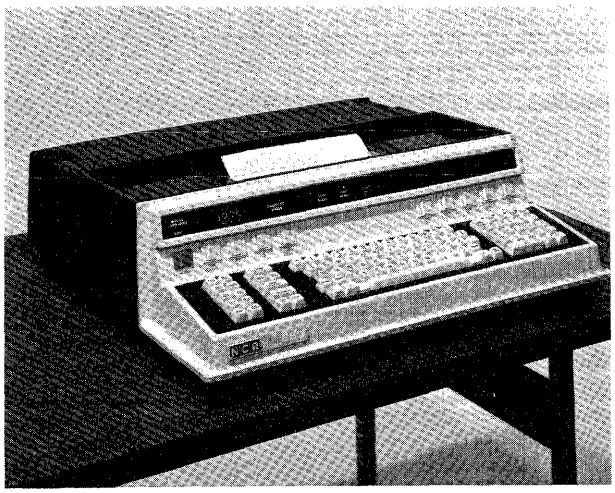
***Disk pack access height is 36 inches.**

PRICING: The Mohawk 8830/8330 Disk Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Mohawk provides two leasing plans, Fixed Term and Variable Term. Both provide lease contracts for two, three, four, or five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and maintenance on a 24-hour, 7 days/week basis. A separate maintenance contract is provided for purchased units.

	Monthly Rental*			
	2-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
8330 Drive	$ 450	$ 425	$19,400	$125
8830-1 Controller (1 to 8 drives)	1,616	1,526	69,900	150
8830-2 Controller (1 to 16 drives)	1,701	1,607	79,900	170
Two-Channel Switch	126	119	5,600	140
Four-Channel Switch	248	234	12,100	275
360 Mode***	266	251	12,000	295

*Lease prices shown include 24-hour, 7-days/week maintenance and are for the Fixed Term Plan. Lease prices under the Variable Term Plan are 5% higher.
**Monthly maintenance is shown for prime shift; unlimited maintenance is priced 1.2 to 1.5 times higher.
***Required for operation with System/360 Models 65, 67, and 75. ■

NCR 260 Series Teleprinter Terminals



These teleprinters contain the familiar NCR Thermal Printer mechanism and are designed to serve as Teletype replacements. The new 260 ASR features single or dual magnetic tape cassette drives, an edit capability, and an optional format feature. Rated operating speeds are 10, 15, and 30 characters per second.

MANAGEMENT SUMMARY

NCR's now-familiar Thermal Printer forms the nucleus of its 260 Series teleprinter terminals, designed for compatibility with the Teletype line of ASCII teletypewriters. The NCR terminals have long been available in RO (receive-only) and KSR (keyboard send/receive) configurations, but NCR is now promoting the new and attractively styled ASR configuration (shown above) which is scheduled for July 1973 deliveries. Deliveries of the RO and KSR configurations began in late 1967 when NCR made its first shipments to OEM customers; end-user deliveries began in late 1971.

The RO and KSR versions are purely functional devices and do not include any special enhancements. Both versions are unbuffered, and data transmitted by the KSR is transmitted on a character basis as each character is keyed.

The 260 ASR is a buffered unit and is available with one or two cassette tape drives. The ASR also features an extended keyboard with a separate 10-key adding-machine keygroup, special function keys, a row of switch/indicators for tape and printer functions (located behind the keyboard), and a separate record counter for each cassette drive. The integral buffer serves two purposes; it buffers data between cassette tape and line, printer, or keyboard, and it allows the operator to key an 80-character record and to make corrections prior to releasing the record.

The ASR's edit capability allows the operator to backspace and rekey any number of characters or to clear the buffer and begin over again. Operator Lead-Through, a special feature available for the ASR only, provides a formatting capability for data entry applications, such as order entry, that favor the fill-in-the-blanks approach. The feature automatically prints format descriptors, such as ▷

CHARACTERISTICS

MANUFACTURER: The National Cash Register Company, Data Entry Products and Systems, Main & K Streets, Dayton, Ohio 45409. Telephone (513) 449-2000.

MODELS: The NCR 260 is available in an RO, KSR, or ASR configuration; the ASR version includes one or (optionally) two integral cassette tape recorders. Only the ASR version is buffered.

COMMUNICATIONS: Asynchronous in the half- or full-duplex mode at operator-selectable speeds of 10, 15 (ASR only), or 30 char/second. The transmission code is 10- or 11-unit, 8-level ASCII including parity. The unit code structure is determined by strapping.

The Series 260 teleprinters are transmission-compatible with Teletype Models 33, 35, and 38 at 10 char/second and with Teletype Model 37 at 15 char/second.

The terminals include one of two communications interfaces: an EIA Standard RS-232C interface for connection to a Bell System 103 Series Data Set (or an equivalent modem) or a 20 ma. current loop interface for direct attachment to a telegraph-grade line.

NCR offers two telephone-coupler modems (Models 260-400 and 260-500) that connect the 260 ASR to the telephone network via a conventional telephone and handset. The couplers also permit a hard-wired connection to the line via a Bell System Data Access Arrangement. Model 260-400 operates in the originate mode only; Model 260-500 operates in originate or answer mode and features automatic answering.

DEVICE CONTROL: Buffered operation is provided only for the ASR configuration; the RO and KSR versions are unbuffered. The ASR version contains an 80-character semiconductor buffer, which is used to accumulate data to be written on or read from magnetic tape and to accumulate keyed data when operating in the edit mode. The edit mode allows the operator to key an 80-character block and to correct typing errors by backspacing and rekeying the correct data prior to printing, transmitting, or recording the block on tape. The operator is alerted to a buffer-full condition upon keying the 72nd character; a full-buffer condition inhibits further entry until the data has been transferred. Separate keys allow the operator to clear the buffer or to space forward or backward. The print head moves to the left margin when the buffer is cleared and moves forward or backward to correspond with the current buffer position. When not operating in the edit mode, keyed data is transmitted as each character is keyed.

Keyed or received data is printed as each character is keyed or received, provided the printer has been enabled.

Data is recorded in fixed- or variable-length blocks as selected by the operator. Maximum block size is 80 eight-bit data characters. Each block is preceded and terminated by a start-of-block and end-of-block control character, respectively, and includes two CRC check characters (16 bits). ▶

NCR 260 Series Teleprinter Terminals

"name," "sales number," etc. prior to each keyed entry and provides additional buffering for up to 128 or 256 characters. The format can be loaded from cassette or entered via the keyboard.

The ASR 260 also includes a search function which allows the operator to key a record number and to initiate the search function. The advancing tape increments a four-digit record counter as each inter-record gap is encountered, and is halted at the beginning of the specified record.

Two modems for use with the 260 ASR are also available from NCR; one is an originate-only modem, and the other is an originate-and-answer modem with an automatic answering capability.

Printing is virtually noiseless, so the non-impact printing technique lends itself well to quiet environments. The printer operates at line speed and provides up to 80 print columns, which is in keeping with conventional teleprinter parameters. Both upper and lower case alphabetics are printed, but the lower case letters are printed as half-size equivalents of the corresponding upper case letters. □

A four-digit block count indicator (one per cassette recorder), incremented or decremented (depending on tape direction) by a detected inter-record gap, indicates the number of the current block as it is read from or written on tape and can be used to search for a specific tape block. Controls are provided to move the tape forward or backward by one block, rewind or position the tape at load point (a small hole at the beginning of the recording), read or write tape, write a tape mark, and (if a second cassette recorder is used) duplicate a single record or a whole tape.

The optional Answerback feature, available for either the KSR or ASR version, responds with a programmed 21-character sequence to a keyed Here Is or a received ENQ. Break, when keyed, transmits a space sequence.

The optional Operator Lead-Through feature, available for the ASR version only, is a programmable feature designed for applications that require data to be entered according to a rigid format. The feature implements formatted operation by means of an extended buffer with a capacity of 128 or 256 characters and associated control keys. Via keyboard or cassette, the buffer is loaded with "lead through" information, which contains the format descriptors in sequence corresponding to the order of key entry. The operator-initiated feature prints the format descriptor prior to each keyed entry; the operator can advance to the next descriptor or repeat the previous descriptor via the appropriate control keys.

The optional Top-of-Form Sensing feature automatically spaces the paper to the top of the next form when a keyed or received form feed character is detected. The option can accommodate paper ranging from 1.5 to 22 inches in length.

ERROR CONTROL: Odd, even, or mark character parity, as selected, is generated and accompanies all transmitted messages. Parity is checked when receiving, and a special symbol is substituted for a character received in error.

Cyclic redundancy checking and generation is performed on recorded data in addition to a read-after-write check.

KEYBOARD: 57-key Teletype-style keyboard, with a 20-key numeric keygroup to the right of the main keygroup and two separate keygroups containing a total of 17 special-function keys to the left of the main keygroup. Function selection switches, located above the keyboard, provide for additional tape and printer functions. The keyboard can generate any of 128 ASCII characters including upper and lower case alphabetics, numerics, specials, and control characters.

PRINTER: Non-impact, using an electrothermal printing technique. Characters are formed within a 5-by-7 dot matrix; character size is 0.110 inch high by 0.082 inch wide.

Prints any of 94 ASCII symbols, including upper and lower case alphabetics, numerics, and special characters, at selectable speeds of 10, 15 (ASR only), or 30 char/second (determined by the transmission rate). Lower case letters are printed as capitalized, half-size equivalents of the corresponding upper case letters.

Line length is 80 characters (8 inches). Horizontal and vertical spacing are 10 char/inch and 6 lines/inch, respectively. The printer has a friction-feed platen and accommodates a 100-foot or (optionally) 430-foot roll of 8.5-inch-wide NCR thermal paper, which fits inside the printer.

CASSETTE TAPE RECORDER: Records data on a "Philips-type" cassette, which contains 282 feet of 0.15-inch magnetic tape recorded at 800 bits/inch using the Manchester Bi-phase recording technique. The inter-record gap is 0.8 inch.

Read/write tape speed is 7.5 inches/second, and data transfer rate is 6000 bits/second (750 char/second). Maximum rewind time is 70 seconds.

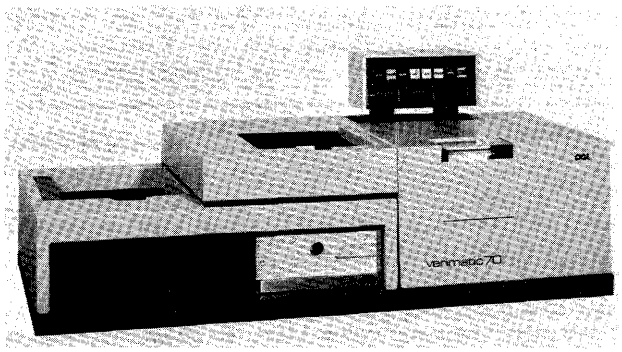
PRICING: The Series 260 Terminals are available for purchase or on a one-, two-, or three-year lease that includes maintenance. A separate maintenance contract is available for purchased units.

Monthly Rental*

Model 260	1-Year Lease	2-Year Lease	3-Year Lease	Purchase	Monthly Maint.
ASR	$150	$130	$120	$4,395	$25.00
KSR	95	80	70	2,320	10.00
RO	75	70	65	1,960	8.00
Options					
Answerback			10	170	2.00
Operator Lead Through			10	245	2.50
Top-Of-Form Sensing			12	260	2.75
Second Cassette Recorder			NA	NA	NA
Modems (for ASR only)					
260-400 (originate only)			15	430	4.50
260-500 (orig. or answer)			20	560	5.00

* Includes maintenance. ■

Peripheral Sciences Verimatic 70 and 170



The Verimatic balancing and editing control systems employ programmed cards and logic circuitry to perform various editing and validation checks on 80-column punched cards in lieu of standard keyed verification. Even when some supplementary verification is required, the Verimatic can raise throughput significantly and effect substantial cost reductions.

MANAGEMENT SUMMARY

Peripheral Sciences call its Verimatic 70 and 170 devices balancing and editing control systems rather than automatic verifiers. That's a fair characterization of a technique that takes dead aim on the costly and tedious procedure of column-for-column comparison in the verification of punched cards, but does not propose to perform exactly the same process automatically.

Three types of control cards are used in the Verimatic. Instruction codes are punched into a Program card and a Segment card; fixed data is punched into the Segment card as well as instructions; and a set of legal values is punched into a Table card.

Data already keypunched into the cards to be verified is then read into the system. At this point, semiconductor logic circuits compare the incoming data with the programmed data. Many errors on the keypunched cards can be detected in this way. A list printer then prints numbered and coded information describing these errors and their location on journal paper. Corrections can be made from this listing before the error cards are committed to the central computer, just as would be done if the errors had been exposed by standard verification.

It is possible that some errors will pass the Verimatic validation checks undetected. The Verimatic compensates for this disadvantage, however, by performing a number of useful functions that go well beyond conventional verification.

The Verimatic system confirms that a field is alpha, numeric, or alphanumeric, as defined by the format program, and it also checks for proper field length. It detects imbedded blanks and determines whether fields have been skipped, columns missed, duplicate columns dropped, or left zero-fill errors made. It ensures that duplications throughout the card deck are valid. It detects improper codes punched into the transaction cards. The Verimatic also compares punched data with a table of acceptable values (table look-ups) and performs range checks. Finally, the Verimatic verifies check-digits in designated fields, using modulo 7, 10, or 11.

CHARACTERISTICS

MANUFACTURER: Peripheral Sciences, Inc., 203 East Main Street, Norristown, Pennsylvania 19401. Telephone (215) 279-4285.

CONFIGURATION: Constructed as a system, the Verimatic models feature a panel display and switch box at the upper right of the device and include an input stacker, an output stacker, a visible station, a program card station, a roll paper feeder and output station, and a serial printer. Three counters, which are located directly below a row of indicator/pushbutton switches that are used to operate the Verimatic, display the number of cards processed, the number of cards in error, and the number of errors detected.

The Verimatic 70 shown in the photo employs a mechanical card reader, whereas all current models incorporate a fully electronic, vacuum-feed reader.

DEVICE CONTROL: The following cards are employed by the Verimatic: Program card (a control card that carries instruction codes), Segment card (a control card that carries fixed data and some limited instruction codes), Table card (a control card that carries tables of legal values), Transaction cards (cards previously punched by a keypunch operator and which now must be verified and validated), and Trailer card (a control card that has "12" punches in columns 1 through 9). Two Program Cards and two Segment Cards can be loaded into the Verimatic memory at the same time; hence, the device can check cards characterized by either of two formats without reloading.

The input stacker is loaded in the following sequence: Program card I, Segment card I, Program card II, Segment card II, Table card, Transaction cards, and Trailer card. The program codes in the control cards perform the following functions with respect to the Transaction cards: field definition (begin and end); format check (blank, numeric, or alpha); table look-up (comparison of a punched numeric value with entries in a table of legal values); duplication check (compares specified field of first Transaction card with identical field of succeeding Transaction cards); range check (value in Transaction card must lie between two specified values); power-of-ten range check (determines whether specified high-order columns are zero); check-digit verification (determines whether a specified numeric in Transaction card conforms with a Modulo 7, 10, or 11 check-digit routine); accumulating numeric fields (total limited to twice the field size or 20 digits, whichever is lower; when batch completion punch is recognized, Verimatic prints total, resets to zero, and continues); transaction code checking (compares a field of the Transaction Card with the specification of that field in the Program Card and prints mismatches); error message identifier (prints a field that identifies an error card); blank card check (detects a blank Transaction card); and illegal Hollerith code check (detects presence of illegal Hollerith code or invalid punches on Transaction card).

Peripheral Sciences Verimatic 70 and 170

In addition to the host of errors that these validation checks can uncover, the Verimatic detects many others by means of batch tabulating and balancing. Another capability is that of generating operator performance statistics, which consist of the number of cards processed, the number of cards in error, the number of total keystroke errors, and the operator identification number. This evidence brings to light both superior and inadequate operator performances and can lead to a constructive solution of personnel problems.

In May 1973, Peripheral Sciences introduced a new high-speed model of the Verimatic system, the Verimatic 170. The 170 system has a throughput of approximately 18,000 lines per hour, compared with slightly over 10,000 lines per hour for the original Model 70. The 170 also accepts 51-column cards. It is intended primarily for applications that involve large-scale balancing. In particular, the 170 can print two fields side-by-side on the output journal tape (e.g., account number and dollars) without decreasing the throughput. When a 600-card/minute reader is incorporated, the throughput of the 170 advances to about 28,000 lines/hour. Peripheral Sciences asserts that the Verimatic 170 is currently the fastest balancing and editing system available for punched cards short of a full-fledged computer system.

Both the 70 and 170 can batch-balance an unlimited number of fields in an 80-column record and supply totals for each of these fields. They provide zero balance figures. They also print a total by using a control punch present in the cards or by using changes in programmed control fields, such as an account number. The Verimatic 70 can print a single field of up to 10 characters while totaling, whereas the 170 can print two separate fields side-by-side at its rated speeds. Field length to be accumulated is limited to 10 digits per field. There is no limit to the number of fields that can be totaled in a given card. The Verimatic accepts both positive and negative entries.

The Verimatic system offers some highly worthwhile benefits: (1) it replaces expensive and time-consuming computer balance runs; (2) it allows balancing of cash payments in clerical areas; (3) it simplifies keypunch controls; (4) it provides an audit trail through use of its journal tape output; and (5) it performs its checks at the verification stage, only one step removed from keying and before source documents have become hard to access.

The Verimatic performs these functions, moreover, at the rate of about 300 to 500 cards/minute, and without the cost of a keypunch operator pounding out keystrokes. As acknowledged previously, some errors will still slip through the Verimatic, so neither keyed verification nor computer edit programs should be entirely discarded.

Peripheral Sciences began delivering the Verimatic 70 in June 1971. To date, there are about 30 installations in the Philadelphia and New York City metropolitan areas, where the product was exclusively marketed until April 1973. The Dasa Corporation was then made an exclusive sales and service representative for Peripheral Sciences in the United States, including Baltimore, Boston, Chicago, Cleveland, Denver, Los Angeles, Union, N.J., and Washington, D.C., as well as Philadelphia and New York. The Verimatic is presently marketed by both companies.

USER REACTION

Users describe both the Verimatic 70 and 170 as reliable in operation. They say that the devices are reasonably free from breakdown and execute their specified functions faithfully. Maintenance service has been called prompt and effective, whether provided by Peripheral Sciences (no longer the case) or by Dasa. The great majority of breakdowns are mechanical, often involving either the card reader or the printer. For this reason, Peripheral Sciences has replaced the mechanical reader that it used originally with a fully electronic, vacuum-feed reader. The new reader's inability to score error cards is viewed as a drawback by some users, but since the machine temporarily halts after an error, other users are satisfied to rotate the error card and resume operation to gain the benefits of the vacuum reader.

It is noteworthy that most users interviewed by Datapro supplement the Verimatic with keyed verification of certain critical fields, such as account numbers not subject to check-digit verification. In a few cases, when fields immune to Verimatic checking were uncritical and the manager was satisfied to uncover errors in these fields with the computer edit program, verification was dispensed with entirely. Users were pleased with the Verimatic action because it is much faster than keyed verification and locates errors prior to computer processing. Batch balancing was considered one of the most useful checks that the Verimatic performs. □

The numeric codes printed for error messages are as follows: 0 for failure to match data table; 1 for failure in check-digit verification; 2 for incorrect duplication; 3 for range check discrepancy; 4 for illegal alpha, numeric, or blank format; 5 for invalid character; 6 for illegal transaction code; and 7 for illegal blank card.

PRICING: The Verimatic 70 can be obtained by purchase or on a 1-, 2-, or 3-year lease arrangement. If the unit is purchased, a separate maintenance contract is also necessary. The purchase price is $14,850, and the monthly maintenance cost is $50 for the user's prime-shift hours. An additional charge is made for emergency service. Monthly rental charges, including maintenance, are $545 on a 1-year lease, $445 on a 2-year lease, and $395 on a 3-year lease.

The Verimatic 170 can be purchased for $21,750; maintenance for this model is also $50/month. The 170 can be leased on a 2-year basis for $695/month and on a 3-year basis for $595/month, maintenance included.

Maintenance is performed by the Dasa Corporation under the supervision of Peripheral Sciences.

The company also is developing slower and less expensive models for both the 80- and 96-column markets. ■

Potter Grand Slam Printers

This plug-compatible replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit employs compressed type in order to contract printouts to 10-5/8 by 8-1/2 inches. The Grand Slam operates at a moderately higher speed than the IBM printer while providing the standard IBM features. Both on-line and off-line models are offered.

MANAGEMENT SUMMARY

How far has America come along the bleak road of shortages? In particular, how serious, really, is the hoopla about paper shortages? If this country—and the world—have truly entered an era of shortages in basic resources, then Potter Instrument Company has performed a noteworthy public service by developing its new Grand Slam Printer. Certainly the Grand Slam concept of reducing the print size in order to reduce the size of printed computer documents distinguishes this plug-compatible IBM 1403 replacement from all those that produce conventional printing.

How high do base paper costs have to soar and how much printing volume must be produced to make a reduction of nearly half the normal quota of paper a compelling saving? There is yet another vital question for the data processing manager to ponder. Suppose paper is rationed sometime hence. Suppose one can obtain only part of what one normally needs. Would a print system that is capable of compressing all of the required lines onto about half the normal quantity of paper assist survival under these difficult circumstances? All of these questions, which would have been considered overdrawn a year ago, must be treated with respect today.

These conservation-age benefits, moreover, can be obtained at a considerable saving compared with the cost of the IBM 1403 Model N1 Printer.

The normal printout size of the Grand Slam is 10-5/8 by 8-1/2 inches, compared with the conventional size of ▷

CHARACTERISTICS

MANUFACTURER: Potter Instrument Company, Inc., 532 Broad Hollow Road, Melville, New York 11746. Telephone (516) 694-9000.

MODELS: LP6403 High Speed On-Line Printer; LP6413 Off-Line Printer.

PRINTER CONTROLLERS: Both printers have an appropriate internal control unit, its characteristics depending on whether the model is intended to operate on-line or off-line. The CC5826 Potter Card Control Unit, a separate control unit for the IBM 2540 Card Read Punch, is an option.

COMPATIBILITY: The Potter Grand Slam Printer and its internal control unit serve as a plug-compatible replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit, Models 1, 2, 3, or 5, including models with the Third Printer Control feature. No equivalent is offered for the IBM 2821 Model 4, which is a controller for the IBM 1404 Printer. The CC5826 optional control unit allows attachment of an IBM 2540 Card Read Punch.

The Grand Slam equivalents of the various IBM controller models are listed below.

IBM 2821 Model	Grand Slam Equivalent	Operating Configuration
1	LP6403 Printer + CC5826 Control	Printer + CC5826 Control and IBM 2540
2	LP6403 Printer	Printer only
3	LP6403 Printer	2 LP6403 Printers
4	–	–
3*	LP6403 Printer	3 LP6403 Printers
5	LP6403 Printer + CC5826 Control	2 LP6403 Printers + CC5826 Control and IBM 2540
5*	LP6403 Printer + CC5826 Control	3 LP6403 Printers + CC5826 Control and IBM 2540

* IBM model with Third Printer Control feature.

The Grand Slam Printer can be used with IBM System/360 Models 25 through 195 and System/370 Models 125 through 195.

The patented belt chain of the Grand Slam cannot be interchanged with the IBM train cartridges. In contrast to the IBM 1416 Interchangeable Train Cartridge, which contains a 240-character type array, each Potter chain module contains 432 characters.

The Universal Character Set feature, an option on the IBM 1403 Printer, is a standard feature on the Potter Grand Slam. Like the 1403, the Potter Grand Slam provides buffering for two 240-character train images; these buffers are switch-selectable. The character sequence can be entered into the computer from the IBM 2540 Card Read Punch and loaded into the Grand Slam from the computer. ►

Potter Grand Slam Printers

14-7/8 by 11 inches. This size will usually eliminate any need for photo or xerographic reduction of the output. To achieve this size, the Grand Slam prints 15 characters per horizontal inch instead of the conventional 10 characters, and prints either 8 or 10 lines per vertical inch instead of the conventional 6 or 8 lines. Like other impact printers, it can handle up to 6-part forms.

Potter states that a patented belt chain and free-flight high-energy hammers produce clean printouts. Character sets are easily changed by the operator by replacement of the entire chain module.

The possibility of additional savings should not be overlooked. The reduction in paper volume reduces storage space needs and similarly reduces postage fees and related distribution costs. Furthermore, the dimensions of the Grand Slam printer itself are 87 inches in width by 48 inches in height by 30 inches in depth; hence, it requires only 7.7 square feet of floor space.

Other important features of the Potter Grand Slam printer are as follows:

- On- and Off-Line Operation—Model LP6403 contains an internal controller that interfaces directly with an IBM System/360 or 370 computer, and Model LP6413 contains an interface to a 9-track magnetic tape drive for recording at either 800 or 1600 bpi.

- Slave Printer Operation—Up to two Model LP6403 printers can be connected to another LP6403 operating on-line to a multiplexer channel of a System/360 or 370. Additional LP6403 printers can in turn be operated from the slave LP6403 printers. The internal control units make these configurations possible.

- Universal Character Buffer—This internal buffer provides buffering for two user-specified character sets that correspond in sequence to the graphics on the belt chain. Buffer capacity is 240 characters, which matches the capacity of the optional UCB for the IBM 1403. This provision is consistent with keeping the Grand Slam software compatible with IBM 360/370 computers. The stored character sets are selectable by the operator at the computer.

- Format Tape—Vertical format control is effected by 12-channel format tape, as in the IBM 1403.

- High Print Speed—The Grand Slam achieves speeds of 1260 to 1550 lines/minute with a 48-character font and the Potter Adaptive Control. The standard print rate of the IBM 1403 is 1100 lines/minute.

The Grand Slam Printer will be serviced by the Potter organization. Service centers are located in all principal cities. Delivery is scheduled for the first quarter of 1974. □

Vertical formatting of the Grand Slam is effected by a 12-channel tape loop identical to that used in the IBM 1403. Like the IBM 1403, the Grand Slam does not incorporate a vertical format control buffer.

The print size of the Grand Slam is two-thirds that of the 1403 and other conventional printers. In executing 132 print columns, the printer spaces 15 characters per inch horizontally and 8 or 10 lines per inch vertically (switch selectable). The print chain contains 432 character positions. The resulting print compression utilizes only 55 percent of the area required by conventional printing, and thus reduces paper consumption by nearly one-half.

At a chain speed of 153 inches/second, the Grand Slam attains a printing speed of 1260 to 1550 lines/minute with a 48-character font and the Potter Adaptive Control. Vertical movement of a single space requires 17 milliseconds at a skipping rate of 15 inches/second. Skipping of from 2 to 6 lines is executed at 30 inches/second, and skipping of 7 lines or more is performed at 75 inches/second. The power rollers of the Grand Slam are especially useful in pulling paper through during lengthy skips.

Up to 6-part forms can be employed. The forms can be from 4 to 18-1/2 inches wide, including margins, and can be from 7 to 22 inches long, fold to fold. The normal dimensions of the printed output are 10-5/8 by 8-1/2 inches. The maximum stacking height is 15 inches.

A standard feature of the Grand Slam series is the print retry function, which automatically starts a reprinting of the line when a transient impulse causes an error condition.

The LP6413 Off-Line Printer has the same basic properties as the on-line LP6403. Instead of incorporating a 360/370 interface, however, the LP6413 employs a tape drive interface that enables the printer to accept data obtained from IBM 1403-formatted 9-track tape recorded at either 800 or 1600 bpi.

PRICING: Potter Grand Slam Printers can either be leased or purchased. The on-line LP6403 can be purchased for $54,950 or rented for $1,470 per month under a 3-year lease contract. This lease price includes a monthly maintenance charge and allows up to 100,000 pages per month to be printed. Beyond 100,000 pages per month, Potter imposes an additional use charge of 0.4 cent per page up to a limit of $600 per month. Maintenance for purchased units is priced at $220 per month for prime-shift coverage.

The off-line print station, the LP6413, is combined with an external Potter PS3800 Control Unit, which controls off-line operation of the printer and adapts it to either 9-track, 800-bpi or 9-track, 1600-bpi tape according to the programming. Monthly rental under a 3-year lease is $1,820, including maintenance, when 800-bpi tape is used; purchase price is $66,150, and monthly maintenance for the printer costs $270. For operation with 1600-bpi tape, monthly rental under a 3-year lease is $1,910, including maintenance; purchase price $69,450, and monthly maintenance costs $270.

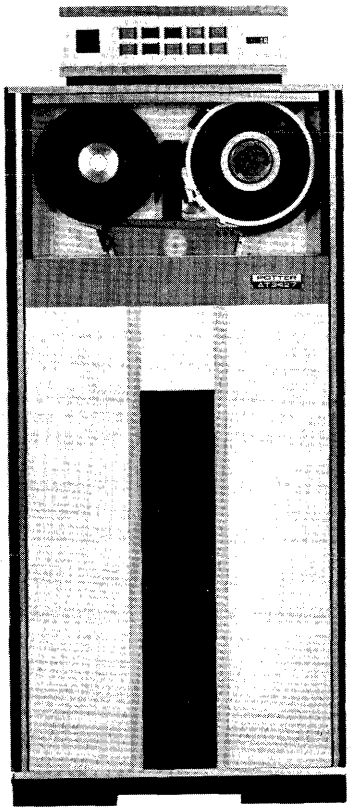
A typical monthly rental for a 9-track drive using 800-bpi tape is $175 for the 3-year contract term. Similarly, for 1600-bpi tape a typical charge is $210.

Various maintenance contracts are available. The prime-shift contract covers a 9-hour day for 5 days a week from 8 a.m. to 5 p.m. Other arrangements, up to 24-hour service for 7 days a week, are available at higher prices. Monthly rentals in the table below include maintenance charges. Conversion from lease to purchase is possible through a purchase-credit arrangement. Although the first belt chain is included in the basic printer price, additional chains must be ordered separately.

Device	Monthly Rental*	Purchase	Monthly Maint.
Standard Belt Chain (each)	$ 70	$2,000	$25
CC5826 Card Control Unit	280	7,900	30
Adaptive Control	No Charge	No Charge	No Charge

* Three-year lease term. ■

Potter 3420 Series Magnetic Tape Subsystem



This plug-compatible replacement for IBM's 800/1600-bpi 3420/3803-1 tape subsystem offers savings of up to 25 percent over its IBM counterpart. Potter, however, does not currently offer compatibility with IBM's new 6250-bpi 3420 drives and 3803-2 controller.

MANAGEMENT SUMMARY

The Potter 3420 Series Magnetic Tape Subsystem is a plug-to-plug replacement for IBM's 800/1600-bpi 3420/3803-1 Magnetic Tape Subsystem, introduced in November 1970. However, the Potter subsystem does not currently provide compatibility with IBM's new high-performance 3420/3803-2 Magnetic Tape Subsystem, introduced in March 1973, which records at 6250 bpi via the Group Coded Recording (GCR) technique.

The Potter 3420 Series Subsystem offers a family of tape drives consisting of five members whose characteristics (including options) match those of the IBM 3420 Models 3, 5, and 7. Potter is marketing a complete tape subsystem as well as individual drives.

The Potter Tape Subsystem employs the radial attachment technique for connecting tape drives to the controller that characterizes the IBM 3420/3803 subsystem. With this technique, each tape drive is connected independently to the control unit instead of in the conventional "daisy chain" or series arrangement where all drives are connected in sequence, beginning at the controller and ending with the last drive. The radial technique is superior to daisy-chaining because it permits ▷

CHARACTERISTICS

MANUFACTURER: Potter Instrument Company, Inc., East Bethpage Road, Plainview, New York 11803. Telephone (516) 694-9000.

TAPE DRIVES: Five models, compatible with the IBM 3420 Series Magnetic Tape Units: Potter Models AT 3423-1, SC 3423-1, AT 3425-1, SC 3425-1, and AT 3427.

TAPE CONTROLLER: Potter Model TC 5805 Tape Controller.

COMPATIBILITY: The Potter 3420 Magnetic Tape Drives are designed as plug-compatible replacements for the IBM 3420 Series Magnetic Tape Units, Models 3, 5, and 7. The Potter Models are listed below with the equivalent IBM 3420 models and their characteristics.

IBM 3420 Model	Potter AT/SC 3420 Model	Tape Format Tracks	Tape Speed, ips	Tape Density, bits/inch*	Transfer Rate, K bytes/sec
3	3423-1	9	75	800/1600	60/120
3	3423-1	7	75	556/800	41.7/60
5	3425-1	9	125	800/1600	100/200
5	3425-1	7	125	556/800	69.6/100
7	3427	9	200	800/1600	160/320

*The Dual Density feature on 9-track drives is optional.

The Potter 3420 Series drives can be used with IBM System/360 Models 30 through 195 or with IBM System/370 Models 135 through 195 via either the Potter TC 5805 Tape Controller or the IBM 3803-1 Tape Control.

The standard Potter 3420 Series drives, like their IBM counterparts, are 9-track, phase-encoded drives that read and write at a single density of 1600 bits/inch. The Dual Density feature, available for all Potter 3420 Series models, also permits reading and writing at a density of 800 bits/inch using NRZI encoding. The Seven-Track feature, available for Potter Models AT 3423-1 and AT 3425-1 only, permits reading and writing in the 7-track, NRZI-encoded mode at selectable densities of 556 or 800 bits/inch.

Standard features include automatic (AT Series drives) or semi-automatic (SC Series drives) threading with or without tape cartridges, power window, automatic latching hub, automatic tape cleaning, and read-backward capability.

The Potter TC 5805 Tape Controller is designed as a plug-compatible replacement for the IBM 3803-1 Tape Control and as a controller for the Potter 3420 Series Magnetic Tape Drives. Like the single-channel IBM counterpart, each Potter TC 5805 and a string of up to 8 tape drives operate as a tape subsystem for System/360 Models 30 and above and for System/370 Models 135 through 195.

The basic TC 5805 Tape Controller Accommodates up to eight 9-track, phase-encoded tape drives. Dual Density and ▶

Potter 3420 Series Magnetic Tape Subsystem

a drive to be switched off-line and exercised by diagnostic routines without interrupting or affecting the operation of the remaining drives.

The Potter TC 5805 Controller incorporates MSI circuitry and is equipped with microprogrammed diagnostics. The stored diagnostics are designed to help the service engineer isolate and diagnost malfunctions by exercising the faulty drive in the off-line mode.

Potter tape drives feature a single vacuum-capstan tape drive mechanism. A rubberized surface on the capstan, with the aid of vacuum through its surface, grips the Mylar side of the tape, which is wrapped in a "U" turn about the capstan. The drives also feature a retractacle read/write head, which is in the retracted position during initial load and rewind operations. Potter has been successfully using the retractable head design on its tape drives for a number of years, despite the fact that this design technique is believed to be more conducive to head/tape misalignment problems. The Potter design uses a detent to lock the head into the operating position, thus reducing the risk of misalignment.

The Potter subsystems, as well as individual drives, are available on a monthly rental basis and on extended lease periods ranging from one to five years. Potter prices its subsystems and individual drives as much as 25 percent below the equivalent IBM equipment under a one- or two-year lease. Further savings can be realized under Potter's extended lease periods.

Potter provides its own nationwide sales and service through 30 offices located in major cities.

Customer deliveries of the 3420 Series Magnetic Tape Subsystem began during the second quarter of 1972. Initial deliveries of the 3420-1 Series drives were made during July and August 1973.

USER REACTION

Some of the Potter users interviewed by Datapro have experienced no problems at all. Most of them rated the overall performance as good, though not outstanding, and judgements of the maintenance service ranged from fair to excellent. A number of the interviewed users, however, have encountered problems with the drives, including the original 3420's and the new 3420-1 models. Most numerous were complaints concerning inability to read tapes written by another Potter 3400 Series drive. In some cases this problem was resolved shortly after installation; in others, the problem remains unchanged or has become an intermittent failure. □

Seven-Track features are required for the controller when operating with drives incorporating these features; however, both features cannot be incorporated on the same controller.

The Seven-Track feature also includes translation and data conversion functions. When selected, the translator function writes 8-bit, EBCDIC-coded bytes as 6-bit BCD-coded equivalents on 7-track tape, the converse translation is performed when reading. When selected, the data conversion function writes three 8-bit bytes as four 6-bit characters on 7-track type; the converse function is performed when reading.

The Two-Channel Switch feature provides a second channel interface as an alternative path to the controller and attached tape drives.

Pooling options permit up to 16 tape drives to be switched among two, three, or four TC 5805 Controllers to allow simultaneous operation of two, three, or four tape drives over as many I/O channels.

The physical characteristics of the tape drives and controller are virtually the same as those of the equivalent IBM tape drives and tape control. The drives and controller operate in the same environment as the equivalent IBM equipment, with essentially the same power requirements. The physical characteristics are as follows:

	Width, inches	Depth, inches	Height, inches	Weight, pounds
Drives:				
SC 3420 Series	28	29	65.5	670
AT 3420 Series	29	29	69	670
TC 5805 Controller	30	30	60	450

PRICING: The Potter 3420 Series Magnetic Tape Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Potter provides lease plans for one through five years in addition to a month-to-month arrangement. Lease rates include all cables, installation, diagnostic performance checks, and unlimited usage. A separate maintenance contract is available for leased or purchased equipment.

	Monthly Rental*				
Tape Drive (7 or 9 track)	1-Yr. Lease	2-Yr. Lease	5-Yr. Lease	Purchase	Monthly Maint.**
AT 3423-1	$404	$374	$318	$9,100	$115
SC 3423-1	361	336	291	7,900	105
AT 3425-1	425	395	335	9,500	120
SC 3425-1	383	358	308	8,300	110
AT 3427	550	500	390	14,900	120
Dual Density	21	21	16	450	5
Controller					
TC 5805	558	508	397	15,100	70
Dual Density	66	61	46	1,400	5
Seven Track	61	56	41	1,700	5
Two-Channel Switch	123	113	83	3,300	10
Controller Switch					
Two controllers	154	139	109	4,300	15
Three controllers	195	180	140	5,500	20
Four Controllers	236	216	171	6,700	25

* Monthly rental charges include maintenance for 24 hours/day, 7 days/week.
** Prime shift maintenance. ■

Potter System 85

Potter's new diskette data station accepts keyed data and stores the formatted records on a floppy disk, or diskette. These records can be transmitted to either another data station at a different location or to a central IBM computer. A 180-lpm printer produces a formatted hard copy of the keyed data.

MANAGEMENT SUMMARY

Is Potter trying to wedge its way into IBM's act, or has IBM already purloined Potter's? Announcement of the IBM 3740 Data Entry System in the United States came early in 1973; introduction of the archetypal Potter DDS 1073 Diskette Data Station took place at the Fall Joint Computer Conference in December 1972. On the other hand, IBM's European unveiling of its system was made earlier in the fall. Well, enough of that.

The concept revolves around the so-called floppy disk, which has now been given the more dignified designation of diskette. There is another important element central to this concept, namely, the minicomputer. Despite its small volume, which enables it to fit into the trim controller cabinet adjacent to the System 85's keyboard console, its processing power for this kind of application is on a par with that of a conventional computer. One of its main functions is to act as a controller for the disk drive and printers. Another, of course, is to regiment the incoming data as it is keyed. Therefore, let us add a diskette drive and an electronic ▷

CHARACTERISTICS

MANUFACTURER: Potter Instrument Company, Inc., 532 Broad Hollow Road, Melville, New York 11746. Telephone (516) 694-9000.

CONFIGURATION

The DDS 8505 Diskette Data Station (popularly designated the System 85) employs a flexible diskette and is organized into a keyboard, a diskette drive, an electronic display unit, a matrix printer, and a minicomputer. All components are contained within the station housing except the keyboard and display panel, which are both accessible to the operator. Two communications controllers are available as options.

DISKETTE: Enclosed in a plastic envelope, the 8-inch single disk serves as a lightweight, reusable plastic recording device. The disk and envelope together compose the diskette, which is occasionally referred to as a cartridge. It is inserted into the loading slot present at the top of the diskette drive. When the cover is closed, the disk is automatically positioned and made ready for operation. The envelope remains stationary at all times, while the internal disk spins freely. Cutouts in the envelope allow a read/write head and sector sensing devices to function.

The disk contains 74 usable tracks, each divided into 26 sectors. Each sector, in turn, holds 128 characters. The first track always stores an index of the data sets, or files, present on the disk; hence, up to 1898 records comprising 242,944 characters can be stored on each disk when 128-character records are recorded. If the record length is decreased to 80 characters, the disk has a maximum capacity of 151,840 characters. Data can be transferred from the disk at a rate of 30,000 characters/second. These characteristics are the same as those of the IBM 3740 diskette.

DDS 8562 PRINTER/KEYBOARD: This unit consists of a keyboard located at the front of the data station, where it is accessible to the operator, and a helix printer mounted at the rear of the data station, where it discharges printed hard copies of data.

The keyboard is of solid-state construction and consists of 64 alphanumeric characters. Additional function keys are provided to control such operations as record, backspace, homing, selection of operating mode, and others. The keyboard arrangement follows the IBM 29 pattern.

The printer operates at 180 lines/minute, which amounts to 396 characters/second in view of its 132-column capability. Either a 64- or 128-character set can be installed. ➤

Potter System 85

rather than a mechanical keyboard, and include an electronic display panel and a matrix printer. The result is a rather elegant stand-alone key data entry device that makes mechanical contrivances like the keypunch seem archaic.

In place of a card that is subjected to mechanical manipulation and human handling, the Potter system employs an 8-inch, reusable plastic diskette that the operator simply inserts it into a slot at the top of the drive as she would put a 45-rpm record into a slot-actuated player. The cost of the diskette is about $6.00. It consists of a disk that is permanently enclosed but free to spin within a plastic envelope that is always stationary. Slits in the envelope provide access paths for the read/write head and sector sensing devices.

The diskette storage capacity of 1898 records corresponds to about 3,000 cards. Instead of having an 80-character or 96-character limit, records can be up to 128 characters long in the Potter system. This and other system characteristics conform with those of the IBM 3740 system, with which the System 85 is completely compatible.

One advantage that Potter takes of this compatibility is to offer two communications adapters, one for Binary Synchronous Communications (BSC) and the second for asynchronous communications. With either adapter, data records stored on the diskette can be transmitted to a remote IBM System/360 or 370 computer or to an IBM System/3 computer. Communications can also be established, of course, with other facilities that conform with IBM formats.

It is possible, furthermore, for one diskette station to communicate with another diskette station. In this mode, data on the diskette of one station is transferred to the diskette of the other station. Data received in this way can be regarded as a second class of input, which can be transferred to the keyboard buffer by the controller like any other stored data for insertions, deletions, and corrections.

Having made a decision to market the DDS 8505 primarily as a data entry terminal situated at the data sources, Potter offers effective means for transferring the data to a computer via communications lines. Because the system is compatible with the IBM 3740, however, direct data transfer is not precluded. The IBM 3540 Diskette Input/Output Unit, which transfers data directly from a diskette to an IBM System/370 computer, can be used for this purpose in the Potter system as well as in the 3740. Similarly, the IBM 3747 Data Converter can convert data records on the Potter diskette into IBM-compatible tape, either 7- or 9-track.

The vertical spacing is 6 lines/inch. The printing structure is based on a 5-by-7 dot matrix, but a 9-by-7 or 9-by-9 dot matrix is available as an option. An adjustable tractor can feed forms up to 14-7/8 inches wide. Top-of-form and programmed vertical form controls are standard, while 4- or 12-channel vertical format control units are optional. The Potter printer can handle 6-part forms. It operates after the keying of a record has been completed.

ELECTRONIC DISPLAY: Consists of a 32-character display unit situated to above and to the left of the keyboard. The last 8 positions present data, and the 24 remaining positions convey system status information, such as column position, current disk address, keyboard shift mode, current field type, operating mode, etc.

DDS 8547 DISKETTE DRIVE: Accepts the IBM 3740 diskette, with which the Potter diskette is compatible; the drive turns at the rate of 360 revolutions/minute (equivalent to 167 milliseconds/revolution), transfers data at the rate of 250,000 bits/second, and has a track-to-track access time of 10 milliseconds.

DDS 8505 CONTROLLER: Consists of an internal minicomputer that buffers the incoming data to permit assembling an entire record before its transfer to the disk. The controller can then cause the printer to produce a hard copy. It also governs the operation of the electronic display and maintains control over all disk drive operations. Finally, the controller structures the incoming data in accordance with the selected format as part of its control over all keyboard functions.

Because the minicomputer utilizes read/write storage, it can serve many other functions as well. So far Potter has developed two capabilities; one is a 3740 emulator and the other is communications.

COMMUNICATIONS ADAPTERS: Can be selected to provide Binary Synchronous Communications (BSC) or asynchronous communication. In either mode, data can be transmitted through a modem to a computer center or to another diskette data station.

OPERATING MODES

- Data entry (keying of data into the controller for formatting and release to the diskette).
- Verify (rekeying of data for character-to-character comparison; character mismatches disable the keyboard and require corrective action by the operator).
- Search (automatic search and recovery of records designated by record address, which consist of track and sector numbers, or by an end-of-data indicator, or by either of two other procedures based on field content)

SYSTEM PROFILE

Records can vary in length from 1 to 128 characters. The capacity of a diskette is 1898 records, which corresponds to 3000 punched cards. Other pertinent information appears under Diskette and Diskette Drive, above. Up to 10 format programs can be stored in the system at any time. They are originally keyed and recorded on the diskette. A separate diskette can be used for this purpose, but the programs often reside on the same diskette as the data

Potter System 85

Somebody—is it IBM or Potter?—deserves credit for originating a pretty little concept, and both rate a nod for getting the action started.

Picture an operator keying rapidly in an environment made quiet by an electronic keyboard. Occasionally, she may have need to glance up at an electronic display that exhibits the last 8 characters keyed and 24 characters denoting system status and error information. Incoming data is structured by a format control program similar to the way a drum card controls data entered on a keypunch. This format program is keyed beforehand, field by field, into the system and stored on the diskette. Appropriate indications of alphabetic or numeric fields, duplication, skipping, and right justification (left zeros) are included. Fields can also be designated as bypass fields to be ignored when a record is subsequently verified. Any of 10 format programs is available at any one time, and these may be summoned manually or through program chaining; that is, they are linked automatically as specified. Assembled records are then released to the diskette and stored there without either the clatter or encumbrance of dealing with cards. There are ample means to access and retrieve these records at will.

Check digit verification is a standard feature. The superiority of this quiet and professional operation to the tumult of keypunches is obvious. The power of the diskette relative to cards is evident in various ways, and an illustrative example is the 19 individual files it contains for storing data and format programs.

A noteworthy feature of the Potter system is the 180-lines/minute printer that is mounted directly behind the keyboard. This printer, utilizing vertical forms control and horizontal tabbing, both under program control, can provide printouts of such items as orders, invoices, packing slips, and inventory listings in exactly the same format into which the keyed data was processed. It can also print data received from another diskette station or from a computer.

For the next few years, at least, the main competition for diskette data entry will continue to be provided by keypunching. Inferior or not, keypunches will be preferred by managers who lack the enterprise to make a constructive change. But there will also be serious competition from key-to-cassette devices and key-to-tape data entry stations. In many respects, diskette stations and magnetic tape terminals function in much the same way as the diskette station and have analogous capabilities. The diskette, however, appears to be a more convenient and supple storage medium than magnetic tape because of its substantially shorter access time and greater handling convenience. For example, tape reel and tape cassette handling is eliminated, and attendant storage problems are avoided.

records. In either case, these programs are loaded into the controller from the diskette at the start of data entry.

SYSTEM SOFTWARE

Considering the small physical size of the console, a surprising number of software functions are executed by the minicomputer. In addition to implementing the usual data entry operations, such as skipping, duplication, right justification, backspacing, forward spacing, alpha-only entry, numeric-only entry, etc., the software also applies check digit verification, modulo 10 or 11, and carries out program chaining. Hence, all 10 formats stored on the diskette can be summoned automatically as each record is keyed. The search techniques previously described under Operating Modes are another important software function. All of the control operations, such as those of the printer and the electronic display, are under software control as well.

Control of data entry requires a particular programming function that is unnecessary in keypunching. An index must be compiled so that stored data records (or format control programs) can be located on the diskette and retrieved by the controller. As mentioned earlier, the first track of the disk contains this index, which consists of the name, beginning address, and ending address of the data record. An address is identified in terms of its track and sector number. Of the 26 sectors on the index track, 7 are assigned to other uses and 19 data records, or labels, are stored in the remaining locations. Each control program is treated as a data record on the diskette. Index information can be prerecorded in order to simplify the operator's responsibilities.

It should be noted that the data actually keyed need not fill the available space. To mark the end of the actual data space, an end of data address is maintained in the index record. Certain indicators, such as record length, bypass (skip when converting or transferring data), write/protect, end-of-batch marks (indicators denoting the end of related data records), and verify marks must be manually recorded in specified positions in the index track.

SYSTEM OPERATION

Like a keypunch or a key-to-tape or key-to-cassette data entry station, the DDS 8505 is a stand-alone device. Unlike a keypunch, however, a diskette station dispenses with the use of cards and related manual operations. It also dispenses with installing and removing tape reels or tape cassettes. An 8-inch reusable plastic diskette is employed instead, and it can be readily interchanged with others according to need and convenience.

Up to 10 format control levels are at the disposal of the operator. This flexibility far outstrips the two format levels available in most keypunches. Editing in the form of fields that admit alphabetic-only or numeric-only data can be established by means of the format program. As previously mentioned, an end-of-record indicator is added to the program to mark the end of the data record. For convenience during updating, bypass fields can be designated so that they are ignored. The usual skipping and duplication processes are carried out. Characters are accumulated in a buffer until a full record has been assembled in accordance with the format control program. The record is then released to the diskette.

When a particular record needs to be accessed, it can be retrieved by any one of the previously mentioned search

Potter System 85

It should be recognized that many keypunch installations are already large enough to justify shared-processor key-to-disk installations; hence, this technology also competes against the diskette concept. Although key-to-disk systems hold a clear-cut advantage over the diskette station in processing power, their costs tend to be substantially higher. These offsetting considerations show that there is a proper market niche for the diskette concept, just as there is a place at the larger end of the data volume scale for key-to-disk systems. Under the impetus of IBM promotion, diskette data entry should grow and help create a market for the Potter system.

Delivery of the System 85 has been promised for the first quarter of 1974. □

modes. One method is to key a record address (track and sector numbers). Using the "search on end of data" the operator can position the data station to the last record of the data set so that she can add new information to it. Content searches consist of creating a mask in the controller corresponding to a partial or entire record and then searching for the record that matches all of the specified descriptors.

As the necessity arises, the operator can glance up at the display panel, which exhibits 8 data characters and 24 positions of system status messages.

While keying is in progress, no other system operation can be performed, such as printing hard copy or releasing data to an output transfer device.

The weight of the controller is approximately 140 pounds, and it is 22.1 inches wide, 25.6 inches deep, and 30 inches high.

COMMUNICATIONS: With the Binary Synchronous Communications Adapter, the transmission rate can be 2000 bits/second over dialed lines or 2000 to 2400 bits/second over leased lines. Transmission can be in half-duplex mode. There is also an asynchronous communications option. A range of asynchronous transmission rates can be accommodated, according to the user's preference.

PRICING

All components of the System 85 can be purchased or leased under various term plans. Rental figures that follow include prime-shift maintenance and are based on a 24-month lease term. A separate maintenance agreement is available for purchased items.

Component	Monthly Rental	Purchase	Monthly Maint.
DDS 8505 Controller	$190	$4640	$20
Bisync. Communications Adapter	30	1400	5
Async. Communications Adapter	20	785	1
Unattended operation	6	160	1
Second disk attachment	11	270	1
Basic DDS 8505 Unit:			
Without BSC	345	8550	55
With BSC	375	9950	60
(includes 1 disk, printer, keyboard, and display panel in both cases) ■			

Raytheon PTS 100 Programmable Terminal System

MANAGEMENT SUMMARY

Raytheon's long-anticipated entry into the intelligent CRT terminal market was announced with the introduction of its PTS 100 Programmable Terminal System at the 1971 SJCC. Deliveries, however, did not begin until September 1972.

The PTS-100 is currently marketed as a replacement for IBM's 2848/2260 Display System. Raytheon offers a software emulator package that provides all functions of the IBM 2848/2260 plus some additional features. The emulator operates in either local or remote environments and supports all available IBM 2260 screen sizes except 240-character screens. Raytheon plans to introduce an emulation package for the IBM 3270 during the third quarter of 1973.

Raytheon offers the PTS 100 System in two single- or dual-display stand-alone models and in two clustered models, a small-to-medium-scale cluster and a medium-to-large-scale cluster. An attractively-styled keyboard/display unit with a 15-inch CRT is common to all PTS 100 models.

Raytheon provides strong software support for the PTS 100. In addition to the IBM 2848/2260 emulator, the software currently includes three macro assemblers, an IOCS monitor, and a library of utility programs. The assemblers permit the user to generate application programs for the PTS 100 on a Raytheon Model 704 ➢

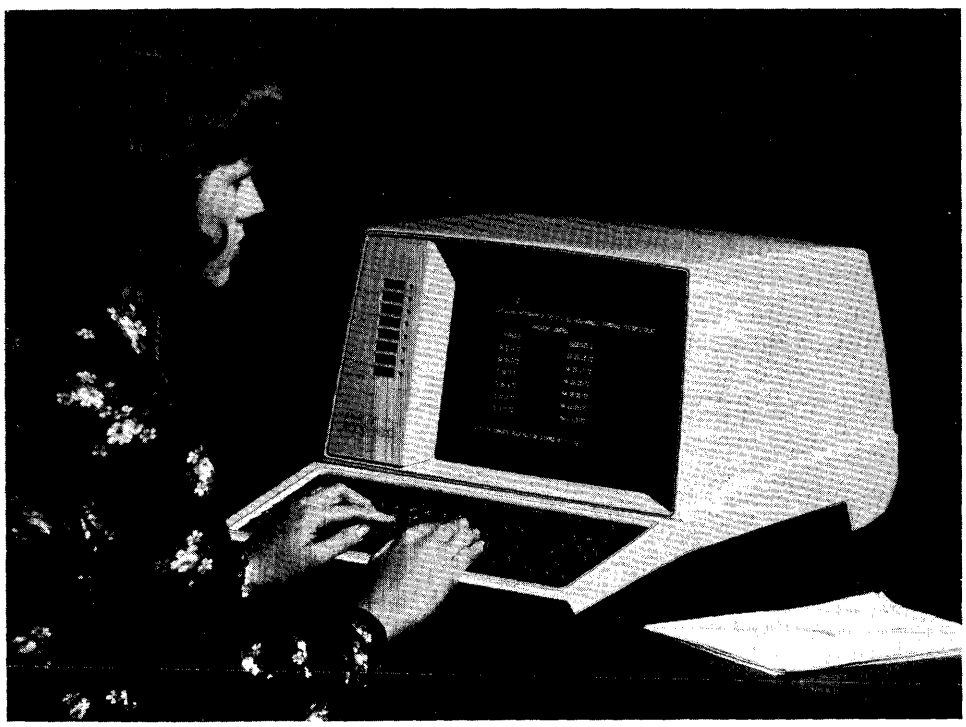
The PTS 100, a replacement for the multistation IBM 2848/2260 Display System through emulation software, is available in stand-alone form and in a broad range of clustered configurations, including 4 to 96 displays with screen sizes up to 1920 characters. Numerous auxiliary devices are supported.

CHARACTERISTICS

MANUFACTURER: Raytheon Data System Company, Division of Raytheon Company, 1415 Boston-Providence Turnpike, Norwood, Massachusetts 02062. Telephone (617) 762-6700.

MODELS: The PTS 100 Programmable Terminal System includes four models. Models 1010A and 1015A are both single-display stand-alone terminals that can accommodate a second display unit; the two models are essentially the same except that the 1015A can accommodate more auxiliary devices. Model 1015B is a medium-scale clustered display terminal that accommodates 4 to 16 display units. Model 1020B is a large-scale clustered display terminal that accommodates 4 to 96 display units.

CONFIGURATION: The basic PTS 100 System (all models) is built around a 16-bit minicomputer with 8K or 16K bytes (depending on model) of MOS semiconductor memory, expandable to 64K bytes in 4K- or 8K-byte increments. In addition to its complement of CRT display units, the system can include a variety of peripheral devices, including printers, teletypewriters, card readers, magnetic disk drives, and a magnetic tape cassette recorder. ➢



A PTS 100 system can include from 1 to 96 CRT display units, as well as a variety of auxiliary I/O devices. Display screen capacities of 480, 960, and 1920 characters are available.

Raytheon PTS 100
Programmable Terminal System

minicomputer, on an IBM System/360 computer under OS or DOS, or on a 16K-byte PTS 100. A variety of utility programs provides strong assistance to the user for loading, debugging, and maintaining his application programs.

Salient features of the PTS 100 System as compared with those of the counterpart IBM display terminals include:

- Display Capacity—The PTS 100 is available with screen sizes of 480, 960, and 1920 characters; IBM 2260 screen sizes range from 240 to 960 characters; IBM 3270 screen sizes are 480 or 1920 characters.

- Total Displays—The PTS 100 can accommodate up to 96 480-character displays, up to 48 960-character displays or up to 24 1920-character displays. By comparison, the IBM 2260 can accommodate 16 480-character displays or 8 960-character displays, but no 1920-character displays; the IBM 3270 can accommodate up to 32 480- or 1920-character displays.

- Display Arrangement—The PTS 100 is available in any of four display arrangements. The 480-, 960-, and 1920-character display arrangements correspond with those of the IBM 2260 and 3270 displays; however, Raytheon also provides a second display arrangement for 960- and 1920-character displays. Although these differences in display arrangements provide greater flexibility, they require slight software changes to the access method to establish the new display parameters.

- Auxiliary Devices—The PTS 100, unlike the IBM display units, includes a multiplexer channel with 3, 7, or as many as 23 subchannels, which can accommodate a variety of low-speed I/O devices such as impact printers, card readers, cassette tape recorders, and communications interfaces. Disk storage, rated at 2.5 or 5.0 million bytes, attaches directly to the minicomputer's high-speed I/O bus, which can also interface a host computer via a channel interface.

- Communications—PTS 100 transmission speeds range up to 9600 bps, and the PTS 100 can accommodate EBCDIC, ASCII, SBT, or BCD codes via program translation. The IBM 2260 and 3270 Displays are limited to transmission rates of 2400 bps and 4800 bps, respectively.

First production deliveries of the PTS 100 were made during the last quarter of 1972.

Service is provided by Raytheon Service Company, a worldwide service organization with headquarters in Boston, Massachusetts.

The minicomputer features a bidirectional I/O bus with a maximum transfer rate of 1 million bytes/second. The I/O bus can support up to eight high-speed I/O devices including disk storage, magnetic tape units, host processor channel interfaces, and special user interfaces.

Low-speed I/O devices are attached via a multiplexer channel with a maximum transfer rate of 9600 bits/second. A multiplexer channel contains four (Model 1010A) or eight (all other models) subchannels. Via an adapter, each subchannel can accommodate one peripheral device or communications interface operating in the half-duplex or simplex mode; full-duplex operation requires two subchannels. One multiplexer subchannel is dedicated to input from all keyboards associated with the attached display units; therefore, three or seven subchannels are available for external device usage. Model 1020B can accommodate 1 or 2 additional multiplexer channels to provide a total of 15 or 23 usable subchannels.

The PTS 100 System is designed for remote operation in a communications environment or for local operation as a computer peripheral subsystem for an IBM System/370 or System/360 via the computer's multiplexer or selector channel. The data transfer rate in this mode is 80,000 bytes/second.

The parameters of each of the four models of the PTS 100 System are listed below.

Model	Memory Size, bytes	Multiplexer Subchannels	1920-char. Displays	960-char. Displays	480-char. Displays
1010A	8K to 16K	3	1	or 2	or 2
1015A	8K to 16K	7	1	or 2	or 2
1015B	8K to 16K	7	4	or 8	or 16
1020B*	16K to 64K	7/15/23	24	or 48	or 96

*Can accommodate one or two additional multiplexer channels.

COMMUNICATIONS: Synchronous or asynchronous in the half- or full-duplex mode. Four modem adapters are each designed to accommodate specific transmission codes and code levels, including 6-level, 6-unit code; 8-level, 8-unit code; and 10-level, 8-unit code. Each adapter provides an EIA Standard RS-232C or CCITT V.24 modem interface and can operate at speeds up to 9600 bits/second. The adapter designed for 10-level, 8-unit code supplies its own clocking; however, clocking, derived from an external modem, must be applied to the other adapters.

CRT DISPLAY: Via a 15-inch (diagonal measurement) CRT. The standard display arrangements are as follows:

Characters/Display:	480	960	960	1920	1920
Lines/Display:	12	15	12	24	30
Characters/Line:	40	64	80	80	64

A character set of 64 ASCII symbols, including upper-case alphabetics, numerics, and special characters, is displayed in green against a dark background. An optional 96-character set of displayable symbols includes lower-case alphabetics. Characters are generated by a 7-by-7 (64-character set) or 7-by-9 (96-character set) dot matrix.

DEVICE CONTROL: The nucleus of the PTS 100 is a general-purpose minicomputer that executes all terminal

Raytheon PTS 100
Programmable Terminal System

Raytheon is also marketing the PTS 100 System as an add-on or replacement terminal for IBM's 2948/2915 display terminals used in its PARS/IPARS airline reservation system. Supporting software interfaces the PTS 100 with the IBM systems software. Raytheon is a leading supplier of reservation and departure control systems to such major airlines as Air Canada, TWA, Air France, Iberia, KLM, Qantas, Finnair, Swissair, and Alitalia. □

operations under program control. Standard operating software currently includes the IBM 2848/2260 Emulator, the Input/Output Control System (IOCS) Monitor, three assemblers, and a library of utility programs.

The IOCS Monitor controls all I/O functions, including scheduling and queuing of I/O operations, error detection and handling, servicing user program requests for control operations on the I/O devices, and handling I/O activity to maintain maximum I/O speeds without burdening the user program. Four macro commands initiate all I/O operations.

Source programs can be assembled on the PTS 100 using the Native Assembler, on a Raytheon Model 704, or on an IBM System/360 computer under OS or DOS. Each assembler requires 16K bytes and provides the same assembly-language statements, which can define and use macro instructions. Macro definitions fall into two categories: those that relate the object program to facilities of the PTS 100 software, and those created for the current program and for inclusion in the macro library for future use. Assembler capabilities also include automatic optimization of instructions as 16- or 32-bit machine instructions and the generation of object text in absolute or relocatable form for entry into the PTS 100 terminal.

Utility programs include: an absolute or relocatable loader, which loads either kind of program and links independently assembled program segments; a file update program, which features program or line insert, program correct, program or line delete, program or line replace, program output, and file directory creation; a debug program, which provides debugging aids for programmers; a system generator, which permits the user to generate a system from user-supplied parameters such as memory size, interrupt level assignments, logical and physical device assignments, and monitor modules required; a dump (list) program for peripheral devices; and a memory dump program.

The IBM 2848/2260 Emulator package provides complete operating compatibility with the IBM 2260 Display Station and includes all IBM 2260 optional features plus additional features inherent to the PTS 100. Featured are a full range of cursor controls, including cursor right, left, up, down, and home; edit controls that include character insert and delete; line and screen erase; and horizontal tab. Operating software can be loaded from cards or magnetic tape cassette.

KEYBOARD: Three standard keyboards are available: two typewriter-style keyboards, with or without a numeric keyset, and a keyboard designed for the PARS/IPARS Airline Reservation System. All keyboards generate the full ASCII character set, including upper- and lower-case alphabetics.

PRINTER: Teletype Model 33 ASR, KSR, or RO at 10 char/second (see Report 70D-830-01) or GE TermiNet 300 or 1200 at 30 or 120 char/second (see Reports 70D-450-03 and 70D-450-04).

CARD READER: Reads 80-column cards punched in Hollerith or binary codes at a rated speed of either 300 or 1000 cards/minute. Input hopper and output stacker card capacities are 600 cards each for the 300-cpm reader and 1000 cards each for the 1000-cpm reader.

DISK STORAGE: Two disk drives offer storage capacities of 2.5 million or 5 million bytes each.

CASSETTE TAPE RECORDER: Records data on a "Philips-type" cassette, which contains 300 feet of 0.15-inch magnetic tape recorded at 800 bits/inch. Record length is variable, with 60 bytes/record minimum. Total cartridge cassette is rated as 120,000 bytes for 80-byte records or 307,000 bytes for 960-byte records. Read/write and rewind tape speeds are 10 and 40 inches/second, respectively. Maximum rewind time is about 90 seconds.

PRICING: The Raytheon PTS 100 is available for purchase or on a one- to five-year lease, which includes prime-shift maintenance. Raytheon declined to supply complete pricing information, but furnished prices for the following representative systems and auxiliary devices.

Model (2)	Monthly Rental (1)	Purchase (3)
1010A (with one 1920-char. display)	$215	$4,800
1015A (with two 960-char. displays)	315	7,050
1015B (with eight 960-char. displays)	985	12,175
Auxiliary Devices		
Printer, 30 cps	150	3,600
Printer, 120 cps	(4)	(4)
Magnetic Tape Cassette Recorder	25	1,200
Card Reader, 300 cpm	150	4,000
Card Reader, 1000 cpm	240	6,500
Disk Storage 2.5 million bytes	(4)	5,000
Disk Storage 5.0 million bytes	(4)	7,500

(1) Prices are for a one-year lease and include maintenance for 8 hours/day, 5 days/week.

(2) Includes a communications interface.

(3) Monthly maintenance for purchased equipment is priced at 0.5 percent of the purchase price.

(4) Pricing available from Raytheon only. ■

Recognition Equipment Total Data Entry System

MANAGEMENT SUMMARY

Can two separate systems, like two independent persons, be wedded and achieve a greater distinction than either could have alone? This old question of creating a whole greater than the sum of its parts is raised anew by the multimedia concept, which joins an optical scanner and a multistation key-to-disk facility with the intent of letting the scanner take advantage of the keystation CRT display, key/disk software, and the shared disk drive. Recognition Equipment's Total Data Entry System is an important example of this new concept.

A partner in this system is one of Recognition Equipment's Input 80 Models, and its mate is a slightly modified Entrex System 480. Some of the differences between the System 480 as marketed by Recognition Equipment and the standard system marketed by Entrex are that the former is limited to 22 keystations compared with 32, and that it has additional software to store a video description of rejected characters sent to it by the scanner on the disk and to display this information later on a keystation CRT.

Ideally, the following operating procedures are envisaged. Source documents unsuitable for scanning are assigned to the key entry section of the installation and are processed there in the conventional way, subject to the editing, verification, reformatting, and other routines of the section. Material amenable to scanning, on the other hand, is assigned to the Input 80 scanning unit, where only routine operator support is required. Identified characters are coded and temporarily stored on Input 80 magnetic tape for subsequent batch transfer to the disk in the key-to-disk section, or they are transferred record by record.

If a character is rejected, its video description is also recorded on tape and eventually transferred to the disk.

This multimedia data entry system combines a key-to-disk facility consisting of up to 22 keystations with an Input 80 Model A, B, or C optical scanning unit. The two systems can function independently, each supported by its own software and peripherals, or the scanner output can be sent to the keystation section for character insertion, editing, and reformatting.

CHARACTERISTICS

MANUFACTURER: Recognition Equipment Incorporated, P.O. Box 22307, Dallas, Texas 75222. Telephone (214) 259-8611.

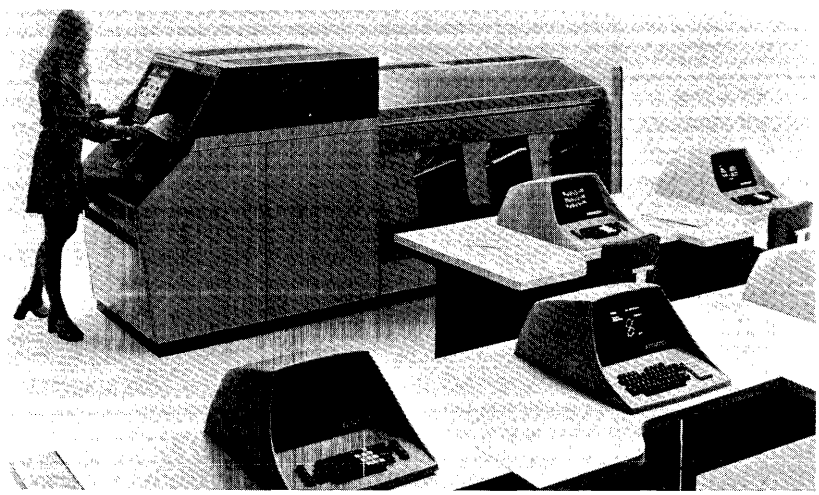
CONFIGURATION

The REI Total Data Entry System combines up to 22 CRT keystations with an Input 80 Model A, B, or C OCR scanning system. The keystation section is supported by a central processor, a single disk drive (or optionally, a total of up to four disk drives), a single magnetic tape drive (or up to four drives), an optional communications interface, and an optional line printer. Each scanning system incorporates a separate programmed controller, its own magnetic tape drive, and an optional line printer. A special interface is required between the scanning system and the key-to-disk section.

CRT KEYSTATION: Features either an IBM 29 Card Punch keyboard or a typewriter-style keyboard. A 10-key adding machine pad for numeric entries is located to the right of the typewriter-style keys. Both keystation models implement a set of 64 characters. There are 17 function keys for carrying out system operations.

The CRT screen displays up to 480 characters that are presented in 12 lines of 40 characters each. Keyed data and field names appear in the bottom 10 lines.

The keystations can be situated up to 1000 feet from the control processor.



REI's Total Data Entry System effectively combines the CRT keystations in the foreground and the Input 80 optical scanner in the background.

Recognition Equipment
Total Data Entry System

At the keystation operator's convenience, a video reproduction of the reject is constructed from its stored description and displayed on the keystation CRT screen. (The keystation is then in what Recognition Equipment calls the Video Re-entry mode, which is often referred to as batch re-entry.) If the operator can identify the character, she keys it into the record. If she cannot, the entire document can be reproduced on the CRT screen. As a last resort, the operator can always consult the original. Once the missing character is keyed, the next reject immediately appears on the screen. The striking advantage of this off-line correction technique is that optical scanning by the Input 80, when it is operating, races on apace without interruption.

Alternatively, the coded scanner output and reject descriptors can be transferred to the main disk as they are formed, character by character. This method also allows the keystation operator to recall the data at a convenient time. A video replica of a character requires 27 bytes of information for handprinted characters and 75 bytes for machine printing.

Another important consideration is that, once scanner data is on the main disk file, it not only can be manipulated by the sophisticated software there, but this activity is also independent of scanner operation and will therefore not retard it. Hence, it is possible to reduce the responsibility of the optical scanner to scanning by consigning editing, verification, batch balancing and reformatting to the key-to-disk facility. This approach can raise the scanner's throughput to a level that is capable of fully justifying the high cost of optical scanning.

The approach of recording scanner output on tape for intermediate storage pending batch transfer to the main disk is also noteworthy. The time at which this release is made can be chosen to preclude any possibility of interfering with keystation operation. However, no interference is normally expected from record-by-record transfer of the data.

Another important feature of Total Data Entry is that each Input 80 scanning unit has a complete complement of peripheral devices, not simply the magnetic tape drive mentioned previously. The unit has a control processor, an I/O typewriter, and a line printer as well as a tape drive. If the scanner is fully integrated with the key-to-disk facility, the line printer and the tape drive are redundant except for the important case of using the tape drive as an intermediate storage medium. The control processor is certainly always necessary for character identification, and the typewriter for conversation with the system.

The inclusion of the redundant components, however, offers an advantage in another sense. Unifying the software of the two sections is a substantial undertaking that requires some time. If in the early stages of operation the

INPUT 80 SCANNERS, MODELS A, B, AND C: These scanners can be configured as single-font, multiple-font, or multifont systems with or without handprint reading ability. Single-font systems can read any one of a wide selection of typed fonts, while multiple-font systems can read up to nine different type fonts. Multifont systems can read virtually all type fonts intermixed, even on the same line, in a variety of character pitches. The manufacturer states that documents with degraded characters, smudges, tears, and skew lines can be read. Each line of machine-printed data is read at speeds of up to 3600 characters/second. Handprinted characters can be read at the rate of up to 1200 characters/second. Under control of the central processor, the transport mechanism feeds and aligns each page, and then moves the paper at up to 80 inches/second.

Machine-printed characters can be read if their pitch lies between 4 and 12 characters/inch. Handprinted characters must be spaced at 4 characters/inch. The actual character reading rate is 300 times the pitch in characters/inch.

Under program control, a Line Marker (optional) marks lines containing rejected (unidentified) characters. The system also has a Mark-Sense option (that is, the ability to use marked, preprinted symbols as program-defined information indicators). Another option, but standard on Model C, is a page-sequence numbering device that under program control numbers pages as they are read.

The throughput characteristics of Models A and B are identical, but Model C performs somewhat slower. Models A and B process from 37 to 300 documents/minute, whereas Model C processes from 18 to 240 documents/minute. The throughput rate for 8-1/2 by 11-inch pages containing fifteen 8-inch lines is 64 pages/minute for Models A and B and 32 pages/minute for Model C. For pages that measure 5-3/4 by 4 inches, the throughput is 300 pages/minute for Models A and B and 200 pages/minute for Model C.

Each Input 80 model has a self-contained processor with a 24-bit word structure plus memory parity and a cycle time of 1 microsecond. Each processor has a minimum capacity of 16,384 words, which is expandable to 32,768 words in 8K-word increments in Models A and B, but only to 20,480 words in one 4K-word increment in Model C.

Models B and C include a magnetic tape drive that records either at 800 bits/inch NRZI or at 1600 bits/inch phase-encoded on 9-track tape. The tape speed of these drives is 12.5 inches/second. An optional drive with a tape speed of 25 inches/second is also available. Model A is normally equipped with a unit that records at 800 bits/inch NRZI on 9-track tape. In addition, options permit the use of 7-track drives that record at 200, 556, or 800 bits/inch or a dual-density 9-track drive that records at 800 or 1600 bits/inch; the tape speed of these drives is 75 inches/second. The standard coding is EBCDIC for 9-track tape snd BCD for 7-track tape; ASCII is optionally available for 9-track tape.

The standard line printer for Models B and C operates at 300 lines/minute, but optional printers that operate at 490 and 900 lines/minute are also available. The line printer of Model A can print at 1000 lines/minute, or at 600 lines/minute if the user prefers. All are 132-column printers with a vertical spacing of 6 lines/inch or optionally of 8 lines/inch. They utilize fanfold continuous forms in widths from 3-1/2 to 19 inches.

All models include an I/O typewriter that operates at 10 characters/second in Models B and C and at 14 characters/second in Model A.

Recognition Equipment
Total Data Entry System

user wants to operate the two sections in tandem, letting each perform the kind of work for which it is best suited, then the installation can process the full gamut of forms it needs to handle far sooner than it could otherwise. Having their own software routines for editing, balancing, and verification, the Input 80 scanners are designed to stand alone. Natually, more elaborate routines then those offered by the Input 80 are available in the key-to-disk section, but the Input 80 will generally meet all basic requirements.

The first Total Data Entry installation was made in Germany in the summer of 1973, and the first system in the United States was installed in August 1973. There are two other installations in Europe at this writing.

Recognition Equipment, a long-time leader in OCR techniques, claims that the recognition technology of Input 80 enables it to ignore smudges and gray and dirty backgrounds, and that it fills in gaps of weak strokes and handles pages with carbon backing, staples, paper clips, tears, folds, pasted labels, dog-ears, etc.

Recognition Equipment field engineers are on call from various service centers and from company headquarters.

USER REACTION

Although it is still too early to elicit substantial user experience and reaction, Datapro interviewed the single U.S. user at this time. He is presently employing 12 keystations, with one in the scanning room at the disposal of the programmers working on the system. As this disclosure implies, the keying and scanning sectors of the system are currently operating independently, and a staff of programmers is working to unify the two parts.

Therefore, it is quite significant that the system is entering data and justifying itself while such work proceeds. The manager, in fact, was enthusiastic and praised the system strongly, calling it a tremendous advance over the key-tape stations that were replaced. This experience shows that a facility that employs both a key-to-disk data entry system and an optical scanner can be extremely powerful, even when the scanner is not exploiting the features of the key-disk system. □

CONTROL PROCESSOR: Has a capacity of 65,536 bytes, a 16-bit word length, and a 1.2-microsecond memory cycle time. Safety features include power failure detection and automatic restart. The processor has two index registers and multiple interrupt levels.

DISK DRIVE: A Diablo Systems Model 31, this unit has a capacity of 2.5 million bytes, a transfer rate of 184,000 bits/second, an average positioning time of 67 milliseconds and an average rotational delay of 20 milliseconds. The drive has six read/write heads that retract automatically upon power failure. Up to four units can be operated in the system with an appropriate controller.

MAGNETIC TAPE DRIVES: These units write formatted data on 1/2-inch IBM-compatible 9-track magnetic tape. The maximum allowable reel size is 7 inches. Forward operating speed is 12.5 inches/second. Recording can take place on 9-track tape at 800 bits/inch NRZI or on 9-track tapes at 1600 bits/inch in phase-encoded format. Up to 4 drives of the same type can be operated from the control processor. Intermixing of drives necessitates separate controllers.

PRINTER: This is a 132-column serial printer that prints from 60 to 200 lines/minute. Vertical spacing is 6 lines/inch.

COMMUNICATIONS: A controller capable of Binary Synchronous transmissions, compatible with an RS-232C modem, is available. It operates in half-duplex mode at rates of up to 9600 bits/second.

REMOTE TERMINALS: Keystations located more than 1000 feet from the control processor can be linked to the processor by a C1-conditioned 2-wire line and operated in full-duplex mode at a rate of 1200 bits/second. One line must be provided for each keystation.

INPUT 80 FONTS

The standard fonts available to a user are the following: IBM 1403, X03 (1403 Modified), ANSI (OCR-A, Size A), ISO (OCR-B, Size 1), 1428 OCR, Anelex, 1403 Standard Numeric, ANSI Numeric, ISO Numeric, 3/16 Gothic, E-13B, 407E-1, 1428E, and 7B. Other fonts are obtainable upon request.

If a single-font capability is specified, the system has a basic 40-character vocabulary, expandable in increments of 1 character (minimum order of 10 characters).

If the system has a multiple-font capability, a maximum of 9 fonts can be selected from the preceding list. Each font has a basic 40-character vocabulary, expandable in increments of 1 character (minimum order of 10 characters) to a maximum vocabulary of 360 characters. The particular font to be recognized will be selected by the control processor under program control.

To read different fonts on an intermixed basis, a multifont system must be installed. The basic multifont system is equipped with 120 recognition patterns, and up to 240 other patterns can be added. In the multifont mode, each character pattern can be used to recognize more than one unique font.

When capable of reading handprinting, the system recognizes the digits 0 through 9, the letters c, s, t, x, and z, and plus and minus signs. This option is available with the preceding machine-print options.

DOCUMENT SPECIFICATIONS

All three Input 80 models handle pages and documents of the same specifications, as presented below:

- Height–4 to 14 inches.
- Width–5-3/4 to 9 inches.
- Weight–20-lb to 45-lb paper (card stock).
- Margins–Machine-printed characters: 1/4 inch from all edges; handprinted characters: 1/2 inch from all edges.

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- Minimum line spacing–6 lines/inch (single space); 3 lines/inch (double space).

OPERATING MODES

- Data entry (consists of record format selection, batch or job assignement, keying of data, and error correction).
- Video Re-entry or Find (enables operator to access a designated batch stored on the disk and, beginning at any designated record, to scan either forward or backward on the screen; batch can be re-entered for updating or error correction; these functions are often called Search and Re-entry in other systems).
- Verify (character-by-character rekeying of data previously recorded by the same or a different operator for the purpose of direct comparison; in typical operation verification is performed only on fields that contain previously overriden errors or are out of balance; scan verification from the CRT screen without rekeying is often used).
- Record format entry (following completion of layout form by supervisor, an operator or the supervisor calls for record format field definition program while in Entry mode; the system then successively displays questions on the screen; answers from the form are keyed into the format library; this mode, therefore, is a special case of Entry).

SYSTEM OUTPUT

- Industry-compatible magnetic tape (see Magnetic Tape Drives)

SYSTEM PROFILE

The system characteristics below, especially the disk storage distribution, are intended to indicate the general capabilities of the keyed data section and should not be considered rigid. For example, data record storage can be expanded at the expense of record format storage at the user's discretion. All disk specifications can be increased by simply expanding the disk capacity, which has been assumed to be 2.4 million bytes.

- Record length–can be up to 1,000 characters (or optionally up to 4,096 characters) on the output tape; there is no system limitation on the input side, but 280 characters might be considered a practical working limit.
- Record formats–200 is representative of what would be stored in most application environments.
- Data record storage–about 30,000 80-character records or about 20,000 120-character records.

Exact figures for the number of edit routines and the number of system management programs that can be stored will not be stated since additional storage capacity can be added if needed to accommodate new routines.

SOFTWARE

Data derived from the scanning operations can be transferred to the keyed-entry sector for manipulation by the software residing there. This system cohesion is brought about by an interface channel that links the scanner to the control processor of the key-to-disk section.

Optical recognition of characters is carried out by the Input 80 unit under special recognition programs in the processor supplied with the scanner and housed within the Input 80 cabinet.

KEY-TO-DISK SECTION: Each keystation has access to 10 input formats at any time, and any number of stations can use the same formats at any time. The possible record length is unlimited, and it can be structured into 999-character fields. When writing to tape, the records can be blocked up to a limit of 4096 characters.

On the keying side of system operations, the system performs the editing and validation operations previously mentioned. Check digits can be generated for modulo 7, 10, or 11. Batch balance verification is achieved with five conditional accumulators. A significant capability is that of record-end and batch-end editing, which are carried out independently of the keying operations. The accumulators can be used to crossfoot within record limits, and the resulting subtotals can be accumulated throughout a batch and then compared with a previously entered final batch total. All four basic arithmetic operations can be performed. Another capability is data sorting and batch collating for tab-shop-style processing and creation of output files.

Numerous output reformatting features are available. Records within the block that is written to tape can vary in length. Constants and constant fields can be emitted into appropriate field locations at this time. (Many duplication operations normally performed during keying are thereby changed into output operations.) Fields can be rearranged within a record. Headers and trailers for the output blocks are generated. If new data is derived from processing keyed data through arithmetic operations or accumulations, entirely new record formats can be created by output (reformatting) programs.

Up to four tape drives of the same type can be operated from the minicomputer processor. Different tape drives can be employed if appropriate controllers are introduced. As a particular batch is written to tape, keying other batches can proceed without interference.

INPUT 80 SECTION: The Input 80 scanner identifies the characters on a source document, converts this information into the assigned code, formats and edits it, and then writes the form on magnetic tape or causes it to be printed by the line printer.

GENERAL DATA CAPTURE PROGRAM: This program allows the user to insert parameters that specify field location and length, the field category, the fonts to be read in the respective fields, and the character sizes. The program then causes the optical system to capture the characters on the source document and to rescan error lines automatically, reformat output records, zero-fill or zero-suppress, left or right justify, calculate check digits, accumulate totals by page and batch, verify field length and content, select the proper output stacker, assign a document sequence number, and write each line or page on magnetic tape or effect a printout. A user exit is provided so that particular editing routines can be incorporated. A noteworthy capability is that of intermixing fonts.

SYSTEM OPERATION

Source material is divided into two classes: the kind that is suitable for optical scanning and that which is better handled by human operators. Aside from its interaction

Recognition Equipment
Total Data Entry System

with the scanner section, the keystation facility operates in a conventional manner, as if the scanner were not present.

ERROR CONTROL: Parity generation and checking is performed on data transferred between the computer and disk and between disk and tape or to other output devices. Odd parity is written on 7-track tape and either odd or even parity on 9-track tape. Longitudinal and cyclic redundancy characters are created and written on disk and tape. A read-after-write check is performed on both tape and disk. Data written on a disk is read during the next revolution and compared with the original data in core; erroneous data is immediately rewritten. Validation and other errors lock the keyboard and cause a tone to sound.

COMMUNICATIONS: The keystation section can incorporate one or more remotely located keystations connected to the control processor over a leased telephone line or the switched telephone network. A leased line must allow full duplex operation and be C1 conditioned. A separate line is required for each keystation and must be dedicated during station operation. Recognition Equipment supplies the modem through Entrex. The transmission rate is 1200 bits/second.

PRICING

The Total Data Entry System can either be purchased or leased under a two-year or five-year lease. Maintenance charges are included in the lease costs that follow, but a separate maintenance contract is offered for purchased items. Service is provided at normal rates during the user's prime shift; emergency service, however, incurs a surcharge.

The table below lists charges for basic installations in terms of the number of CRT keystations only, and purposely excludes scanner costs from consideration. It also assumes that only one tape drive is operative and no other peripheral devices are installed. The objective of the table is to provide a basis for comparing costs of the Total Data Entry System as a key-to-disk facility only with prices of other key-to-disk systems. The table is also intended to help the user determine the increment of cost represented by the scanner model that he incorporates. Other assumptions are 64K bytes of processor storage for all cases and 2.5 million bytes of disk storage for an installation with fewer than 20 keystations and 5.0 million bytes for a 22-station installation. A serial printer is not included. On the other hand, the cost of the interface channel between the two sections is included and thereby raises the figures below accordingly.

Data Stations	Cost per Data Station	System Rental	Purchase	Maint.
12	$220/mo.	$2,557/mo.	$ 74,680	$517/mo.
15	192/mo.	2,803/mo.	105,570	568/mo.
22	170/mo.	3,662/mo.	140,480	742/mo.

A basic configuration, which includes one keystation, a control processor with 64K bytes of storage, one tape drive (9-tracks at 800 bits/inch), a 2.5-million-byte disk drive, and an interface channel between the scanner and keystation sections, rents for $1,655/month (2-year lease), and can be purchased for $54,750. A separate maintenance contract costs $330/month.

Prices for other individual components are listed below. A 2-year lease is assumed.

Device	Monthly Rental	Purchase	Monthly Maint.
Keystation	82	3,630	17
Magnetic Tape Drive (9-track, 800 bpi)	270	7,500	85
Magnetic Tape Drive (9-track, 1600 bpi)	295	8,100	95
Exchange price (1600 bpi unit for 800 bpi)	150	5,665	10
Disk Drive (2.5 million bytes)	285	9,500	55
Communicator and BSC Controller	210	6,945	40
Remote Terminal (modems included)	100	3,680	10
Serial Printer	215	7,860	25
Input 80 Model A Scanner	12,990	446,000	2,195
Input 80 Model B Scanner	10,775	358,000	2,110
Input 80 Model C Scanner	7,975	259,250	1,700

Remcom 2775 and 2780 Data Communications Terminals

MANAGEMENT SUMMARY

The Remcom 2775 and 2780 Data Communications terminals are designed as low- and medium-speed terminals, respectively, for use in a remote batch processing environment. Both terminals are directly compatible with the IBM 2780 Data Transmission Terminal for communication with an IBM System/360 or System/370 computer. A hard-wired controller, common to both the Remcom 2775 and 2780, emulates all basic functions of the IBM 2780 and provides compatibility with the IBM Binary Synchronous Communications technique. Remcom terminals are software-compatible with OS/360 via Type I, ASP, and HASP remote job entry control programs and with DOS/360 via POWER and GRASP. In addition, the Remcom terminals are compatible with IBM's telecommunications software, BTAM and RTAM.

The assets of Remcom Manufacturing Company were acquired from Tracor, Inc. in May 1972 by Semiconductor Component Substrates (SCS) Corporation, a manufacturer of metallized ceramic and plastic packages (substrates) for the semiconductor industry. Remcom is now operated as the Systems Group of SCS, and its corporate name has been changed to SCS-Remcom Corporation.

Remcom currently offers its 2775 and 2780 terminals in one basic configuration that corresponds to IBM's 2780 Model 1—printer and reader. This configuration is available in two different models of the 2775 and four different models of the 2780, all reflecting variations in the printer and reader speeds. Punched card output has ▷

Remcom's 2775 and 2780, designed as low-to-medium-speed replacements for the IBM 2780, are available in several different models that reflect a wide range of peripheral speeds. The hard-wired controller, common to both terminals, can be replaced with a minicomputer to form the "intelligent" Remcom 4775 and 4780 Terminals.

CHARACTERISTICS

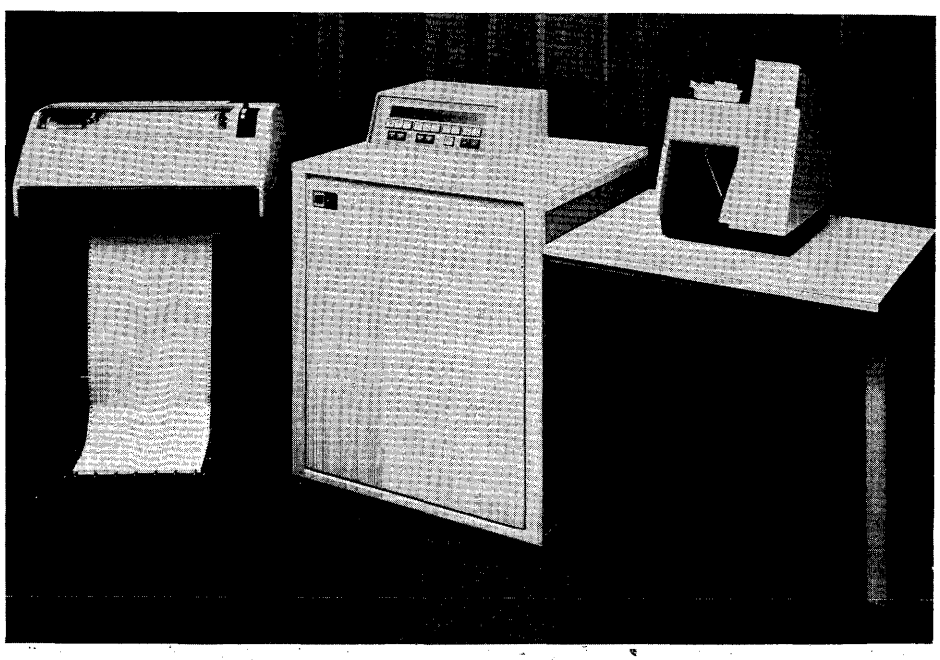
MANUFACTURER: SCS-Remcom Corporation, 2705 National Drive, Garland, Texas 75041. Telephone (214) 328-9991.

MODELS: Remcom Models 2775, a low-speed batch terminal, and 2780, a medium-speed batch terminal.

CONFIGURATION: The Remcom 2775 includes a controller, communications interface, table-top card reader, and free-standing line printer. Two models are available, as characterized in the table.

The Remcom 2780 includes a controller, line printer, card reader, and communications interface, all combined as a single free-standing unit. A card punch is optional. Four models are available, as characterized in the table.

COMMUNICATIONS: Transmission is synchronous in the half-duplex mode at speeds up to 30,000 bits/second for the Remcom 2775 and up to 50,000 bits/second for the Remcom 2780. The terminals are compatible with the IBM Binary Synchronous Communications (BSC) technique and employ the 8-level EBCDIC or 8-level (including parity) ▶



The Remcom 2775, a "hard-wired" batch terminal for low-speed applications, includes printer, controller with operator panel, and table-top card reader The faster Remcom 2780 is identical in appearance with the "intelligent" Remcom 4780 shown in Report 70D-722-02.

Remcom 2775 and 2780
Data Communications Terminals

recently been offered as an option for the Remcom 2780, and printer-only configurations are also available.

The peripheral speeds of the Remcom 2775 range from about the same to below those of the IBM 2780; however, for low- to medium-volume applications the peripheral speeds of the 2775 are commensurate with its price, which is below that of the counterpart IBM terminal. On the other hand, the peripheral speeds available with Remcom's 2780 are substantially faster than those of IBM's 2780. To take full advantage of the higher performance, the terminal's data transmission rate must be matched with the operating speed of the peripherals; e.g., a 300-cpm reader should be matched with a 4800-bps communications facility, while a 600-cpm reader needs a transmission rate about twice that of the 300-cpm reader. The current practical operating limit on a leased voice-grade facility is 9600 bps. Therefore, it would be pointless to consider faster peripherals than the ones Remcom offers—unless the higher speed is necessary to speed up an off-line operation or the user is going broad-band. On the other hand, print operations that include a considerable amount of paper spacing lead to a drop-off in communications efficiency.

Standard among Remcom's repertoire of features are EBCDIC Transparency, Multiple Record Transmission, and Automatic Turnaround. These features are optional with the IBM 2780. The Multiple Record Transmission feature permits a transmission block to contain up to seven records. Horizontal tabulation and automatic answering are Remcom optional features that are also offered as options with the IBM unit.

Other salient features include a data compression/decompression feature that can compress up to 16 spaces into a single character, a 132-character print line, and a 12-channel vertical format loop (optional for the Remcom 2775). These enhancements over the IBM 2780 extend operating flexibility, but require changes to existing control programs or applications programs. The use of a time-sharing service may well preclude using enhancements if the service refuses to provide a control program that exactly meets your terminal's characteristics.

Remcom began deliveries of its 2780 Terminal in March 1970. To date, over 250 units have been delivered.

Deliveries of the 2775-01 began in April 1972. To date, over 40 units have been installed. The 2775-02 is scheduled for initial customer deliveries in February 1973.

A Datapro survey of installations using the Remcom 2780 and 2775 terminals found users to be more than satisfied with the performance and reliability of both products. Users' comments bear greater significance for the 2780, which in many cases has been in operation for over two years. In several cases, the Remcom 2780 had replaced its

REMCOM TERMINAL CHARACTERISTICS

Terminal Model	Buffer	Printer, lines/min.	Card Reader, cards/min.
2775-01	Single	135	400
2775-02	Dual	300	400
2780-01	Dual	480	300
2780-03	Dual	480	600
2780-07	Dual	600	600
2780-08	Dual	800	600

ASCII transmission code. An EIA Standard RS-232C interface provides for connection to a communications facility via a modem, which must provide clocking at a specific transmission rate. A full-duplex communications facility is used to eliminate turnaround delays.

Transmission characteristics are compatible with various IBM controllers and communications adapters equipped for binary synchronous transmission. The terminals are designed for communicating with a System/360 Model 25 via the ICA, with System/360 Models 25 through 195 and System/370 Models 135 through 195 via a 2701/2703 line controller or 3705 programmable controller, with a System/370 Model 135 via its Integrated Communications Adapter, with a System/3 equipped with a Binary Synchronous Adapter, or with an IBM 1800 computer via a communications adapter. The Remcom 2775 and 2780 operate in a point-to-point communications arrangement only; multipoint operation is not available. Automatic answering is optional for operation over the public telephone network.

DEVICE CONTROL: The Remcom 2775 and 2780 are hard-wired terminals that operate in one of four modes: transmit, receive, transmit-transparent, and off-line list. The transmit and receive modes transmit data read from punched cards and print received data, respectively. These two operating modes provide device selection via program control. The transmit-transparent mode (EBCDIC code only) performs the same operation as the transmit mode, except that control-character recognition is disabled to permit the transmission of all 256 EBCDIC code combinations. Listing (printing data read from punched cards) can be performed while off-line, with editing capabilities including print-line suppression, horizontal and vertical tabulation, and data truncation.

Message blocking and deblocking is performed via buffering. The 2780 is equipped with dual 400-character buffers, and the 2775 is available with either single (2775-01) or dual (2775-02) 400-character buffers. A buffer capacity of 600 bytes is optional for all models of the 2775 and 2780. Dual buffering permits overlapped operation of I/O and communications by alternating the two buffers between the communications line and a selected I/O device for sequential transmission blocks. Block length is determined by buffer capacity. Received messages can contain any number of records per block, limited only by block length. However, transmitted message blocks cannot exceed two or seven records per block to provide compatibility with the IBM 2780. Record length is variable up to 80 text characters for transmitted records and up to 132 text characters for receiving printer messages. When operating in the transmit-transparent mode, only fixed-length 80-character records are transmitted.

The Data Compression/Decompression feature uses a special control character to define up to 16 consecutive

Remcom 2775 and 2780
Data Communications Terminals

IBM counterpart. Little or no downtime was reported. When service was required, users reported excellent reponse and competent service.

Service is provided by Remcom and by Sorbus, a nationwide service organization headquartered in King of Prussia, Pa. Canadian installations are serviced by Remcom and Control Data Corporation. □

spaces. Card data is compressed, and printer data is decompressed. This feature is not affected when operating in the transparent mode, but can be disabled on a card-by-card basis when a card is sensed with a 12-2-9 punch combination in column 1.

All received message blocks are acknowledged, and an acknowledgement is anticipated in response to all transmitted message blocks.

Horizontal Tabulation is optional and is implemented via a stored horizontal-format record composed of space characters interspersed with horizontal tab characters. The Horizontal Tab feature can also be used in the transparent mode.

Vertical formatting is implemented via a 12-channel punched tape loop. A vertical formatting command within the received print record can specify a skip of 1 to 3 vertical spaces or to 12 tape channels. Vertical formatting is performed after a line is printed. Vertical formatting is not affected by operation in the transparent mode.

ERROR CONTROL: Cyclic Redundancy Checking (CRC) is employed for EBCDIC-coded transmissions; Vertical Redundancy Checking (VRC) and Longitudinal Redundancy Checking (LRC) are employed for ASCII-coded transmissions. Two CRC characters are generated and appended to the end of each transmitted record. CRC checking is performed on received records. VRC (odd parity) accompanies each transmitted ASCII character; an LRC character (even parity) is appended to the end of each transmitted record. VRC and LRC are performed on each received ASCII-coded message. A negative acknowledgement (NAK) is transmitted in response to errors detected within the received message block. A message block is automatically retransmitted in response to a received NAK. An odd/even block check is performed on all message blocks received, and the corresponding odd/even block count is generated for all transmitted blocks. This technique is employed to ensure that message blocks are not lost or duplicated.

CARD READER:

Remcom 2775: Reads 80-column Hollerith-coded cards at a rated speed of 400 cards/minute and is equipped with a single 600-card input hopper and a 1000-card output stacker. The card reader is a product of True Data Corporation.

Remcom 2780: Reads 80-column Hollerith-coded cards at a rated speed of 300 or 600 cards/minute. Single input hopper and output stacker capacities are rated at 450 cards each in the 300-cpm reader and 1000 cards each in the 600-CPM reader. Both readers are produced by GDI.

CARD PUNCH: The Remcom 6620 Card Punch (produced by Honeywell Bull) is available as an option only with the Remcom 2780. The punch is rated at 60 (80 columns) to 200 (10 columns) cards/minute and punches in standard Hollerith code. Hopper and stacker capacities are 1500 cards each.

PRINTER:

Remcom 2775: Printing is performed by a 132-positon dot matrix printer at a rated speed of 135 (2775-01) or 300 (2775-02) lines/minute using the full character set of 64 ASCII symbols. Horizontal spacing is 10 char/inch; vertical spacing is 6 or 8 lines/inch. The printer accommodates pin-fed continuous three-part forms from 4 to 14-7/8 inches wide. Six-part forms can be accommodated when using a special carbon-backed paper supplied by Remcom. Vertical format control, an option, is implemented via an industry-standard 12-channel tape loop. Horizontal tabulation is optional. The Remcom 2775-01 uses the Potter LP 3000 matrix printer, and the 2775-02 employs the Potter LP 3300, an upgraded version of the LP 3000.

Remcom 2780: Printing is performed by a 132-position drum printer (produced by Control Data) at a rated speed of 480, 600, or 800 lines/minute using a limited character set. The printer employs the full character set of 64 ASCII symbols. Horizontal spacing is 10 chars/inch; vertical spacing is 6 or 8 lines/inch. The printer accommodates pin-fed continuous six-part forms from 3-1/2 to 20-5/8 inches wide and up to 17 inches long. Vertical tabulation is standard; horizontal tabulation is optional.

PRICING: The Remcom 2775 and 2780 are available for purchase or on a one-, two-, three-, or five-year lease which includes maintenance. A separate maintenance contract is available for purchased units.

Terminal Model	Monthly Rental* 1-Year Lease	5-Year Lease	Purchase	Monthly Maint.
2775-01	$ 595	$ 524	$19,950	$120
2775-02	717	631	24,634	140
2780-01	859	756	30,365	165
2780-03	912	803	31,750	180
2780-07	1,045	920	33,425	195
2780-08	1,167	1,027	36,925	220
2775-01**	500	440	17,100	100
2780-03**	775	682	27,630	125
2780-07**	906	797	29,150	185
2780-08**	1,013	891	32,300	185
Options				
Auto Answer	13	13	260	10
Horizontal Tab	17	17	400	10
Line Feed Suppress	10	10	230	8
Data Compression/ Decompression	40	40	970	15
Overprint	40	40	980	15
Data Check	3	3	125	0
Dual 400-Byte Buffers	45	45	1,140	15
Vertical Tab	40	40	1,250	10
6620 Punch	315	315	13,700	50

* Lease prices include prime-shift maintenance.

** RO version; includes printer only. ■

Remcom 4780 Stored Program Terminal

MANAGEMENT SUMMARY

The recently announced 4780 Stored Program Terminal marks Remcom's entry into the programmable remote batch terminal market. Designed around a minicomputer, the 4780 uses the same peripherals employed by Remcom's 2780 (Report 70D-722-01). The 4780 is available in three models, which differ only in printer speed. Drum printers, manufactured by Control Data Corporation, are offered with print speeds ranging from 480 to 800 lines per minute.

The assets of Remcom Manufacturing Company were acquired from Tracor, Inc. in May 1972 by Semiconductor Component Substrates (SCS) Corporation, a manufacturer of metallized ceramic and plastic packages (substrates) for the semiconductor industry. Remcom now operates as the Systems Group of SCS, and its corporate name has been changed to SCS-Remcom Corporation.

Remcom is marketing the 4780 as a replacement for any of three prominent batch terminals supplied by leading mainframe manufacturers. These include the IBM System/360 Model 20 under OS/HASP, the Control Data 200 User Terminal under SCOPE or MACE, and the ▷

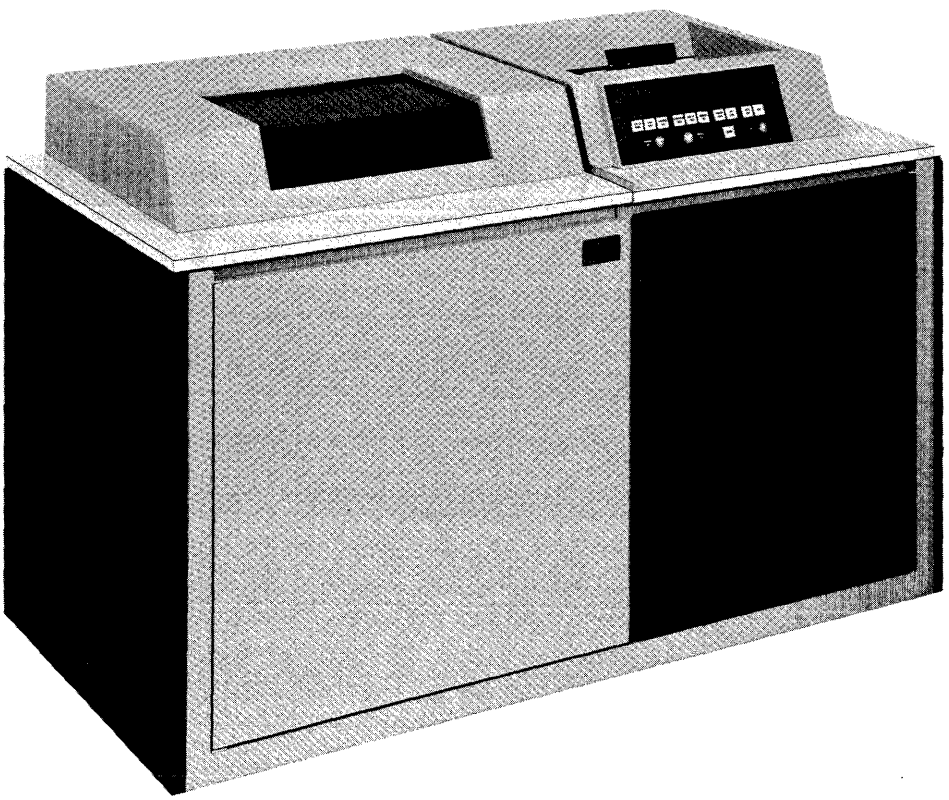
The Remcom 4780, an "intelligent" remote batch terminal that employs Remcom 2780 peripherals, serves primarily as an IBM-compatible HASP multi-leaving terminal at transmission rates up to 19,200 bits/second. Remcom also supports the terminal as a replacement for the CDC 200 User Terminal and the UNIVAC 1004.

CHARACTERISTICS

MANUFACTURER: SCS-Remcom Corporation, 2705 National Drive, Garland, Texas 75041. Telephone (214) 328-9991.

CONFIGURATION: The basic Remcom 4780 Stored Program Terminal is constructed around a general-purpose minicomputer with a 4096-word (8192-byte) core memory and includes a communications interface, line printer, and card reader, all contained within a single cabinet. The basic memory can be expanded to 24,576 words in 4096-word increments. Options include a free-standing card punch, an operator's console including either a Teletype Model 33 KSR or a CRT display unit, and a local interface for direct connection to an IBM 2700 Series or 3705 communications controller.

The Remcom 4780 Terminal is available in three models: ➤



The "intelligent" Remcom 4780 is identical in appearance with the older Remcom 2780, a hard-wired terminal that employs the same peripheral devices. A single cabinet houses the line printer, card reader, and control unit.

Remcom 4780 Stored Program Terminal

UNIVAC 1004 under EXEC II or EXEC 8. Support for these applications is available from Remcom in the form of communications software designed to emulate the terminal which the 4780 is to replace.

As a HASP multileaving terminal, the 4780 is capable of operation over a broad-band communications facility at transmission speeds up to 19,200 bits per second. Actually, transmission speed is a software limitation, since the hardware interface can handle rates up to 50,000 bits per second.

Remcom does not provide an assembler to support user-generated application programs, nor does it currently encourage or promote off-line data-processing activities. Off-line activities are limited to listing or duplicating (with the optional card punch) functions, but can be performed concurrently with on-line activities.

Remcom is planning a magnetic tape capability for the 4780 that will be available by mid-1973. Other plans include an RPG compiler and an operator's console, which would include a Teletype Model 33 KSR or a keyboard/display unit. First customer deliveries of the 4780 are scheduled for November 1972.

Just recently, Remcom introduced the 4775 as the second member of its 4000 Series family of intelligent batch terminals. Like the 4780, the 4775 was developed from an existing product, the 2775 (Report 70D-722-01). The 4775 combines the 2775 peripherals with the minicomputer used in the 4780 Terminal. To date, Remcom has not defined the software support or pricing for the 4775, but judging on the basis of the differences between the 2775 and the 2780, the 4775 will probably perform as a low-performance 4780 at a reduced price.

Service is provided by Remcom and by Sorbus, a nationwide service organization headquartered in King of Prussia, Pennsylvania. Canadian installations are serviced by Remcom and Control Data Corporation. □

Model	Printer, lines/min	Card Reader, cards/min
4780-03	480	600
4780-07	600	600
4780-08	800	600

COMMUNICATIONS: Transmission is synchronous in the half-duplex or full-duplex mode at speeds up to 50,000 bits/second. The communications interface is designed to EIA Standard RS-232C. Transmission parameters such as speed, code, control signals, line discipline, blocking/deblocking, etc., are a function of the communications software. Hardware capability is provided for 6- through 8-level transmission codes.

LOCAL INTERFACE: For terminal operation up to 2000 cable-feet from an IBM System/360 or System/370 computer. Operates at switch-selectable data rates of 2400, 4800, or 9600 bits/second.

DEVICE CONTROL: The SUE 1110 general-purpose minicomputer, produced by Lockheed Electronics, forms the nucleus of the Remcom 4780 terminal. In combination with the Remcom-produced I/O multiplexer and interface, the minicomputer executes all terminal operations under the direction of the operating software.

Operating software includes programs that emulate the following remote batch terminals for use with the corresponding computers:

- IBM System/360 Model 20–for communication with IBM System/360 or System/370 computers as a HASP multileaving terminal.
- Control Data 200 User Terminal–for communication with CDC 6000 or Cyber 70 Series computers.
- UNIVAC 1004–for communication with UNIVAC 1106 or 1108 computers.

Operating software is loaded from punched cards via a basic loader program.

The SUE 1110 minicomputer has a memory cycle time of 900 nanoseconds and a word length of 16 bits. Its minimum and maximum core storage capacities are 4,096 and 24,576 words, respectively. (See DATAPRO 70 Report 70F-400-01 for further information on the SUE 1110.)

CARD INPUT/OUTPUT: Reads and (optionally) punches standard 80-column cards in Hollerith or binary mode under program control. Reader and punch speeds are 600 and 60 cards/minute, respectively. Reader hopper and stacker capacities are 1000 cards each. Punch hopper and stacker capacities are 1500 cards each.

PRINTER: Line printers are available for operation at 480 (standard), 600, or 800 lines/minute. All print up to 132 columns and provide a 64-character set of ASCII symbols. Horizontal and vertical spacing are 10 char/inch and 6 or 8 lines/inch, respectively. The printers accommodate pin-fed, continuous forms from 3-1/2 to 20-5/8 inches wide, up to 17 inches long, and with up to 6 parts. Vertical formatting is controlled by a 12-channel tape loop.

PRICING: The Remcom 4780 is available for purchase or on a one-, two-, three-, or five-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental*			
Terminal Model	1-Year Lease	5-Year Lease	Purchase	Monthly Maint.
4780-03**	$1,062	$ 935	$36,950	$200
4780-07**	1,200	1,056	38,650	200
4780-08**	1,350	1,188	45,525	220
Options				
6620 Card Punch	315	315	13,700	50
Data Check	3	3	125	0
Memory module (4K words)	150	150	5,200	50
Local Interface	80	80	3,200	15

* Lease prices include prime-shift maintenance.

** Terminal prices do not include operating software, which is priced at a one-time charge of $100 per communications program package. ■

Sanders System 6000

The System 6000 Operator Station. A maximum or 12 stations can be used in a system.

The System 6000 is a multi-station key-to-tape data entry system. Each of a maximum of 12 stations consists of a CRT display for visual verification of keyed data and a typewriter-style keyboard. Keyed data is recorded on any of up to four computer-compatible tape drives selected from the individual keyboard/display stations.

MANAGEMENT SUMMARY

The System 6000, another entry in the multiple-input-station category and a descendent of the Sanders 720 product line, features a CRT display and typewriter-style keyboard for each operator terminal. As many as 12 operator terminals, including one supervisory terminal, can be incorporated into a System 6000.

The technique of pooling all records corresponding to a specific file onto one tape is an inherent characteristic of the multiple-station configuration.

The System 6000 user can elect to incorporate up to four computer-compatible tape drives to accommodate random generation of multiple data files from various combinations of operator terminals. Tape drives can be manually selected at each operator terminal.

The System 6000 operator can elect to duplicate fixed information within an 83-character field into subsequent records of the same file.

A typist, not a keypunch operator, is required for operating the System 6000 input units. The combination of typewriter-style keyboard and CRT display can be

CHARACTERISTICS

MANUFACTURER: Sanders Data Systems, Inc., Daniel Webster Highway South, Nashua, New Hampshire 03060.

CONFIGURATION: Includes a controller, up to 11 operator stations, and one supervisor station. The basic controller includes one or two computer tape drives; an additional two computer tape drives can be accommodated with an added expansion module.

Each station incorporates a typewriter-style keyboard and CRT display, with provision for an optional tape-cassette transport, and can be located up to 200 feet from the controller.

Eight controller models provide a wide range of System 6000 configurations. A controller model is selected according to the number of stations in the configuration and the display-memory capacity per station.

TAPE OUTPUT: 7- or 9-track tape drives produce IBM 729 compatible or IBM 2400 Series compatible tape.

Character and longitudinal parity are written on the 7-track tape, character parity and cyclic redundancy character on the 9-track tape.

Tape movement is reel-to-reel; a full 8.5-inch (1200 feet) reel can be recorded.

Recording density for the 7-track tape is 556 or 800 bits/inch; density for the 9-track tape is 800 bits/inch.

Record length is variable from one to 1015 characters. Tape speed is 12.5 inches per second.

CRT DISPLAY: An integral function of each Operator and Supervisor Station. A horizontally oriented CRT provides a viewing area 7.5 inches high by 9.5 inches wide. Stroke-generated characters are displayed in green against a black background.

The display is arranged in 32 lines of 84 character positions per line to total 2688 character positions per display.

A set of 64 USASCII characters can be displayed, including upper-case alphabetics, numerics, and specials.

Sanders System 6000

thought of as an ordinary typewriter with the resultant page displayed instead of printed.

Formatting is of special interest here since many office operations involve printed forms where the typist fills in designated fields.

System 6000 provides format control; the operator can key the format into memory, or with options, enter it automatically from a recorded tape cassette. The stored format is retained and displayed from record to record until it is replaced.

Data entered under format control can be entered into variable data fields only. As one field is completed, the operator simply tabs to the next field as if she were typing a printed form.

Having completed the record, the operator can perform any necessary editing through the combined use of cursor and edit keys. The record, stripped from its format, is then written onto magnetic tape. If desired, the complete display (format and variable data) can be entered on tape.

Record lengths of 256, 512, and 1024 characters are available, but are dependent upon the number of terminals in the configuration and/or the choice of controller. Although entered formats reduce the available memory space, thus reducing the allowable record size, this is not usually a serious drawback.

A big plus is the display capacity of the CRT screen—2688 character locations. This is not to be confused with the display memory capacity, which runs from 9.5 percent to 38 percent of display-screen capacity.

In addition to the operations that can be performed on an operator terminal, the supervisor terminal is used to record tape header and trailer information (file labels) and file gaps on the tape selected at the supervisor terminal, and to record format tapes when the Format Loader option is employed.

Aside from application differences stemming from use of the CRT display in the Sanders 6000, direct price comparisons between multi-station key-to-tape units and single-station units such as those produced by Mohawk and Honeywell can be somewhat difficult. To illustrate this point, consider a high-volume installation that can effectively use a pooling arrangement with single-station key-to-tape devices. Assume that, taking all facets of the job into account (such as record length, amount of skipping and duplication, and operator effi-

DEVICE CONTROL: Provided by format control characters (formaters) entered into the display memory via keyboard or the Format Loader option and by keyboard-initiated edit functions.

The display memory, a 1024-character delay line, is logically segmented in some system configurations to provide four 256-character or two 512-character segments for accommodation of up to four or two display stations, respectively.

The maximum System 6000 configuration contains three delay-line memory modules.

The display memory is non-spatial; i.e., with formaters, stored data can be displayed in any of the 2688 CRT display positions.

System 6000 operates in the Entry mode only. The Entry mode is divided into two categories: Data Entry and Format Entry. Both modes permit extensive editing to be performed.

When in the Data Entry mode, data can be entered in a "free-form" style or under control of a fixed format stored in the display memory and displayed on the CRT screen.

The fixed format or overlay is composed of alphanumeric and format-control characters; only the alphanumeric characters are displayed.

The six format-control characters include Home, Carriage Return, Start Blink, Horizontal Tab, Vertical Tab, and Clear Blink. These formaters are used to delimit, blink, and position data fields in any of the 2688 locations on the CRT screen.

Each of the format control characters uses a single character position in display memory; however, both horizontal and vertical tab characters cause four display positions to be skipped.

The format, entered in the Format Mode, can be keyed from the station's keyboard or by the Format Loader option, which facilitates loading a recorded format from magnetic tape.

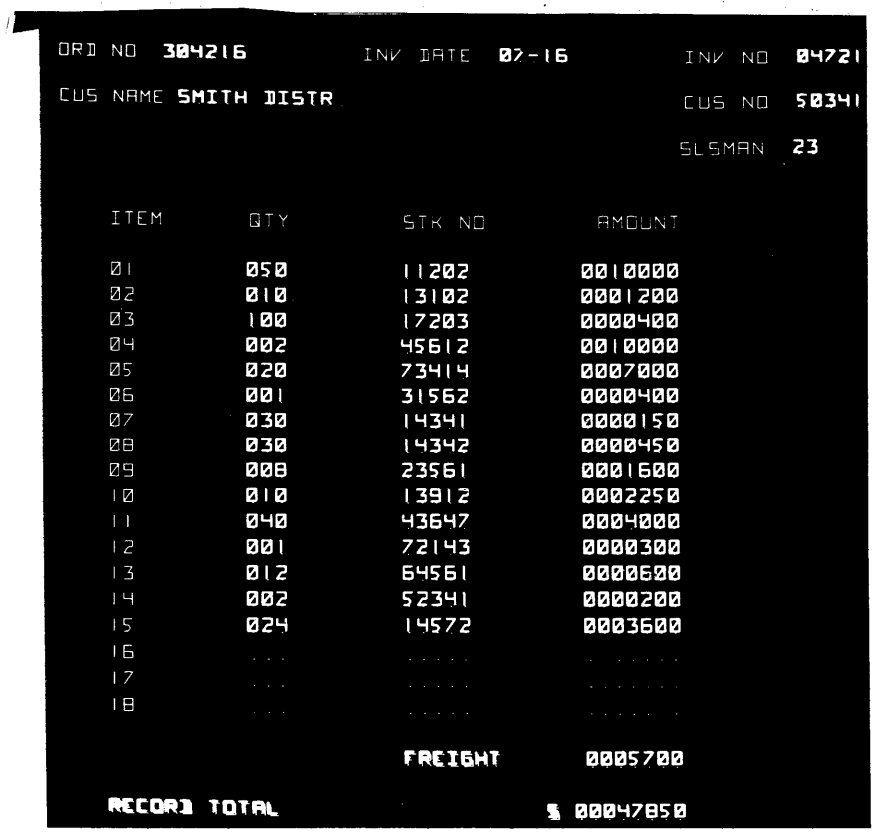
The Format Cassette, a magnetic tape contained in a "Philips-type" cassette, is recorded at the supervisor station only, then hand-carried to any of the operator stations, inserted in a Format Cassette Transport, and loaded into the display memory where the format is displayed on the screen. Subsequent formats are sequentially loaded from the same tape.

The standard Dual Intensity feature produces a marked contrast between format data and variable data for ease of composition. Variable data is displayed with greater intensity. Non-recording leaders (dots) are used to produce a more comprehensive format.

An extensive edit capability, provided via keyboard controls, divides edit functions into Data and Format Entry categories.

Dependent upon the selected edit function, data or format characters can be: (1) typed into display memory to replace any existing characters; (2) added to the

Sanders System 6000



A typical System 6000 display, showing how format data (including dotted leaders) is displayed at a reduced intensity.

ciency), the output from 10 stations will fully occupy the 3-station pooler arrangement. In this case, the price of 13 units should be compared to the price of a 10-keyboard multi-station arrangement. The flexibility of the single-station arrangement, which permits each operator to be working on a different job, can be approached in a multi-station unit by adding output tape drives at extra charge.

First deliveries of the Sanders System 6000 were made in February 1970. Lead time on orders is 30 days.

Sanders computer-related products are serviced by Sanders personnel at 28 nationwide service points, which are located within a 100-mile radius of any city with a population of over 100,000. □

existing text, spreading the text to accommodate the inserted characters; and (3) deleted from the existing text, closing the text to maintain continuity.

Editing is executed by positioning the blinking cursor to the location where the editing is to be performed, then initiating the desired edit operation.

Flexible cursor manipulation permits the operator to: advance or backspace the cursor by four spaces (Horizontal Tab/Back Tab); advance the cursor by four lines (Vertical Tab); advance the cursor to the beginning of the next line or to the end of the previous line (Carriage Return/Back Return); advance or backspace the cursor by one space (Frontspace/Backspace); and return the cursor to the "Home" or starting position on the screen.

Depression of any one of the cursor keys enters the format control character, corresponding to the key depressed, into display memory.

Data is recorded on tape when the operator has completed the entry operation, having verified the entered data and performed editing when necessary. The tape drive is selected from a maximum of four drives, then the Write Record function is initiated, causing only the variable data to be written. The format remains in memory and continues to be displayed; however, the variable data, when written on tape, is replaced with dotted leaders.

The Write Page function causes the entire display to be written; this includes both format and variable data, but excludes formaters except as an option.

Data is written on tape at the rate of 10,000 characters per second.

Sanders System 6000

Duplicate information (i.e., information which is to remain the same from record-to-record) can be retained by the Ident Protect feature, which retains up to the first 83 characters of a record.

ERROR CONTROL: Character parity accompanies each character keyed, stored in the display memory, and recorded on tape. A read-after-write check is performed on character and block parity for all data recorded.

A detected parity error causes the computer tape to be backspaced to the interrecord gap and the write operation to be performed a second time. A detected error after the second write causes the tape to be backspaced and nulls to be written over the faulty record.

The display facilitates operator recognition and correction of keying errors.

KEYBOARD: 51-key typewriter style; includes alphanumerics and cursor control keys within the main key group. An extra group of 11 keys to the right of the main key group provides for edit and control functions. The keyboard can produce any of 64 USASCII characters plus six format-control characters. Repetitive entry of data or formaters is provided via a repeat key.

PRICING: The System 6000 is available for purchase or on a one- or three-year lease, which includes maintenance and a 50-foot cable allowance for each terminal. A separate maintenance contract is provided for purchased units.

Pricing is complex and is dependent on the size of the configuration, which can range from a single station, a controller with minimal memory size, and one computer tape drive to a 12-station system with four tape drives.

All Rental prices shown are for a one-year lease. The Operator or Supervisor Station is priced, per unit, at:

Rental: $140 per month.
Purchase: $4,522.
Maintenance (purchased equipment): $35 per month.

Controllers range in price from $213 to $267 per month ($7,776 to $10,197 purchase). Maintenance for purchased equipment is $40 per month. The price range is a function of the unit's memory capacity and the number of Operator Stations it can accommodate.

The initial tape drive, which includes an Output Tape Adapter, is priced at $244 per month ($10,320 purchase) for either 7- or 9-track drives. Additional drives are priced at $111 per month (4,320 purchase); maintenance for purchased drives is $15 per month.

The Format Loader option is priced at $24 per month ($820 purchase) per operator station and $30 per month ($1,170 purchase) for the supervisor station. The option consists of a Format Read Adapter (operator station), Format Record Adapter (supervisor station), and Format Cassette Transport (all stations).

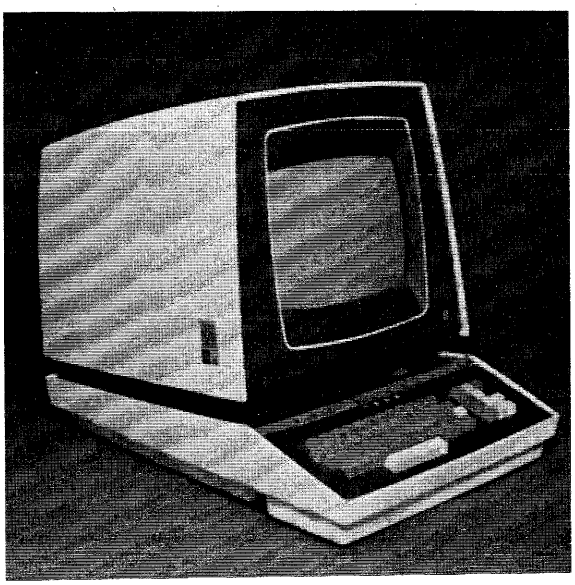
Sanders supplies tape cassettes for the Format Loader option at $6 per cassette.

Prices of typical System 6000 configuations are shown in the table. (These prices do not include the Format Loader option.) ■

TYPICAL SYSTEM 6000 CONFIGURATIONS

Number of Stations	Memory per Station	Tape Drives	Rental	Purchase	Maintenance
3	256 char.	1	$ 877	$31,662	$160
3	1024 char.	2	$1,040	$36,318	$175
6	256 char.	3	$1,546	$55,080	$295
12	256 char.	4	$2,524	$87,740	$520

Sanders 620 and 622 Stand-Alone Data Display Systems



The Sanders 620 and 622 are designed to operate as single-unit video display communications terminals. Compatible with the Sanders 720 Data Display System and the IBM 2260 and 2265 Display Stations, they operate in a polling or contention, single-station or multi-station environment. Up to sixteen 620 and/or 622 units can operate over a single voice-band facility via the 716 Serial Distributor.

MANAGEMENT SUMMARY

The Sanders 620 and 622 Stand-Alone Display Systems were developed to complement the Sanders 720 multi-station display system and to accommodate users requiring only one display location. The first 620 systems were delivered in late 1968, about two years after the first 720. The 622, a follow-up of the 620, was delivered in September 1970. Lead time on orders is 30 days.

The 622 includes as standard equipment several features that are 620 options, as well as a greater display buffer capacity than that of the 620. The 620 provides a 780-character display buffer, whereas the 622 is equipped to display 1024 characters. Both units can display data in any of over 2000 screen locations.

The 620 and 622 retain much of the display flexibility and many of the editing capabilities of the well-known 720. Several of these capabilities are standard for the 622 and optional for the 620.

Multiple 620's and 622's at one location can operate over a single communications line; separate data sets for each display are not required. However, for any multiple-display configuration at one location, other than the most basic terminals, a 720 system will be more economical, even where only a few displays are required.

The 620 or 622 can be equipped to accommodate a printer for hard-copy output. The user can specify any one of three Sanders character or line printers or a Teletype Model 33 or 35 RO teleprinter. Two versions of character printers are available; one employs a print wheel and prints 30 characters per second, and the other is a matrix printer that prints 165 characters per second. The line printer is rated at an average of 200 lines per minute.

CHARACTERISTICS

MANUFACTURER: Sanders Data Systems, Inc., Daniel Webster Highway South, Nashua, New Hampshire 03060.

CONFIGURATION: The Sanders 620 and 622 can be used in a single-station environment or in a multiple-station environment with up to sixteen 620 and/or 622 display units connected to common line via a 716 Serial Distributor and modem.

COMMUNICATIONS: Asynchronous or synchronous in the half-duplex mode. Transmission rates of 110, 1000, 1200, or 1800 bits per second (asynchronous) or 2000 or 2400 bits per second (synchronous) can be selected.

The 620 and 622 use the 8-level ASCII transmission code (including parity). With asynchronous transmission, a 10- or 11-unit code structure is used, which includes the ASCII character bracketed by a start and one or two (as specified by the user) stop bits.

The 620 and 622 and their companion 716 Serial Distributor are designed for operation over a voice-band facility via a modem compatible with the Bell System 100 or 200 Series Data Sets.

The 620 and 622 can operate in a contention or polling environment. In the contention mode, the operator initiates communication between the terminal and the remote computer. In the polling mode, the terminal is under control of the stored program at the remote computer.

The message format is compatible with the IBM 2260 and 2265 Display Stations. The text portion of each message is preceded by a four-character address and command sequence. The command is not present in the address sequence when operating in the contention mode.

The 620 and 622 Display Systems are compatible with the Sanders 731 Display Communications Buffer, which is designed to interface an IBM System/360 computer. When operating in a computer environment, the 620 and 622 can be directly connected to the 731 Buffer; data is transferred at up to 2400 bits per second.

CRT DISPLAY: A 12-inch (diagonal measurement) CRT provides a 9.5-inch by 7.5-inch viewing area; horizontal or vertical screen orientation can be specified. A character set of 64 ASCII stroke-generated characters, including upper-case alphabetics, numerics, and special symbols, is displayed in green against a dark background.

The user can specify one of two standard display arrangements: 64 characters in each of 32 lines (horizontal screen orientation) or 52 characters in each of 40 lines (vertical screen orientation). As an option, a display arrangement of 84 characters in each of 32 lines (horizontal screen orientation) can be specified. A maximum of 780 (Model 620) or

Sanders 620 and 622 Stand-Alone Data Display Systems

Format and Conversation modes, both standard for the 622 and optional for the 620, extend the capabilities of these units beyond those of more conventional display units. The Conversation mode permits line-by-line display of inquiries and responses without the need to retransmit the full contents of the data buffer. Essentially, this feature permits the display unit to send and receive sequential lines of data down the face of the CRT without disturbing previously-displayed data. The Format mode permits fixed formats, called from the computer or entered from the keyboard, to be stored and displayed. This capability allows the operator to "fill in the blanks" and then transmit only the keyed data; the displayed format is maintained for subsequent entries.

For the user who is considering a sophisticated, stand-alone display terminal, the Sanders 620 and 622 rank as important candidates. □

1024 (Model 622) characters can be displayed in any of the more than 2000 screen positions.

DEVICE CONTROL: Standard operating modes include Poll (transmit), Write (receive), and Format Type.

Message composition, including editing, is performed in the Format Type mode. Keyed data is entered in memory and displayed on the CRT screen.

Communication between the remote computer and the 620 or 622 occurs in the Poll and Write modes. Data is transmitted from the display memory to the remote computer in the Poll mode; data received from the remote computer enters the display memory and is displayed on the CRT screen in the Write mode.

A fixed format can be stored and displayed to facilitate message composition when operating in the Type mode (optional for the 620). The format can be entered from the keyboard or received from the computer. Format descriptors identify and restrict data entry to the variable fields. Start and stop characters, displayed as delta symbols, are used to define field length. When transmitting in the Type mode, only the variable data is transmitted; the fixed format remains displayed for the next entry operation.

The Conversation Type mode (optional for the 620) allows the user to operate in a conversational mode where both the inquiry and response are displayed. This mode can be established by the computer or from the keyboard.

The Hard Copy option permits data to be printed from the display memory. Two print modes permit printing the entire contents of display memory as it appears on the CRT screen or just the variable data fields or selected message segments. Either print mode can be selected manually or by program.

The keyboard is locked and the 620 or 622 will not accept a computer message while performing print operations.

The cursor can be advanced by one position, backspaced by one position, moved to the initial position of the following line (carriage return), or returned to the initial memory-display position. Cycle left and cycle right controls cause the cursor to step forward or backward repetitively.

Horizontal and vertical tabulation, standard features for the 622, are optional for the 620. Each horizontal and vertical tab character occupies one memory position but effects a skip of four display positions or lines. A horizontal tab entered into the 61st through 64th character positions on a line causes an automatic carriage return. Vertical tab characters cause four line-feeds and a carriage return.

ERROR CONTROL: Character parity accompanies each character keyed, stored in display memory, and transmitted. Even parity is used for asynchronous transmission, odd parity for synchronous transmission.

Parity is checked for all messaged received; an error symbol is displayed for a character received in error.

Longitudinal redundancy generation and checking and message acknowledgement are no-charge options. With this option, negative and positive acknowledgement to received messages is transmitted to the remote computer. The display units respond to a received negative acknowledgement by retransmitting the last message.

KEYBOARD: 50-key typewriter-style. Any of 64 ASCII characters, including upper-case alphabetics, numerics, and special characters, can be generated from the keyboard. A separate group of 12 keyss provides cursor, edit, and communication control functions.

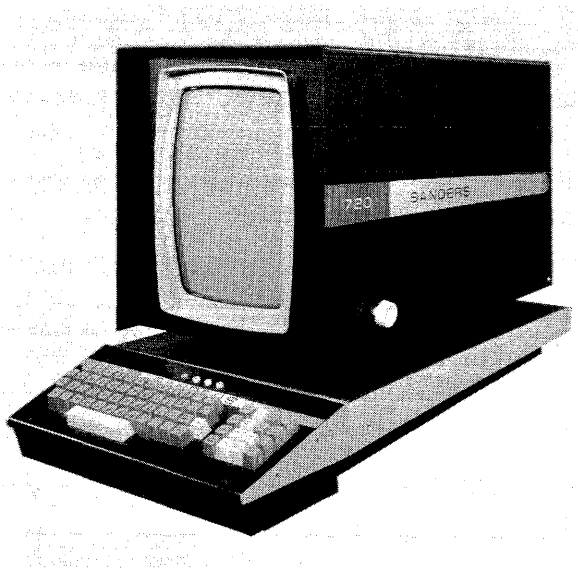
PRINTER: The Hard Copy Option provides a print capability for the 620 or 622 Display Unit. The option can accommodate a Teletype Model 33 or 35 RO teleprinter or either of three Sanders printer models. These include a 30-char/second impact page printer, a 165-char/second matrix printer, and a 200-line/minute line printer. Each printer uses a standard 64-character set of ASCII symbols and prints up to 132 char/line. The line printer is also available with a 96-character symbol set.

PRICING: The Sanders 620 and 622 Displays and 716 Serial Distributor are available for purchase or on a one- or three-year lease, which includes maintenance. A separate maintenance contract is available for purchased equipment.

	Monthly Rental*			
Device	1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
620 Display	$189	$120-187	$5,670	$42
622 Display	199	120-197	6,100	47
Interface:				
Asynchronous	N/C	N/C	N/C	N/C
Synchronous	5	N/C	105	N/C
84-Char. Line	3	N/C	100	N/C
Hard Copy Option:				
620 Display	231	135-207	6,720	47
622 Display	241	135-217	7,150	47
Printers:				
Page Printer (30 char/sec)	118	109	2,450	40
Matrix Printer (165 char/sec)	255	235	5,000	67
Line Printer (200 lines/min)	370	339	8,700	92
Format & Conversation Modes**	200	120-187	5,985	42
Tabulation**	4	N/C	126	N/C
716 Serial Distributor:				
With clock	65	28-45	1,485	10
Without clock	42	18-29	945	7

*Includes prime-shift maintenance.
**Optional for 620; included in 622 price.
N/C—No charge. ■

Sanders 720 Data Display System



The Sanders 720 is a multiple-display, multiple-printer video display system designed for local or remote operation with a computer. Sanders provides an interface and buffering arrangement for use with an IBM System/360. A wide range of display configurations is available.

MANAGEMENT SUMMARY

The 720 System is a highly expandable family of components designed primarily for users of large-scale CRT display stations. The 720 System can be remote from a computer, communicating over a voice-grade line, or it can be connected directly to an IBM System/360 multiplexer or selector channel.

The 720 Display System is by no means new; first deliveries were made in late 1966, after prior announcement and showings of prototypes. During the time since its introduction, the Sanders 720 has become a standard of comparison for measuring the editing capabilities of CRT display units.

These editing features still make the 720 stand out in a crowd. With the public interest seemingly on low-cost terminals for time-sharing, the 720 remains a leader among large-scale display systems.

Several concepts were pioneered by Sanders when the 720 was first announced. The use of a display area larger than the data buffer permits the user more flexibility in designing readable display formats; this concept basically provides more display positions than the maximum number of displayable data characters. In the 720, the maximum number of characters displayed varies from 256 to 1024, depending on the amount of memory incorporated, whereas the number of display positions is over ▷

CHARACTERISTICS

MANUFACTURER: Sanders Data Systems, Inc., Daniel Webster Highway South, Nashua, New Hampshire 03060.

CONFIGURATION: The system is designed for a multiple-station arrangement. Basic components include the Model 708 Display Unit, Model 722 Typewriter-Style Keyboard Unit, and Model 701 Control Unit.

The 701 Control Unit provides the communications interface, edit, character-generation and control logic, buffer memory, and multiplex circuits for up to twelve stations, which can consist of: a 708 Display Unit, a 722 Keyboard Unit, a 737 Photopen Cursor Controller (light pen), and a Teletype Model 33 or 35 RO (read-only) teletypewriter.

The 701 can accommodate one, two, or three 1024-character memory modules; each module can accommodate one, two, three, or four 708 Display Units with its associated keyboard.

Each 708 Display Unit can be located up to 1000 cable-feet from the 701 Control Unit; each 722 Keyboard Unit can be attached to its associated 708 Display Unit or located up to 10 cable-feet from the display.

Configuration rules restrict the display-unit/memory-module relationship such that all memory modules associated with the same 701 Controller must accommodate an identical number of display units.

The relationship between the number of display units attached to the 701 Controller and the memory capacity per display unit is as follows:

Displays Per Controller	Memory Modules Per Controller	Memory Capacity Per Display
1	1	1024
2	1; 2	512; 1024
3	3	1024
4	1; 2	256; 512
6	3	512
8	2	256
12	3	256

A System 720 configuration can include up to sixteen 701 Control Units and up to 192 Display Stations connected to a common communications facility via the 716 Serial Distributor. The basic 716 will accommodate ▶

Sanders 720 Data Display System

2000. This result is achieved by the capability to specify vertical or horizontal spacing of more than one position with just one command character. In the 720, a space code can represent a skip of one or four characters or lines.

An additional concept that makes the 720 a powerful terminal is its editing capabilities–particularly the Insert and Delete functions. These functions allow the operator to insert characters in the middle of a display, with automatic expansion–including carry-over to subsequent lines–to accommodate the extra data. Conversely, data can be deleted with automatic contraction. While probably not essential when working to a fixed format, the Insert and Delete functions are very valuable when working in a free format with large data entries.

The expansibility of a 720 System is extraordinary. Up to 192 Display Stations can share a communications line or be connected on-line to a System/360 computer through a Sanders-supplied buffer unit. Seldom will the full capability for expansion be utilized, particularly for the communications configuration, because of limitations on data transfer capability. Such a large communications system would severely limit the amount of time each display could be active, and CRT units are expensive low-volume terminals. However, for some applications where the convenience of CRT operation outweighs equipment costs, it could be practical.

The 720 System is designed to permit extensive hard-copy output via teleprinters. Each display can have its own printer, or one printer can be shared among a group of displays.

The light pen option allows an operator to conveniently select portions of the data on the screen for transmission. This feature could facilitate look-up operations involving multiple levels of indexes or lists.

Configuring a Sanders 720 System with the many required and optional features is complex. Sanders provides a very neat book of sectional overlays to assist in specifying configurations.

The 720 is code and transmission compatible with the IBM 2260 and 2265 display terminals. Direct replacement or substitution of the 720 for these units is supported by basic Sanders software for interfacing the 720 in either a local or remote IBM System/360-Sanders 720 configuration.

up to four Controllers, and it can be expanded to accommodate up to 16 Controllers in increments of four.

The 720 System can be used in a computer environment as a peripheral subsystem or in a communications environment as a remote terminal. The 731 Display Communications Buffer provides the computer interfacing capabilities for either environment. The 731 is designed to interface up to eight 701 Control Units or eight communications lines to an IBM System/360 computer via the System/360 Multiplexer Channel or Selector Channel. The peak data transfer rate in the burst mode is 47,500 characters per second.

COMMUNICATIONS: Asynchronous or synchronous (optional) in the half-duplex mode. Transmission rates are switch-selectable at 110, 1200, 1800 (asynchronous), 2000, 2400, 8600, 4800, 7200, and 9600 (asynchronous or synchronous) bits/second.

The 720 System employs the 8-level ASCII transmission code (including parity) With asynchronous transmission, a 10- or 11-unit code structure is used, which includes the ASCII character bracketed by a start and one or two (as specified by the user) stop bits.

The Model 701 Control Unit can be directly connected to a voice-band communications facility via a modem compatible with the Bell System 100 or 200 Series Data Sets. A number of 701 Controllers can be connected to a common communications facility via the 716 Serial Distributor.

CRT DISPLAY: A 12-inch (diagonal measurement) horizontally or vertically oriented CRT provides a 7.5 inch by 9.5 inch viewing area.

A character set of 64 ASCII stroke-generated characters, including upper-case alphabetics, numerics, and special symbols, is displayed in green against a gray background.

Vertical screen orientation provides the user with a "page-like" presentation; the screen is arranged in 40 lines of 52 characters each. Horizontal screen orientation provides a screen arrangement of 32 lines of 64 or 84 (optional) characters each. Data can be displayed in any of over 2000 screen positions. The CRT features non-glare display characteristics.

DEVICE CONTROL: The 720 can operate in a contention or polling environment. In the contention mode, the operator initiates communication between the terminal and the remote computer. In the polling mode, the terminal is under control of the stored program at the remote computer.

Standard operating modes include transmit, receive, and entry.

Sanders provides two modes of data entry, which it refers to as Edit I and Edit II.

Edit I mode permits data entry into the display memory in addition to edit operations such as data insert and delete functions, which spread or close the existing text as data is inserted or deleted.

Edit II mode permits the supervisor or controlling program to enter fixed format into display memory. Fixed fields contain format descriptors that identify and

Sanders 720 Data Display System

Sanders is quite willing to undertake modifications of the standard features of a 720 System to accommodate special requirements, and a number of customers have taken them up on this.

To put the 720 System into proper perspective, you must realize the environment of its development. Sanders is heavily involved with the design of systems for information handling for both military and commercial users. Some of the features and components of the 720 System were developed because adequate components were not available from the computer manufacturers involved in Sanders-designed information systems.

Other Sanders products based upon the display of information are the stand-alone 620 and 622 displays, the System 6000 for keyboard-to-tape preparation of computer input, the Advanced Data Display System (ADDS/900) for display of graphic as well as alphanumeric information, large-screen displays, and the SD-500 Microfilmed Data Storage and Retrieval System. □

restrict data entry to the variable data fields. Insert and delete functions are also provided for operation in the Edit II mode.

When operating with a fixed format, only the variable data is transmitted; the format remains displayed for the next data entry operation.

The cursor can be advanced by one position, backspaced by one position, moved to the initial position of the next line (carriage return), to the final position of the previous line, or to the initial position of the first line.

Horizontal and vertical tabulation are standard. Each horizontal and vertical tab character occupies one memory position but effects a skip of four display positions or lines.

The clear function erases the entire display (or only variable fields when operating with a stored format).

A block of text bracketed by start- and stop-blink control characters blinks to alert the operator.

The Hard Copy option permits data to be printed from the display memory. Two print modes permit printing the entire contents of display memory as it appears on the CRT screen or just the variable data fields or selected message segments. Either print mode can be manually selected.

A wide variety of printer configurations permits the user to dedicate a printer to a particular display unit or to a group of displays. Additional logic modules are available to handle heavy printing demands.

The 737 Photopen Cursor Controller option allows the operator to position the cursor to the character position directly under the Photopen light pen. The operator can then transmit the block of text beginning with the repositioned cursor.

ERROR CONTROL: Character parity accompanies each character keyed, stored in display memory, and transmitted. Parity is checked for all messages received, and an error symbol is displayed for a character received in error.

Longitudinal redundancy generation and checking and message acknowledgement are optional features and are available at no additional cost. With this option, positive and negative acknowledgement to received messages is transmitted to the remote computer. The 720 retransmits a message when a negative acknowledgment is received from the computer.

The display facilitates operator recognition of keying errors.

KEYBOARD: 51-key typewriter-style. Any of 64 ASCII characters, including upper-case alphabetics, numerics, and special characters, can be generated from the keyboard. A separate group of 16 keys provides cursor, edit, and communication control functions.

Repetitive entry of data or initiation of a function corresponding to a keytop symbol is performed by depressing the desired key in conjunction with the Repeat key.

The keyboard can be attached to the display unit or physically separated from it by a 10-foot cable. As an option, a second keyboard can be connected to a display unit. Keypunch-style and adding-machine-style keyboards are also available from Sanders.

PRINTER: The Hard Copy Adapter provides a print capability for the 720 Display unit. The adapter can accommodate a Teletype Model 33 or 35 RO teleprinter or a Sanders 30-char/second impact page printer. The page printer uses a standard 64-character set of ASCII symbols and prints up to 132 char/line.

PUNCHED TAPE: The Advanced Paper Tape Adapter interfaces the 720 System with any combination of up to three punched tape readers (Teletype Model CX or equivalent) and punches (Teletype Model DRPE or equivalent). The unit accommodates 8-level ASCII and 5-level Baudot codes.

PRICING: The Sanders 720 System is available for purchase or on a one-, two-, three-, four-, or five-year lease, which includes maintenance. A separate maintenance contract is available for purchased equipment.

Pricing is complex and is dependent on the size of the configuration, which can range from a single display station and a controller with minimal memory size to a controller with 12 display stations—or the configuration might encompass several controller display arrangements.

All pricing below is based on a one-year lease. Sanders provides substantial discounts for multiple components, including multiple displays operating from the same controller.

The 708 Display Unit with typewriter-style keyboard is priced at $95 to $126 per month or $3,177 purchase. Maintenance for purchased units is $37 per month.

The 701 Control Unit with serial (communications) or parallel (direct connection) interface and single memory

Sanders 720 Data Display System

module ranges in price from $225 to $273 per month ($7.088 purchase). The price range is increased to $267 to $336 per month ($8,663 purchase) when adding a second memory module and to $309 to $399 per month ($10,238 purchase) when adding a third memory module. Maintenance for a purchased Control Unit is priced at $53 per month, which also includes maintenance at the first display device.

The wide range in rental prices for the 708 Display Unit, 701 Control Unit, and memory modules reflects the discount policy for quantities of eight or more components; discounts range between 20 and 32 percent.

The 706 Hard Copy Adapter ranges in price from $155 to $258 per month ($4,643 to $7,769 purchase) depending on printer/display station arrangement and adaptability to a Teletype Model 33 or 35 teletypewriter. Sanders provides the teletypewriter at $49 or $100 per month ($945 or $2,195 purchase) for the Teletype Model 33 RO and 35 RO, respectively. Maintenance for a purchased 706 Adapter and a single teletypewriter costs about $35 per month; maintenance for each purchased teletypewriter costs about $20 per month.

The 30-char/second page printer rents for $118 per month and sells for $2,450. Maintenance for purchased units is $40 per month.

Pricing for the 737 Photopen Cursor Controller (light pen) and Advanced Paper Tape Adapter is available by request only.

The optional 84-character line for the horizontal CRT orientation is priced at $3 per month ($100 purchase).

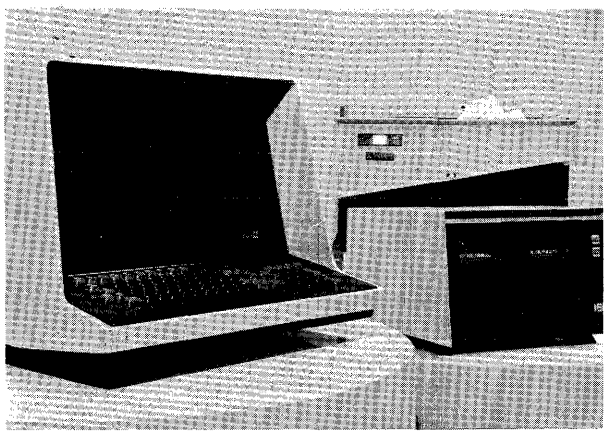
The 716 Serial Distributor, which permits the use of up to four 701 Controllers per voice-band line, is priced at $42 to $65 per month ($945 to $1,485 purchase) Expansion modules, which permit four more 701 Controllers to be attached to the Serial Distributor, are each priced at $9 per month ($279 purchase).

Prices of typical Sanders 720 System configurations are shown in the table. Each configuration includes a typewriter-style keyboard and an asynchronous communications interface. The Hard Copy and Photopen options are not included. ■

TYPICAL SANDERS 720 SYSTEM CONFIGURATIONS

Number of 708 Displays	Average Cost per Display	Memory per Display	Monthly Rental	Purchase	Monthly Maintenance
3	$247/mo.	1024 char.	$ 742	$18,875	$120
6	$185/mo.	512 char.	$1,111	$28,250	$225
12	$123/mo.	256 char.	$1,480	$46,700	$435

Sanders CAN DO System (Series 800)



The Sanders 804 stand-alone display terminal is shown with the optional dual cassette recorder (right foreground) and 300-cpm card reader (right rear). The Sanders 810 displays, used in multi-station configurations, are identical in appearance.

The versatile Sanders CAN DO System is built around programmable CRT display terminals designed to operate in a stand-alone or multi-station environment. I/O capabilities include printed output, punched card input, and cassette tape input/output, as well as disk storage. Sanders-supplied software includes an IBM 2260/2265 emulator and a data entry package.

MANAGEMENT SUMMARY

Sanders' CAN DO System is a noteworthy member of the new generation of "intelligent" computer terminals, so named because a minicomputer is the nucleus of terminal control. The CAN DO System is suitable for a broad range of applications that require stand-alone and/or clustered terminals, local and/or remote operation, I/O capability, disk storage, IBM 2260/2265 compatibility, etc. The system's high degree of flexibility is largely due to its modular construction; a large number of basic components can be configured in a variety of different ways to produce a multiplicity of configurations.

Salient features of the CAN DO system – which compare very favorably with those of the IBM 3270 Information Display System – include:

- A wide range of transmission parameters that provide compatibility with virtually any communications device.
- Transmission speeds up to 1200 characters per second (9600 bps) – double the capability of the IBM 3270.
- Display screens with minimum and maximum display capacities equivalent to those available for the IBM 3270 (480 and 1920 characters), in addition to other display capacities not available for the 3270.
- Display arrangements equivalent to those available for the IBM 3270, in addition to several that are not available for the 3270.
- Three grades of printers, ranging from 30 characters per second to 200 lines per minute, compared with ▷

CHARACTERISTICS

MANUFACTURER: Sanders Data Systems, Inc., Daniel Webster Highway South, Nashua, New Hampshire 03060.

MODELS

804 System – A single-station programmable terminal system.

810 System – A multi-station programmable terminal system.

CONFIGURATION

Stand-Alone: The 804 is a stand-alone display terminal that contains a byte-oriented minicomputer with a basic 2048-byte MOS integrated-circuit read/write memory (expandable to 8192 bytes in 2048-byte increments), an alphanumeric typewriter-style keyboard (others are available), and a CRT display screen. I/O device options include a single- or dual-transport magnetic tape cassette recorder, a card reader, any of three printer models, a communications interface, and an internal or external modem.

Multi-Station: The 810 is a cluster terminal system that can accommodate up to 8, 16, 24, or 32 individual display terminals and is designed for operation in a local (computer) or remote (communications) environment. An 810 system can include any of five models of terminal processors. Each contains essentially the same minicomputer as that provided with the 804, identical basic and expansion read/write memory capacities, and I/O device options; however, configuration rules for I/O device attachments differ according to the processor model. The five models of terminal processors are:

LTP8 – For local operation with an IBM System/360 or System/370 computer. The LTP8 attaches to the computer's multiplexer channel via an integral channel adapter, which can accommodate up to three additional LTP8 terminal processors to provide a maximum cluster of 32 display units.

TP4, TP8, and TP4/BC – For remote operation via a communications facility. The three terminal processors can each interface with a modem to provide a cluster of up to eight display units, or each can interface with the Communications Processor (CP). Terminal Processors can also be clustered via the Sanders 716 Serial Distributor, which can accommodate up to four processors.

CP – For remote operation via a communications facility or local operation via a channel adapter. The ➤

Sanders CAN DO System (Series 800)

printer speeds of 40 or 66 characters per second provided by the IBM 3270.

- Punched card input–not available with the IBM 3270.
- The use of tape cassettes for both data and programs – not provided by the IBM 3270.
- Disk storage – from 2.5 to 20 million bytes.
- Transmission compatible (hardware only) with the IBM 1050 System.
- Ability to interface with the Sanders 720 Display System.
- Separate buffering for each device; printer/screen capacities are not degraded for large configurations.
- Configuration flexibility – up to 32 display units, in addition to other I/O devices, per configuration.

Sanders has not defined the area of its prime market thrust, but the CAN DO System is well suited for applications such as remote batch processing, remote job entry, order entry, and interactive operations. Sanders currently supports these applications with two standard software packages: a data entry package and an IBM 2260/2265 emulator called BOSS.

The data entry package permits the user to generate his own record formats and to maintain format and data files. A specific format can be accessed and displayed for data entry; the entered data can be edited, arithmetic calculations can be performed (if required), and then the data can be transmitted to a remote computer or terminal or accumulated on tape for later transmission. New formats can be called up at any time to replace an existing format

The IBM 2260/2265 emulator provides transmission compatibility with all IBM System/360 and System/370 computers, enabling the CAN DO system to operate under control of the existing IBM software support for the 2260 and 2265 Display Stations. To date, Sanders has not promised an emulator for the newer IBM 3270 Infomation Display System. Sanders divides its software support into three classes. The first includes all standard software offered at no cost to the user. The second includes packages developed for special user applications, the availability of which is under negotiation. The third class includes all unsupported software – a catch-all for programs generated under the shared knowledge of users and Sanders.

Available software for the CAN DO System currently consists of the two application packages described above, plus assemblers that operate under IBM System/360 or 370 OS or DOS, program loaders, utilities, and a few

Communications Processor can function as a communications concentrator and can accommodate up to four terminal processors to provide a maximum cluster of 32 display units. The Communications Processor can also accommodate up to four Sanders 720 Data Display Systems via the 720 Parallel Adapter. Each 720 system can accommodate up to 12 display units; See Report 70D-734-03 for details on the 720 system.

Display unit and I/O device parameters for each of the five models of terminal processors are presented in the following table; all entries represent maximum numbers.

	LTP8	TP4	TP8	CP	TP4/BC
Display memories	8	4	8	0	4
Displays per memory–					
12-line displays*	8	8	8	0	8
24-line displays*	8	4	8	0	4
Device options**	3	8	4	9	4
Disk adapters***	0	0	0	2	1
Disk drives	0	0	0	8	4

* Total displays per terminal processor cannot exceed 8.

**Device options include the cassette recorder with single or dual transports, card reader, three printer models, and an internal modem. Special adapters for interconnecting terminal processors in a multi-cluster network are also included as device options.

***Each adapter accommodates four 2.5M-byte or 5M-byte drives; drives can be mixed on the same adapter. Sanders recommends the use of only one disk adapter.

COMMUNICATIONS: Asynchronous or synchronous in the half- or full-duplex mode. Asynchronous transmission rates can be specified as 110, 134.5, 300, 600, 1200, or 1800 bits/second. Synchronous rates are available at 2000, 2400, 3600, 4800, 7200, or 9600 bits/second. External clocking can be specified to provide transmission rates other than the ones listed.

Transmission code can be specified as 8-level (including parity) ASCII or EBCDIC or 7-level IBM PTTC/BCD or PTTC/EBCD code. Start and stop bits, required for asynchronous transmission, transform 8-level codes to 10 or 11 code levels (including one start bit and one or two stop bits) and 7-level codes to 9 code levels (including single start and stop bits).

The communications adapter can be equipped with either an EIA Standard RS-232C interface for connection to an external modem or a logic-level interface for connection to an internal (PC board) modem or a Sanders 716 Serial Distributor. Sanders provides modems for either arrangement. Internal and external modems are available for asynchronous operation at rates up to 1200 or 1800 bits/second; external modems, with or without auto answer, are also available for synchronous operation at 2400 bits/second over the public telephone network.

CRT DISPLAY: A 12-inch (diagonal measurement) CRT provides a 7.5 by 9.5 inch viewing area. A character set of up to 96 ASCII characters, including upper- and lower-case alphabetics, numerics, and special symbols is displayed in white against a dark background. Characters are generated via a 5-by-7 dot matrix. The CRT screen is viewed through a tinted anti-glare shield.

Sanders CAN DO System (Series 800)

> smaller programs for specific applications. Sanders is currently developing software to support the system's disk capability.

First customer deliveries of the single-station 804 System were made in December 1971. Deliveries of the multi-station 810 System have not been made to date, primarily because of delays in developing the disk software. First deliveries of the 810 System will probably be made during the second or third quarter of 1972. □

➤ The following screen capacities and display arrangements are available.

804 System

Char/Display:	960	960	1920
Lines/Display:	12	15	24
Char./Line:	80	64	80

810 System

Char./Display:	480	768	960	1536	1920
Lines/Display:	12	12	12/24	24	24
Char./Line:	40	64	80/40	64	80

The following three display character sets are available: upper-case only, IBM 2260-compatible upper- and lower-case, and IBM 2260-compatible upper-case only. The display arrangement and character set must be identical for all display units associated with a common terminal processor.

DEVICE CONTROL: All operations are software-controlled by Sanders' standard operating software and by user-created application programs that can reside on cassette tape, punched cards, or at the remote computer. Program entry is controlled by an ROM (firmware) program loader. The user can specify one of three discrete loaders, each corresponding to a specific method for entering programs: from punched cards, cassette tape, or a communications facility where the terminal is operating on-line with a remote computer.

Operating software currently includes two application packages: Data Entry and BOSS, an IBM 2260/2265 emulator. Other programs (some available now, others in various stages of completion) include assemblers, debug aids, test programs, a math package, edit routines, device handlers, communications routines, and utilities.

The Data Entry package includes the following components:

Tape Preformatter–used to initialize a blank tape cassette with header and data area.

Menu–operates in one of three operator-selectable modes and is used to create a table (listing) of existing tape cassette programs, call a program from the listing, and read an object program from cards.

Descriptor–used to create formats in which variable fields for data entry are defined by field descriptors. Formats are stored on cassette tape and are loaded by command.

Data Entry–used to enter keyed data into descriptor-defined variable fields within a fixed format.

The math package includes routines for addition, subtraction, and multiplication using decimal arithmetic.

Edit routines include character and line insertion and deletion, and partial scrolling.

Utility routines and device handlers are provided for all I/O (including disk) moves and functions.

PROCESSOR: The integral minicomputer is a byte-oriented (8 bits/byte), serial microprocessor which has an instruction execution time of 6.4 microseconds and 16 basic instructions; of these, 15 logical instructions are expandable to 80 via the use of modifiers. Instructions are 16 bits long and are accessed during one memory cycle.

Read/write control memory is a random-access memory with a cycle time of 6.4 microseconds. Available storage capacities are 2K, 4K, 6K, and 8K bytes. Memory organization is on a page basis; each page contains 256 16-bit words (512 bytes). The first one or two (communications loader only) pages are reserved for the ROM program loader. Both ROM and read/write memories feature semiconductor construction.

Internal processor architecture includes three general-purpose registers, each with a single-level stack, an instruction address register with combined page reference register and four-level stack, and a memory access register. The Model 810 microprocessor also includes 64 general-purpose (scratchpad) registers. All stacks use the "push-down/pop-up" technique for manipulating data and addresses, which is a last-in/first-out arrangement for interconnecting registers. The microprocessor also features an I/O device interrupt capability.

KEYBOARD: Five keyboard styles are available:

IBM 2260 typewriter style (with or without numeric pad)–generates any of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols. The numeric pad provides 10 numerics and a decimal point.

IBM 2260 data entry style–a keypunch-style keyboard that generates any of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols.

Full ASCII typewriter style–generates any of 128 ASCII characters including upper- and lower-case alphabetics, numerics, and specials. A numeric pad provides 10 numerics, 9 specials, and a decimal point. Eight function-code keys are included.

Data Entry typewriter style–generates any of 64 ASCII characters including upper-case alphabetics, numerics, and specials. A numeric pad provides 10 numerics and a decimal point.

PRINTER: Three printers are available:

Model 3110–a 30-char/second impact page printer with an adjustable line length of 13 to 132 columns. Printing is performed via a rotating print wheel that contains a set of 64 ASCII characters. Accommodates six-part, continuously-sprocketed forms up to 14-7/8 inches wide. Horizontal and vertical spacing are 10 char/inch and 6 lines/inch, respectively. The printer employs a Singer print mechanism. ➤

Sanders CAN DO System (Series 800)

Model 3120–a 165-char/second matrix printer that prints up to 132 char/line. Any of 64 ASCII symbols are formed within a 5-by-7 dot matrix. Accommodates six-part, continuously-sprocketed forms up to 14-3/8 inches wide. Horizontal and vertical spacing are 10 char/inch and 6 lines/inch, respectively. The printer is a Centronics Model 101.

Model 3130–a line printer with a rated speed of 200 or 110 lines/minute with a set of 64 or 96 ASCII graphics, respectively. Prints up to 132 columns and accommodates six-part, continuously-sprocketed forms up to 16 inches wide via adjustable tractors. Horizontal spacing is 10 char/inch; vertical spacing is 6 or 8 lines/inch. The printer is manufactured by Odec.

CARD READER: Model 3310 reads 80-column, Hollerith-coded cards at 300 cards/minute. Hopper and stacker capacities are 450 and 500 cards, respectively. As an option the reader can accommodate 51-column cards. The unit is designed for table-top operation and is manufactured by Peripheral Dynamics, Inc.

CASSETTE TAPE INPUT/OUTPUT: The Model 3210 Dual Cassette Tape Transport features two independent cassette tape recorders with shared electronics. Each drive accommodates a Philips-type cassette containing 300 feet of 0.15-inch-wide magnetic tape. Phase-encoded data is recorded serially at 400 bits/inch. The tape format accommodates 8-bit characters with record lengths up to 2,048 characters. Total storage capacity is rated at 300,000 characters. Manual or programmable tape functions include rewind-search, fast forward search, read, write, and stop. Search and rewind functions are performed at 100 inches/second; read/write functions are performed at 6 inches/second. Maximum search time is 36 seconds. The tape transports (drives only) are manufactured by Cramer Electronics (Auricord).

DISK STORAGE: Two models of disk drives are similar, except for data format, to the IBM 5444 drives used on IBM's System/3. Storage capacities are 2.5 million and 5.0 million bytes. Both models feature a 2.5M-byte removable disk cartridge; and the 5M-byte drive also contains a 2.5M-byte fixed disk. Data access is provided by two or four vertically-aligned heads, one per disk surface. Average rotational delay and data transfer rate are 20 milliseconds and 200,000 bytes/second, respectively. Average head positioning time is 85 milliseconds.

PRICING: The Sanders CAN DO System is available for purchase or on a one-, three-, or five-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental (1) 1-Yr. Lease	3-Yr. Lease	Purchase	Monthly Maint.
System 804 (basic terminal without keyboard)	$170	$154	$ 4,630	$25
System 810 (basic) processor):				
LTP8	255	238	13,700	98
TP4	140	128	5,900	30
TP8	140	128	5,900	30
TP4/BC	140	128	5,900	30
CP	120	110	4,900	30
Memory Options:				
4K bytes	30	27	1,000	4
6K bytes	60	54	1,900	5
8K bytes	90	81	2,700	6
System 810 Displays:				
With Keyboard	60-65	54-59	1,475-1,525	10
Without Keyboard	50	45	1,100	5
Audible Alarm	3	3	90	0
Display Memory Modules (2):				
System 804	0-30	0-27	0-1,100	0
System 810	22-40	20-36	1,200-1,550	2
System 804:				
Keyboards (3)	10; 15	9; 14	375; 425	5
Audible Alarm	3	3	90	0
Communications Interface:				
Asynchronous	25	22	750	2
Synchronous	25	22	750	2
Special Adapters:				
Parallel Adapter	45	40	750	2
Inter-Processor Connector–				
Master	50	45	750	1
Slave	40	36	450	1
Channel Adapter	175	162	6,300	30
Local Comm. Adapter	45	41	750	10
720 Parallel Adapter	20	18	570	2
G.P. Buffered Channel (4):				
1K byte	25	23	750	5
2K bytes	50	46	1,500	11
4K bytes	75	69	2,000	14
I/O Devices (5):				
30 cps Printer	143; 153	132; 141	3,200; 3,425	43; 44
165 cps Printer	280; 290	257; 266	5,750; 5,975	70; 71
110/200 lpm Printer	395; 405	362; 371	9,450; 9,675	95; 96
300 cpm Reader	155	140	2,600	25
Single Cassette Recorder	65	60	1,950	21
Dual Cassette Recorder	85	78	2,550	24
Disk Storage (6):				
Disk Adapter (Up to 4 drives)	38	35	1,090	0
2.5M-byte Disk Drive	320	295	7,800	60
5M-byte Disk Drive	371	346	9,300	60
Modems, Internal:				
Asynchronous (up to 1200 or 1800 bps)	30	27	338	5
Synchronous (2400 bps)	60	54	990	7
Modems, External:				
Asynchronous (up to 1800 bps)	35	32	670	5
Synchronous (2400 bps)	65	59	1,420	7

(1) Lease prices include prime-shift maintenance.
(2) Price per module; price range reflects display arrangement, upper-/lower-case options, and 2260 character set.
(3) Higher-priced keyboards include a numeric pad.
(4) Required only for disk storage.
(5) Prices include interface adapter; printer prices reflect 1K-byte and 2K-byte adapters. The 30 and 165 cps printers and corresponding adapters are available with a serial or parallel interface; both interfaces are priced the same.
(6) Disk Adapter accommodates up to four 2.5M-byte and/or 5M-byte drives; a G.P. Buffered Channel is a prerequisite for disk storage. ■

Sanders 8170 Interactive Terminal System

MANAGEMENT SUMMARY

Sanders, a long-time leader in sophisticated display systems, introduced the 8170 in September 1973 as a direct replacement for the IBM 3270 Information Display System. Designed for remote applications only, as a clustered terminal, the 8170 can accommodate from 2 to 32 CRT display units and as many as 8 printers. The 8170 features a programmable microprocessor control unit that performs all operations under the direction of the program residing in the unit's control memory. The control program, On-Line I, can be loaded from punched cards or cassette tape, or received from the remote computer via the communications facility.

On-Line I is primarily an emulation program that emulates all functions of the IBM 3270 and provides complete compatibility with respect to line discipline, commands and command-code structure, and addressing sequence.

The salient features of the 8170 are compared with those of the IBM 3270 system in the following paragraphs.

- Display capacity – The 8170 offers a choice of three screen sizes: 480, 960, or 1920 characters. IBM provides two screen sizes: 480 or 1920 characters.
- System configuration – The 8170 can accommodate from 2 to 32 CRT display units in increments of 8 units and as many as 8 printers in increments of 2 printers. By contrast, the IBM 3270 can accommodate any mix of up to 32 devices including CRT display units and printers; as many as 31 printers can be attached.
- Printed output – Sanders offers a choice of three printer models, consisting of two serial impact ➢

Available in a remote cluster configuration only, the Sanders 8170 is a direct replacement for IBM's 3270 Information Display System. The 8170 features a programmable controller and can accommodate as many as 32 displays and 8 printers. Data validation, an optional enhancement, can improve communications efficiency.

CHARACTERISTICS

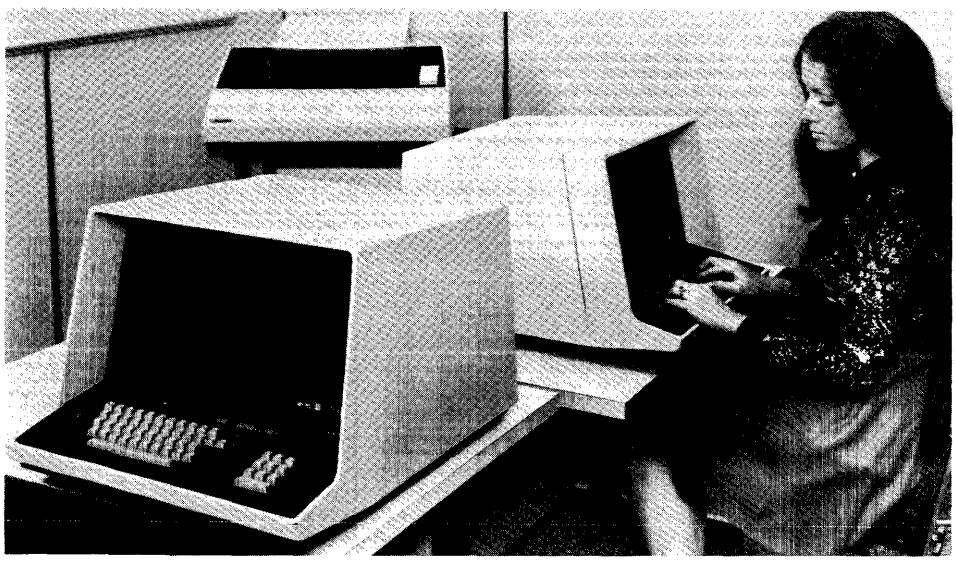
MANUFACTURER: Sanders Data Systems, Inc. (a subsidiary of Sanders Associates, Inc.), Daniel Webster Highway South, Nashua, New Hampshire 03060. Telephone (603) 885-2222.

CONFIGURATION: The 8170 is designed as a remote cluster display terminal only. The 8170 includes a programmable microprocessor control unit that can accommodate from 2 to 32 CRT display units with the same screen size and up to 8 printers in any mix of 3 models. As many as 8 display units can share 2 printers in a local-copy mode.

The basic 8170 control unit contains one Device Adapter, which can accommodate up to 8 display units and 2 printers. Three additional Device Adapters can be added to provide accommodation for the full complement of display units and printers.

Each Device Adapter can also accommodate a dual cassette recorder or a card reader; however, either device requires one printer position per adapter, reducing the maximum number of attachable printers to four.

Buffer capacity corresponds to screen size of the available display units: 480, 960, or 1920 characters. Different buffer capacities cannot be mixed within the same control unit. ➤



The attractively styled Sanders 8170 display units are available with either typewriter or data entry (keypunch-style) keyboards and with screen capacities of 480, 960, or 1920 characters.

Sanders 8170 Interactive Terminal System

printers rated at 30 cps (Singer) and 165 cps (Centronics 101) and a line printer (Odec) rated at 200 lpm. All three printers provide 132 print positions and can be combined in any mix on the 8170. By contrast, IBM offers two serial impact printers rated at 40 cps and 66 cps. Like its IBM counterparts, each Sanders printer functions as a remote device and can be initiated at the display unit, but printing is executed only by the receipt of a print command received from the computer. As a no-cost option, the Sanders 8170 can share two printers with a group of up to eight displays to provide printed copy in a local mode.

- Displayed output – The Sanders 8170 features a standard displayable character set of 96 symbols, including upper and lower case alphabetics. Upper case characters are displayed within a 5-by-7 dot matrix; lower case characters are formed within a 5-by-9 dot matrix. By contrast, IBM's 3270 display unit has a standard 64-character set of upper case alphabetics (lower case alphabetics are available via an RPQ), which are formed by a 7-by-9 dot matrix. The Sanders 8170 has one beam intensity level and provides beam blanking to mask confidential data for security purposes. A standard blink function permits programmed blinking of characters or fields to alert the operator's attention.

- Data validation – As an option, the control program, On-Line I, can include data validation routines that, when invoked via the keyboard, provide several validation functions, such as range checking, check-digit operation, zero balancing, etc. This feature is intended to improve data communications efficiency through the elimination of extraneous error messages. (The program enhancement feature will not be available until the second quarter of 1974, but the feature can be added to existing terminals in the field.)

- Key Entry – Two keyboard styles that duplicate IBM 3270 keyboards are available: typewriter and data entry.

- Communications – Transmission speeds for the 8170 range from 1200 to 4800 bits per second, which is identical with the range of transmission speeds offered by IBM. Sanders also offers its own external modem, which precludes the need to obtain modems from another source.

- Software support – The 8170 is compatible with and can utilize all existing IBM software for the 3270.

The 8170 offers substantial savings over its IBM counterpart. Sanders prices the 8170 about 11 to 17 percent below IBM's prices for equivalent systems. Further savings can be garnered through extended lease periods of up to five years.

Each CRT display unit or printer can be located up to 2000 cable-feet from the control unit, which is connected to an external modem via a 50-foot cable.

COMMUNICATIONS: Transmission is half-duplex synchronous at speeds up to 4800 bits/second, using 8-level EBCDIC transmission code. The 8170 employs the IBM Binary Synchronous Communications (BSC) technique and is transmission-compatible with the IBM 3270 Information Display System. The 8170 provides an EIA Standard RS-232C interface and connects to a voice-grade communications facility via a modem. The following table shows the relationships between transmission speed and modem type; although Bell System modems are shown, equivalent modems from independent manufacturers (including Sanders) can be used.

Transmission Rate	Bell System Modem
1200 bps	202C/D/E/R
2000 bps	201A
2400 bps	201B/C
3600 bps	203A/B/C
4800 bps	208A/B

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT. The three standard display arrangements are as follows:

Characters/display:	480	960	1920
Lines/display:	12	12	24
Characters/line:	40	80	80

A character set of 96 EBCDIC characters, including upper and lower case alphabetics, numerics, and special symbols, is displayed in white against a dark background. Each character is formed by a standard matrix of 5-by-7 (upper case) or 5-by-9 (lower case) dots.

Beam intensity, via program control, can be switched between normal intensity and off (blanked). Characters or fields can be blinked.

SOFTWARE SUPPORT: The 8170 is supported under existing IBM software support for the IBM 3270, which includes the following IBM access methods: BTAM under DOS, DOS/VS, OS, or OS/VS2; TCAM under OS; and VTAM under DOS/VS, OS/VS1, or OS/VS2. The 8170 is also supported for use with the following IBM Program Products: VIDEO/370, DATA/360, IMS, IQF, CICS, and TSO.

DEVICE CONTROL: The 8170 operates under the control of the program stored at the computer and provides complete compatibility with the addressing sequence, command code structure, and line discipline employed by the IBM 3270 Information Display System. The 8170 responds to and executes the full repertoire of IBM 3270 commands via the control program stored in the programmable microprocessor. The control program, called On-Line I, can be loaded from punched cards, cassette tape, or the remote computer via the communications facility. On-Line I emulates all functions that are basic to the IBM 3270 and also provides enhancement, including editing and validation functions such as those related to typical data entry applications. The control program must be loaded into each Device Adapter and its associated cluster of displays.

Cursor control is functionally the same as in the IBM 3270. The controls position the cursor up, down, left, or right, either step-by-step or repetitively (if the key is held down);

Sanders 8170 Interactive Terminal System

Sanders does not provide nor support the use of a light pen or operator I/O card reader at this time. Sanders plans to implement these features around the end of 1974.

First customer deliveries are scheduled for January 1974. □

the cursor can also be backspaced one character position, moved to the beginning of the next line or the next unprotected data field, tabbed to the beginning of the next unprotected data field, and backtabbed to the beginning of the previous unprotected data field.

Program Function and Program Attention keys, a standard feature of the IBM 3270, are also standard in the 8170. Each of these keys generates a unique code that is recognized by the controlling software as a specific program request or data identifier. Program Function codes accompany the displayed data as it is transmitted to the computer, while Program Attention codes are transmitted separately.

KEYBOARD: Either of two keyboard arrangements can be specified: typewriter or data entry (keypunch). The keyboards are identical in layout and key arrangement with the equivalent IBM 3270 keyboards, and include a separate group of 12 Program Function keys located to the right of the main keygroup.

PRINTED OUTPUT: Three impact printers are available, with the following rated speeds: 30 char/second, 165 char/second, and 200 lines/minute. Each of the printers provides 132 print positions and is equipped with a 64-character set of ASCII symbols. The 200-lpm line printer is also available with a 96-character set.

Horizontal and vertical spacings are 6 lines/inch and 10 char/inch, respectively. Vertical format control, implemented via a 1-inch tape loop, is provided for both the 165-cps and 200-lpm printers. The printers accommodate pin-fed, continuous 6-part forms up to 14-7/8 inches wide via an adjustable tractor.

PRICING: The Sanders 8170 is available for purchase or on a one- through five-year lease that includes maintenance. A separate maintenance contract is available for purchased equipment. Sanders refused to provide detailed prices for the 8170, but offered the following representative prices for typical terminal arrangements:

Number of Displays *	Screen Size Chars.	Monthly Cost per Display**	Total Monthly Rental**	Purchase	Monthly Maint.
4	480	$130	$ 520	$ 20,800	$ 98
8	480	105	840	33,600	170
16	480	103	1,640	65,600	343
24	480	102	2,440	97,600	516
4	960	145	580	23,200	98
8	960	125	1,000	40,000	170
16	960	126	2,020	80,800	343
24	960	127	3,040	121,600	516
4	1920	155	620	24,800	98
8	1920	138	1,100	44,000	170
16	1920	132	2,115	84,600	343
24	1920	130	3,130	125,200	516

* Includes data entry or typewriter style keyboards.
** Monthly rental prices are for a one-year lease and include prime-shift maintenance.

Auxiliary I/O devices are priced as follows:

	Rental***	Purchase	Maint.
Printer:			
30 cps	$153	$3,425	$44
165 cps	290	5,975	71
200 lpm	405	9,675	96
Print Stand	6	175	NC
Dual Cassette Unit	85	2,550	24
Card Reader	155	2,600	25

*** Monthly rental under a one-year lease, including maintenance. ■

Scan-Data 2250 OCR, Key Entry, and Mixed Media Systems

MANAGEMENT SUMMARY

Data entry facilities can now be ordered from Scan-Data Corporation on a prescription basis. The firm is already well known for the reliability of its software-supported 2250/1 OCR Systems. In the past, however, Scan-Data had nothing to offer the user whose application environment dictated a complete reliance on keyed data entry. Now, let a user prescribe a particular keyed data entry requirement, and Scan-Data will propose and deliver a particular configuration of the Scan-Data 2250/2 Key Entry System. If the user's source data is diversified, with part of it tractable to optical scanning and the rest best suited to high-production key entry, Scan-Data now offers a tightly integrated multimedia data entry system, the 2250/3, in which data read by the optical scanner is transferred to the key entry data file and treated there like any other data by the controlling software.

The Scan-Data 2250/2 Key Entry System was announced in November 1973, and it is now available for delivery. This newest contender in the key-to-disk market was designed and is manufactured by Pertec Corporation. As of the announcement date, Scan-Data is the only distributor of the system.

The 2250/2 offers a number of striking characteristics that reflect the three years said to have been spent in its design. Up to 32 CRT keystations can be supported, and the keyboard pattern can resemble an IBM 29 keypunch, a typewriter, or a keypunch/adding machine combination. Keystations with different styles can be intermixed in a given installation. Each keyboard can execute three shifts – alphabetic, numeric, or lower case alphabetic. From the three keyboard styles, the user can fit one to the experience of the operator who will use it. For instance,

This multimedia data entry system integrates the 2250/1 OCR System with the 2250/2 Key Entry System, which supports up to 32 keystations. The combined system easily merges data from the two sections, performs extensive editing and checking of the data, and writes validated data on IBM-compatible magnetic tape.

CHARACTERISTICS

MANUFACTURER: Scan-Data Corporation, 800 E. Main Street, Norristown, Pennsylvania 19401. Telephone (215) 277-0500.

MODELS

- Scan-Data 2250/1 OCR System – an optical scanning page and document reader that identifies data prepared by typewriters, line printers, adding/bookkeeping machines, imprinters, and pencils; different fonts on the same page can be accommodated.
- Scan-Data 2250/2 Key Entry System – a stand-alone key-to-disk system that supports up to 32 keystations.
- Scan-Data 2250/3 Mixed Media System – an integrated optical scanning and multiple-station key entry system, in which scanned and keyed data is under common software control.

CONFIGURATION

The optical scanning section incorporates a program-controlled flying spot scanner, a paper transport mechanism, a minicomputer controller, an on-line CRT display, a Model 33 KSR Teletypewriter, up to four magnetic tape drives, a paper tape reader/punch, optional disk

The Scan-Data 2250/2 Key Entry System can support as many as 32 of the Scan-Plex II CRT display keystations shown here. When an optical scanner is added, the resulting configuration is known as a 2250/3 Mixed Media System.

Scan-Data 2250 OCR, Key Entry, and Mixed Media Systems

an inexperienced operator with only a typing background would obviously be more comfortable with a typewriter-style keyboard. Because a keystation can be located up to 1,000 feet from the control processor, or even 6,000 feet away with optional equipment, a station can be situated in a data source environment, away from the battery of other key operators, and a clerk can be assigned to that station.

The ability to transform any keystation into a supervisory console is also advantageous. If a remotely located clerk should need supervisory help, the supervisor can key in the proper password and then interrogate the system from that station without the need to walk back and forth.

Each keystation features three distinct operating modes for operators with varying levels of experience. In the *Formatted* mode, field names and corresponding keyed data both appear in the body of the display. These field prompters assist in job training or in expediting an unfamilar job. In the *Unformatted* mode, field names are displayed one by one on the top line of the display, and each one remains until the operator is ready to key the next field. Only data appears in the body of the display. In the *Blind* mode, the keyed data does not build up on the screen, and instead only the last character keyed is shown on the top line. Skilled operators usually regard this kind of presentation as the only one of the three that is not distracting.

Each keystation has access to 32 different program formats for an assigned job. Any or all of these control formats are available to as many keystations at the same time as desired. After the operator has finished keying a complete record, another program level automatically succeeds the previous one (format chaining). This sequence of execution can be modified manually by the operator or by the onset of conditions specified in the format programs.

The main editing and validation procedures are as follows: alpha-only entry, numeric-only entry, must enter, must complete, boundary checking, range checking, ascendancy checking, sign checking, comparison logic (greater than, less than, equal to), check digit verification (modulo 7, 10, or 11, or user-specified), crossfooting, record subtotalling, and batch totalling and balancing. The conditions for comparison tests, such as those of range checking, are specified in the format program by means of COBOL verb statements and designations of the fields to be affected. By means of these elementary COBOL statements, virtually any kind of conditional test that the user may require can be programmed into the system. COBOL statements can also be used to enter constants into registers and to mandate their insertion into records, either at the time of keying or at the time of formatting, according to specified conditions. Tables can be stored for look-up operations, and the allowable detail of the tables is limited only by the available processor and disk storage space. User effort can be negligible if simple tests are specified and more substantial if complex test routines are introduced; the system can perform tests and checks up to the degree of complexity that the user cares to install.

drive(s), and an optional line printer. An optional adjunct to the scanning system is the Scan-Plex I Key Station.

The 2250/2 key-to-disk section of the system consists of up to 32 Scan-Plex II Key Stations, a minicomputer central processor, a magnetic disk storage facility, up to four magnetic tape drives, and an optional teleprinter or line printer.

In a 2250/3 Mixed Media System, a special controller or interface channel transfers data read by the scanner to the key-to-disk central processor.

SCAN-PLEX I KEY STATIONS: Up to four Scan-Plex Key Stations can be utilized to enter characters rejected by the OCR system. In this technique a video description of an unrecognized character in bit form is stored on a magnetic disk and later displayed on the Scan-Plex screen for operator identification and keyed entry into the output tape sequence. A single nonrecognized character space is allotted 320 bits. A video representation always incorporates three spaces or 960 bits; hence, the unrecognized character is flanked by two adjacent characters. Each additional nonrecognized space adds the requirement of 320 bits more.

DEC PDP-8/E CONTROL UNIT: This is a general-purpose minicomputer that controls operation of the flying-spot scanner, the paper transport mechanism, the Scan-Plex I Key Stations, and many scanner software programs. It has a cycle time of 1.2 microseconds. The minimum capacity is 8K 12-bit words, expandable to 32K words in 4K increments.

SCANNER MAGNETIC TAPE DRIVES: These drives, available in 7- or 9-track models, can record on industry-compatible magnetic tape at 556, 800, or 1600 bits/inch.

SCAN-PLEX II KEY STATION: Consists of a video display and an electronic keyboard. It is a compact, portable, desk-top unit of the same approximate size as an office typewriter. Any keystation can be converted into a supervisory station by entering a special password. Hence, a supervisor troubleshooting a faulty station can interrogate the system from that station after keying the password.

The keyboard can have any of three standard arrangements: typewriter, standard keypunch, or keypunch/adding machine. Any combination of these keyboard styles can be mixed in a given installation. The controlling format program can specify that the station be automatically shifted into an alphabetic, numeric, or lower case alphabetic shift, or the operator can shift the keyboard manually. When the keystation is in the lower case alphabetic shift, the video display presents each character with an underline to show that it is stored in the system as a lower case character. A cursor in block form appears in the space to be filled next.

The video display is composed of 12 lines of 40 characters each. The first two lines normally present job status information (job name, current field name, current record number, current character position in the record and in the field, current program level, and current status of automatic functions). System messages appear in the third line. Data keyed by the operator, with or without format headers, is exhibited in the remaining nine lines. Semiconductor memory for refreshing the video display is contained within the keystation itself.

Three display modes are available to the operator. In the *Formatted* mode, field names are written on the screen in their appropriate places within the record, and the operator keys data into the respective blanks. This mode is helpful in training novice operators or in expediting an unfamiliar job. In the *Unformatted* mode, a field name is displayed on the first status line when the operator is ready to key the corresponding field; this name yields to the next one upon completion of the field. As the data is keyed, it is presented in the bottom nine lines in the usual way unless the format program orders that it not be displayed. Each data field is

Scan-Data 2250 OCR, Key Entry, and Mixed Media Systems

The data file in disk storage can be searched for a particular record number in a batch, for the next record in a batch carrying an error flag, for the next record having certain field contents specified by the operator, or for the next record within a particular program format having a specified field content. A record can be inserted or deleted from the batch in the Verify, Searching/Modifying, or Updating mode. The system then renumbers the batch from this point forward; if duplications or calculations have been specified, the system automatically performs these operations with respect to the appropriate record.

The ability to perform all four arithmetic operations is an extremely valuable system property. If fast turnaround on certain types of documents is needed, such as invoices, purchase requisitions, trial balances, customer account statements, etc., the system can compute data for such forms and print formatted output from keyed data even as data for other jobs is being keyed. The minicomputer can also be used during off-shift hours for data processing.

These advanced facilities are undoubtedly powerful aids to the key entry process, but are they friend or foe to optical scanning? When an optical scanner manufacturer such as Scan-Data gives sanction to the concept of key entry, a question might well be raised about the viability of scanning as a data entry technique. Nevertheless, the purpose of integrating an optical scanner within a larger data entry system is to strengthen the support given to the scanner in its own domain of superiority and to extend its ability to perform within that domain. Certainly one of the major obstacles besetting the optical scanning industry at present is user reluctance to allow the scanner to process the 80 or 90 percent of a source document that it can read as long as even a small part of the document must be keyed.

How are the diverse pieces fitted together into an organized sequence or format? Manual expedients have had to suffice up to the present time, and they often nullify the object of scanning by lowering throughput. In a multimedia system, however, the optical scanner can be programmed to scan the fields that it can read, these fields can be transmitted to the key entry disk file and stored there, and later a keystation operator can access these fields by means of appropriate identifiers and then insert the remaining fields of the document into their proper places.

Another consideration is that scanned data, like any other kind, contains errors. Sometimes the scanner is at fault, and sometimes the error is on the source document. Must detection of the error await its discovery by the central computer? The key-to-disk system has potent means of detecting errors, and it can find them promptly in scanned data, at an early point of the data entry cycle, as well as in any other kind. In this way, the penalty of errors occasioned by the scanner can be substantially reduced.

Note that these advantages would not be fully realized if the OCR and keyed data entry systems operated independently and were not merged into a single

separated by a single space or by a field separator. In the *Blind* mode, only the last character keyed is displayed, and it appears on the top status line of the screen. Transition from this mode to either of the other two is easily accomplished from the keyboard.

CONTROL PROCESSOR: This specially designed Pertec minicomputer has a 1.25-microsecond cycle time, a 16-bit word structure (plus 2 parity bits), a basic memory of 24,576 words, which can be expanded to 65,536 words in 4K increments, 1 selector channel, which can be increased to 4, and a real-time clock. All words are directly addressable.

MAGNETIC TAPE DRIVES: Six models, all intermixable, can be operated: 7 tracks, 556/800 bits/inch, at 18.75 or 37.5 inches/second forward speed; 9 tracks, 800 bits/inch, at 18.75 or 37.5 inches/second; and 9 tracks, 1600 bits/inch, at 18.75 or 37.5 inches/second. Operation of one tape drive in the system is standard, but a maximum of four is possible. Reel capacity is 600 feet or 2400 feet, depending on the model selected. These units are manufactured by Pertec.

MAGNETIC DISK STORAGE: The standard Pertec magnetic disk drive employed in the 2250/2 system has a capacity of either 2.2 million bytes on a single removable platter or 4.4 million bytes on two platters, one removable and one fixed. Additional drives can be added to the system up to 35.2 million bytes of storage, provided that an optional second Disk File Controller is utilized when the number of disk drives exceeds four. The track-to-track head positioning time is 9 milliseconds, the average positioning time is 35 milliseconds, and the maximum is 60 milliseconds. The average rotational delay is 20 milliseconds.

LINE PRINTER: The Pertec line printer employed in the 2250/2 system prints on standard fanfold forms up to 14-7/8 inches wide and can print up to 6 parts. It can operate at either 160 or 300 lines/minute, as selected by the operator, using a 64-character set.

OCR SYSTEM FONTS

The standard alphanumeric fonts available to users are the following: OCR-A upper and lower case; OCR-B upper and lower case at 10 or 12 pitch; 1403 Selectric; and Pica-72 upper and lower case. Numeric fonts are IBM 1403, IBM 407E, IBM 1428, 3/16-inch Gothic, E-13B, Farrington 7B, Farrington 12F, and NOF. When the optional handprint reading capability is installed, the system recognizes the digits 0 through 9, the letters A, C, T, and X, and the plus and slash symbols.

The Scan-Data systems also offer a self-teaching software option called SWAMI. If an unidentifiable character is degraded in a consistent manner, the system analyzes the character into a sequence of characteristics that it can henceforth associate with that character. The system will subsequently give the character the identity that is entered into the system by keying or by scanning an instruction sheet.

DOCUMENT SPECIFICATIONS

The 2250/1 OCR System can read pages or documents that vary from 5 to 11 inches in width and from 3 to 14 inches in length. The read area of machine-printed data extends a maximum of 5 inches to the left or right of the document centerline. The margins must be at least 1/4 inch at the top and bottom of the document, and at least 1/4 inch at the left and right sides. The acceptable paper weight varies from 15 to 32 pounds, and card stock is also acceptable in small documents.

OPERATING MODES

- Entry–Operator keys data from source documents under control of the format program; she can correct

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operating system. Another advantage that would be lost is reduction of system components through sharing. In a merged, multimedia system, there is no need for a separate tape drive to write scanner output tapes, nor is there any necessity for a separate printer. As explained under Configuration, the Scan-Plex I feature of the 2250/1 OCR System stores video images of character rejects and later displays them on a CRT screen independently of the scanning process for operator recognition and entry.

Prospective users should take note of the ample minicomputer storage provisions and the ability to add disk storage as needed up to 35.2 million bytes. Pertec designed the minicomputer especially for this application, and it is not offered independently at the present time.

To justify its high operating cost, a multimedia system must process large volumes of data. The 2250/3 system will therefore be of interest mainly to organizations with large-scale data entry requirements, such as insurance companies, banking and finance institutions, high-volume retailers, utilities, service bureaus, government facilities, and large manufacturers.

Scan-Data intends to service all 2250 components with its own maintenance organization.

USER REACTION

No customer installations of the 2250/2 Key Entry System or the 2250/3 Mixed Media System had been completed as this report went to press. Users of the Scan-Data optical character readers, however, describe them as medium-speed systems with good reliability. A high percentage of installations that process hand printing utilize Scan-Plex I. They credit it with raising the allowable rejection rate of the scanner. Ability to recognize conventional OCR fonts was described as outstanding. Opinion on SWAMI, the self font-teaching software package, was divided. All of the interviewed users agreed that it worked, prrovided that character degradation was not too extreme or too inconsistent, but some users expressed the view that it slowed down the overall scanning process and lowered throughput. □

errors in any character position before releasing the record to the control processor.

- Verify–An operator rekeys those fields specified for verification by the format program plus other fields that are either contributing to an out-of-balance condition or are designated by the system as containing invalid data.

- Search/Modify–Records stored in the data file can be searched and accessed by the operator according to a particular record number in a batch, by requesting the next record in a batch with an error flag, by calling for the next record having a specific data content entered by the operator, or by requesting the next record within a particular program level having a specific data content. Changes to the record can then be made in the normal way, as described for the Entry mode. Records can also be inserted or deleted from the batch; the batch is then renumbered from this point forward and any specified duplication or calculation that affects subsequent records is automatically performed.

- Update – The operator can key additional data into each of the records of an existing batch; the display cursor is automatically positioned to the beginning of the field(s) designated for Update by the controlling format program. The purpose of this mode is to enable the operator to fill in blank fields of an incomplete record stored in the data file. Usually, this situation arises from use of the scanner to read fields that it can and to let the key station operator fill in unscannable fields at a later time. Another possible situation is that of a relatively static file retained on magnetic tape or disc for periodic updates; fields to be updated are then treated in the same way as a blank field of an incomplete record. Essentially, the Update mode is a form of the Entry mode.

- Supervisor – This mode can be invoked only at a supervisory station for the purpose of supervisor/system conversation or for the performance of supervisory functions such as requesting system hard-copy printout, writing a completed batch to tape, deleting old records from the data file, etc.

- Format Entry – The specifications for a format program and all automatic operations related to it are entered into the format program library by the operator from any keystation.

The format program can inhibit a particular field from being displayed and require the operator in the Entry mode to rekey that field for immediate verification. If the two field entries agree, the system permits the operator to continue. This entry/verification feature can save time when only one or a few fields in each record require verification. Another system feature is concurrent verification, which takes place when an operator keying in the Entry mode is almost immediately followed by a second operator keying the same material.

SYSTEM OUTPUT

- Industry-compatible magnetic tape, as described under "Magnetic Tape Drives."

- Various printed business forms (invoices, requisitions, customer records, etc.).

SYSTEM PROFILE

Since the basic 2.2-million-byte disk drive can be augmented with additional storage of up to 35.2 million bytes and the minicomputer memory can be expanded to 65K words, ample storage can be added to the 2250/2 Key Entry System for implementing any desired complement of features and storing any practical quantity of data records. Therefore, the file capacities appearing below represent a typical division of the basic 2.2-million-byte disk and should not be regarded as fixed.

- Record length–can be any length up to 999 characters; there can be 99 separate fields, or even more if the fields are unusually short. If the record size is greater than can be displayed on a keystation CRT screen, the system automatically starts a new page when necessary, beginning with a reprinting of the last line of the previous page.

- Record blocking–records written to tape can be blocked up to 4096 characters.

- Record formats–for 120-character records or smaller, a 200-program library is representative of most application environments.

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- Data record storage—25,000 80-character records or 18,000 120-character records are normal limits for the data record file.

Exact figures for the number of edit routines and system management programs that can be stored will not be stated, since additional storage capacity can be added as needed to accommodate new routines.

SOFTWARE

All of the conventional keypunch operations, such as skipping, duplication, left-zero fill, line insertion, alpha-only entry, numeric-only entry, etc., are performed in conjunction with operator keying. In addition, the 2250/2 imposes such editing constraints as must enter, must skip, and must complete. Check digit verification, modulo 7, 10, or 11, is also performed. Any violations detected by these procedures disable the keyboard, and the condition must be immediately corrected by the operator. Another useful feature is auxiliary duplication, which consists of emitting constants up to 120 characters long at positions within the record specified by the format program.

An advanced feature of the 2250/2 is "COBOL-procedure programming." Almost 40 COBOL and other procedural-language verbs are available, including Alarm, Call, Compute, Connect, Display, Dup, Field Backspace, Find, If, Move, and Tab. Use of the verbs Allow and Disallow can effect a broad range of character and field validity checking that is limited only by the available processor memory and disk space on the file. The user can also program arithmetic comparison conditions. For example, the operator must enter a certain field if the entry in a prior field exceeds a certain quantity. Or, the quantity entered within a certain field must fall within a specified range (range checking) if the quantity entered in a prior field is less than a certain quantity. Program statements are used to enter the limits of range checks, and to enter a set of table look-up values. If simple range-checking or table look-ups are to be performed, programming with the COBOL statements is not much different from the straightforward entry of parameters common to other systems.

An interesting property conferred by COBOL programming is the ability to alter program level sequencing in accordance with specified conditions. Hence, a particular sequence can be automatically instituted under one condition, and a different sequence can be implemented under another condition, all program-specified.

Extensive crossfooting within each record can be carried out. These totals can be added to those accumulated in previous records.

To implement batch balancing, a predetermined batch total is entered into the system. After the entire batch has been keyed, the aggregate of these entries must equal the predetermined entry. If an imbalance occurs, the batch is flagged to signify that it requires supervisory attention. The records of this batch need be verified only until correction of an error or errors produces a batch balance.

REGISTERS: The following allocation of registers is available to every batch stored in the system:

- Up to 99 character registers, each containing up to 120 characters, are available for storing characters or fields to facilitate their manipulation.
- Up to 99 auxiliary duplication registers, also containing up to 120 characters each, are available for storing and emitting constants.
- Up to 99 balance registers are available for accumulating crossfooting totals and batch totals.
- Up to 99 arithmetic registers are available for COBOL arithmetic operations.

Any register can be displayed on the message line of a keystation CRT screen. Arithmetic registers, in conjunction with COBOL verbs specifying each of the four arithmetic operations, enable elementary data processing to be performed on entered data prior to its release to the output tapes. If the user wishes, he can program various basic operations that are ordinarily performed by the mainframe.

REFORMATTING: In the standard form of the 2250/2 system, fields within a record can be rearranged before writing the record to tape. The records, which must all be of the same length, can be blocked up to a limit of 4096 characters. Constants can be emitted into appropriate field locations at this time as well as during the keying operations. Headers and trailers for the output blocks are inserted. Data obtained by processing keyed data through arithmetic operations or accumulations can also be emitted into the reformatted record. If more complicated reformatting is desired, such as composing entirely new records by abstracting designated fields from stored records, appropriate COBOL statements can be entered into the system.

SYSTEM OPERATION

Output data from the OCR system is transferred to the key entry control processor either record-by-record or in blocks. Once stored in the key entry disk file, this data can be treated in the same manner as keyed data. In particular, it can be subjected to check-digit verification, totalling, and batch balancing. These checks have the ability to detect errors before the data is written to tape. A keystation operator can access the faulty records and key in corrections from the source document. This procedure is especially helpful in correcting scanning errors arising from handprinted numerics.

Note that data obtained from the scanner can be reformatted by the key entry program. It follows that the fields of the source document can be organized in any convenient manner, since they are later rearranged by the system into the desired output form.

Activity at the key entry installation is essentially like that of other key-to-disk systems. The supervisor maintains tight control over all system personnel and operations. She enters job and batch numbers, assigns the keystation operators, designs new program formats and enters them into the program library (or assigns the entry task to an operator), releases completed and reformatted batches on the disk file to tape, deletes outdated records or programs from the disk, requests system information and status messages, and causes printouts of various kinds of information. Operator statistics, which consist of the operator's identity, the time elapsed in keying a batch, the number of keystrokes, the keystrokes per hour, and the number of inserts, deletions, and corrections, represent a particularly useful system printout that the supervisor can specify. The operator and supervisor are assisted by nearly 100 prompts and nearly 100 messages describing system conditions.

Any keystation can be converted to a supervisory station by keying in a special password. Other passwords limit access to batches, records, or fields to authorized persons.

ERROR CONTROL: Parity generation and checking is performed on data transferred between the computer and disk and between disk and tape or other output devices. Odd parity is written on 9-track tape, and either odd or even parity on 7-track tape. Longitudinal and cyclic redundancy characters are created and written on disk and tape. A read-after-write check is performed on both tape and disk. Data written on a disk is read during the next revolution and compared with the original data in core; erroneous data is immediately rewritten. A read check is performed when reading from the disk. Validation and other errors cause electronic blocking of the keyboard and sounding of a tone. If desired, the operator can override errors and flag the record for later action.

Scan-Data 2250 OCR, Key Entry, and Mixed Media Systems

COMMUNICATIONS: Limited communications is available in the 2250/1 and 2250/3 systems from the OCR PDP-8/E processor, but at present the 2250/2 has no communications capability. An announcement is expected in the second quarter of 1974.

PRICING

The pricing plan for the Scan-Data 2250/2 Key Entry System omits mention of purchase prices, and lists monthly rentals for two- and three-year leases. Maintenance charges have been incorporated into the lease costs that follow, and these charges cover the prime-shift hours of 8 a.m. to 5 p.m., Monday through Friday. Additional charges are made for service at other hours. Scan-Data performs maintenance service from offices in 20 major cities in the United States. Distributors perform this service in Canada, Europe and Japan.

The table below lists charges for basic installations in terms of the number of CRT keystations only, and purposely excludes scanner system costs. Another assumption is that only one tape drive is operative and no other peripheral devices are installed. It is further assumed that 32K words of processor memory are employed for 15 stations, 40K words for 24 stations, and 48 words for 32 stations. Similarly, a 2.2 million-byte disk drive is assumed for a 15-station installation, and a 4.4 million-byte disk drive is assumed for the larger installations. Prices for both two- and three-year leases are presented. The table is meant to facilitate cost comparison of the 2250/2 system with competing systems. The table is also intended to help the user determine the increment of operating cost represented by the scanning function that he decides to incorporate.

	Cost per Station		Total Monthly Rental	
No. of Stations	2-Year Lease	3-Year Lease	2-Year Lease	3-Year Lease
15	$216/mo.	$194/mo.	$3,235	$2,920
24	192/mo.	173/mo.	4,610	4,150
32	179/mo.	161/mo.	5,740	5,160

Each keystation, with any selection of keyboard style, leases for $85/month on a 2-year contract and for $75/month on a 3-year contract. A Scan-Plex Control Unit with a 24K-word memory, consisting of a 2.2-million-byte disk drive, a tape drive controller for either 7 or 9 tracks and 556 or 800 bits/inch (capable of supporting up to 4 drives), a magnetic tape drive of compatible specifications, a Scan-Plex II Controller (capable of supporting up to 32 keystations), and 4 keystations, leases for $1,850/month on a 2-year lease and $1,685/month on a 3-year lease. Prices for the various system options follow.

Device	2-Year Lease	3-Year Lease
4K-Word Memory Increment	$225	$205
Dual-Density Controller; 800/1600 bpi	165	150
1600-bpi Tape Drive instead of 800 bpi	75	70
37.5-ips Tape Drive instead of 18.75-ips	100	90
7-Track, 556/800-bpi, 18.75-ips Tape Drive (600-foot reel)	275	250
9-Track, 800-bpi, 18.75-ips Tape Drive (600-foot reel)	275	250
9-Track, 1600-bpi, 18.75-ips Tape Drive (600-foot reel)	350	320
7-Track, 556/800-bpi, 37.5-ips Tape Drive (2400-foot reel)	375	340
9-Track, 800-bpi, 37.5-ips Tape Drive (2400-foot reel)	375	340
9-Track, 1600-bpi, 37.5-ips Tape Drive (2400-foot reel)	450	410
Additional Disk Controller (1 x 4)	220	200
Additional Disk Drives:		
Single Platter (2.2 million bytes)	400	365
Dual Platter (4.4 million bytes)	560	510
Single Platter to Dual Platter Upgrade Option	160	145
Supervisory Teleprinter (33 RO)	65	60
Line Printer (132 columns, 64-character set, 300 lpm)	540	495

The basic OCR System, as described in this report and having an OCR-A or OCR-B full alphanumeric font (upper case only), carries a purchase price of $215,000 and a separate maintenance contract of $925/month, or it rents for $5,925/month on a 2-year lease and $5,425/month on a 3-year lease, including maintenance. Pricing information for the many available options can be obtained from the manufacturer, including pricing of alternative fonts. When OCR and key entry components are integrated into the 2250/3 Mixed Media System, the combined cost is less than that of the components quoted separately. ■

Singer 4300 Magnetic Data Recording System

The Singer 4300 System is now directed primarily toward the data communications market, although conventional data entry applications are also supported. The 4300 is available as free-standing key-to-tape units or in multi-keystation configurations where a common tape at a central station consolidates the entries from several keystations.

MANAGEMENT SUMMARY

The Singer 4300 System, a very flexible, hard-wired key-to-tape system, was originally designed as a key-punch replacement for low- to high-volume data preparation applications. The original 4300 System, initially delivered in January 1970, was a bare-bones product without frills or extra features, such as data communications.

Singer has since recognized a substantially greater potential for its 4300 System in the data communications market and has reacted accordingly. The original 4300 product line spawned a new 4300 System designed to impact two market areas: data communications and data preparation. Thus, the current 4300 System, which was initially delivered in March 1971, is split into two groups: the 4310 Series, oriented toward data communications, and the 4320 Series, oriented toward data preparation. The two groups are fully compatible with one another. Although the original 4300 System is essentially dead, Singer maintains limited production of two members, a Data Recorder and a Data Keyboard, to satisfy customers who don't need the capabilities of the newer models and are not willing to pay for them.

The 4300 System provides the user with the essential components necessary to tailor a key-to-tape installation from stand-alone units, a multiple keyboard system, or a combination of both. The system components include Data Recorders (with integral keyboards), keyboard-only units, and a Central Pooler unit.

The 4300 System can be logically grouped into one of two basic configurations: (1) a small-scale configuration ➤

CHARACTERISTICS

SUPPLIER: Singer Business Machines, 2350 Washington Avenue, San Leandro, California 94577. Telephone (415) 357-6800.

MANUFACTURER: Pertec Business Systems, 17112 Armstrong Avenue, Santa Ana, California 93705. Telephone (714) 540-8340.

MODELS: 4301, 4311, and 4321 Magnetic Data Recorders, 4302 and 4322 Magnetic Data Keyboards, and 4314 Magnetic Data Central Pooler.

CONFIGURATION: The Magnetic Data Recorder is a stand-alone key-to-tape unit that, as an option, can function as a central pooler and can accommodate any mix of up to eight additional Magnetic Data Recorders and Magnetic Data Keyboards.

The Magnetic Data Keyboard is a keyboard-only unit with integral display intended for use in a multiple-keyboard installation where all keyboards are connected to a common tape station (central pooler).

The Magnetic Data Central Pooler is composed of a separate keyboard and magnetic tape unit and can accommodate any mix of up to 64 Magnetic Data Recorders and Magnetic Data Keyboards.

TAPE OUTPUT: 7- or 9-track industry-compatible. Tape movement is reel-to-reel at 12.5 inches/second for Models 4301, 4311, and 4321 and at 40 or 37.5 (1600 bpi only) inches/second for Model 4314. The 4314 Central Pooler accommodates a 10.5-inch reel (2400 feet of tape); the Magnetic Data Recorders each accommodate a 7-inch reel (600 feet of tape).

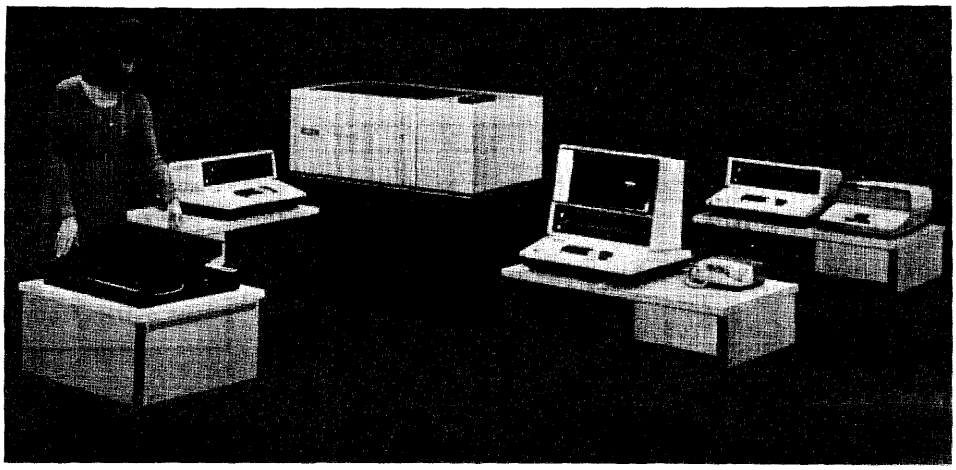
Recording densities are 200, 556, or 800 bits/inch (7-track) and 800 or 1600 (Model 4314 only) bits/inch (9-track). Record length is programmed and is completely variable, in increments of one character, from 20 to 200 characters.

DEVICE CONTROL: Programs are stored in an independent core buffer. Provision is made for storing two programs simultaneously, with manual switching between the programs.

The program controls the format of data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, or right justification (left-zero fill). New programs are entered manually by keying or automatically from magnetic tape.

Operating modes include Data Enter/Verify, Merge, Search, Receive, Send, Program Enter, and Read Tape. In the Enter mode, all data for a complete record is accumu- ➤

Singer 4300 Magnetic Data Recording System



The Singer 4300 System, manufactured by Pertec Business Systems, includes several components that can be assembled in different configurations according to the application. Shown here (left to right) are the 4314 Central Pooler (tape unit and keyboard), line printer, 4311 Data Recorder (with DataPhone), and 4322 Data Keyboard with calculator (Printing Totalizer feature).

that includes a Data Recorder and a pooler adapter with any combination of up to eight attached Data Recorders and keyboard-only units, or (2) a large-scale configuration that includes a Central Pooler with any combination of up to 64 attached Data Recorders and keyboard-only units. The Data Recorders, because they are stand-alone units, can be used in a non-pooling environment; obviously, the 4302 keyboard-only units are restricted to a pooling environment.

During the data entry operation, the record is stored in a buffer until it is released to tape. Once a record is released to tape from a keyboard-only unit, the record is merged at random with records from other input stations on the pooling chain. Unless the record is immediately verified prior to releasing it to tape, it is difficult to imagine searching for it at a later time to verify its accuracy. The normal key-entry procedure is to enter all records in a given batch before verifying. For this reason, Singer is primarily marketing 4300 Systems equipped with keyboard-only units for use in a non-verifying environment. If verifying is required, the Magnetic Data Recorder can be specified.

The resident keyboard included with the Central Pooler is intended to be used for accessing new programs from tape to supply the entire network. This capability is also provided with the pooling adapter option for the Magnetic Data Recorder.

The 4310 Series is equipped for Binary Synchronous Communications and can act as a remote terminal to an IBM System/360 or 370 computer or a Singer System Ten computer. Also, individual members of the 4310 Series can communicate with one another or with an IBM BSC terminal such as the 2770. The 4310 can operate in a point-to-point or multi-point environment under polling and selection by the remote computer.

The 4320 Series features two options not available with the 4310: check-digit verification and a printing totalizer. which includes a Singer (Friden) printing calculator.

lated in a data buffer prior to writing on tape. In the Verify mode, a complete record is read from tape into the buffer memory and compared character for character with the data keyed by the operator from the source document. The Search mode allows a record to be found with the same identifier as that keyed in by the operator; any portion of a record can be used as an identifier.

The Merge mode allows previously recorded data such as a batch of records to be transferred to a Central Pooler and merged on a single tape with record batches from other recorded tapes. Program Enter and Read Tape modes allow programs to be manually entered via keyboard or automatically entered from magnetic tape. The Central Pooler option allows the Data Recorder to operate as a pooler. The Send and Receive option (Models 4311 and 4314 only) allows operation in a communications environment.

Display of current location within a record, data character and program code stored at the current location, and error status is provided by a backlighted keyboard display panel. All this information can be read directly from the display without code translation.

ERROR CONTROL: Conventional read-after-write checking is performed as tape records are written. Character parity is produced along with character generation for each key depression, and is checked when the data is transferred to the buffer. Character parity is also checked when data is read from the buffer.

Following the writing of each record, the tape is backspaced and the record is read and compared bit for bit with the data retained in the buffer. This feature applies equally in the Verify mode when a record is corrected. This bit-for-bit comparison between recorded data on tape and data retained in the buffer is performed on the Data Recorders and Central Pooler. On the Central Pooler, however, the tape is not backspaced; the operation is performed simultaneously with the recording operation.

The Check Digit option (Models 4321 and 4322 only) performs a validity check on selected numeric fields when they are keyed or read from tape in the Data Verify mode. Mod 7, 10, or 11 checking can be specified; several current versions of each are available.

KEYBOARD: 49-key keypunch style; the keyboard, similar to that of the IBM 29 Card Punch, can produce any of 64 character codes that include 10 numerics, 26 alphabetics, and 28 special characters including space.

Singer 4300 Magnetic Data Recording System

> The totalizer feature prints the sum of each of two defined groups of numeric fields within a record as well as the accumulated sum from several records.

Singer has strengthened the 4300 System by adding several I/O devices including three printer models, a paper tape reader, and a card reader. Users oriented toward paper tape or punched cards can transcribe the data onto magnetic tape for transmission to a remote computer.

According to Singer, over 6000 units of the 4300 System have been delivered to more than 1500 users.

Users' comments about the Singer 4300 have been highly favorable. Some are using the 4300 System for a dedicated data preparation environment, while others are interested only in communications. One user commented that he replaced an IBM 2770 and will be communicating with an IBM System/360 Model 50 in a HASP environment. Service has been rated as ranging from good to excellent. □

➤ **Up to 14 control keys provide for initiating functions such as manual duplication, skipping, and left-zero fill, Program One or Two selection (as an alternate to that selected), alpha or numeric mode initiation, error correction, etc. Singer states that it does not provide repetitive entry because this facility frequently leads to operator errors.**

POOLING: Allows short tapes to be consolidated into one longer tape. The 4300 System provides two distinct pooling configurations to permit pooling any combination of up to 8 or 64 Magnetic Data Recorders and/or Keyboards.

COMMUNICATIONS (Models 4311 and 4314 only): Duplicates IBM Binary Synchronous Communications (BSC) discipline. Transmission is half-duplex, synchronous at a specified rate from 600 to 9600 bits/second. Timing can be provided internally or via a modem.

Either ASCII or EBCDIC data codes can be specified. The modem interface is designed to EIA Standard RS-232C. Transmission is compatible with the Singer System Ten computer and with the IBM 2701 Data Adapter Unit or 2703 Transmission Control equipped with a Synchronous Data Adapter Type II. Communications is supported between 7- and 9-track models; however, both the transmitting and receiving units must employ the same data code (i.e., ASCII or EBCDIC).

PRINTER (for Models 4311, 4314, and 4321 only): Three printers are available: a 450-lpm drum printer (Model 4350), a 100-lpm chain printer (Model 4352), and a 30-cps thermal printer (Model 4325). All provide 132 print positions, a 64-character set of symbols, and horizontal and vertical spacing of 10 chars/inch and 6 lines/inch, respectively.

READER (for Models 4311, 4314, and 4321 only): Input devices include an 80-column card reader and a paper tape reader for 5- through 8-level tape codes.

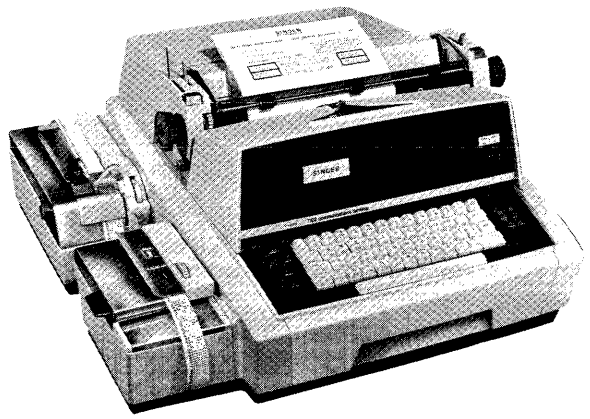
PRICING: The Singer 4300 Magnetic Data Recorder System is available for purchase or for lease for a one-, three-, or five-year term. The monthly lease prices shown below include maintenance. A separate maintenance contract is provided for purchased equipment. Prices are as follows:

	Monthly Rental*			
	1-Year Lease	5-Year Lease	Purchase Price	Monthly Maint.
Data Recorders				
Model 4301 (7- or 9-track)	$118	$108	$4,500	$22
Model 4311 (7-track)	131	120	6,000	24
Model 4311 (9-track)	151	139	6,900	24
Model 4321 (7-track)	131	120	6,000	24
Model 4321 (9-track)	151	139	6,900	24
Data Keyboards				
Model 4302	63	58	2,775	12
Model 4322	88	81	3,700	12
Central Poolers				
Model 4314 (7 track)	226	208	10,125	44
Model 4314 (9 track)	246	226	11,625	44
Options				
Printing Totalizer**	70	64	3,950	21
Communications	64	59	3,150	16
Reverse Channel	16	16	650	5
Check Digit	15	14	675	5
Pooling Adapter	16	15	750	4
Printers–				
450 lpm**	445	390	18,000	140
100 lpm**	262	231	13,365	73
30 cps**	142	127	5,950	33
Readers–				
Tab Card**	151	136	6,250	29
Paper Tape**	129-159	117-144	4,950-6,150	41
Work Station (table)	5	5	175	0

* Includes prime-shift maintenance.

**Prices include cost of required adapter interfaces; price range for Paper Tape Reader reflects cost of optional spooler mechanism. ■

Singer 7102 Communications Terminal



The 7102 is a Singer Flexowriter typewriter with integral communications interface, paper tape reader, and paper tape punch. It can function as a low-speed communications terminal, an input preparation device, or an office typewriter. Edge-punched card/paper tape equipment can be substituted for the standard paper tape equipment.

MANAGEMENT SUMMARY

The Singer 7102 Terminal is based on the well-known Flexowriter line of automatic typewriters. It is one of the few typewriter terminals on the market today that use a type bar and moving carriage mechanism similar to that of conventional manual or electric typewriters.

The 7102 is designed for general-purpose data communications between two terminals or between a terminal and computer (as in time-sharing).

Although the transmission code used is ASCII, the 7102 is not in general directly compatible with other terminals or most time-sharing services operating within the speed range of the 7102. When receiving and printing, the time period required for a carriage-return/line-feed operation (which can be just over one second) must be filled with NUL or DEL characters; this time is longer than on an equivalent Teletype unit, for example. The time-sharing software would need to be slightly modified to prevent transmission of data following a carriage-return/line-feed before the terminal was ready to accept it.

Through the Flexofeed or pin-feed platen options, pin-fed forms can be accommodated. The Flexofeed option is adjustable for different-width forms. Pin-fed forms are used where accurate registration is required, such as for filling in spaces on pre-printed continuous forms.

The two-color ribbon option permits separation by color of transmitted and received data. This may be of some value in facilitating back references to dialogs between the operator and a computer in a time-shared environment.

To prevent scrambling when data is keyed faster than the logic can accept, a two-character buffer is included.

CHARACTERISTICS

MANUFACTURER: Singer Business Machines, 2350 Washington Avenue, San Leandro, California 94577. Telephone (415) 357-6800.

COMMUNICATIONS: Asynchronous in the half- or full-duplex (required for break feature) mode at 10 or 12.2 characters per second.

The transmission code is 8-level ASCII (including even character parity), using a 10- or 11-unit code structure that includes a start and one or two stop bits.

A serial interface is standard; data is transmitted over a narrow- or voice-band facility via a modem compatible with the Bell System 103A or 103F Data Sets.

DEVICE CONTROL: Received control codes such as carriage return, line feed, and horizontal and vertical tab initiate the corresponding function within the 7100.

Manual controls are provided for the paper tape reader, paper tape punch, and the printer.

Two of three manually-selected print modes permit: (1) printing received data in black and transmitted data in red (or vice versa with option), or (2) printing transmitted and received data in black, In both modes, the engraved key-top symbol corresponding to the transmitted control code is printed in red; received control codes are not printed.

The third print mode causes received or transmitted data (except for control codes) to be printed in black. Control codes, represented by the corresponding key-top symbol, are printed in red. Received horizontal tab and backspace codes are printed as "I" and "H" and the respective functions are inhibited.

The operator can elect to inhibit printing of transmitted and received data via the Print Inhibit option.

Other controls cause operations such as starting, stepping, and stopping the paper tape reader; feeding and punching null codes into paper tape; or, with options, punching delete codes into paper tape or edge-punched cards.

A printer control establishes printer on-line/off-line operation. When on-line, data received from the reader, communications facility, or keyboard is printed; off-line operation divorces the keyboard and printer from the other devices and permits concurrent operations to be performed.

Singer 7102 Communications Terminal

Such over-keying occurs most frequently when inputting highly familiar short words such as "the" or for endings such as "ing."

The 7102 has been a successful product for Singer based on the number of units delivered—reportedly several thousand. Its level of acceptance has been achieved largely through user familiarity with the Flexowriter design and the low cost of paper tape. However, the 7102's market life appears to be waning as Singer shifts its focus from paper tape to magnetic tape. □

As an option, the reader, punch, or printer operation can be controlled via the Automatic Device Control, which initiates or terminates device operation through ASCII control codes received from the communications facility or read from paper tape.

Remote interruption, via a received break signal, interrupts the transmission from the 7102 only when the reader is operating. This feature requires a full-duplex communication facility.

ERROR CONTROL: Even parity accompanies each character generated from the keyboard and transmitted, but is not generated from reader-entered data.

As an option, the parity of characters received from the communications facility is checked and a red upper-case M is printed and/or a delete code is punched into paper tape or edge-punched cards in place of a character received in error.

KEYBOARD: 53-key typewriter style. Keyboard can produce any of 128 ASCII character codes including upper- and lower-case alphabetics, numerics, specials, and control characters. A break key generates a continuous space signal when depressed. The basic keyboard is supplemented with device-control keys. Control characters are engraved on the front edges of the keys.

PRINTER: Prints data received from the communications facility, entered from the keyboard, or read from paper tape of edge-punched cards.

Rated printing speed is 10 or 12.2 (optional) characters per second.

Prints a total of 89 ASCII characters; control codes are represented by the corresponding upper-case letter engraved on the key occupied by each control character.

The printer accommodates friction-fed or pin-fed (optional) roll paper or fanfold forms up to 14 inches wide; the writing width is 13.5 inches.

Horizontal spacing is 10 characters per inch; vertical spacing is 6 lines per inch.

The optional Flexofeed forms handler accommodates sprocketed forms having various widths.

PAPER TAPE READER: Reads fully punched one-inch 8-level paper tape at a rated speed of 12.2 characters per second. The reader is code insensitive and thus capable of reading any 8-level code. Mechanical sensing is employed.

The standard reader can be replaced with the Edge-Punched Card/Paper Tape reader option, which has the same characteristics as the standard reader but can also read edge-punched cards.

PAPER TAPE PUNCH: Punches one-inch 8-level paper tape with data received from one of three selected sources: keyboard, paper tape reader, or communications facility.

The rated speed is 12.2 characters per second. Punches ASCII code when data is received from keyboard; any 8-level code can be punched when receiving from another data source.

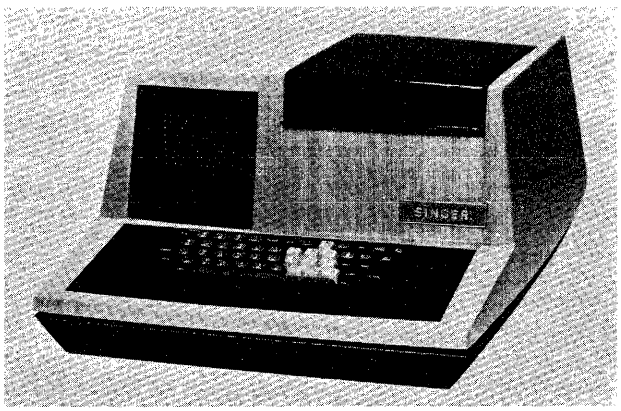
The standard punch can be replaced with the Edge-Punched Card/Paper Tape Punch option, which has the same characteristics as the standard punch but can also punch edge-punched cards.

PRICING: The 7102 is available for purchase or on a one-year lease. The lease price includes maintenance. A separate maintenance contract for purchased units is priced at $237 per year.

The standard 7102 is priced at $140 per month or $4,750 purchase. Substituting the Edge-Punched Card/Paper Tape Reader and Punch for the standard reader and punch increases the cost to $150 per month or $4,950 purchase.

With the addition of all other options, including Print Inhibit, Receive Parity Check, Automatic Device Control, and Pin-Feed Platen, the price of the 7102 is increased to $172 per month or $5,585 purchase. ■

Singer 1500 Intelligent Terminal System



The compact 1501 Workstation houses a 5-inch CRT display, keyboard, miniprocessor with 8K bytes of semiconductor memory, and dual magnetic tape cartridge transports. A communications interface is optional.

The heart of the 1500 system is a desk-top, operator-prompting workstation that features a unique dual cartridge tape transport, a CRT display, optional communications interfaces, and a miniprocessor. On-site data entry and data processing are the chief applications.

MANAGEMENT SUMMARY

The Singer 1500 Intelligent Terminal System emphasizes data entry and data processing in a source data environment and is distinguished by certain unique design features. This uniqueness is derived largely from the 1501 Workstation's dual tape transport system, which employs snap-in cartridges instead of cassettes or reels. As the name of the product implies, Singer is also promoting the Workstation and its peripheral devices as key elements in data entry/communications complexes. The Model 1501 Workstation is thus a compact, desk-top, general-purpose data entry device or intelligent terminal, and in either case it can be part of a sophisticated communications system.

The attractive console contains a 5-inch CRT display and either a keypunch-style or typewriter-style keyboard. At the top of the console, easy access is provided to the snap-in cartridges of the internal dual tape transports. Other vital parts include a serial I/O interface, a miniprocessor and 8K-byte semiconductor memory, and an optional communications interface, asynchronous or binary synchronous (BSC).

As an intelligent terminal, the 1501 Workstation can be useful in many kinds of business applications. The tape cartridge system makes it easy to change the programming from one application to another. One merely snaps in another cartridge containing the new application program, and the tape transport loads it into the processor. In either type of service – data entry or intelligent terminal – the addition of a synchronous or asynchronous communications adapter turns the Workstation into a communications center, day or night.

Let us see what makes the tape transport unusual. The mechanism employs reel-to-reel design principles, although a cartridge rather than an open reel is employed. The advantage of a simple replacement of cartridges is thereby gained without sacrificing the reliability of reel-to-reel operation. Tape is automatically threaded and

CHARACTERISTICS

SUPPLIER: Singer Business Machines, 2350 Washington Avenue, San Leandro, California 94577. Telephone (415) 357-6800.

CONFIGURATION: The hub of the 1500 system is the Singer Model 1501 Video Display Workstation, which can be connected to as many as 64 individual peripheral devices via an internal serial I/O interface. Examples of such devices are the Model 1511, 1512, 1513, and 1514 Tape Drives, the Model 1525 Serial Printer, the Model 1552 Line Printer, and similar equipment that the user might supply.

Singer 1533 Dual Tape Cartridge Drives and the Model 1530 Numeric Keypad interface directly with the internal miniprocessor, as does the Model 1535 Synchronous Communications Adapter or the Model 1534 Synchronous Communications Adapter or the Model 1534 Asynchronous Communications Adapter, both of which are installed inside the Workstation housing. An appropriate modem, such as the Singer Model 2024, interfaces a voice-grade communications line to the adapter.

MODEL 1501 WORKSTATION: As the center of system activity, this unit serves both as a data entry device and as an intelligent terminal. It is a single desk-top console that incorporates two cartridge tape drives (exactly like the Model 1533, but internally mounted), a keyboard, a CRT display, a solid-state 8K-byte memory, a miniprocessor, and a serial I/O interface. Data transfer on the coaxial cable connected to the I/O interface is bidirectional; hence, one line can service all attached peripheral devices. The transfer rate is 24,000 bytes/second in bit-serial form. When a system configuration includes multiple 1501 Workstations attached to the I/O interface, each 1501 can communicate with any other station and any other I/O device under program control.

KEYBOARD: The keyboard comprises 53 keys, which can be arranged in either a keypunch or typewriter pattern. Other arrangements are available upon request. An audible keying cue is provided.

CRT DISPLAY: Up to 256 characters can be displayed in 8 lines of 32 characters each on a 5-inch CRT screen. Characters are formed from a 5-by-8 dot matrix. The screen is refreshed directly from the MOS memory. For the information it displays, the screen has direct access to memory areas as well, and these are program-selectable from any one of 16 memory pages (256 bytes per page). Selective interlacing of half-pages is possible. Other providions include a nondestructive cursor (underscore), selective blanking, and the ability to vary the display characters in accordance with special user needs, such as German umlauts, Arabic symbols, etc.

CARTRIDGE TAPE DRIVES: Each Workstation contains two mechanically independent tape transports that employ polyester magnetic tapes one mil in thickness and 150 mils wide. These transports utilize a special heart-shaped cartridge. The cartridges, which normally hold 100 feet of tape, are snapped into place, and the tape is then automatically threaded and loaded on the take-up reel. The manufacturer claims exceptional reliability for this unique design.

Singer 1500 Intelligent Terminal System

rewound. A friction capstan is used to drive the tape, and the tape speed itself is under servo control.

Data records on the 0.15-inch-wide cartridge tape must be converted to computer-compatible format for entry into a computer. However, data on the cartridge tape can be transmitted over communications lines, as can data on standard tape. The 100 feet of tape in a standard cartridge can hold 900 records of 136 bytes each. A 200-foot cartridge is also available for applications that require data files on the cartridge.

The disadvantage of the cartridge arrangement stems from the same factor that gives it its strength; i.e., it is unique. The number of suppliers handling the cartridges is limited.

An integral facility of the 1501 Workstation is a serial I/O interface, to which up to 64 I/O devices can be connected. These include the Model 1525 Serial Printer and the Model 1552 Line Printer, as well as a number of magnetic tape units that can be used to transcribe data from the cartridge tape to computer-compatible tape. In addition, the user can connect peripheral devices of his own as needed. Data transfer over the I/O cable is bidirectional, so that one line suffices for all activity. Phase-encoded techniques and address polling make operation economical and flexible without degrading reliability and throughput. The transfer rate is 24,000 bytes/second.

Other I/O devices, such as the keyboard, the 1530 Numeric Keypad, and add-on 1533 Dual Cartridge Transports, interface directly with the internal processor. The CRT display has direct access to the 8K-byte memory. As mentioned previously, the optional communications interfaces can be mounted internally. Data can then be directed to a transmission line through an appropriate modem. All major system functions are under the direct control of the controlling processor program. These provisions enable the user to add compatible peripherals and interfaces at will without interruption to Workstation activity. Furthermore, system functions can be changed or modified by simply loading a new tape program from the software library, or by selecting options within a single program.

The procedure for preparing a Workstation for use has implications that should be understood. Fully developed and tested programs are stored on cartridge tape. An appropriate cartridge is inserted into the tape transport mechanism, and when the tape is run, the program is entered into memory. Now the Workstation is capable of performing specific functions. It can generate and print an accounting form such as an inventory control sheet, a tax form, a purchase requisition, or a bill of lading, to name a few examples. Arithmetic operations such as add, subtract, and multiply can be carried out.

Alternatively, the programs read from the tape can prepare the system for data entry. The record formats intended for a specific job are written at the beginning of every tape. Instructions to link the formats automatically in either direction are included. Instructions for skipping, right and left justification, and duplicating are a basic part of the record format. Constants and constant fields can be stored in memory. Several categories of omission detec-

Singer now supplies cartridges that contain 200 feet of tape. This doubling of capacity is made possible by tape that is 1/2 mil in thickness compared with the standard 1 mil.

Built-in sensors detect three tape status conditions: the presence of a cartridge properly loaded, tape not fully rewound, and end of tape. Mechanical interlocks prevent cartridge removal except when tape has been fully rewound into the reel, and they prevent tape motion except when the cartridges are properly seated in their holders. A write-enable pin must be properly inserted into a specified side of the cartridge to permit erasing or recording.

Tape formatting, read forward/backward, and read/write checking are all under processor control. Record size, inter-record gaps, check data, and number of retrys are software parameters. Under the standard software, each cartridge has a nominal capacity of 1000 records of 128 bytes each.

Data is serially recorded by bit at 1600 bpi by means of phase encoding. The record length can be specified as either 128 or 80 bytes. Read/write tape speed is 10 inches/second. A high-speed mode, utilized during rewind and for bidirectional searching, moves the tape at 40 inches/second. Records are counted during high-speed searching.

Hardware logic is provided to allow reading backward without the need of software intervention to invert and shift the data. An 8-bit buffer holds a character on cue for 512 microseconds; during this time, data can be processed before the character is released.

CONTROL PROCESSOR: This unit has 45 instruction types plus a serial I/O channel, a 3 to 6 microsecond instruction cycle time, 1 accumulator, 7 index registers for each 2K bytes of memory, a 16-member instruction address stack, a stack pointer, and a hardware bootstrap loader. Supporting the miniprocessor is a solid-state memory of 8K bytes. External tape transports and the keyboard interface with the processor via separate channels rather than the I/O interface.

MODEL 1533 DUAL TAPE CARTRIDGE TRANSPORT: These units are duplicates of the dual-transport drives that are self-contained in each Workstation. Up to three additional dual-drive units can be connected in series with the 1501 Workstation to expand the total tape facility of the Workstation to a maximum of eight drives. The external drives serve as an auxiliary storage medium for the 1500 system. They can also be used with standard 1500 software for cartridge file sort/merges.

COMPUTER-COMPATIBLE MAGNETIC TAPE UNITS: Aside from data communications, information exchange between the Model 1501 Workstation and other data processing systems is effected by means of the Model 1511/1512 and 1513/1514 tape drives. The main purpose of these drives is to permit data recorded on cartridge tape to be transcribed to standard half-inch, computer-compatible magnetic tape for direct computer entry or other purposes. The first pair of drives employs 7-inch reels, and the other pair employs standard 10-1/2-inch reels. The 1511 produces output tape recorded at 556 or 800 bpi on 7-track tape, while the 1512 records at 800 bpi on 9-track tape. The 1513 records at 800 bpi and the 1514 records at 1600 bpi, both on 9-track tape.

MODEL 1552 LINE PRINTER: Prints on continuous paper forms at 90 to 110 lines/minute, 132 characters/line. Horizontal character spacing is 10 characters/inch, and vertical line spacing is 6 lines/inch. Coding is ASCII.

MODEL 1525 IMPACT PRINTER: This low-cost serial printer operates asynchronously at speeds up to 30 characters/second. Line length is 132 characters. Spacing is 10 characters/inch horizontally and 6 lines/inch vertically. A 64-character ASCII character set is employed.

COMMUNICATIONS: One medium of communication among two or more 1501 Workstations is the coaxial line of

Singer 1500 Intelligent Terminal System

tion can be implemented. Range tables can be stored, and table look-up operations can be performed. Instructions for comparisons can be included, as well as instructions for field balancing and batch balancing. The user can devise his own check digits. And he can change any program at will simply by introducing a new cartridge that holds the desired program.

All programs include instructions for the display of advisories to the station operator. The required procedure is described in simple statements, and the operator is told what data to enter.

Is the 1500 Intelligent Terminal System a sensible replacement for the old keypunch? There are two situations for which a frank answer of "No" must be given. When the objective is nothing more than electronic keying in place of mechanical operations, with little need for records over 80 characters in length and little concern for advanced editing and balancing operations, the 1500 system is simply too expensive compared with a keypunch. On the other hand, if huge volumes of data must be processed, requiring many entry stations at a single location, the 1500 system is equally unsuited. But in the vast middle ground between these extremes, expecially in a source data environment where a modest cluster of 1501 Workstations would be ample for the data requirements, and particularly when the site requires data processing independent of that provided by the central computer facility, the 1500 system appears admirably well suited. It is compact, fairly inexpensive, and equipped with processing flexibility that can be readily adapted to new applications needs. Hence, an important virtue of the 1500 system is its relative immunity to obsolescence.

The history of the Singer 1500 Intelligent Terminal System is interesting. The basic concepts, including the unique magnetic tape cartridge, were developed by Cogar Corporation and introduced in that company's System/4 product in January 1971. Datapro viewed the product favorably at that time, and regretted having to report the demise of the system as an end-user product a few months later. Singer had and still maintains a sizeable financial interest in Cogar. Singer Business Machines took the basic concepts and added its own ideas to come up with the 1500 System, which is uniquely Singer's. Singer now holds exclusive world wide marketing rights to the Cogar System/4 concepts. Cogar manufactures the Singer 1500 systems in Schuyler, New York, to Singer's specifications. □

the serial I/O channel. For transmission over substantial distances, however, one of two data communications adapters must be installed.

The Model 1535 Synchronous Communications Adapter, when coupled on an appropriate modem such as the Singer 2024, the Bell 201A or 201B, or equivalent, permits communication over switched or leased networks with any computer employing IBM binary synchronous communications (BSC) protocol, including the Singer System Ten computer and the Singer 4300 Magnetic Data Recording System. The 1535 interface conforms with EIA RS-232C and CCITT V24 standards.

The Model 1535 SCA is available with or without unattended answer capability. Transmission speeds up to 9600 bits/second are possible on half-duplex two- or four-wire lines. The 1535 can also be interfaced to asynchronous modems, such as the Bell System 202C or equivalent, and operate at a rate of 600, 900, 1200, or 1800 bits/second. Normally, the program sets the transmission rate, which is then controlled by the internal system clock.

Alternatively, the Model 1534 Asynchronous Communications Adapter provides a start-stop transmission capability. It interfaces with the previously mentioned asynchronous modems.

DEVICE CONTROL: All operations are software-controlled by application programs that reside on cartridge tape. These programs direct the execution of specific operations and produce a sequence of displayed options on the CRT screen that guide the operator in selecting a proper operating mode and in specifying certain job functions within the selected mode.

The 1500 system operator begins by inserting the cartridge that contains the desired application program in the cartridge recorder. After automatic threading of the take-up reel is completed, an index or "menu" of operations accompanied by corresponding index symbols is read from the tape and displayed on the CRT screen. The operator selects one of these operations by keying its index symbol. The system then executes a search of the application tape for the designated program. When located, the program is read from the tape and stored in memory. Then, the application tape is rewound for removal. Operation as prescribed by the stored program now ensues.

Operating modes of the 1500 system consist of Program Entry, two classes of Data Entry, Data Verify, Search, Copy, Communications, Edit, and Print.

The two data entry software packages currently available for the Singer 1500 are called Advanced Data Entry (or ADE) and Complex Data Entry (or CDE). Both packages organize keyed data into appropriate fields, alphabetic and numeric as defined, and also implement the usual operational functions such as automatic skipping and duplicating and right and left field justification (left zero fill and blank insertion). Accuracy testing procedures, such as check digit verification, and certain field accumulations and balancing operations are also carried out. Other details are presented later under the SOFTWARE heading.

Record formats can be keyed into memory or prepared formats can be entered from tape in the Program Entry mode. (Note that a record format is the data entry equivalent of an application program.)

Either sight or key verification can be utilized. In the latter case (Data Verify mode), a complete record is read into memory from a previously recorded entry tape and compared character for character with data rekeyed by the operator. Verified records are then written on a second tape. Corrections must be reverified within a field before verification can continue. An important feature of this tape-to-tape technique is the ability to insert or delete records during the verification process. This enables record updating to be accomplished.

The High-Speed Search mode allows the operator to locate a record with the same identifier as that keyed in; any portion of the record can be used as an identifier.

The Copy mode permits duplication of entire tape files or selected records from specific files. The operator can select either of the two cartridge tape drives at a given moment and can select among the externally connected computer-compatible tape drives if there is more than one.

In the Edit mode, data records on cartridge tapes can be transcribed to a computer-compatible format on standard

Singer 1500 Intelligent Terminal System

tape. The Edit program can alternately switch between two cartridge drives to provide continuous transcription through overlapped rewind and read operations. In addition, the Edit program provides for code translation, reformatting, and insertion and deletion of data.

The Print mode is an adaptation of the Edit mode that effects transfer of data records to system printers instead of to tape. The same functions are performed, including reformatting of the stored data records.

SOFTWARE: The *Advanced Data Entry* package contains various selectable programs that add to the standard functions described under DEVICE CONTROL the following features: interfield products and accumulations (up to eight batch totals); up to eight job formats available to the operator on the program tape and, within each format, eight levels that can be linked automatically; logical and string formatting; range checking; equality and inequality comparisons; a record counter and column counter; date validation; check digit verification; and a print format generator. One job format is called from the program tape and stored in memory at a time.

The *Complex Data Entry* package includes all features of the Advanced Data Entry package plus the following: high-level interfield dependency checks; an unlimited number of interpreters for special data checks without reprogramming; and up to 12 job formats available to the operator on the program tape, with 15 levels that can be linked automatically within each job format. The operator is notified in the event of entry error, and all necessary error-recovery capabilities are included. Entry of formatted or unformatted data is permitted at 120 characters per tape block.

The *Sort/Merge* package allows the operator to sort or merge data records contained in tape cartridges and write the data onto other tape cartridges or computer-compatible tape. Supervisory instructions are displayed on the CRT.

The *Copy File Utility* package implements changes to either data files or program files, whether on cartridge tape or computer tape. It is this package that makes possible the procedures of the Copy and Edit modes. Thus, the user can copy complete files of data records or programs, or copy only indicated portions. Furthermore, he can copy up to a specified record, or he can skip records and start with a particular one. He can display designated records. A particularly useful utility is a tape advance function that allows the operator to add records at the end of an existing file. New parameters can be introduced whenever an input tape has been completed, but throughout the job the input and output devices originally selected remain the same. Finally, there is a program interrupt that enables the user to override any selected functions.

The *High-Speed Search and Update Generator* package allows the user to construct a specialized program tape capable of both random retrieval and display of cartridge tape data records from either of the two drives in the Workstation. This package can also be used for file inquiry and selected record updating. Supervisory messages are displayed.

Software routines also accumulate operator and production statistics, such as operator (station) code, number of records keyed, elapsed time, number of keystrokes, number of error corrections, and number of records verified.

ERROR CONTROL: Conventional read-after-write checking is performed as tape records are written, and cyclic redundancy checking is performed as tape records are read. Data written on tape is compared bit for bit with the data retained in memory. The 1500 system automatically rereads a record up to eight consecutive times subsequent to a detected error, after which operator intervention is required. The tape system also features automatic compensation to offset apparent speed changes that arise from physical changes in the tape itself.

The 1500 system has a variety of interlocks to guard against operator error. These interlocks provide file detection sensing, ensure that the cartridges are in place, prevent, conflicting action when the cartridges are in use, and provide end-of-tape detection. Tape rewinding can be accomplished with or without interlock protection.

Keying errors detected by the operator can be corrected by backspacing and rekeying.

PRICING: The Singer 1500 Intelligent Terminal System can be obtained by lease or purchase. Lease contracts are available for one, three, and five years. Maintenance costs are included in the lease prices that appear below; purchased units are serviced under a separate maintenance arrangement. Standard maintenance, including preventive maintenance procedures, is performed during the prime-shift hours of 8 a.m. to 5 p.m. on weekdays.

		Monthly Rentals			
Device		1-Year Lease	5-Year Lease	Purchase Price	Monthly Maint.
1501	Workstation	$275.00	$246.75	$9,250	$50
Magnetic Tape Units:					
1511	7-track, 556/800 bpi, 7-inch reels	190.00	183.00	7,200	30
1512	9-track, 800 bpi, 7-inch reels	190.00	183.00	7,200	30
1513	9-track, 800 bpi, 10.5-inch reels	250.00	226.75	9,250	30
1514	9-track, 1600 bpi, 10.5-inch reels	440.00	380.75	16,500	30
1525	Serial Printer; 30 cps	140.00	122.50	4,500	28
1530	Numeric Keypad	8.25	8.25	250	2
1533	Dual Cassette Transport	80.00	73.50	2,750	15
1535	Synchronous Communications Adapter	40.00	34.00	1,500	2
1552	Line Printer; 100 lpm	315.00	285.00	12,600	76

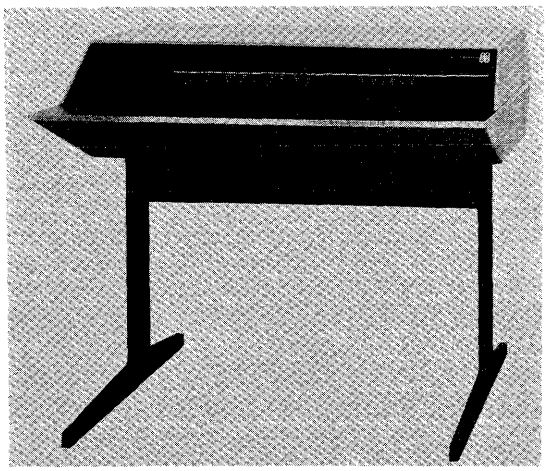
Singer offers the following quantity discounts on the net equipment lease rates (exclusive of maintenance charges) for Models 1501, 1511, 1512, 1513, 1514, 1525, and 1552 only:

No. of Units	Discount
10 to 24	4%
25 to 49	6%
50 to 99	8%
100 or more	Contact Singer

Magnetic tape cartridges are priced as follows:

1 dozen	$69/dozen
2 to 4 dozen	66/dozen
5 to 7 dozen	63/dozen
8 to 11 dozen	60/dozen
12 dozen or more	57/dozen ■

Singer/M&M 500 Series
Modular Remote Batch Terminals



This futuristically styled minicomputer is the heart of the M&M line of intelligent terminals. To the basic processor, a number of peripheral devices can be added, all in free-standing enclosures.

M&M offers four terminals based on the same minicomputer and assembled from a common pool of peripheral devices; differences among the models are marketing restrictions only. This product line has been well received by users who need intelligent terminals to emulate one or more terminals produced by mainframe vendors.

MANAGEMENT SUMMARY

With a highly modular and flexible minicomputer as a base and a wealth of independent peripheral manufacturers to draw upon, M&M's product line has been shaped largely by marketing philosophy. M&M is going after the remote batch terminal market. This class of terminal, in general, puts high-speed peripherals at the remote sites where data is generated and used, and depends on a centralized data processing facility for computation and data management.

The validity of the remote batch concept is based on several factors. The ever-increasing discrepancy between central processor speeds and peripheral speeds emphasizes the importance of multiprogramming as a profitable mode of operation. But to make multiprogramming work, multiple sets of peripherals, particularly card readers and printers, are required because so many of the programs running at the same time utilize them.

The concept of spooling helps to some degree, but for heavy multiprogramming (15 programs or so), one set or even a couple of sets of card readers and printers just can't get the job done. In addition, the growing number of successful time-sharing operations creates a favorable climate for accepting the concept of remote data entry and dissemination. The independent modem manufacturers and neophyte common carriers also heighten the climate for data communications usage in data processing.

The concept of remote batch processing–the extension, if you will, of the computer room operation into remote locations–is not a new one. GE and UNIVAC both announced the capability as part of their state-of-the-art

CHARACTERISTICS

MANUFACTURER: Singer/M&M Computer Industries, Inc., 2201 North Glassell Street, Orange, California 92665. Telephone (714) 998-1551.

MODELS: M&M is marketing four distinct models of progressively increasing performance and cost: Systems 520, 580, 565, and 560. All are based on a 16-bit minicomputer. Each model, in basic form, includes the minicomputer with 4K words of memory (8K bytes), a single-line communications controller, a card reader, line printer, and a Model 33 KSR Teletypewriter (optional in the System 520 and 580). Also included are software packages for emulating popular remote batch terminals. The distinguishing features among the basic models are summarized in the following table:

SYSTEM:	520	580	565	560
Card Reader–				
300 cpm	•	•	•	
600 cpm				•
Line Printer–				
200 lpm	•			
400 lpm		•	•	
650 lpm				•
Communications–				
2000 to 4800 bps	•			
2000 to 7200 bps		•	•	•
9600 to 50,000 bps				
KSR 33	Opt.	Opt.	Std.	Std.
Multileaving program	No	No	Yes	Yes

Standard peripheral options allow upgrading all systems, except the 520, with 600- and 1000-cpm card readers, 650- and 1200-lpm line printers, CRT display, 625-cps paper tape reader, 120-cps paper tape punch, 275-cpm card punch, UNIVAC keypunch, and magnetic tape drives. The communications interface remains constant; however, this is really a product identification matter, because the interface can easily be replaced by another.

Memory capacity of any model can be expanded in increments of 4K words up to the maximum addressing capability of 32K words (64K bytes). An optional maintenance panel is located under the top cover of the processor; this unit is essential if any serious programming effort is intended. It is required for maintenance as well, but could be carried by the service man because it plugs into a reserved location at the top of the stack of circuit boards.

CONFIGURATION: The minicomputer is highly modular. There are 9 circuit-board slots for inserting memory

Singer/M&M 500 Series
Modular Remote Batch Terminals

operating systems in 1964 along with the announcement of the GE-600 family and the UNIVAC 1108. GE (now Honeywell), UNIVAC, Control Data, and IBM (the real motivating force) all support remote batch processing. Many remote computing companies using these and other computer systems also offer remote batch processing capability.

But the problem was that the various computer manufacturers did not support the same terminal equipment. Thus, a potential user with different mainframes in his network of computers, or a prospective user of multiple time-sharing services, had to acquire multiple terminals. Some did. Most didn't, and the concept did not gain ground rapidly. With the advent of low-priced minicomputers, the situation has changed. M&M, along with several other companies, offers a terminal that can imitate the dissimilar remote batch terminals used with the various mainframes.

With the M&M System 500's, the company is not pioneering any new concepts in data communications or data processing. M&M is merely offering its customers great flexibility which translates into reduced operating costs. Instead of acquiring two or more separate terminals, just load a different program and an M&M System 500 becomes an IBM 2780, a Control Data 200 User Terminal, a UNIVAC 1004, a Honeywell GERTS terminal, a Burroughs DC 1100, or an IBM System/360 operating as a HASP multileaving terminal – at least with respect to communications discipline.

About 150 M&M terminals have been installed, mainly in the San Francisco area. Although it is now a subsidiary of The Singer Company, M&M maintains its own service organization to perform the bulk of its maintenance obligations. M&M also markets the 500 Series terminals from its own offices, which are now located in New York, Chicago, Houston, San Francisco, and the company headquarters in Orange, California. Servicing is conducted from the new offices as well. When installations of the terminals are made in locations removed from the sales offices, Singer Information Services will step in with the necessary support. Singer Business Machines markets the M&M terminals in Canada but not in the United States. The terminals are not currently being marketed in Europe, South America, or Japan.

M&M is in the remote batch terminal business; it does not encourage nor actively support off-line data processing functions. However, if you want to explore the very real possibilities for this type of application, sufficient software support and types of peripheral devices are available to keep you happy.

The peripheral components are ones that have already established good names for themselves: Data Products printers, Documation card readers, Hazeltine and Datapoint CRT displays, etc. When a particular peripheral modules and peripheral controllers. Each 4K memory module requires one circuit board (slot). A special slot is reserved for the maintenance panel. Multiple peripheral controllers can be put on one board, but they are not necessarily configured this way. For example, the standard peripheral controller board in a basic terminal includes both card reader and line printer control logic. A separate board is required for the ASR Teletypewriter included in basic configurations, but control logic for multiple units can be combined on one board. A slot is required for the communications controller. Thus, three slots are available in basic terminals with a Teletypewriter, and four in ones without it.

The I/O bus and peripheral logic permit addressing up to 62 individual devices. Restrictions on the slots available within the basic enclosure prevent the implementation of large-scale configurations without the addition of more cabinets. Implementation of the full memory capacity (32K words) leaves no room at all for peripheral controllers.

COMPATIBILITY: M&M currently provides emulators for the most popular remote batch terminals. These include the IBM 2780, the Control Data 200 User Terminal, the UNIVAC 1004, and an IBM System/360 Model 20, 25, or 30 computer being used as a terminal within IBM's HASP concept. The Multileaving feature of HASP is supported; this feature permits transmitting and receiving independent data streams or receiving intermixed data blocks from multiple data files being output on different terminal devices, and tacks ACKS and NACKS onto data blocks being transmitted in the other direction instead of using separate transmissions for them. The Multileaving program feature is reserved for Systems 565 and 560.

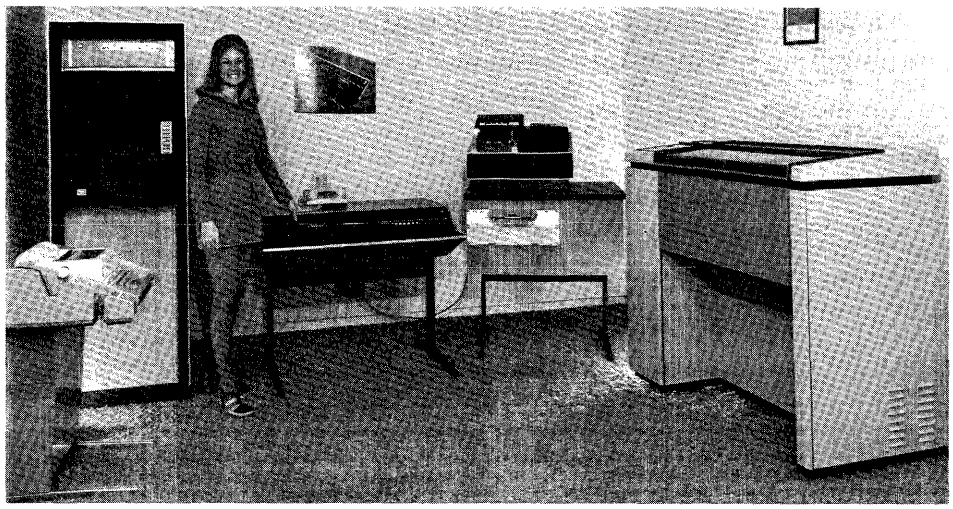
Full compatibility is maintained, and the remote computer does not "know" that it is communicating with an M&M terminal rather than the terminal being emulated. However, some small differences in operator procedure do exist, primarily with respect to the locations and types of switches and indicators provided. The emulation is entirely through software. Changing to imitate another terminal merely requires loading a different program.

The IBM 2780 emulation program supports all three transmission codes: ASCII, EBCDIC, and 6-bit Transcode. Transparency, Multiple Record Transmission, and all other features of the 2780 are supported. The Control Data 200 User Terminal program supports both ASCII and BCD transmission codes. The UNIVAC 1004 programs include versions for operating with either EXEC 8 or EXEC II. M&M also offers a program that adapts its 500 Series terminals for use with the GERTS facility of Honeywell Series 6000 systems through the DATANET 355 front-end communications processor.

COMMUNICATIONS: M&M offers two communications controllers. One operates at up to 7200 bps; the other, at up to 50,000 bps. The principal difference between the two is in the amount of hard-wired logic included. At the higher speeds, the demand on the processor for software management of the conversion between transmission format and computer format becomes too burdensome, so the high-speed interface contains additional logic.

Either interface can accommodate half- or full-duplex transmission and includes an RS-232C interface for convenient modem selection. Both controllers are clocked from the data set and operate at the speed set by the modem. The most common operations by customers at this time are 2000 bps over the switched network and 2400, 4800, 7200, and 9600 bps over leased voice-grade lines.

Singer/M&M 500 Series
Modular Remote Batch Terminals



This is what one of the M&M terminals looks like in expanded form. Peripherals include a Teletype Model 33 ASR, magnetic tape drive, card reader, punched tape reader, and high-speed line printer.

device does not work out, the company changes vendors. It emphasizes service and reliability along with price as its competitive edge.

The M&M 500 Series systems should be of interest to you if you find yourself in any one of these three situations:

- You are an IBM 2780 user.
- You want to use multiple remote batch services, internal or external, that support different terminals.
- As an alternative to decentralized data processing within a large company, you want to consider remote batch processing using one of the various mainframe vendors' central processing equipment and software.

In evaluating the System 520 (the one aimed directly at replacing the IBM 2780) for configurations including a card punch, keep in mind that the punch for the 2780 is part of a card read/punch unit. It cannot handle independent data streams, such as would be required in a HASP Multileaving environment.

A significant additional advantage of the M&M terminals (or anybody else's programmable remote batch terminals) is the relative ease with which new concepts in input/output media or communications can be handled: simply hook on the necessary peripheral device and write a new emulator program.

USER REACTION

The users interviewed by Datapro operated Models 520, 565, and 580 of the Singer/M&M 500 Series terminals. Two outstanding attitudes were made clear. One is that the terminals are extremely reliable and seldom experience downtime, except for the preventive maintenance that is performed monthly. When there was unscheduled downtime, users reported that often the fault

Conditioning required for a leased line is dependent on the data set used. Switches can be installed for alternate connection to two modems to permit communication with remote computers at different speeds or over different lines.

DEVICE CONTROL: For most applications in which the M&M systems are used, the minicomputer is transparent to the user; i.e., he doesn't really realize that he is dealing with a computer. The control panel is laid out to provide the functions a user would expect to get with an IBM 2780, but does not look much like one. For the emulation of other terminals, a Teletypewriter is used to exchange commands and replies. Operation of the terminal is then essentially like the terminal it emulates.

The M&M System 4000 minicomputer is based on the Data General Nova 1200 minicomputer. M&M currently purchases some components from Data General, but manufactures most itself. The principal feature of the System 4000 pertaining to M&M terminal computers is the flexible I/O structure, which simplifies the connection of new types of peripheral devices.

For those users who want to use the terminal as a computer, M&M now provides an Assembler, a debugging program, and a BASIC compiler. FORTRAN should be ready soon. Much of the software developed for the Data General Nova minicomputers could be used, but would sometimes require modification of the input/output coding because different peripheral products are supported.

PRINTERS: Slow, medium, and high-speed printers are available with the basic models and as upgrades. The low-speed printer is the 200-lpm unit available with the System 520. It prints a 64-character set and has 136 print positions. It is manufactured by Kleinschmidt. Average printing speed is over 200 single-spaced lines per minute when reduced character sets are printed.

Three printers are manufactured by Data Products. The speed of the 245/1100-lpm printer, standard with Systems 580 and 565, varies with the number of print positions per line; this unit is a drum printer that operates serially in units of 24 columns. The 650- and 1200-lpm printers are conventional drum printers that can operate at up to 1800 lpm depending on the character set employed in the data being printed. Each of the three Data Products printers

Singer/M&M 500 Series
Modular Remote Batch Terminals

lay with peripheral devices or communication lines rather than with either the hardware or software of the M&M terminal itself. One user who is concurrently operating a different terminal made by a well-known company said that the M&M terminals have caused far less trouble.

The second prevalent attitude is that the software of the M&M terminals gives leeway to the user's resourcefulness and lets him perform tasks that hard-wired terminals could not. An example is HASP Multileaving, which is supported on Models 560 and 565. An engineering firm was pleased with the ability to emulate several computer environments so that the facility could dial up different computers. Cost considerations seemed to restrict the use of high transmission rates, with 4800 bits/second a popular self-imposed limit. □

print 132 columns and can be obtained with up to 160 print positions.

CARD READERS: The 300-cpm card reader is a desk top unit manufactured by Documation. The 600-, 1000, and 1200-cpm readers, also made by Documation, are free-standing units. Each of these readers is fully automatic, with hopper and stacker capacities commensurate with the speed.

CARD PUNCHES: Card punching capability is not standard in any of the four basic systems. A 275-cpm Data Products punch is available. This unit operates at 160 columns per second, and the throughput varies between 100 cpm (80 columns punched) and 275 cpm (20 columns punched). In addition, a UNIVAC 1701 VP Card Keypunch can be used for punched card output; it can also be used offline for punched card preparation and verification. (The UNIVAC punch is covered in detail in Report 70D-877-21.)

DISPLAYS: Either the Hazeltine 2000 (Report 70D-471-01) or the Datapoint 3300 (Report 70D-214-01) can be added to one of the basic M&M systems. Normally, the CRT display unit is used as a replacement for a Teletypewriter console unit.

PUNCHED TAPE: The paper tape reader is manufactured by Chalco Corp. and operates at 625 characters per second. The punch is obtained from Tally Corp. and punches paper or mylar tape at 120 characters per second. Cabinets and spoolers are included with both units.

MAGNETIC TAPE: One to four industry-compatible tape drives can be added that operate at 45 inches per second at a recording density of 800 bytes per inch; either 7- or 9-track versions are available. The tape drive is the Wang Model 10. M&M adds a four-tape controller, which is contained within the cabinet of the first tape drive.

PRICING: The M&M terminal systems are available for purchase or under a one- or three-year lease agreement. Leasing arrangements include maintenance. The prices for the four basic terminals are as follows:

	Monthly Rental*			
	1-Year	3-Year	Purchase	Monthly Maint.
System 520	$ 675	$ 565	$24,990	$125
System 580	940	775	35,590	235
System 565	1,160	995	39,880	265
System 560	1,644	1,400	49,980	330

Replacement and add-on peripheral components are available on a purchase or 1-year lease basis only. Each peripheral device includes the controller (circuit board) and comes in a free-standing enclosure.

Replacement Peripherals	Monthly Rental*	Purchase	Monthly Maint.
Card Readers–			
600 cpm for 300 cpm	$103	$2,500	$ 17
1000 cpm for 300 cpm	244	6,000	40
1000 cpm for 600 cpm	141	3,500	23
1200 cpm for 300 cpm	360	6,900	35
Line Printers–			
650 lpm for 245 lpm	52	2,000	8
1200 lpm for 245 lpm	190	4,710	31
1200 lpm for 650 lpm	138	2,710	23
CRT for ASR 33	29	**	35
Add-On Peripherals			
KSR 33 Teletypewriter	95	2,290	35
CRT Display	123	**	35
Paper Tape–			
Reader	118	2,080	14
Punch	209	7,000	31
Magnetic Tape Drives–			
First	570	14,250	85
Second through fourth	420	–	70
Card Punches–			
275 cpm	610	14,990	100
UNIVAC 1701 Interface	75	1,800	15
Memory Module, 4K	145	3,600	25

* Includes maintenance.
** M&M recommends purchasing display directly from manufacturer. ■

Standard Memories Add-On Main Memory for System/360 and System/3

MANAGEMENT SUMMARY

Standard Memories is concentrating its efforts on a narrow segment of the IBM System/360 market that includes Models 40, 44, and 50, and on the IBM System/3 Model 10. Its SMART Series and Ecom-3 core memories are designed as direct replacements for System/360 and System/3 main memory, respectively, and can be used to extend the storage capacity of an existing installation or to replace all memory down to the minimum storage capacity specified for the particular IBM processing unit.

Standard Memories now offers its System/360 memories on a purchase-only basis. Its marketing effort for these memories is directed primarily toward leasing companies, dealers, and brokers. Standard's System/3 memory, by contrast, can be either leased or purchased.

The SMART Series memories for the System/360 are available in increments of 16K bytes per module with up to 16 memory modules per unit, for a total unit storage capacity of 256K bytes. Operating speed (cycle time), as defined by the IBM processing units, is well below the design limit of the SMART memories–750 microseconds. Standard Memories offers its SMART memories in all capacities that are available from IBM and, in addition, provides storage enhancements up to 1.75 times the IBM-imposed maximum capacity for the Model 40, up to 4 times the IBM maximum for Model 44, and up to 2 times the IBM maximum for Model 50.

The Ecom-3 memories for the IBM System/3 Model 10 are available in 8K-byte increments from 8K to 64K bytes. Standard has reconfigured this memory to mount inside the System/3 processing unit. The memory utilizes the processing unit's internal power supply. Standard claims this arrangement eliminates the static problems related to external memory units that can cause numerous processor check errors.

No software changes to existing IBM equipment are required when adding Standard memory modules within IBM's normal capacity limits, but a few simple logic changes are necessary; on the Model 40, for example, eight logic boards must be installed. System enhancement, on the other hand, requires extensive hardware logic changes within the processing unit besides the normal regeneration of the operating system in order to accommodate the extended core. The parameters of the regenerated operating system must specify the new memory capacity and the model number of the next larger model. Site documentation must also be updated to reflect the changes.

Standard prices its SMART memories dramatically below IBM's pricing for equivalent core storage; purchase prices average 85 percent below IBM's prices. Ecom-3 memory (under a one-year lease) leases for 40 percent below IBM's monthly rental charges and sells for 60 percent below IBM's purchase prices. Further savings can be realized through extended lease terms.

Standard has received written certification from IBM for each of its model installations (including System/3), ▷

Standard Memories offers replacement core memory for IBM System/360 Models 40, 44, and 50 and for the System/3 Model 10. Enhancement capacities, available for each model, and dramatic price savings are Standard's major attractions.

CHARACTERISTICS

MANUFACTURER: Standard Memories, Inc. (subsidiary of Applied Magnetics Corp.), 2801 E. Oakland Park Boulevard, Fort Lauderdale, Florida 33308. Telephone (305) 566-7611.

MODELS: Three models are available for the System/360: SM 400, SM 440, and SM 500. Each model is available in several module capacities. One model, Ecom-3, is available for the IBM System/3 Model 10.

COMPATIBILITY: The Standard Memories core memory systems are designed as plug-compatible add-on or replacement mainframe memories for IBM System/360 Models 40, 44, and 50 and the IBM System/3 Model 10. The memories can be used to extend the core storage capacity of an existing IBM System/360 or System/3 processing unit, to replace all existing IBM core storage down to the minimum storage capacity as specified for the model, or to replace and extend the existing mainframe storage.

Model SM 400, SM 440, and SM 500 memory units are each available with up to 16 memory modules per unit. Each module provides 16,384 bytes, for a total unit storage capacity of 256K bytes. The SMART Series memory modules are designed for 750-nanosecond operation, but cycle times for the different memory models have necessarily been slowed to conform with the operating speeds of their IBM counterparts.

Model SM 400, for the System/360 Model 40, provides storage capacities that, combined with the mainframe storage of an existing IBM 2040 Processing Unit, range from 64K to 256K bytes; enhancement capacities are also available that provide the Model 40 with a total storage capacity of 384K or 448K bytes. Memory cycle time (2.5 microseconds) is identical with that of the IBM Model 40.

Model SM 440, for the System/360 Model 44, provides storage capacities that, combined with the mainframe storage of an existing IBM 2044 Processing Unit, range from 32K to 256K bytes; enhancement capacities are also available that provide the Model 44 with a total storage capacity of 384K, 512K, 768K, or 1024K bytes. Memory cycle time (1.0 microsecond) is identical with that of the IBM Model 44.

Model SM 500, for the System/360 Model 50, provides storage capacities that, combined with the mainframe storage of an existing IBM 2050 Processing Unit, range from 256K to 512K bytes; enhancement capacities are also available that provide the Model 50 with a total storage capacity of 768K or 1024K bytes. Memory cycle time (2.0 microseconds) is identical with that of the IBM Model 40.

The physical size of the SMART memory cabinet is the same for all models. The cabinet measures 23.5 inches square by 29 inches high and accommodates up to 256K bytes of core storage; its maximum weight is 200 pounds.

The SMART Series core memories contain an integral power supply that satisfies memory power requirements, as well as diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode.

Model Ecom-3, for the System/3 Model 10, provides storage capacities that, combined with the mainframe ➤

Standard Memories Add-On Main Memory for System/360 and System/3

which assures the continuation of IBM service at all Standard installations. Standard says that IBM has been very cooperative in its treatment of independent installations.

Service is provided by Comma Corporation (a subsidiary of Control Data Corporation) or by Sorbus, with direct support by Standard Memories. Both service organizations provide nationwide service.

First deliveries of the SMART series memories were made in September 1971 for standard module sizes and in March 1972 for enhanced systems. To date, Standard has over 180 installed systems.

Standard began deliveries of its System/3 memory in December 1974 and, to date, has installed about 140 units.

USER REACTION

In Datapro's 1975 survey of add-on main memory users, 11 users reported on their experience with Standard Memories replacement memory units. The sample included 9 units for System/360 Models 30 (2), 40 (4), 44 (1), and 50 (2) having an aggregate capacity of 2,432K bytes; one 8K-byte memory for the System/3 Model 10; and two memory units for DEC PDP-11/45 and -15/40 computers having capacities of 64K words each. The users' ratings are presented in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	8	4	0	0	3.7
Equipment reliability	7	4	1	0	3.5
Maintenance service**	5	3	1	1	3.2
Ease of installation	6	6	0	0	3.5

* Weighted Average on a scale of 4.0 for Excellent.
**Serviced by Comma and Sorbus.

These users were well satisfied with Standard's memories, as indicated by the high scores they assigned in all categories. Installation and testing time averaged 1.5 days. Only one user reported serious problems during installation of an upgrade from 64K to 256K bytes on a Model 40; this installation took three days, but the user had no problems since.□

storage of an existing IBM 5410 Processing Unit, range from 16K to 64K bytes in increments of 8K bytes. The effective cycle time of the Ecom-3 memory is identical with that of the corresponding IBM memory–1.52 microseconds per 1-byte fetch. The Ecom-3 memory is powered by the 5410 processor and consists of two or three 11.5-by-16-inch boards that mount in a rack attached to the inside of 5410's rear door. Each of the one or two memory boards can contain up to 32K bytes of core memory. The memory includes an on-/off-line switch for ease of isolation.

PRICING: Standard Memories' SMART Series core memories are available for purchase only. Standard offers separate maintenance contracts from Comma, a subsidiary of Control Data Corporation, or Sorbus. The Ecom-3 memory for the System/3 Model 10 is available for purchase or lease. Leases are offered on a month-to-month basis or for 1, 2, and 3 years and include prime-shift maintenance.

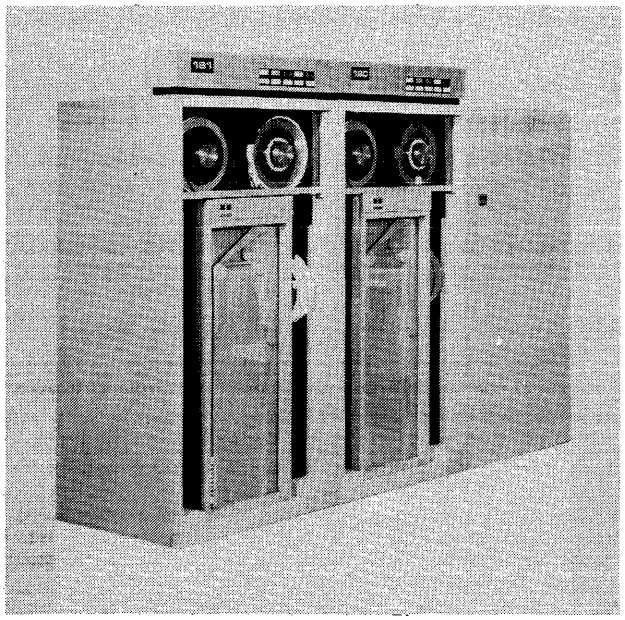
Representative prices are as follows:

Processor Conversion		Purchase
IBM 360/40		
From 2040E	(32K) to:	
F	(64K)	$16,000
G	(128K)	22,000
GF	(192K)	32,000
H	(256K)	39,000
HG	(384K)	60,000
HGF	(448K)	72,000
From 2040F	(64K) to:	
G	(128K)	19,000
GF	(192K)	29,000
H	(256K)	36,000
HG	(384K)	58,000
HGF	(448K)	68,000
From 2040G	(128K) to:	
GF	(192K)	18,000
H	(256K)	25,000
HG	(384K)	45,000
HGF	(448K)	56,000
From 2040H	(256K) to:	
HG	(384K)	33,000
HGF	(448K)	40,000
IBM 360/44		
From 2044G	(128K) to:	
H	(256K)	36,000
HG	(384K)	56,000
I	(512K)	80,000
From 2044H	(256K) to:	
HG	(384K)	40,000
I	(512K)	53,000
IH	(768K)	95,000
IBM 360/50		
From 2050G	(128K) to:	
H	(256K)	29,000
HG	(384K)	43,000
I	(512K)	64,000
IH	(768K)	99,000
J	(1024K)	135,000
From 2050H	(256K) to:	
HG	(384K)	33,000
I	(512K)	44,000
IH	(768K)	80,000
J	(1024K)	115,000
From 2050I	(512K) to:	
IH	(768K)	45,000
J	(1024K)	79,000

IBM System/3 Model 10	Monthly Rental*	Purchase
From 8K to:		
12K	**	**
16K	$175	$ 7,650
24K	315	7,795
32K	455	10,795
48K	675	16,795
64K	915	22,795
From 16K to:		
24K	175	7,650
32K	315	7,795
48K	555	13,795
64K	795	19,795
From 24K to:		
48K	455	10,795
64K	675	16,795
From 32K to:		
48K	315	7,795
64K	555	13,795
From 48K to:		
64K	315	7,795

* Monthly rental charges are for a one-year lease and include prime-shift maintenance.
**Available from IBM only.■

STC 3400/3800 Magnetic Tape Subsystem



This subsystem is a plug-compatible replacement for IBM's 1600-bpi 3803/3420 Magnetic Tape Subsystem. The STC units offer a wider choice of speeds than the IBM counterparts—including a 400KB model that is 25% faster than IBM's 3420 Model 7 drive.

MANAGEMENT SUMMARY

The STC 3400/3800 Magnetic Tape Subsystem is designed as a plug-to-plug replacement for IBM's 1600-bpi 3420/3803 Magnetic Tape Subsystem. Besides providing all the features that characterize the counterpart IBM subsystem, STC offers two additional drives with performance characteristics that fall between those of the IBM 3420 Model 3 and 5 tape drives and above that of the Model 7. These added drives allow the STC user to configure his subsystem from a broad and continuous range of tape speeds and data transfer rates.

The 3400/3800 subsystem has been a bread-and-butter product for STC. Since the initial production deliveries in January 1972, well over 6,000 units have been shipped (including drives and controller). Although it remains an active product, the STC 3400/3800 has been superseded by the STC 3600/3800 (Report 70D-789-03), a replacement for IBM's latest 6250-bpi 3420 tape subsystem.

STC's top-of-the-line 3400 series drive, Model ST 3480, was introduced in November 1971. The ST 3480 is 25 percent faster than IBM's 3420 Model 7 tape drive, providing a data transfer rate of 400,000 bytes per second. The ST 3480 uses the same STC controller used by the other family members; however, a special adapter (available at added cost) must be installed within the controller to handle the ST 3480 drives. First deliveries of the ST 3480 were made during the second quarter of 1972, and more than 600 have been installed to date.

The STC 3800-III Control Unit incorporates MSI circuitry and is equipped with microprogrammed diagnostics. The stored diagnostics are designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive in the off-line mode.

The STC 3400 Series drives contain all the features that were developed for the earlier STC 2400 Series drives. ▷

CHARACTERISTICS

MANUFACTURER: Storage Technology Corporation, 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

TAPE DRIVES: STC Models 3430, 3440, 3450, 3470, and 3480.

TAPE CONTROLLER: STC 3800-III Tape Control Unit.

COMPATIBILITY: The STC 3400/3800 Magnetic Tape Subsystem is designed as a plug-compatible replacement for the IBM 3420/3803 Magnetic Tape Subsystem. The STC 3400 Series drives offer the same functional capabilities as the IBM 3420 Series Magnetic Tape Units. STC provides three models with characteristics equivalent to the IBM 3420 Models, 3, 5, and 7, plus two additional models with characteristics that fall between IBM Models 3 and 5 and above Model 7. The STC models are listed below with the equivalent IBM 3420 models and their characteristics.

IBM 3420 Model	STC 3400 Model	Tape Format, tracks	Tape Speed, ips	Tape Density, bits/inch*	Transfer Rate, char/sec
3	ST 3430	7	75	556/800	41,700/ 60,000
3	ST 3430	9	75	800/1600	60,000 120,000
–	ST 3440	7	100	556/800	55,600/ 80,000
–	ST 3440	9	100	800/1600	80,000/ 160,000
5	ST 3450	7	125	556/800	69,500/ 100,000
5	ST 3450	9	125	800/1600	100,000/ 200,000
7	ST 3470	7	200	556/800	111,200/ 160,000
7	ST 3470	9	200	800/1600	160,000/ 320,000
–	ST 3480	9	250	1600	400,000

*Dual Density operation on 9-track drives is optional.

The STC 3400 Series drives can be used with IBM System/360 Models 30 through 195 or with IBM System/370 Models 135 through 195 via the STC 3800-III Tape Control Unit.

The standard STC 3400 Series drives are available as 7- or 9-track units. The 7-track drives read and write at selectable densities of 556 or 800 bits/inch using the NRZI recording technique; a 200-bpi capability is available at added cost. The basic 9-track drives read and write at a single density of 1600 bits/inch. With the Dual Density feature, the 9-track drives can operate at 1600 bits/inch using the phase-encoding technique or at 800 bits/inch using the NRZI technique. ▶

STC 3400/3800 Magnetic Tape Subsystem

Key features include automatic threading, dynamic amplitude control, velocity feedback reel control, automatic reel hub, analog capstan control, and the capability to be field-upgraded. The STC tape drives also feature single-capstan tape control, vacuum tape buffers, a prealigned fixed head assembly to minimize head-to-tape alignment errors, and radial attachment to the controller.

STC offers substantial price breaks for its 3400/3800 subsystem under a five-year lease; but under a one- or two-year lease, savings are slim on all units except the 3470. Under a five-year lease, STC's prices range from 10 to 20 percent below IBM's under the Extended Term Plan. STC's prices are just 2 percent below IBM's prices under one- or two-year lease terms or on a purchase basis, except that the ST 3470 tape drive leases for 13 percent and sells for 8 percent below the prices of IBM's 3420-7 drive.

Storage Technology provides its own maintenance in 21 major cities, including New York, San Francisco, Boston, Philadelphia, Detroit, Dallas, Denver, Chicago, Cleveland, and Los Angeles. STC guarantees response time to service calls within a 50-mile radius of a service point to be equal to or better than the corresponding IBM service.

USER REACTION

In Datapro's 1975 survey of plug-compatible tape drive users, 30 users reported on their experience with a total of 592 STC 3400 series drives. Their ratings are presented in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	28	8	0	0	3.8
Ease of operation	29	7	0	0	3.8
Equipment reliability	23	12	1	0	3.6
Maintenance service	19	13	3	0	3.5

*Weighted Average on a scale of 4.0 for Excellent.

Most STC users have a high regard for STC and its tape drives, as indicated by the high marks in the table. Few of the users reported problems. Of those that did, three reported initial control unit failures; two of these have been resolved, but the third user, who reported the failures as more prevalent than those experienced with IBM, continues to experience failures.

Another user with a stiff performance standard of a maximum of 10 hours of down-time per month (equivalent to 2 percent of his total operating time) reported that the STC drives were down an average of 16 hours per month. He attributed the drive problems to power supply failures. Two minor complaints received were "reel safety latches make it difficult to remove reels," and "self-loading drives necessitate trimming tape periodically for maximum effectiveness."

Complimentary comments, in line with the products' high scores, were "more reliable than equivalent IBM drives" and "STC drives have not caused the entire system to fail like the IBM drives have." □

Standard features include automatic threading, power windows, cartridge-handling capability, automatic reel locking, read-backward capability, etc.

The STC 3800-III Tape Control Unit is designed as a plug-compatible replacement for the IBM 3803 Tape Control and as a controller for the STC 3400 Series Magnetic Tape Drives. Like its single-channel IBM counterpart, each STC 3800-III and its tape drives operate as a tape subsystem for System/360 Models 30 through 195 or System/370 Models 135 through 195. The basic 3800-III provides control and data handling capability for up to sixteen 9-track, phase-encoded tape drives. The ST 3800-III requires the 3480 Attachment for use with ST 3480 drives.

Options for the 3800-III provide compatibility with 7-track or 9-track (at 800 bpi) drives or a combination of both. Translation and data conversion features are included with 7-track compatibility. When selected, the translator function writes 8-bit EBCDIC-coded bytes as 6-bit, BCD-coded equivalents on 7-track tape; the converse translation is performed when reading. When selected, the data conversion function writes three 8-bit bytes as four 6-bit characters on 7-track tape; the converse function is performed when reading.

The Character Insertion feature (available from IBM as an RPQ) replaces each incorrect character read from tape with a special error character as specified.

The Two-Channel Switch feature provides a second channel interface as an alternative path to the controller and its attached tape drives.

Pooling options permit up to 8 or 16 tape drives to be switched among two, three, or four 3800-III Control Units to allow simultaneous operation of two, three, or four tape drives over as many Selector Channels.

The physical characteristics of the STC tape drives are virtually the same as those of the equivalent IBM tape drives. the STC drives and controller operate in the same environment as the equivalent IBM equipment, with essentially the same power requirements.

PRICING: The STC 3400/3800 Magnetic Tape Subsystem is available for lease or purchase. STC provides lease contracts for one, two, three, and five years. Lease rates include all cables, installation, diagnostic performance checks, complete service (24 hours/day, 7 days/week), and unlimited usage.

STC provides servicing for purchased units under one of three service contracts: Prime Shift (9 hours/day, 5 days/week), Extended Shift (16 hours/day, 5 days/week), and Total Service (24 hours/day, 5 days/week). Service calls beyond contract-specified hours are billed at a rate of $20/hour plus travel costs, which are limited to a $10 maximum charge.

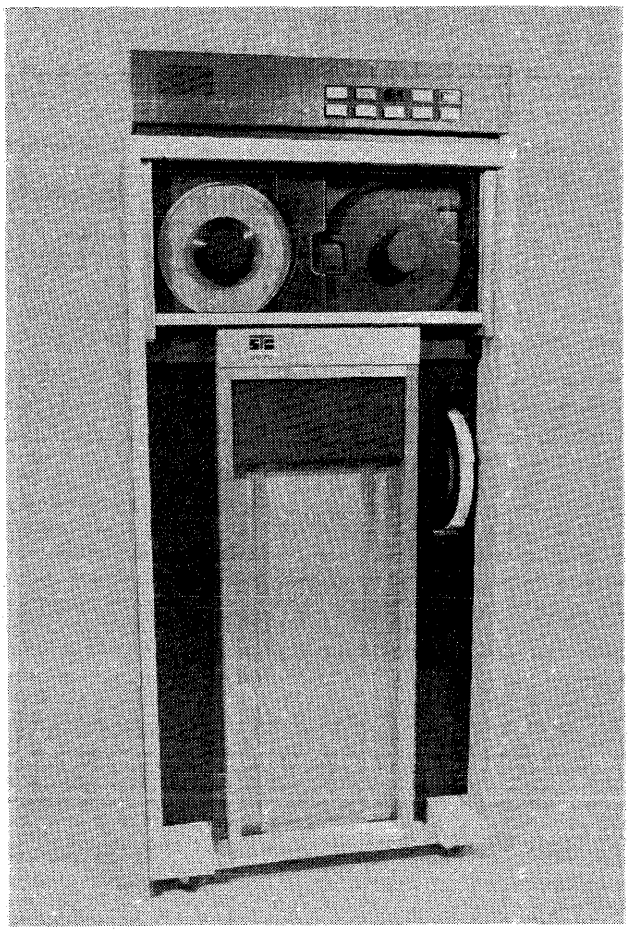
	Monthly Rental*				
Tape Drives	1-Year Lease	2-Year Lease	5-Year Lease	Purchase	Monthly Maint.**
3430	$426	$389	$360	$16,840	$71.50
3440	476	435	400	19,625	77
3450	500	457	420	21,105	77
3470	576	526	485	24,525	88
3480	712	650	605	32,000	108
Dual Density Feature (800/1600 bpi)	21	21	21	910	11
3800-III Controller	604	552	510	25,740	11
Controller Options					
3480 Drive Attachment Compatibility:	120	111	100	4,935	5
7-track; 200/556/800 bpi	64	59	55	2,745	3***
9-track; 800 bpi	64	59	55	2,745	3
9-track; 200 bpi	152	146	135	6,435	6
7- and 9-track; 200/556/800 bpi	128	118	110	5,490	6***
Character Insertion	98	92	85	4,140	5
Two-Channel Switch	135	124	115	5,715	5
Controller Switch (for (8 or 16 drives):					
Two controllers	178	162	150	7,560	11
Three controllers	227	211	195	9,630	16
Four controllers	260	243	225	11,025	16

*Includes maintenance for 24 hrs/day, 7 days/week. Monthly rental under a three-year lease is priced at about 88 percent of the monthly rental under a one-year lease.

**Prime Shift; Extended Shift and Total Service are priced at about 1.18 and 1.47 times the rates for Prime Shift, respectively.

***Maintenance rates are doubled for 200-bpi, 7-track compatibility. ■

STC 3600/3800 Magnetic Tape Subsystem



STC was the first independent manufacturer to introduce tape drives that provide compatibility with IBM's 6250-bpi 3420 Series drives, using the GCR encoding scheme. The STC tape subsystem offers substantial savings over the equivalent IBM equipment and is meeting the test of user satisfaction.

MANAGEMENT SUMMARY

The STC 3600/3800 Magnetic Tape Subsystem is a plug-compatible replacement for IBM's 6250-bpi 3803/3420 Magnetic Tape Subsystem. STC introduced its 3600 Series tape drives on March 8, 1973, the day after IBM introduced its new 3420 series drives that read and write tape at an unprecedentedly high data storage density of 6250 bytes per inch.

IBM's introduction of the 6250-bpi recording density represented a major leap forward for the magnetic tape industry. The new de facto standard is almost four times the density of the previous industry standard for high-performance recording–1600 bytes per inch, which was established just a few years earlier. The 6250-bpi density also more than triples the storage capacity of a standard 2400-foot reel as compared with data recorded at 1600 bpi. Coupled with high tape speeds of up to 200 inches per second, the 6250-bpi density provides data transfer rates almost four times as high as those available with 1600-bpi tape.

STC's drives are fully compatible with IBM's 6250-bpi recording scheme, called Group-Coded Recording (GCR), ▷

CHARACTERISTICS

MANUFACTURER: Storage Technology Corporation, 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

TAPE DRIVES: STC Models 3630, 3650, 3670, and 3685.

TAPE CONTROLLER: STC 3800-IV Tape Control Unit.

COMPATIBILITY: The STC 3600/3800 Magnetic Tape Subsystem is designed as a plug-compatible replacement for the new 6250-bpi models of the IBM 3803/3420 Magnetic Tape Subsystem. STC also provides plug-compatible replacements for the original models of the IBM 3803/3420 subsystem via its 3400/3800 tape subsystem; see Report 70D-789-02.

The standard 3600 series drives are 9-track units that read and write data using the new Group-Coded Recording (GCR) scheme at a density of 6250 bits/inch. STC offers three models with characteristics equivalent to those of the IBM 3420 Models 4, 6, and 8, plus an additional dual-speed, dual-density model. The STC models are listed below with the equivalent IBM 3420 models and their characteristics.

IBM 3420 Model	STC 3600 Model	Tape Speed, ips	Tape Density, bits/inch	Transfer Rates, K bytes/second 6250 bpi	1600 bpi
4	3630	75	6250/1600*	470	120*
–	3640**	100	6250/1600*	625	160*
6	3650	125	6250/1600*	780	200*
8	3670	200	6250/1600*	1250	320*
–	3685	125/250	6250/1600	780	400

* Dual-density operation is optional for both STC and IBM drives.

** Available for OEM use only.

Note: Interblock gap is 0.3 inches for operation at 6250 bpi and 0.6 inches for operation at 1600 bpi.

The STC 3800-IV Tape Control Unit provides control and data handling capability for any mix of up to eight STC 3400 Series and/or 3600 Series drives, and can accommodate up to 16 drives in a switching arrangement. The 3800-IV controller provides as standard a single-channel computer interface.

Options for the 3800-IV controller provide compatibility with 7-track (200, 556, or 800 bpi) and/or 9-track (800 bpi) STC 3400 Series tape drives (Report 70D-789-02). ▶

STC 3600/3800 Magnetic Tape Subsystem

and STC-recorded tapes are fully interchangeable with IBM-recorded tapes. Compatibility with IBM's GCR scheme is implemented via microprogram control. STC began its production deliveries in April 1974, and has shipped about 500 units to date.

IBM disclosed its standard for the GCR recording scheme following initial deliveries of its 6250-bpi drives in November 1973. The GCR scheme records characters serially in each track, longitudinally along the tape instead of in the conventional lateral recording format.

The major advantages of the new recording scheme are superior error correction and resynchronization capabilities. Simultaneous errors in two separate tracks can be detected and corrected on the fly. Resynchronization is used to reestablish correct detection of the recorded data and is implemented by periodic resync bursts.

STC prices its drives about 12 percent below IBM's drives under a one- or two-year lease, and its controller about 10 percent below IBM's price. Savings of about 20 percent below IBM's Extended Term Plan prices on drives and about 15 percent on the controller can be realized under a 5-year lease.

STC inked a $10 million, 5-year agreement with UNIVAC in February 1975 to supply UNIVAC with 3600 series drives and 3300-IV controllers for use with its own computers; the contract included an option for UNIVAC to manufacture the equipment. Burroughs is currently looking at STC as a source for high-density drives and is also said to be interested in manufacturing rights.

USER REACTION

In Datapro's 1975 survey of plug-compatible tape drive users, four users reported on their experience with a total of 290 STC 3600 series drives. To supplement this rather limited user reaction, Datapro interviewed five additional users with a total of 63 drives, for a grand total of nine users with 353 drives. Their ratings are presented in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	6	3	0	0	3.7
Ease of operation	5	4	0	0	3.6
Equipment reliability	4	5	0	0	3.4
Maintenance service	5	4	0	0	3.6

*Weighted Average on a scale of 4.0 for Excellent.

These are well satisfied users, as shown by the high marks they assigned in all four rating categories. Except for one user who experienced initial controller problems (an intermittent failure that was resolved in two weeks), none reported any significant problems. The users that Datapro interviewed are delighted with the product and will turn to STC for any future requirements. □

The STC 3600/3800 Subsystem is designed to interface with the IBM System/360, Models 50 through 195, and System/370, Models 135 through 195. The model and mix of STC 3600 Series drives that can be accommodated by any System/360 or 370 model computer are determined by the maximum data transfer rate of the computer's I/O channels. STC recommends a maximum I/O transfer rate 20 percent below that of the computer's I/O channel.

The optional Two-Channel Switch permits the STC 3800-IV controller to be connected to a second computer for shared operations or to two channels on the same computer. Switching can be performed under program control.

Pooling options permit up to 8 or 16 drives to be switched (under program control) among two, three, or four STC 3800-IV controllers to provide concurrent operation of two, three, or four tape drives over as many Selector Channels on the same or different computers.

PRICING: The STC 3600/3800 Magnetic Tape Subsystem is available for purchase or on a one-, two-, three-, or five-year lease, which includes maintenance for 24 hours per day, 7 days per week. Lease rates also include all cables, installation, diagnostic performance checks, and unlimited equipment usage.

STC provides service for purchased units under one of three service contracts: Prime Shift (9 hours/day, 5 days/week), Extended Shift (16 hours/day, 5 days/week), and Total Service (24 hours/day, 5 days/week). Service calls beyond contract-specified hours are billed at a rate of $38/hour plus travel costs, which are limited to a $10 maximum charge.

	Monthly Rental*				
Tape Drives	1-Year Lease	2-Year Lease	5-Year Lease	Purchase	Monthly Maint.**
3630	$607	$555	$515	$24,000	$82.50
3650	680	622	580	28,000	88
3670	752	688	640	31,000	115
3685	860	780	717	37,500	143
Dual Density Feature (6250/1600 bpi)	22	22	22	950	5.50
3800-IV Controller	1,012	925	860	42,940	143
Controller Options					
3480/3685 Drive Attachment	120	111	103	4,935	5
Compatibility:					
7-track; 200/556/800 bpi	49	43	40	1,975	2
9-track; 800 bpi	91	86	80	3,720	2
Two-Channel Switch	135	124	115	5,715	5
Controller Switch (for 8 or 16 drives):					
Two controllers	178	162	150	7,560	11
Three controllers	227	211	196	9,630	16
Four controllers	260	243	226	11,025	16

* Includes maintenance for 24 hrs/day, 7 days/week. Monthly rental under a three-year lease is priced at about 88 percent of the monthly rental under a one-year lease.

**Prime Shift; Extended Shift and Total Service are priced at about 1.18 and 1.47 times the rates for Prime Shift, respectively. ■

STC 8000 Series Disk Subsystem

MANAGEMENT SUMMARY

Billed as "Super Disk," STC's innovative disk storage subsystem was introduced in October 1973 as an attractive alternative to the IBM 3330 Disk Storage Facility. The 8000 Series subsystem, consisting of fixed disk modules, represents a dramatic departure from the familiar 3330-type architecture. Yet the STC 8000 offers full subsystem compatibility with its IBM counterpart, with identical channel interface logic, power and signal cable connections, and operating characteristics. No hardware or software modifications to existing IBM equipment are required.

To offset the lack of disk-pack interchangeability in its fixed-disk drives, STC offers an additional controller and string of one to eight IBM 3330-equivalent disk pack drives. The added string can contain any mix of 100-megabyte and 200-megabyte drives. The control module and its string of drives, however, preclude the use of an eighth fixed-disk drive module. This restriction is established by IBM's operating software, which defines each 100 million bytes of disk storage as an addressable unit and permits a maximum of 64 logical unit addresses.

STC now offers an IBM 3330-equivalent disk pack drive subsystem as an alternative to its fixed-disk subsystem for users who must have disk pack interchangeability throughout the entire subsystem. The channel-attached STC subsystem, consisting of any mix of single-spindle, top-loading 100-megabyte and 200-megabyte drives, provides up to 6.4 billion bytes of storage through the maximum complement of 32 drives, the equivalent of IBM's maximum configuration.

STC now offers fixed-disk or removable-pack disk subsystems as replacements for the IBM 3330 Disk Storage Facility. The fixed-disk storage provides 400 or 800 megabytes per drive, while the 100- and 200-megabyte 3330-style drives provide pack interchangeability with their IBM counterparts.

CHARACTERISTICS

MANUFACTURER: Storage Technology Corporation (STC), 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

SYSTEM COMPONENTS

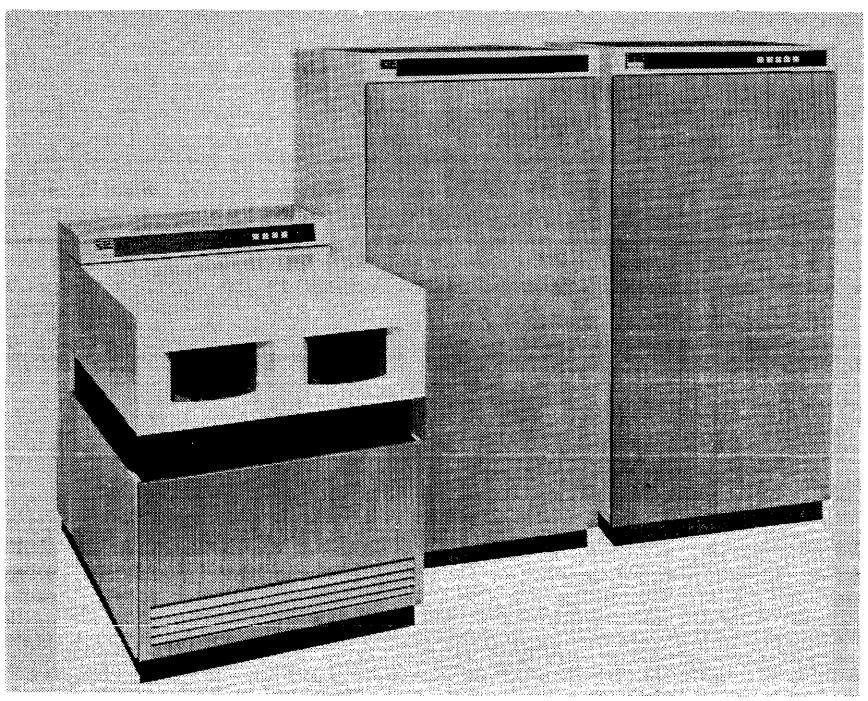
FIXED-DISK DRIVES: Model 8400, which contains two fixed-disk stacks, and Model 8800, which contains four fixed-disk stacks.

REMOVABLE-PACK DISK DRIVES: Model 8100, a standard-density drive, and Model 8200, a double-density drive. Both drives contain a single spindle and are pack-compatible with the IBM 3330/3333-1/2 and 3330/3333-11 disk modules, respectively.

DISK CONTROLLERS: The Model 8000 Disk Control Unit is the main controller. The Model 8001 Control Module is required only to attach Model 8100 or 8200 Disk Modules to the 8000 Disk Control Unit.

CONFIGURATION

Any of three basic configurations can be specified: fixed-disk only, consisting of 8400 and 8800 Disk Modules; fixed and removable disk combined, consisting of various



Shown from left to right are the 800-million-byte 8800 Drive Module, the 8001 Control Module, and the 8000 Controller. The 8000 can control up to eight 8400 and/or 8800 Drive Modules, while the 8001 is required only when interchangeable-pack 3330-style drives are used.

STC 8000 Series Disk Subsystem

STC's fixed-disk subsystem is composed of a microprogrammed controller and from one to eight disk drive modules, each containing a cluster of two or four non-interchangeable disk stacks served by a common access mechanism that STC calls an arc actuator. Each stack of 16 disks holds 200 million bytes of data. An 8000 Series subsystem can be composed of any mix of up to eight 400-million-byte and/or 800-million-byte drive modules to provide on-line storage capacities of up to 6.4 billion bytes—equivalent to the maximum subsystem capacity provided by 32 of IBM's double-density 3330 disk drives.

The 8400/8800 disk modules, in effect, correspond to a fixed-disk arrangement with disks stacked 32 or 64 high. Each cylinder is composed of all the tracks on the two or four disk stacks that can be read or written at one arm position. The cylinders are grouped into four or eight logical units or "files," each with the same capacity as a single-density IBM 3330 disk pack. The STC file corresponds to an IBM spindle in respect to data layout and logical organization. STC's file concept was devised for compatibility with IBM's existing disk access software.

The concept of four or eight logical files per access mechanism, as compared with the usual one file per access mechanism, can result in performance degradation, depending on the user's file sizes, file organization, and method of access (e.g., random, sequential, or a combination of both). To establish maximum utilization of the 8000 Series drives, thereby gaining optimum performance, STC says it will evaluate each customer's existing data sets for size, application, frequence of access, logical arrangement on the disks, etc.

An increase in the number of files handled by a single access mechanism magnifies the difficulties encountered when the drive becomes inoperative; i.e., a large amount of data is unavailable to the computer while the drive is down, unless the storage medium can be removed and used on another drive. The fact that the STC 8000 Series drives do not employ removable disk packs can be a two-fold disadvantage: (1) data cannot be retrieved from an inoperative drive, and (2) pack interchangeability is not provided. The second disadvantage is largely offset by the capability to add STC's 3330-type Model 8100/8200 drives, which offer disk pack interchangeability. To compensate for bad spots or unusable areas on the disk surfaces, STC provides 8 spare surfaces on the 8800 and 4 spare surfaces on the 8400. The spare surfaces are made available for use by service personnel, who must interchange the read/write address lines.

On the brighter side, STC's file concept provides a cylinder capacity three or six times as large as that of the IBM 3330. The larger cylinder capacity provides increased performance and permits up to 1.5 million bytes to be transferred in one seek operation, as compared with 247,000 bytes for the IBM 3330. The STC drives also

combinations of 8400 and 8800 Disk Modules and 8100 and 8200 Disk Modules; and removable disk only, consisting of 8100 and 8200 Disk Modules. Each of these configurations requires the Model 8000 Disk Control Unit.

The fixed-disk configuration includes an 8000 Disk Control Unit and any mix of from one to eight 8400 and 8800 Disk Drive Modules. An 8400/8800 Disk Attachment feature is required on the Model 8000 Disk Control Unit.

The combined fixed- and removable-disk configuration includes an 8000 Disk Control Unit, any mix of one to seven 8400 and 8800 Disk Modules, an 8001 Control Module, and any mix of one to eight 8100 and 8200 Disk Modules. An 8400/8800 Disk Attachment feature on the Model 8000 controller is required for the 8400 and 8800 Disk Modules.

The basic removable-disk configuration includes an 8000 Disk Control Unit, one or two 8001 Control Modules, and any mix of one to eight 8100 and 8200 Disk Modules per 8001 Control Module for a maximum of 16 spindles. When the 32-Drive Addressing option is specified, the 8000 Disk Control Unit can accommodate one or two additional 8001 Control Modules and their associated string of up to eight drives each for a maximum of 32 spindles.

The Dual Path option provides access to any 8400 or 8800 Disk Module or any 8100 or 8200 Disk Module within a string by either of two 8000 Disk Control Units, under program control.

The Two- or Four-Channel Switch option permits the 8000 Series Subsystem, via the 8000 Disk Control Unit, to be shared between two or four computers, two or four controller positions on the same computer, or a combination of both arrangements. Switching is performed under program control.

COMPATIBILITY: The STC 8000 Series Disk Subsystem is designed for connection to an IBM System/370 computer, Models 135 through 195, via the Block Multiplexer Channel as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 8000 Series subsystem provides complete compatibility with the IBM 3330 command structure and is supported under specific levels of OS, DOS, and all levels of OS/VS and DOS/VS; no changes to existing operating software are required.

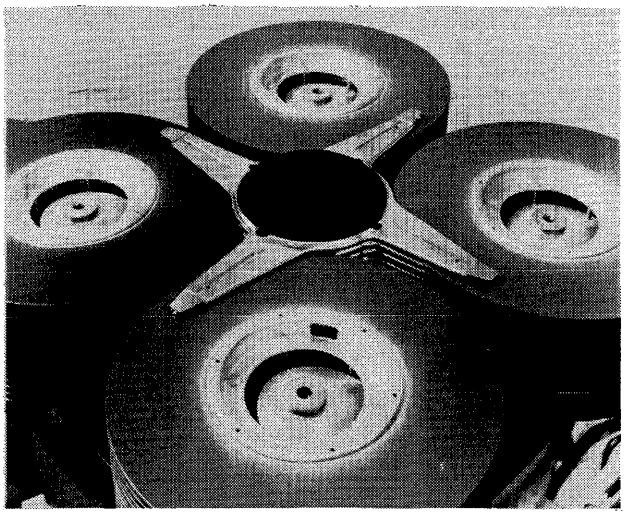
STORAGE CAPACITY

8400/8800 DISK MODULES: The data storage capacity of the STC 8400 Drive module is 400.072 million bytes; that of the STC 8800 Drive module is 800.144 million bytes. By comparison, the IBM 3330 Models 1 and 2 and 3333 Model 1 provide a per-pack storage capacity of 100.018 million bytes, and their double-density counterparts, the 3330 Model 11 and 3333 Model 11, provide a per-pack storage capacity of 200.036 million bytes. The total on-line storage capacity of an 8-drive STC 8400 subsystem is 3.2 billion bytes, and that of an 8-drive STC 8800 subsystem is 6.4 billion bytes.

The per-track storage capacity of the STC 8000 drives is identical with that of the IBM 3330: 13,030 bytes.

8100/8200 DISK MODULES: The data storage capacity of the 8100 Disk Module is identical with the per-spindle capacity of the IBM 3330 Model 1 or 2 Disk Storage Module: 100.018 million bytes. The data storage capacity of the 8200 Disk Module is identical with the per-spindle capacity of the IBM 3330 Model 11 Disk Storage Module: 200.036 million bytes. The total on-line storage capacity of

STC 8000 Series Disk Subsystem



This inside view of a Model 8800 drive module clearly shows the common "arc actuator" access mechanism that serves the four stacks of disks. Each stack contains 16 disks and stores 200 million bytes. The disks are removable only for servicing.

provide a slight advantage in access time over their IBM counterparts.

Standard IBM features provided with both STC's fixed-disk and removable-pack subystems include Multiple Requesting, Record Overflow, Command Chaining, and Rotational Position Sensing (RPS). Write Format Release, an IBM 3330-11 feature, is also standard for STC's fixed-disk and double-density drives.

Two- or four-channel selection is available, permitting the 8000 controller to be connected to two or four computers for shared operation, between two or four controller positions on the same computer, or in a combination of both arrangements. Switching is performed under program control.

STC also offers an enhanced version of IBM's String Switch feature, which it calls the Dual Path feature. Dual Path, like its IBM counterpart, operates under program control and permits any one drive in a string to be shared by another controller; however, unlike its IBM counterpart, the Dual Path feature allows two controllers to access two different drives in the same string. By contrast, IBM's String Switch inhibits access to a second drive in the same string by another controller, once selection has been established.

Initial customer deliveries of the fixed-disk version of the 8000 Series Subsystem were anticipated for September 1974, but the first fixed-disk subsystem was not delivered until March 1975. This initial subsystem has been up and running since early March.

Today's general lack of interest in fixed-disk storage can be attributed to IBM's championship of disk-pack technology since the early 1960's. IBM delivered its first

a 16-drive double-density subsystem is 3.2 billion bytes, while that of a 32-drive double-density subsystem is 6.4 billion bytes.

ACCESS ARRANGEMENT

8400/8800 DISK MODULES: The STC 8400 and 8800 drive modules contain two or four disk stacks, respectively. Each stack, removable for servicing only, provides access to 552 recording cylinders, consisting of 29 tracks each, via a central access mechanism that serves all of the disk stacks. The access mechanism, called an "arc" actuator, consists of two or four sets of 16 vertically aligned positioning arms coupled together at right angles. Each set of positioning arms contains 32 vertically aligned read/write heads, one per disk surface.

Head positioning is performed simultaneously on all disk stacks within a drive module, so that a set of two or four corresponding cylinders is accessed by the execution of a single seek command. Each cylinder position within one stack provides access to 377,870 bytes of storage. Because two (Model 8400) or four (Model 8800) cylinders are accessed simultaneously, the actual cylinder capacity available at one position is two or four times that of a single cylinder–755,740 or 1,511,480 bytes, respectively.

8100/8200 DISK MODULES: The single-spindle STC 8100 or 8200 drive modules each provide access to 404 or 808 recording cylinders, respectively. Like its IBM counterpart, each model provides access to 19 tracks per cylinder, and each cylinder is accessed via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

STORAGE MEDIA

8400/8800 DISK MODULES: The 8400 and 8800 drive modules contain two and four fixed-disk stacks, respectively. Each stack contains 16 disks and provides 32 recording surfaces; of these, two surfaces are reserved as spares and one for diagnostics. Each recording surface is divided into 552 tracks.

8100/8200 DISK MODULES: Each spindle of the STC 8100 standard-density drives accommodates an IBM 3336-1 or an equivalent disk pack. Each spindle of the STC 8200 double-density drives accommodates an IBM 3336-11 or an equivalent disk pack. All of these packs contain 12 disks and provide 19 recording surfaces; however, the IBM 3336-11 packs are equipped with a mechanical interlock to prevent inadvertent use of the double-density packs or standard-density units, and the converse.

FILE ORGANIZATION

8400/8800 DISK MODULES: The 8400 drive module is divided into four logical files, and the 8800 is divided into eight logical files. The capacity of each file is 100.018 million bytes, which is the equivalent of a single-density IBM 3330 spindle. Each logical file in the 8400 is composed of 138 contiguous cylinders of 58 tracks each, while each file in the 8800 is composed of 69 contiguous cylinders of 116 tracks each.

The file address scheme is established via a microprogram stored in the controller. Individual file addresses cannot be interchanged without manipulation of the microprogram.

8100/8200 DISK MODULES: Each 100M-byte or 200M-byte disk pack corresponds to one logical file, as in the IBM 3330-1 or 3330-11, respectively. Module Select (file identification) plugs, one per drive, are interchangeable and specify the logical address of each spindle.

STC 8000 Series Disk Subsystem

removable-pack drive, the 1311 Disk Drive, in 1963 as part of its 1440 computer system. Removable-pack technology became attractive as a way of keeping drive costs down but storage capacity up, since new packs can be mounted as others fill up. But with today's large storage capacities, the need to remove packs during daily operation has largely disappeared. Therefore, IBM computer users with large disk storage requirements would be well advised to carefully consider all the pros and cons of a shift to the STC 8000 Series Subsystem.

Storage Technology, the leading supplier of IBM-compatible magnetic tape drives, provides its own maintenance through a staff of over 450 service personnel in 21 major cities, including New York, San Francisco, Boston, Philadelphia, Detroit, Dallas, Denver, Chicago, Cleveland, and Los Angeles. STC guarantees its response time to service calls within a 50-mile radius of a service point to be equal to or better than the corresponding IBM service. □

PERFORMANCE

The performance characteristics of the STC 8000 Series drives are compared with those of the IBM 3330 drives in the following table.

Disk Drive	Head Positioning Time, msec Minimum	Average	Maximum	Tracks per Inch
STC 8400/8800	7	27	50	250
STC 8100/8200	7	28	55	192; 384*
IBM 3330/3333	10	30	55	192; 384*

***Double-density drives.**

Rotational speed (3600 rpm), average rotational delay (8.33 milliseconds), and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically in both the STC and IBM drives.

PHYSICAL CHARACTERISTICS

The physical arrangement of the STC 8000 Series Subsystem is totally different from that of the IBM 3330. The physical characteristics of the STC units are listed below:

	Width, inches	Depth, inches	Height, inches	Weight, pounds
8100 Drive	24	36	40	480
8200 Drive	24	36	40	480
8400 Drive	32	44	46	1150
8800 Drive	32	44	46	1300
8000 Controller	30	30	60	350
8001 Control Module	30	30	60	250

Floor space requirements (excluding service area) are 6.25 square feet for the 8000 Controller and 8001 Control Module, 9.77 square feet each for the 8400 and 8800 drive modules, and 6 square feet each for the 8100 and 8200 drive modules. Maximum floor space (excluding service area) required for an 8-drive 8400/8800 subsystem is 84.41 square feet. By comparison, an 8-spindle, channel-attached IBM 3330 subsystem requires 55.49 square feet of floor space, excluding service areas.

PRICING

The STC 8000 Series Subsystem is available for purchase or on a one-, two-, or five-year lease, which includes maintenance for 24 hours per day, 7 days per week. Lease rates also include all cables, installation, diagnostic performance checks, and unlimited equipment usage.

STC provides service for purchased units under one of three service contracts: Prime Shift (9 hours/day, 5 days/week), Extended Shift (16 hours/day, 5 days/week), and Total Service (24 hours/day, 5 days/week). Service calls beyond contract-specified hours are billed at a rate of $38/hour plus travel costs, which are limited to a $10 maximum charge.

	Monthly Rental (1) 1-Year Lease	2-Year Lease	5-Year Lease	Purchase	Monthly Maint. (2)
Model 8000 Disk Control Unit	$1,240	$1,130	$ 980	$52,720	$146
Fixed-Disk Subsystem					
8400/8800 Disk Attachment (3)	419	380	350	17,820	27
Model 8400 Disk Module (2 200M-byte stacks)	1,050	955	860	44,550	184
Model 8800 Disk Module (4 200M-byte stacks)	1,625	1,485	1,335	69,300	243
Dual Path	88	88	75	3,715	5.50
Removable-Pack Subsystem					
Model 8001 Disk Control Module (4)	297	270	233	12,625	16.50
Model 8100 (100M bytes)	535	490	425	22,770	92
Model 8200 (200M bytes)	800	730	635	34,155	92
32-Drive Addressing	315	286	260	13,365	11
Dual Path	88	80	75	3,715	5.50
Channel Switches					
Two channels	178	162	150	7,575	11
Four channels	386	351	320	16,385	22

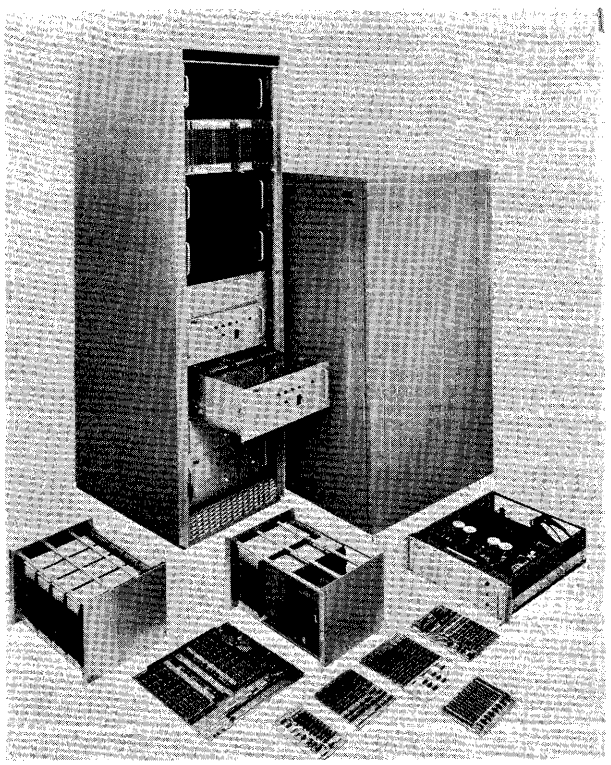
(1) Includes maintenance for 24 hours/day, 7 days/week.

(2) Prime Shift; Extended Shift and Total Service are priced at about 1.25 and 1.5 times the rates for Prime Shift service, respectively.

(3) One per string of up to eight Model 8400 and 8800 Disk Modules.

(4) One per string of up to eight Model 8100 and 8200 Disk Modules. ■

STC 3755 Monolithic Memory for System/370 Model 155



The STC 3755 Monolithic Memory cabinet is at upper right in this photo, which also shows a variety of other semiconductor memory products manufactured by Intel Corporation.

STC's 3755, an MOS semiconductor replacement memory for the IBM 370/155, provides twice the per-cabinet storage capacity of the IBM 3360 at a cost well below that of the equivalent IBM memory.

MANAGEMENT SUMMARY

Storage Technology Corporation, a leading manufacturer of high-performance IBM-compatible magnetic tape drives and the producer of Super Disk, an innovative alternative to IBM's 3330 Disk Storage Facility, entered the System/370 add-on main memory market in January 1973 with a plug-compatible replacement for the IBM 3360 Processor Storage used with the 370/155. Produced by Intel Corporation, a leading semiconductor memory manufacturer, STC's 3755 Monolithic Memory employs MOS semiconductor technology, in contrast to IBM's use of conventional core memory in the 370/155, and is available in 1/2-megabyte and 1-megabyte storage capacities per cabinet.

The salient features of the STC 3755 can be summarized this way:

- Storage capacity—the 3755 provides twice the per-cabinet storage capacity (1024K bytes) of IBM's 3360 Processor Storage. A full 2 million bytes of STC memory can be attached to IBM's 2-port primary Storage Adapter in the 370/155, as compared with 1 million bytes of IBM 3360 main storage. Like its IBM ▷

CHARACTERISTICS

SUPPLIER: Storage Technology Corporation, 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

MANUFACTURER: Intel Corporation, 3065 Bowers Avenue, Santa Clara, California 95051. Telephone (408) 246-7501.

COMPATIBILITY: STC's Monolithic Memory employs MOS semiconductor construction and is designed as plug-compatible add-on or replacement main memory for the IBM System/370 Model 155. STC memory can be used to extend the storage capacity of an existing IBM System/370 processing unit and/or to replace all of the unit's existing core storage.

The STC 3755 memory is designed as a direct replacement for the IBM 3360 Processor Storage used with IBM System/370 Model 155, and is available in 512K- or 1024K-byte storage capacities.

The effective cycle time of the STC 3755 is the same as that of the corresponding IBM unit: 2.07 microseconds per 16-byte fetch.

The STC semiconductor memory is constructed from 32K-word by 1-bit pluggable MOS arrays; each array includes 512 words by 1 bit of bump storage. A total of 36 MOS arrays form a basic storage module providing 32K words of storage. (Each word is composed of four 9-bit bytes, including parity.) Each 3755 cabinet contains up to eight basic storage modules, providing a total of 1024K bytes of storage. The 3755 memory also contains 4096 words of "bump" or auxiliary storage.

No hardware or microcode changes are required when replacing IBM 3360 storage with STC 3755 storage having the same storage capacity; however, hardware and microcode changes are necessary when increasing the capacity of processor storage.

The physical specifications and heat dissipation of the STC 3755 are compared with those of IBM 3360 Processor Storage in the following table.

Memory Model	Storage Capacity, bytes*	Depth, inches	Width, inches	Height, inches	Weight, pounds**	Heat Dissipation, BTU/hr.**
STC 3755	1024K	31	31	60	700	6,800
IBM 3360-3	512K	31.5	62	60	1,800	13,500

* Maximum storage capacity per memory cabinet.
** Per 512K bytes of storage.

The STC 3755 memory is equipped with an integral power supply that satisfies the memory power requirements and with diagnostic circuitry that, via an external maintenance panel, permits complete diagnosis of malfunctions in a ➤

STC 3755 Monolithic Memory for System/370 Model 155

counterpart, the STC 3755 includes 4096 words of bump storage per 512K bytes of storage; however, unlike IBM, STC integrates the bump storage with main memory.

- Floor space–the 3755 occupies only one-half the floor space of the IBM 3360 and, with a full 1-megabyte capacity, weighs one-half as much as a 1/2-megabyte IBM 3360.

- Power requirements–the 3755 requires one-half the power and dissipates one-half the amount of heat produced by equivalent IBM 3360 storage.

- Pricing–the 3755 leases for 42 percent (under a 2-year lease) below and sells for 74 percent below IBM's monthly rental and purchase prices, respectively, for 512K bytes of storage. Further savings can be realized under extended lease terms.

An STC 3755 user can gain a further substantial saving of $83,040 for a second IBM Storage Adapter with a third port or $108,960 with a fourth port, required when upgrading a 370/155 beyond 1 megabyte using IBM memory. The STC user can upgrade to a full 2 megabytes of STC memory on the primary Storage Adapter, provided no IBM memory remains. In cases where a user owns his 370/155 and has purchased just 512K bytes of IBM memory (one port covered), STC can attach up to 1.5 megabytes of its memory on the second port. A shared-port feature, to be available by April 1974, will allow sharing a single port between IBM and STC memory. Intel is currently developing an equivalent to IBM's second Storage Adapter to permit the attachment of enhancement capacities to four megabytes on the 370/155's primary Storage Adapter. The feature will be available in March 1974.

STC provides its own maintenance through a staff of over 300 service personnel in 21 major cities, including New York, San Francisco, Boston, Philadelphia, Detroit, Dallas, Denver, Chicago, Cleveland, and Los Angeles. STC guarantees its response time to service calls within a 50-mile radius of a service point to be equal to or better than the corresponding IBM service.

Customer deliveries of the 3755 began in January 1973. To date, seven units have been installed totaling 8 megabytes of semiconductor storage. STC has received IBM certification for maintenance continuance.

STC had introduced a memory similar to its 3755 (the 3765) for the IBM 370/165, but, as a result of IBM's introduction of the 370/158 and 168, withdrew the 3765 from its product line because the small 370/165 installation base of about 200 machines offers a slim market potential. By comparison, the current 370/155 market is sizable, with an estimated base of about 1100 machines.

USER REACTION

All STC users contacted by Datapro were well pleased with the overall performance and reliability of the STC 3755 memory. STC's initial 3755 installation, a 1-megabyte replacement for 1 megabyte of IBM core, required about 15 actual hours out of a 40-hour period, the balance of which was used for engineering and instruction to service personnel. This user states that STC's memory performed flawlessly for a full year, but was removed in December 1973 because the 370/155 was replaced with a 370/158.

Another user replaced his IBM memory with 1 megabyte of STC memory in April 1973, which took about 10 to 12 hours to install. In July, this user added another 1/2 megabyte of STC memory, which required an installation period of two weekends to implement extensive engineering changes. Overall performance and equipment reliability were reported as very good since the unit has been in operation. STC's service was rated excellent by the users. □

off-line mode. The memory is powered from a 208/230-volt, 3-phase, 4-wire source. Power consumption is rated at 2 KVA per 512K bytes of storage.

PRICING: The STC 3755 Monolithic Memory is available for purchase or on a two-, three-, four-, or five-year lease. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and complete service on a 24-hour/day, 7-day/week basis. A separate maintenance contract is available for purchased units.

	Monthly Rental*			
	2-Year Lease	5-Year Lease	Purchase	Monthly Maint.**
STC 3755:				
512K bytes	3,500	2,700	75,000	200
1024K bytes	7,000	5,400	150,000	200

*** Monthly rental under a two- through five-year lease includes 24-hr/day, 7-day/week maintenance.**

**** For prime shift. ■**

STC UNIVAC-Compatible Magnetic Tape Subsystems

MANAGEMENT SUMMARY

STC, the industry's leading independent manufacturer of magnetic tape subsystems for the IBM replacement market, now offers similar products for users of the UNIVAC 400 and 1100 Series computers. STC supplies two magnetic tape subsystems as plug-to-plug replacements for the Uniservo family of tape subsystems as used with the UNIVAC 418, 494, 1106, 1108, and 1110 computers, including the Uniservo VI C, VIII C, 12, 16, and 20 drives. No hardware or software modifications to existing UNIVAC equipment are required to accommodate the STC subsystems. Tapes written on UNIVAC drives can be read by STC drives, and the converse.

The STC 3400/3820 Subsystem includes three drive models with speeds of 125, 200, and 250 inches per second. The lower-speed drives are available as 7- or 9-track versions and are comparable in capability, although not in performance, to the UNIVAC Uniservo 12 and 16 tape drives. The STC 3480, available only as a 9-track drive, is functionally comparable to the Uniservo 20, but offers superior performance. The 3400/3820 subsystem employs STC's standard 3400 series drives, which have received broad user acceptance, with over 6,000 units (including controllers) installed to date. The 3820 controller is an STC 3800-III Tape Control Unit redesigned for direct connection to the 36-bit word-parallel interface of the UNIVAC computer, IOC, or IOAU. A UNIVAC Multiple Subsystem Adapter is not required for this connection, yet the STC subsystem can be operated under the Uniservo VIII C software handler or the byte-oriented MSA software.

The STC 3600/3821 Subsystem is composed of STC's standard 3600 series drives and 3800-IV Tape Control ➢

These subsystems are high-performance, plug-compatible replacements for the Uniservo tape subsystems used with UNIVAC's 400 and 1100 Series computers. In addition to price/performance advantages over the existing UNIVAC subsystems, STC offers high-density operation at 6250 bpi using IBM's GCR encoding scheme.

CHARACTERISTICS

MANUFACTURER: Storage Technology Corporation, 2270 South 88th Street, Louisville, Colorado 80027. Telephone (303) 666-6581.

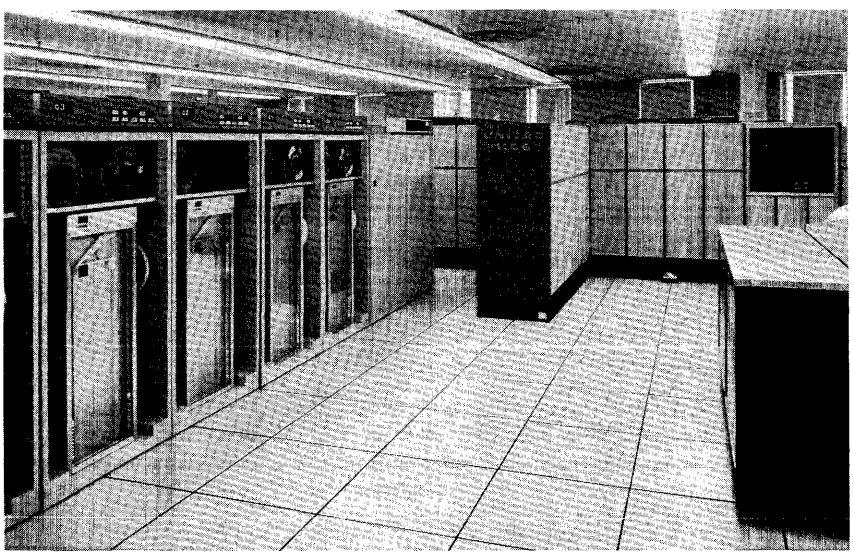
TAPE SUBSYSTEMS: The STC 3400/3820 Magnetic Tape Subsystem, for NRZI or PE operation at industry-standard densities up to 1600 bpi; and the STC 3600/3821 Magnetic Tape Subsystem, for GCR operation at 6250 bpi or PE operation at 1600 bpi.

TAPE DRIVES: STC Models 3450, 3470, and 3480 for the 3400/3820 Subsystem and Models 3650, 3670, and 3685 for the 3600/3821 Subsystem; see table.

TAPE CONTROLLERS: STC Models 3820, for the 3400/3820 Subsystem, and 3821, for the 3600/3821 Subsystem.

COMPATIBILITY: The STC 3400/3820 and 3600/3821 Magnetic Tape Subsystems are designed as plug-compatible replacements for the following UNIVAC magnetic tape subsystems as used with the UNIVAC 400 and 1100 Series computers:

- Uniservo VI C
- Uniservo VIII C
- Uniservo 12
- Uniservo 16
- Uniservo 20 ➤



The STC 3400/3820 Magnetic Tape Subsystem (at left) is shown in use in a large-scale UNIVAC 1108 computer installation.

STC UNIVAC-Compatible
Magnetic Tape Subsystems

CHARACTERISTICS OF THE STC AND UNIVAC TAPE DRIVES

Tape Subsystem & Drive Model	Tape Format, Tracks	Tape Speed, ips	Tape Density, bits/inch	Transfer Rate, K frames/sec	Rewind Time, seconds	Write Access, msec
STC 3400/3840–						
3450	9 or 7	125	1600/800*(9 tk), 800/556/200 (7 tk)	200/100 (9 tk), 100/69.5/25 (7 tk)	55	2.0
3470	9 or 7	200	1600/800* (9 tk), 800/556/200 (7 tk)	320/160 (9 tk), 160/111.2/40 (7 tk)	45	2.0
3480	9	250	1600	400	45	2.2
STC 3600/3821–						
3650	9	125	6250/1600*	780/200	55	1.5
3670	9	200	6250/1600*	1250/320	45	0.95
3685	9	250/125	6250/1600	780 @125 ips, 400 @250 ips	45	1.5
UNIVAC Uniservo–						
VI C	9 or 7	42.7	800 (7 or 9 tk), 556/200 (7 tk)	34.2 (7/9 tk), 23.7/8.5 (7 tk)	180	–
VIII C	9 or 7	120	800 (7 or 9 tk), 556/200 (7 tk)	96 (7/9 tk), 66.7/24 (7 tk)	120	–
12	9 or 7	42.7	1600/800* (9 tk), 800/556/200 (7 tk)	68.3/34.2 (9 tk), 34.2/23.7/8.5 (7 tk)	180	–
16	9 or 7	120	1600/800* (9 tk), 800/556/200 (7 tk)	192/96 (9 tk), 96/66.7/24 (7 tk)	120	–
20	9	200	1600	320	60	2.0

* Dual Density operation is optional.

NOTE: Interblock gap is 0.75 inch for 7-track operation, 0.6 inch for 9-track operation at densities up to 1600 bpi, and 0.3 inch for operation at 6250 bpi.

Unit redesigned for direct connection to the UNIVAC word-parallel interface. This subsystem provides UNIVAC users with the capability to employ the high-performance digital recording technique announced by IBM on March 7, 1973 – a recording density of 6250 bytes per inch using the IBM GCR recording scheme. Coupled with high tape speeds of up to 200 inches per second, the 6250-bpi density provides data transfer rates almost four times those available with 1600-bpi tape. The STC 3600 series drives include three 9-track models that operate at 6250 bpi and feature a 1600-bpi Dual Density option. Operating speeds are 125, 200, and 250 or 125 inches per second; the third model is a dual-speed drive that records at 6250 bpi at the 125 ips speed or at 1600 bpi at the 250 ips speed. Because UNIVAC currently does not offer a tape subsystem comparable with STC's 3600/3821, its existing operating software is not designed to accommodate the sophisticated error recovery capability provided by the 6250-bpi technology.

Both STC controllers, Models 3820 and 3821, feature microprogrammed operation, a sophisticated error detection and correction capability, microprogrammed diagnostics, and a radial tape drive interface, and are equipped with a maintenance panel that enables the CE to

The characteristics of the STC 3400 and 3600 Series tape drives as compared with those of the UNIVAC Uniservo drives are presented in the accompanying table.

The standard STC 3400 Series drives are available as 7- or 9-track units. The 7-track drives read and write at selectable densities of 200, 556, or 800 bits/inch using the NRZI recording technique. The basic 9-track drives read and write at a single density of 1600 bits/inch. With the Dual Density feature, the 9-track drives can operate at 1600 bits/inch using the phase-encoding technique or at 800 bits/inch using the NRZI technique. Standard features include automatic threading, power windows, cartridge-handling capability, automatic reel locking, read-backward capability, etc.

The basic 3820 Tape Control Unit, exclusive of optional features, is a single-channel controller for the STC 3400 series drives and provides control and data handling capability for any mix of up to sixteen 9-track, phase-encoded (1600 bpi) tape drives. The STC 3820 requires the 3480 Attachment to accommodate STC 3480 drives.

The Standard STC 3600 series drives are 9-track units that read and write data using the new Group-Coded Recording (GCR) scheme at a density of 6250 bits/inch. STC currently offers three models of the 3600 series drives for use with the UNIVAC 400 and 1100 Series computers, with data transfer rates of 780K or 1250K bytes/second at 6250 bpi. The Dual Density option permits operation at 1600 bpi using the phase-encoding recording technique. The 3600

STC UNIVAC-Compatible Magnetic Tape Subsystems

perform a comprehensive diagnosis of subsystem malfunctions.

Key drive features include automatic threading, dynamic amplitude control, velocity feedback reel control, automatic reel hub, analog capstan control, and the capability to be field-upgraded. All STC 3400 series drives can be upgraded to provide a 6250-bpi capability.

Initial deliveries of the STC 3400/3820 Subsystem were made in September 1973, and STC has made three installations to date. Both STC subsystems are available for delivery 60 days after receipt of order.

Storage Technology provides its own maintenance in 21 major cities, including New York, San Francisco, Boston, Philadelphia, Detroit, Dallas, Denver, Chicago, Cleveland, and Los Angeles. STC guarantees response time to service calls within a 50-mile radius of a service point to be equal to or better than the corresponding UNIVAC service.

STC users have a high regard for the 3400/3800 subsystem and for STC, as described in the User Reaction section of Report 70D-789-02. □

series family includes a dual-speed, dual-density drive with transfer rates of 780K bytes/second at 6250 bpi (125 ips) and 480K bytes/second at 1600 bpi (250 ips).

The STC 3821 Tape Control Unit, a single-channel controller designed primarily for the STC 3600 series drives, can also accommodate 9-track, phase-encoded 3400 series drives. The 3821 provides control and data handling capability for any mix of up to eight STC 3600 series and/or 3400 series drives and can accommodate up to 16 drives in a switching arrangement. The STC 3821 requires the 3685 Attachment to accommodate STC 3685 drives.

Options for the 3820 and 3821 controllers include: (1) 7- and 9-Track Compatibility at 200, 556, and 800 bpi via the NRZI recording technique and 1600 bpi via the phase-encoding technique; and (2) Dual Density operation for 9-track drives to permit switchable densities of 1600 bpi (PE) and 800 bpi (NRZI). Translation and data conversion features are included with 9-Track Compatibility. When selected, the translator function writes 6-bit Fieldata-coded characters as 8-bit EBCDIC or ASCII equivalents on 9-track tape; the converse translation is performed when reading. When selected, the data conversion function writes four 6-bit characters as three 8-bit bytes on 9-track tape; the converse function is performed when reading. The Character Insertion feature replaces each incorrect character read from tape with a special error character as specified.

The STC 3400/3820 and 3600/3821 subsystems are available with switching options that include a Two-Channel Switch and Tape Drive Switching. The Two-Channel Switch feature provides a second channel interface as an alternative path to the controller and its attached tape drives. The Tape Drive Switching feature pools up to 8 or 16 tape drives among 1 or 2 STC 3820 or 3821 controllers. Switching can be performed under program control. This feature permits concurrent operation of two tape drives over two channels on the same or different computers.

The physical characteristics and heat dissipation of the STC 3400 and 3600 series drives and the 3820 and 3821 Controllers are as follows:

	Width, Inches	Depth, Inches	Height, Inches	Weight, lbs.	Heat Dissipation, BTU/hr.
3400/3600 Drives	30	30	66	900	4,600
3820/3821 Controllers	30	61	66	900	6,400

The 3400/3820 and 3600/3821 subsystems are powered from a 208/230-volt three-phase source. Power requirements are 3.0 KVA for the 3820 and 3821 Controllers and 2.0 KVA for each of the 3400 and 3600 series drives.

PRICING: The STC 3400/3820 and 3600/3821 Magnetic Tape Subsystems are available for purchase or on a one-through five-year lease. Lease prices include maintenance for 24 hours per day, 7 days per week. Lease rates also include all cables, installation, diagnostic performance checks, and unlimited equipment usage.

STC provides service for purchased units under one of three service contracts: Prime Shift (7 hours/day, 5 days/week), Extended Shift (16 hours/day, 5 days/week), and Total Service (24 hours/day, 7 days/week). Service calls beyond contract-specified hours are billed at a rate of $38/hour plus travel costs, which are limited to a $10 maximum charge.

Detailed pricing for the STC 3400/3820 Subsystem is presented below. Pricing for the 3600/3821 Subsystem is not available at this writing.

	Monthly Rental*			
	1-Year Lease	5-Year Lease	Purchase	Monthly Maint.**
3450 Tape Drive	469	400	21,105	72
3470 Tape Drive	545	445	24,525	85
3480 Tape Drive	681	545	32,000	100
Tape Drive Features:				
Dual Density	20	20	910	11
7-Track Compatibility	0	0	0	11
3820 Controller	1,325	1,095	31,600	145
Controller Features:				
9-Track Compatibility (1600/800 bpi)	61	50	2,745	3
7- and 9-Track Compatibility (1600/800/556/200 bpi)	122	100	5,490	5
Character Insertion	92	80	4,140	5
3480 Attachment	105	90	4,935	–
Two-Channel Switch	87	70	4,260	5
Controller Switching–				
1 x 8	0	0	0	0
1 x 16	163	130	7,350	11
2 x 8	168	135	7,560	5
2 x 16	168	135	7,560	11

* Includes maintenance for 24 hrs/day, 7 days/week.
** Covers Prime Shift maintenance; Extended Shift and Total Service are priced about 1.25 and 1.5 times the Prime Shift cost, respectively. ■

Sycor Model 340 Intelligent Terminal

MANAGEMENT SUMMARY

The Sycor 340 has proved to be a highly successful product. During its six-year history, the company has produced more than 10,000 terminals. Sycor is currently delivering 700 terminals per month, compared with 400 terminals per month during the last quarter of 1972.

Preceded by earlier, less sophisticated versions (Models 301 and 302), the Sycor 340 continues to reflect the main thrust of the company's market direction: data entry applications. Sycor was the first of the independents to introduce a key-to-cassette capability with program support and a visual presentation, via CRT display, of the job in process. Moreover, the company has long promoted the key-to-cassette concept as an economically attractive form of data entry.

Billed as an intelligent terminal, the Sycor 340 contains a microprocessor with an 8K read-only memory and is primarily oriented toward source data entry applications. The basic Model 340 employs the kind of programming associated with keypunch equipment, i.e., record format control.

In normal practice, the user keys each record format, which is displayed as it is keyed, performs any necessary editing, and then outputs the record format on magnetic tape. A sequence of record formats is normally recorded, and the formats can be linked so that the preceding format automatically accesses the following one from tape to begin the next entry operation. The recorded formats can be individually selected via a search operation, then ▷

Designed and sold primarily as a key-to-cassette data entry terminal, the widely used Sycor 340 can also serve as a HASP, TWX, or time-sharing communications terminal. The basic cassette tape can be augmented by printed output, 7- or 9-track magnetic tape, or punched cards. Effective software support includes TAL, a specialized data entry language.

CHARACTERISTICS

MANUFACTURER: Sycor, Inc., 100 Phoenix Drive, Ann Arbor, Michigan 48104. Telephone (313) 971-0900.

CONFIGURATION: The basic Model 340 Terminal is a single unit that contains a microprocessor with 8K bytes of read-only memory and 1K bytes of random-access memory (for internal buffering only), keyboard, CRT display screen, and one or (optionally) two magnetic tape cassette recorders. The unit can accommodate a synchronous or asynchronous communications interface or both. The Model 340 can be equipped with an additional 3K bytes or 7K bytes of random-access memory (the Extended Memory feature) to allow implementation of user programs.

The Model 340 Terminal can accommodate a variety of peripheral devices, including four printer models rates at 30 cps, 80 cps, 165 cps (50 lpm), or 300/600 lpm; a 250-cpm, 80-column card reader; and a 7- or 9-track, industry-compatible magnetic tape drive. A card punch adapter is available; Sycor provides the card punch (Burroughs A149) on an RPQ basis only.

COMMUNICATIONS: Transmission is half-duplex, synchronous or asynchronous. The asynchronous interface ▶

The basic Sycor 340 Terminal contains a microprocessor, CRT display screen, keyboard, and one or two cassette tape recorders. This system, configured to handle branch-office data entry and communications functions, also includes a 30-cps printer (at left) and a data communications interface.

Sycor Model 340 Intelligent Terminal

loaded in display memory prior to an entry or data-transfer operation. The record format is displayed on the CRT screen so that the operator need only "fill in the blanks" with information from a source document. The keyed data, minus the format, is recorded on tape. When linked together, the next format is automatically read from tape and displayed for the following entry operation; this operating technique, however, requires a second cassette recorder.

Checks can be performed on the entered data to ensure that it is both complete and correct. These checks can include Check Digit Validation (Mod 10 or 11), Zero Balancing, and Omission Detection, which ensures that each entry is complete. The Zero Balancing option is part of an arithmetic option that can generate totals or subtotals.

Pooling or combining selected records from a number of cassette tapes onto a single cassette tape is made possible by the inclusion of a second cassette recorder. The second recorder can also be used for program entry when not used for pooling. Program entry can be awkward on a 340 Terminal with a single recorder. The operator must first insert the program cassette, search for and load the selected record format, remove the program cassette, and insert the data cassette.

The Sycor 340's basic capabilities can be substantially enhanced through the addition of the Extended Memory feature, which is available as a 3K-byte or 7K-byte MOS random-access memory. The feature equips the 340 to use a variety of Sycor-supplied software facilities, including a specialized data entry language that Sycor calls TAL (for Terminal Application Language), a HASP communications package, an interactive communications package for time-sharing applications (ITS), and a communications package that transforms the Sycor 340 into a master station for communication with unattended Sycor 340 terminals over the dial network.

Under TAL, the user can create his own application programs and tailor them to the demands of his environment. TAL consists of a comprehensive repertoire of instructions which are implemented in the form of macro statements. The TAL source program is converted to machine language in one pass of the Sycor Program Generator. Typical applications for the use of TAL include payroll data entry, order entry, and inventory control.

The HASP package is designed to emulate an IBM 2770 or 2780 communications terminal (without transparency) for operation as a remote terminal to an IBM System/360 or 370 computer running under OS/HASP Version III.

Sycor also supports the Model 340 as a TWX terminal for use on the Western Union TWX network. The TWX-compatible option permits the Sycor 340 to communicate with any other terminal on the TWX network.

As a general-purpose communications terminal, the Sycor 340 leaves little to be desired. It is compatible with IBM Binary Synchronous Communications (BSC) procedures is rated at 110 to 1200 bits/second; synchronous interfaces are available for operation at 1200, 2000, 2400, 3600, or 4800 bits/second using 8-level ASCII (with parity) or EBCDIC transmission codes. Synchronous transmission employs the IBM Binary Synchronous Communications (BSC) technique and is compatible with IBM Binary Synchronous terminals such as the 2770, 2780, 3780, and 3735. The EBCDIC Transparency feature, however, is not provided.

The Model 340 is equipped with an EIA Standard RS-232C interface and can be used over a dialed, leased, or private-line communications facility via an external modem. Sycor offers its own modem (Model 3460), which is compatible with the Bell System Data Set 202C (without reverse channel), for use at 1200 bps. The Model 3460 provides automatic answering as a standard feature. For synchronous operation, the following table lists the Bell System modems that correspond to the available data rates. Equivalent modems from independent manufacturers can be used in place of the Bell System modems.

Data Rate, bits/second	Bell System Modem	Line Conditioning
2000	201A	C2
2400	201B	C2
3600	203A	C2
4800	208A/B	–

The enhanced 340 Terminal with Extended Memory and software support is compatible with an IBM System/360 or 370 computer operating under OS/HASP. The 340 can operate point-to-point with other BSC terminals, including the IBM 1130 and System/360 Model 20 computers.

Communications features include automatic answering and Data Compression/Decompression. The latter feature economizes on the transmission of spaces by substituting control characters followed by a binary count of the number of spaces to be transmitted.

CASSETTE TAPE: One or (optionally) two cassette tape recorders each accommodate a "Philips-type" cassette, which contains 280 feet of 0.15-inch magnetic tape recorded at 800 bits/inch. Total cassette capacity is rated at 200,000 characters. Data is recorded serially by bit on 2 complementary parallel tracks in the form of 9 bits/character, which includes 1 parity bit. Record gaps are 1 inch long. Record length is variable from 1 to 256 characters. A cassette can store up to 800 256-character records or up to 1400 80-character records.

The cassette tape recorders on the basic 340 Terminal move tape at 3.9 inches/second except when the terminal is transmitting or receiving data; its tape speed is then 12.5 inches/second. The high-performance feature provides the 12.5-inches/second speed for all terminal operations. The data transfer rate at 3.9 inches/second is 350 or 116 char/second for read or write operation, respectively; at 12.5 inches/second, the data transfer rate is 1000 or 333 char/second for read or write operations, respectively. The lower transfer rate when writing is an effective rate that results from the unit's read-after-write checking feature. Rewind speed is 120 inches/second.

Data transcription between cassette tape and computer-compatible magnetic tape is performed via the 340 Terminal and a separate magnetic tape unit under program control.

COMPUTER TAPE: 7-track 556/800 bits/inch (Model 3457); 9-track, 800 bits/inch (Model 3459); or 9-track, 1600 bits/inch. All models record data on 1/2-inch tape in industry-compatible formats. Each of these computer-compatible tape drives is a separate, desk-top unit with a read/write speed of 12.5 inches/second. Rewind speed is 50 inches/second. The tape drives are manufactured by Wangco and accommodates an 8.5-inch reel (1200 feet).

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at speeds up to 3600 or 4800 bps. An asynchronous communications capability of up to 1200 bps is also available. The Sycor 340 can operate as an interactive communications terminal or as a batch terminal. A host of peripherals is available, including a 250-cpm card reader, four printer models ranging from a 30-cps impact printer to a 300- or 600-lpm drum printer, and 7- and 9-track magnetic tape drives. A card punch is available, but only as an RPQ item.

Sycor announced its original Key-Cassette Terminals in the third quarter of 1968, and deliveries began in February 1969. By mid-1971, Olivetti, Sycor's European marketing agent, had delivered over 1200 terminals. The Model 340 Terminal was announced in February 1971. Sycor also has a marketing agreement with Mitsui & Co., Ltd. of Tokyo. Mitsui has established an end-user sales organization (within Japan only) that markets, distributes, and services products purchased from Sycor.

Service is provided by Sycor and by Sorbus, a nationwide service organization with headquarters in King of Prussia, Pennsylvania.

USER REACTION

All Sycor 340 users contacted by Datapro were well pleased with the performance of the terminals and with the associated service; Sycor and Sorbus were both judged very responsive. Users rate the hardware reliability (including peripherals) as good or excellent. TAL, introduced in mid-1972, is now heavily used; users report that it is easy to learn by clerical personnel and effective in its use as a data entry language. In general, users report good software support from Sycor. □

DISPLAY: 9-inch (diagonal measurement) CRT display provides 576 display positions arranged in 9 lines of 64 characters per line, with a viewing area 5.5 inches high by 4.75 inches wide.

A character set of 62 ASCII characters, including uppercase alphabetics, numerics, punctuation, and special characters, is generated by a 5-by-7 dot matrix and displayed in green against a dark background.

DEVICE CONTROL: A stored format program, keyed or read from tape, controls the format of data recording by delimiting alphabetic, numeric, and alphanumeric fields and by initiating automatic field skipping, right justification (left zero or left blank fill), check digit validation (optional), or the generation of totals, subtotals, or zero balances (optional).

The program also includes format descriptors, which are displayed on the CRT to aid the operator during a keying operation. The format descriptors are displayed to the left of each variable field, which begins with a displayed symbol to define the type of field; e.g., A for alphanumeric, N for numeric. All format descriptors are protected from accidental erasure or over-recording. When transmitting, only the selected variable data is transmitted; the displayed format remains.

The basic 340 Terminal provides five operating modes: Format mode, Batch mode, Search mode, Automatic Unattended mode, and Program mode.

The Format mode is used when entering data from the keyboard or for reformatting previously-recorded data. Under program control, data entering the display buffer goes into variable fields that follow format descriptors until a complete record or "page" has been entered. Once entered, the record can then be edited prior to its transfer to a selected output device such as the second cassette recorder, printer, or communications line. Alternately, records can be written on the selected output medium as soon as the last data field is entered.

The Batch mode is used for data transfer between selected input and output devices. In this mode, the display buffer operates as two 256-character buffers that are toggled between input and output.

The Search mode is used to locate a specific record or program (record format) recorded on tape by comparing a keyed identifier of up to 256 characters with the data read from tape. Any portion of a record can be used as an identifier. The program, normally loaded from a cassette, is located via a Search operation, which searches the recorded formats for the identifier that compares with the one keyed by the operator; the selected format is then loaded.

The Automatic Unattended mode is similar to the Batch mode, except that the 340 Terminal responds to a selection sequence received from a remote Sycor 340 operating as a master station or a remote computer such as an IBM System/360 or 370. The selection sequence identifies the terminal, the terminal peripheral, and the desired mode of operation (e.g., read from cassette tape or print a message).

The Program mode is usable only on terminals equipped with Extended Memory and is defined by the program loaded in memory. The program can be loaded from cassette tape, computer tape, or punched cards.

Advance and Backspace keys move the cursor forward or backward to allow for correcting errors or modifying data. These controls are repetitive when key pressure is sustained.

File maintenance is performed by inserting the cassette containing the file to be updated or modified. Each record to be modified is retrieved and displayed via a Search operation. Then, by using the Advance and Backspace keys to position the cursor, data within the existing text can be deleted or changed and new data added. The modified record can then be reinserted into the position previously occupied by the original record on tape.

Pooling can be performed when the terminal is equipped with a second cassette recorder. Selected records from any number of cassettes can be consolidated on one cassette tape, or an entire field can be copied onto a second cassette tape. The second cassette recorder can also be used to enter record formats from a program cassette.

Totals or subtotals can be generated and zero balancing performed under program control by the addition of two 10-digit accumulators (the Arithmetic option).

Vacant or incomplete data fields, as a result of omitted or missing data, are detected and an error message is displayed on the screen when the Omission Detection and Capacity Control option is included. To continue, the operator must reenter the data correctly.

Large formats can be segmented into pages (program chaining). The chaining feature, included with the second recorder, automatically displays the next "page" of format descriptors when the previous "page" is completed.

The Tab Compression option permits the insertion of a horizontal tab character following data in a partially filled or skipped field; the remaining positions within the field are filled with spaces, which are eliminated when the field is transmitted or transferred to an output device.

SOFTWARE: The Sycor 340 is substantially enhanced when the Extended Memory feature is added. The feature

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provides 3K or 7K bytes of MOS random-access memory and permits the Model 340 to execute user-generated application programs for specialized data entry and communications applications.

Sycor provides a simple but flexible data entry language called TAL (Terminal Application Language), which consists of macro statements that can be linked to data entry fields defined in the displayed data entry format. The TAL instruction repertoire includes check digit, range checking, table checking, data manipulation, arithmetic (addition, subtraction, multiplication, and division), test, branching, verify, and I/O instructions. The keyed TAL source statements are converted to machine language by the Program Generator (in one pass) and are written on cassette tape. The result is the desired application program.

A Sycor-supplied software library, contained on cassette tape, includes TAL, The Program Generator, a loader, and several device control routines.

Sycor also provides application software packages under the category of Preprogrammed Systems. These require a minimum of 3K bytes of Extended Memory and include: (1) the HASP package that emulates an IBM 2770 terminal without transparency for use with an IBM 360/370 computer running under OS/HASP: (2) the Interactive Time-Sharing (ITS) package for communication with ASCII-oriented time-sharing systems at speeds up to 1200 bits/second; and (3) the Communication Station package for operation as a master station communicating with unattended Sycor 340 Terminals.

ERROR CONTROL: Character parity is generated and accompanies each character written on the cassette tape. A read-after-write check is performed on each record written. A detected error sounds an alarm and disables the keyboard while a re-write attempt is made. The computer-compatible magnetic tape unit also performs a read-after-write check on recorded data and attempts a rewrite when errors are detected. A cyclic redundancy check is performed on 9-track drives; odd or even character parity and longitudinal redundancy checking are performed on 7-track drives.

Validation errors alert the operator by blinking the originally recorded character above the cursor, sounding the alarm, and disabling the keyboard. Correction is performed by rekeying.

Mod 10 or 11 check digit validation is included in the software library, along with additional error checking routines.

KEYBOARD: 49-key typewriter-style keyboard with an additional 10-key numeric inset at right of main keygroup. Three groups of key arrangements above the main keygroup provide control of functions. Any of 64 ASCII characters can be generated, including upper-case alphabetics, numerics, punctuation, and special symbols.

CARD READER: A desk-top unit (Model 3440) reads 80-column cards at 240 cards/minute. A single input hopper and output stacker have a rated capacity of 600 cards, each.

PRINTERS: Any of four printers can be used, including three serial printers rated at 30 char/second (Model 3480), 80 char/second (Model 3481), or 165 char/second (50 lines/minute – Model 3482), and a drum printer (Model 3486) rates at 300 or 600 lines/minute. Each of the printers has 132 print positions and a 64-character set of ASCII symbols. Horizontal and vertical spacing for all printers is 10 char/inch and 6 lines/inch, respectively, and horizontal and vertical tabulation is program-controlled for all models.

The 30-cps printer, manufactured by Singer, is a full-character printer that employs a helical print wheel and accommodates pin-fed, six-part, continuous forms from 3-7/8 inches to 14-7/8 inches wide. The 80-cps and 165-cps printers are both matrix printers manufactured by Centronics; both units form characters within a 5-by-7 dot matrix and accommodate pin-fed, six-part continuous forms from 3-7/8 inches to 14-7/8 inches wide. The drum printer, manufactured by Data Printer, is rated at 300 lines/minute for 132-column printing and 600 lines/minute for 72-column printing.

PRICING: The Model 340 Intelligent Terminal is available for purchase or on a one-, three-, or five-year lease. Maintenance is priced separately for both leased and purchased equipment.

	Monthly Rental* 1 - Year Lease	5-Year Lease	Purchase	Monthly Rental*
Model 340 Terminal				
With one cassette recorder	$150	$113.	$6,600	$25
With two cassette recorders	178	134	7,720	30
Features				
High-Performance Cassette Recorder (each)	10	7.50	400	–
Data Compression	5	3.75	200	2
Tab Compression	5	3.75	200	2
Omission Detection & Capacity Control	10	7.50	320	4
Arithmetic Option (includes 2 10-digit accumulators)	20	15	800	4
Extended Memory:				
3K bytes	20	16	800	7
7K bytes	60	48	2,400	23
Software Library (recorded on tape cassette)	–	–	15	–
Peripherals				
Model 3440 Card Reader, 250 cpm	100	75	3,500	20
Card Punch Adapter***	11	8.25	440	5
Model 3457/3459 Tape Unit (7- or 9-track)	160	120	6,400	25
Printers:				
Model 3480; 30 cps	110	88	3,800	20
Model 3481; 80 cps	130	104	4,900	45
Model 3482; 165 cps	195	156	5,900	55
Model 3486; 300/600 lpm	360	288	16,300	110
Communications				
Asynchronous Interface	15	15	600	5
Synchronous Interfaces:				
1200 bits/sec	20	15	900	10
2000/2400 bits/sec	35	26	1,540	10
3600/4800 bits/sec	20	16	900	20
Unattended Operation	10	7.50	320	5
Modem (Bell 202C Compatible)	18	18	720	7

*Lease prices do not include maintenance.
**Maintenance is shown for purchased or leased units under a one-year lease only.
***Card punch is available from Sycor on an RPQ basis.

Magnetic tape cassettes sell for $7 each; a 10 percent discount applies to orders in excess of 50 units. ■

Sycor 250 Intelligent Display System

MANAGEMENT SUMMARY

A direct replacement for the IBM 3270 Information Display System, the Sycor 250 features user-implemented data validation functions and an optional, Sycor-built dual diskette unit with a storage capacity of 500,000 bytes. Sycor introduced its 250 system at the National Computer Conference in June 1973, and since its initial production deliveries in January 1974 has shipped more than 2,500 units. About 1,500 of those units have been delivered to Olivetti, which markets the display system as the TCV 270, primarily in European countries.

Dedicated to serving the data entry market, Sycor has integrated the basic data validation features of its earlier and highly successful 340 Intelligent Terminal (Report 70D-792-01) into the 250 system, thus permitting its users to perform a number of checks to verify the accuracy of the entered data prior to transmission to the remote computer. With the aid of a parameterized language called Field Instruction Language, or FIL, users can create and store fixed formats for fill-in-the-blanks applications and define the checking functions and parameters for each of the corresponding fields. The data entry capability is implemented by a microprocessor with an 8K-byte read-only memory and a basic 1K-byte user-programmable memory that is expandable to 6K bytes.

Besides lower cost, user programmability and the availability of diskette storage are the key advantages of the Sycor 250 over the IBM 3270. The data entry feature augments terminal operation by implementing error detection and correction measures at the source of entry ➢

The Sycor 250 is a direct replacement for the IBM 3270 Information Display System. Available in remote stand-alone and remote cluster configurations only, the 250 features a user-programmable data entry capability, a dual diskette unit, and two models of matrix printers.

CHARACTERISTICS

MANUFACTURER: Sycor, Inc., 100 Phoenix Drive, Ann Arbor, Michigan 48104. Telephone (313) 971-0900.

MODELS: Model 251/257, a remote cluster display system, and Model 255, a remote stand-alone display terminal.

MULTISTATION CONFIGURATION: The remote cluster configuration is formed by a Model 251 Remote Control Unit and up to 32 discrete devices, including any mix of Model 257 CRT display units and two printer models. Each device is buffered and can be located up to 2000 cable-feet from the control unit. Each display unit can support a local printer, a diskette unit, a light pen, and a badge reader. Buffer capacity of the local printer corresponds to the screen capacity of the associated display unit.

The Model 251 Remote Control Unit is available in two versions:

- **Model 251-1—contains a 480-character buffer and accommodates only devices having a 480-character buffer.**
- **Model 251-2—contains a 1920-character buffer and accommodates devices having buffer capacities of 480 or 1920 characters.**

SINGLE-STATION CONFIGURATION: The Model 255 Stand-Alone Terminal contains a microprocessor controller, ➢

This stand-alone Sycor 250 terminal consists of a CRT display, keyboard, printer, and dual diskette unit (foreground), a recent addition to the product line. In cluster configurations, a Sycor 250 System can include any mix of up to 32 keyboard/display units and printers.

Sycor 250 Intelligent Display System

rather than at the remote computer. This concept can lead to greatly improved data communications efficiency (and therefore to cash savings) through the elimination of complicated correction procedures. During the data entry operations, the operator is immediately alerted to a detected error in the field occupied by the cursor. Following correction, entry continues into the next field as guided by the cursor.

Fixed formats can be stored on diskette for immediate access. The diskette option also provides a batch capability for the 250. Keyed data can be batched on diskette during the day and transmitted (unattended) to the host computer after hours to avoid peak loads at the host computer. The diskette option also eliminates lost operator time resulting from computer downtime or line outages by capturing the keyed data on disk for later transmission. Other diskette-related applications include local file inquiry, report production, handling multiple print formats for multi-file operation, and page scrolling functions.

The architecture of the 250 provides each display station in a cluster with its own microprocessor, so that several jobs can be performed concurrently with no system degradation. All terminal functions are controlled by firmware that resides in the microprocessor's ROM. In addition, the firmware assembles keyed or received source statements into user programs. A total of 12 user-created formats can be stored at the terminal and used at any one time; additional user formats can be stored on the optional diskette unit or at the remote computer and retrieved as needed.

The Sycor 250 provides complete compatibility with the IBM 3270 with respect to line discipline, commands, command code structure, and addressing sequence. All features currently available with the IBM 3270 are included in the Sycor 250.

Here's how the salient characteristics of the Sycor 250 compare with those of the IBM 3270 system:

- Display capacity—The Sycor 250 provides two screen sizes, 480 and 1920 characters, which are identical with those available from IBM.

- System configuration—The Sycor 250 is available as a stand-alone or clustered remote terminal only. Sycor has not announced a local cluster version for direct channel attachment to replace an IBM 3270 system operating as a computer peripheral subsystem. The total number of device attachments for the cluster version of the Sycor 250 is the same as the number accommodated by the IBM 3270: 32 devices, including any combination of display units and printers. In addition, each display unit can accommodate a printer operating in local or overlapped mode, a diskette unit, a light pen, and a badge reader.

a display screen, and a keyboard. It is available in two versions that differ in display buffer and screen capacity: Model 255-1 has a 480-character capacity; and Model 255-2 has a 1920-character capacity. Either version of the Model 255 can support a local printer, light pen, and badge reader. Buffer capacity of the local printer corresponds to the screen capacity. Connection to a communications facility is established via a modem.

COMMUNICATIONS: Transmission is half-duplex, synchronous at 4800, 3600, 2400, 2000, or 1200 bits/second, using 8-level EBCDIC or ASCII (with parity). The Sycor 250 terminals employ the IBM Binary Synchronous Communications (BSC) technique and are transmission-compatible with the IBM 3270 Information Display System. Transmission speeds of 7200 and 9600 bits/second are scheduled for the fourth quarter of 1975.

The Sycor 250 terminals have an EIA Standard RS-232C interface and connect to a voice-grade communications facility via a modem. The following table shows the relationship between transmission speed and modem type; although Bell System modems are shown, equivalent modems from independent manufacturers can be used.

Transmission Rate	Bell System Modem
1200 bps	202C/D/E/R
2000 bps	201A
2400 bps	201B/C
3600 bps	203A
4800 bps	208A/B

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT. The following standard display arrangements are available:

Terminal arrangement:	Cluster	Cluster	Stand-alone	Stand-alone
Display model:	257-1	257-2	255-1	255-2
Characters/display:	480	1920	480	1920
Lines/display:	12	24	12	24
Characters/line:	40	80	40	80

A character set of 64 ASCII characters, including upper case alphabetics, numerics, and special symbols, is displayed in green against a dark background. The Dual Case option provides an additional set of 26 lower case alphabetics. Each character is formed by a 7-by-9 dot matrix.

The Status Line, a standard feature, is displayed at the top of the screen as an extra line and is protected from inadvertent key entry. The Status Line presents information to the operator concerning the operation of the terminal (e.g., error conditions).

SOFTWARE SUPPORT: The Sycor 250 is supported under existing IBM software support for the IBM 3270, including the DATA/360 and VIDEO/370 on-line data entry programs, the IMS data base management system, and the CICS data communications monitor.

DEVICE CONTROL: The Sycor 250 operates under control of the program stored at the remote computer and provides complete compatibility with the addressing sequence, command code structure, and line discipline employed by the IBM 3270 Information Display System. The Sycor 250 responds to and executes the full repertoire of IBM 3270 commands via a microprocessor and Sycor firmware, which resides in an 8K-byte read-only memory (ROM).

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- Communications—Transmission speeds for the Sycor 250 currently range from 1200 to 4800 bps. Those for the IBM 3270 range from 1200 to 7200 bps. Sycor, however, plans to provide speeds of 7200 and 9600 bps in the fourth quarter of 1975.

- Software support—the Sycor 250 is compatible with all existing IBM software for the 3270, including IMS and CICS.

- Printed output—Two printer models are available with the Sycor 250; both are variations of the same matrix-type printer and differ in speed only. Available speeds are 80 and 165 characters per second. The printers are available as buffered or unbuffered units; a 480- or 1920-character buffer is available. Only the buffered units can operate as communications terminals to communicate directly with the computer. The unbuffered Sycor units, when employed as local-copy printers, use the display buffers of the associated display units; therefore, displayed data cannot be erased until the data has been printed, causing a degradation of performance. However, the Overlapped Printer Option permits data to be transmitted directly to an unbuffered printer via a 500-character buffer, thus bypassing the display buffer of the associated display unit. With the option installed, local copy is initiated manually. By contrast, IBM offers two matrix printers for use with its 3270, one rated at 40 cps and the other at 66 cps; each printer attached to the IBM 3270 operates either as a local printer or communications printer, as directed by computer-issued commands.

The Sycor printers are manufactured by Sycor under an agreement with Logabax S.A., a French-based minicomputer and peripheral manufacturer that originally developed the units. The printers are available with single or dual tractor feed for independent printing of pre-printed forms.

Service is provided by Sycor, which has service locations in 95 cities in major metropolitan areas, and by Sorbus, a nationwide service organization with headquarters in King of Prussia, Pennsylvania.

USER REACTION

Datapro interviewed four users of the Sycor 250, who reported on their experience with a total of 55 Sycor display units and 24 Sycor printers. Their ratings are presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	0	3	1	0	2.8
Ease of operation	1	3	0	0	3.3
Hardware reliability	0	4	0	0	3.0
Maintenance service	0	3	1	0	2.8
Software and technical support	1	3	0	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

Features include all those provided by the IBM 3270 plus an exclusive Sycor feature, Field Instruction Language (FIL), a parameterized programming language that allows the user to create and store fixed formats for fill-in-the-blanks data entry applications and to define special checking functions for any given field via the use of Field Definition Tables. The special functions currently include check digit verification, zero balancing, logical operations, skipping, omission detection, and capacity control (field completion). The user-programmable feature is implemented via a basic 1K-byte programmable random-access memory, expandable to 6K bytes in 1K-byte increments.

Field Definitions Tables are linked to a displayed format by specific attribute (function) characters displayed in the Status (top non-data) Line. In the table, each data field is identified by its position on the screen, and the functions associated with each field are specified. Field definitions can be created and assembled by the terminal just before data is entered, or they can be stored in their original source statement format to be recalled and assembled as required.

Program Function and Program Attention keys, designated PF_n and PA_n, respectively, a standard feature of the IBM 3270, are also a standard feature of the Sycor 250. Each of these keys generates a unique code recognized by the controlling software as a specific program request or data identifier. The two key functions differ in that a Program Function code accompanies the displayed data as it is transmitted to the computer, while a Program Attention code is transmitted separately.

A light pen is available as an option and functionally corresponds to IBM's Selector Pen, a 3270 option. Any one of several alphanumeric or numeric fields of fixed or variable format can be selected by the pen, which transmits the address of the selected entry to the computer to initiate the programmed function.

The diskette option includes a bootstrap loader, initiated by key depression, and a 3K-byte disk control program that resides on diskette. The disk control program implements data storage and retrieval functions between display unit and diskette and between the host computer and diskette via the display units. The program also provides a key search function with an unlimited key-field length and a batch print (disk dump) function that prints the entire contents of diskette storage.

The Overlapped Printer Option, for unbuffered printers only, permits received data to be transferred from the communications facility to a 500-character print buffer, thereby bypassing the screen of the attached display unit. The operation is initiated by a special control character in the data stream. A local printed copy of displayed data can be initiated via key depression, but the standard 3270 Copy command is invalid for the unbuffered printers, and can be used with buffered printers only.

KEYBOARD: Either of two keyboard arrangements can be specified: typewriter or data entry. The keyboard, similar in layout and key arrangement to the equivalent IBM 3270 keyboards, include a separate group of 12 Program Function keys (optional for the typewriter-style) located at the right of the main keygroup and a row of 6 function keys located above the main keygroup. An adding machine pad is also optional for the typewriter-style keyboard.

PRINTED OUTPUT: Two models of matrix-type impact printers are available. Each model is offered as a buffered printer with a 480- or 1920-character buffer or as an unbuffered printer. The model numbers of the printers with various combinations of speed and buffering arrangement are listed in the following table.

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As the ratings indicate, these users were reasonably well satisfied with the product and with Sycor's response to their needs. They cited cost, print speed, programmability, and small physical size as principal advantages of the 250. No noteworthy disadvantages were reported. Two users reported problems with their printers, and Sycor is responding to both these users with direct replacements. □

Printer Model Numbers

Print Speed	Buffered, 480 char.	Buffered, 1920 char.	Unbuffered
80 cps	2582-1	2582-2	2582-3
165 cps	2583-1	2583-2	2583-3

Each printer model has 132 print positions and prints any of 96 ASCII characters, including upper and lower case alphabetics, numerics, and special symbols. Each character is formed by a 7-by-7 dot matrix.

Tractor feed is standard for all models and includes a removable tractor that accommodates pin-fed, continuous, 6-part forms from 2-1/8 to 15-1/2 inches wide. An optional Dual Tractor Feed accepts two forms.

Horizontal and vertical spacing are 10 char/inch and 6 lines/inch, respectively. Horizontal tabulation is standard. Vertical format control, also standard, is implemented via a 5-channel tape loop which contains two operator-selectable programs. Channels 1, 2, and 3 are used for Program One; channels 3, 4, and 5 are used for Program Two. Channel 3, common to both programs, is used for Line Feed Stop. A separate sensor is provided for end-of-form control.

DISKETTE STORAGE: The optional diskette unit accommodates two IBM 3740-style diskettes, providing a maximum on-line storage capacity of 486,288 bytes. The diskettes are rotated at 360 rpm, resulting in an average rotational delay of 83 milliseconds. Positioning time is 2.5 milliseconds per track. Data is transferred at 31,250 bytes/second. The recording technique is not compatible with that of the IBM 3740.

The diskette unit organizes a diskette into 73 data tracks plus 3 spare tracks and 1 index track. Each track is divided into 26 sectors, and each sector holds 128 bytes.

PRICING: The Sycor 250 is available for purchase or on a one-year lease which includes maintenance. A separate maintenance contract is available for purchased equipment.

	Monthly Rental*	Purchase	Monthly Maint.
Cluster Arrangement			
Controller:			
Model 251-1 (480 char.)**	$105	$2,290	$25
Model 251-2 (1920 char.)**	125	3,790	29
Display Unit:			
Model 257-1 (480 char.)	98	3,340	22
Model 257-2 (1920 char.)	122	4,220	26
Stand-Alone Display Terminals			
Model 255-1 (480 char.)**	127	4,310	29
Model 255-2 (1920 char.)**	143	4,840	33
Printers			
Model 2582-1 (480 char., 80 cps)	190	6,380	45
Model 2583-1 (480 char., 165 cps)	255	8,800	55
Model 2582-2 (1920 char., 80 cps)	195	6,600	45
Model 2583-2 (1920 char., 165 cps)	260	9,020	55
Model 2582-3 (unbuffered, 80 cps)	155	4,800	35
Model 2583-3 (unbuffered, 165 cps)	225	5,900	50
Options			
Model 2500 Diskette Unit	125	4,200	20
Operator ID Card Reader	30	880	10
Light Pen	20	660	5
Security Keylock	50 OTC	50	0
Numeric Keyboard Lock	0	0	0
Overlapped Printer Option***	20	675	5

*For one-year lease; includes prime-shift maintenance.

**Includes basic 1K-byte user-programmable memory.

***For unbuffered printers only.

OTC–One-time charge. ■

Tab Products
Punch-Verifiers and Interpreters

These buffered electronic 80-column keypunch-verifiers can automatically sequence 5 or 10 program levels stored in a special buffer and can insert stored constants automatically into designated fields. Keyed data is entered into one of two data buffers and can be corrected before a card is punched.

MANAGEMENT SUMMARY

Before concluding that the card keypunch is obsolete, consider the Tab line of punch-verifiers. The only fair-minded conclusion to reach is that these devices have clearly attractive features and are well suited for a substantial class of applications. Due recognition must also be given to the preference of innumerable users for punched cards over magnetic tape. For many of them, an electronic punch like the Tab device represents a great improvement over what they are now using.

Nor should this attitude be considered pure obstinance. In many respects cards remain simpler and easier to handle physically than magnetic tape. (And if one really wants magnetic-tape input to the mainframe, the cards can always be converted to tape automatically.) Therefore, if a machine can be contrived to handle cards automatically in most respects, perform quietly, and incorporate many of the buffering advantages of key-to-tape systems, the burden of proof is upon those who contend that punches are obsolete and should never be used.

The basic Tab punch is a punch-verifier with five program levels. Since each program level is equivalent to the format control exerted by a drum card in a purely mechanical card punch unit, the basic Tab unit can format incoming data in five different ways instead of the two that are customary for a mechanical punch. A program card is punched in the usual way, but instead of mounting it on a drum the program card is placed in the Input hopper and by the touch of a button the card contents are transferred into a semiconductor program buffer. Other Tab models can store 10 programs, and models still to be delivered will store 31 program levels.

CHARACTERISTICS

MANUFACTURER: Tab Products Co., 2690 Hanover Street, Palo Alto, California 94304. Telephone (415) 493-5790.

MODELS: 405: Punch-Verifier, 5 program levels; 405-10: Punch-Verifier, 80 character constants; 405-20: Punch-Verifier, card printing and interpreting; 405-30: Punch-Verifier, 80 character constants, card printing and interpreting; 410: Punch-Verifier, 10 program levels; 410-10: Punch-Verifier, 80 character constants; 410-20: Punch-Verifier, card printing and interpreting; 410-30: Punch-Verifier, 80 character constants, card printing and interpreting; 431: Punch-Verifier, 31 program levels; 431-10: Punch-Verifier, 80 character constants; 431-20: Punch-Verifier, card printing and interpreting; 431-30: Punch-Verifier, 80 character constants, card printing and interpreting.

All models include left zero and blank fill as standard. Constants are also available in sets of 160 or 240 characters of memory. Models with a 31-program-level buffer are not currently available, but delivery is scheduled for the first or second quarter of 1974.

CARD OUTPUT: Standard 80-column cards are punched in standard 80-column card code. Input hopper capacity is 450 cards, Output stacker capacity is 600 cards, and Correction stacker capacity is 15 cards.

Tab states that the electronic action of the punch enables a punching rate of 30 cards/minute and a verifying rate of 28 cards/minute. Interpreting is also accomplished at 30 cards/minute. The constant emitting feature raises throughput further by saving keystrokes. Stored program levels enable jobs requiring successively different formats to be handled in one pass without changes in job setup.

DEVICE CONTROL: The Tab Punch-Verifier incorporates the following kinds of independent semiconductor memories: a program buffer, which can store 5, 10, or 31 levels, depending on the model; a data input buffer, which always receives data as it is keyed; a data output buffer, which receives the contents of the data input buffer as soon as column 80 is keyed; and a constant buffer, which stores 80, 160, or 240 characters entered from the keyboard.

Sequencing of the program levels can be either automatic or manual, as determined by the setting of a keyboard switch. The program controls the format of the entered data by defining alpha and numeric fields, by specifying automatic field skipping, duplicating, right justification (left zero fill within numeric fields and left blank fill within alpha fields),

Tab Products
Punch-Verifiers and Interpreters

An important capability of the Tab punches is automatic sequencing of these programs–equivalent to program chaining in key-to-shared-disk systems. Each program is assigned a number, and the desired program sequence is one of the program inputs. Hence, regardless of the order in which the programs are entered, the number sequence entered into the program buffer determines the order in which the program levels will be executed. Manual sequencing is also possible provided that a control on the keyboard is tripped first.

The value of automatic sequencing can be understood by visualizing an invoice in which the first entry is the name and address of the recipient company. The fields for this information would consist of the company name, street address, city or town, state, zip code, and telephone number. The format for the supplier might be similarly organized. In contrast, the next line of information might consist of the shipping dates, delivery term, method of payment, method of shipment, tax status, account number, job number, a code number, invoice status, and shipping date. The organization of this class of information is obviously different from the first two and would require a completely different format. The quantity, part number, and description of the item to be shipped and its cost would require still another format. Other infomation on the form might require still other formats. By means of automatic sequencing, a succession of cards embodying the necessary information could be punched in the correct format and in the correct sequence. This capability is usually found only in much more sophisticated equipment, and certainly not in mechanical card punches.

Another important feature is insertion of constants. Either 80, 160, or 240 constants, according to the model, can be entered into memory from the keyboard and remain there until changed by the operator. Under program control, an appropriate constant is emitted into a field automatically, without the need for a keystroke.

All models perform left zero and blank fill as standard operations. Automatic duplication of columns and skipping of columns are also performed.

In addition to the program buffers, the Tab punch-verifier has a data input buffer and a data output buffer. The operator always keys data into the input buffer. Automatic operations are performed electronically by the machine. At any time prior to entering column 80, the operator can correct an error before it is punched into a card. Once column 80 is keyed, the data is immediately transferred to the output buffer, and a card is automatically punched.

While this card punching takes place, the operator proceeds to key the next record into the input buffer without any delay. Columns to be duplicated are obtained from the preceding record, which is still in the output buffer. In the rare case of realizing that an error had been

and by causing the insertion of constants at designated positions of the record. Automatic sequencing of programs is goverened by the sequence number punched into the original program cards that are loaded into memory. A keyboard display informs the operator of the program number in effect. A "sequence repeat" switch enables the operator to repeat any program. Manual control can be exerted over constant emitting as well as over program sequencing if desired.

Modes of operation consist of Load Data/Program, Punch, and Verify. Certain models, as listed above, can also Interpret.

In the Load Program mode, programs read from the program card are entered into program memory, erasing any prior programs. The Load Data mode enters the data read from a master card into the data memory buffer. Program and master cards are fed from the Input hopper.

The data input buffer can be loaded by keying data, by inserting constant information from a master card, by emitting constants, by duplication, or by zero and blank fills. Prior to entering column 80, the operator can correct errors before a card is punched. The backspace key is used to go back one or two spaces, the field repeat key is used to return to the start of the current field, and the card repeat key is used to return to column 1. Keying at any column replaces the previous character with a new one. After column 80 is filled, the contents of the input buffer are automatically transferred to the output buffer and punching of a card commences. While punching proceeds, the operator keys the next record into the input buffer without any interruption. Columns are duplicated from the previous record, which remains in the output buffer until it is displaced by the new record. In fact, if the operator became aware that the preceding card was in error, she could easily create a correct card by duplicating all the columns from the output buffer except those to be corrected.

In the Verify mode, the punched cards to be verified are placed in the Input hopper. Their contents are read, one by one, into the data buffers. The operator rekeys the data from the source document and a mismatch between a keyed column and the corresponding column in the buffer produces an error condition. After corrections are keyed into the buffer, a new card is automatically fed from the Correction stacker and punched.

All printing models have the Interpret feature. Prepunched cards to be interpreted are placed in the Input hopper and are automatically fed and interpreted.

A two-digit numerical column indicator located between the visible station and the Output stacker displays the card column to be punched or verified next. Status conditions such as interlock and error are displayed by indicator lamps on the status panel, and the operating mode is displayed at the keyboard.

ERROR CONTROL: Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character.

PRINTER: Models that print can produce any of 64 characters.

KEYBOARD: A keypunch-style keyboard can produce any of 64 character codes: 10 numerics, 26 alphabetics, and 28 special characters. Various control keys initiate functions such as manual duplication and skipping, error correction,

Tab Products
Punch-Verifiers and Interpreters

made in column 80, the operator can automatically duplicate the first 79 columns from the output buffer contents and then correctly key column 80. Later the preceding error card is removed from the deck. Each punched card can be viewed in the visible station.

Verification is carried out by first stacking previously punched cards into the Input hopper. The contents of the first card are automatically entered into a data buffer. The verifying operator keys the same information from the source document and a comparison is made, column by column, with the buffer image. Mismatches produce an error condition, and the operator must key a correction. When the buffer image has been corrected, a new card is automatically fed from the Correction hopper, and punched. The old card is passed into the Reset stacker, and the corrected card, with an identifying correction code punched into a corner, is sent to the Output stacker. Cards that need no correction are punched with an OK code. Successive cards to be verified go into alternate date buffers. This provision enables a duplicated column to be compared with the corresponding column of the preceding card.

The electronic keyboard has a feature called n-key rollover, which assures the proper sequence of keyed input even when two or more keys are depressed at almost the same time.

The punch-verifier-interpreter models can print while punching and can print correction cards when the unit is verifying. Prepunched cards can be interpreted at speeds of up to 30 cards/minute, depending on the number of columns to be interpreted. An ink roll, which can be readily removed, is employed instead of a conventional ribbon.

Another time-saving feature is automatic fast release. Cards having a limited number of columns to be punched or verifed move through the unit at accelerated speeds without special programming.

The Tab Punch-Verifier was first delivered in September 1972, and 550 units have been installed to date. The company points out that automatic sequencing of programs and emitting of constants are exclusive features at the present time.

Tab Products reported a profit of $889,000 in its last fiscal year ended May 31, 1973. Its gross sales in fiscal 1973 were 17 percent greater than in 1972. A bank credit of $7.5 million was recently obtained to underwrite rentals of the punch-verifier.

The company provides its own maintenance from 11 offices in the United States.

USER REACTION

Users of the Tab Punch-Verifier told Datapro that they have been replacing IBM 29 Card Punches, IBM 59 Verifiers, and IBM 129 Card Data Recorders with the single Tab unit. (Tab states that its unit is also replacing the Univac 1700 Series Card Punches.) The convenience of combining the two basic functions in one device drew favorable comment. A particular feature that users like is the capability to key corrections into the buffer image of the card undergoing verification and then automatically feed and punch a new card.

Without exception, users regarded the one-pass capability of the Tab unit, in which as many as 10 program levels are automatically sequenced and displayed, as a time-saving advance over mechanical punches. There also was general agreement that throughput had increased appreciably with the Tab units. Not all users employ emitting of constants, but those that do feel that the feature is a timesaver. Reliability of the Tab device was describing as outstanding, both in accuracy and freedom from breakdown, once a few installation problems were overcome. Tab service was called prompt and effective. The machine was considered easy for operators to use. □

➤ **card ejection, right justification, etc. The keyboard layout is like that of an IBM 129 Card Punch.**

PRICING: The various Tab models are available for purchase and can be obtained on either a 90-day or 1-year lease. A separate maintenance contract is available for purchased equipment. The following prices include Tab maintenance in the monthly rental prices. Prices for the new models with 31 program levels are not yet available.

Model	Description	Monthly Rental	Purchase Price	Monthly Maint.
405	Punch-Verifier; 5 program levels	$115.00	$5,225	$20.00
405-10	Punch-Verifier; 80 character constants	127.50	5,625	25.00
405-20	Punch-Verifier; card printing & interpreting	145.00	6,325	30.00
405-30	Punch-Verifier; 80 character constants, card printing & interpreting	157.50	6,725	35.00
410	Punch-Verifier; 10 program levels	120.00	5,500	20.00
410-10	Punch-Verifier; 80 character constants	132.50	5,900	25.00
410-20	Punch-Verifier; card printing & interpreting	150.00	6,600	30.00
410-30	Punch-Verifier; 80 character constants, card printing & interpreting	162.50	7,000	35.00 ■

Tally Punched Tape Transmission Terminals

The Tally System 111 transmits data from punched tape at 120 characters per second and includes reel handling facilities.

Tally's line of punched tape transmission terminals falls into three groups: 60, 72, and 120 char/sec. Transmission at 60 or 72 char/sec is parallel, while transmission at 120 char/sec is bit-serial. Models are available with capabilities for unattended operation and simple but effective error control.

MANAGEMENT SUMMARY

The Tally line of punched tape transmission terminals was a natural outgrowth from the line of paper tape readers and punches Tally has produced for a number of years.

These units have been designed to facilitate transmission, to a central point, of data collected during the day from business machines such as teletypewriters or accounting machines.

A total of four models are currently offered in three speed ranges (60, 72, and 120 characters per second) and with different special features. All models have been in service for three years or more. The chief distinction among the three speed groups is the method of transmission. The 60 and 72 char/sec models transmit in a parallel mode and the 120 char/sec models transmit in a bit-serial mode.

The System 311 is a combination send/receive unit that operates in serial mode at 120 char/sec; its receiving capabilities are described in Report 70D-822-02.

Users express general satisfaction with the Tally punched tape terminals; some, in fact, say that the reliability of this equipment persuaded them to install other Tally products.

Tally Corporation first delivered the transmitting terminals in late 1960. The number of currently active installations is placed at well over 5000, and possibly as many as 10,000.

A tentative relationship between Tally and the Ball Corporation of Muncie, Indiana, which was announced on ➢

CHARACTERISTICS

MANUFACTURER: Tally Corporation; 8301 180th Street; Kent, Washington 98031. Telephone (206) 251-5500.

MODELS: The accompanying chart identifies the transmitter models that Tally presently markets.

Compatibility between various Tally punched tape transmitters and receivers is fairly easy to determine. This rule will serve as a guide:

> A parallel transmitter sends to a parallel receiver with the same or higher speed rating. Serial transmitters send to a serial receiver with a matched speed rating.

Special features such as unattended operation and error control do not prevent communication between dissimilarly equipped units. The error-checking facility in a receiver must be turned off when receiving from a transmitter not equipped with retransmission capability.

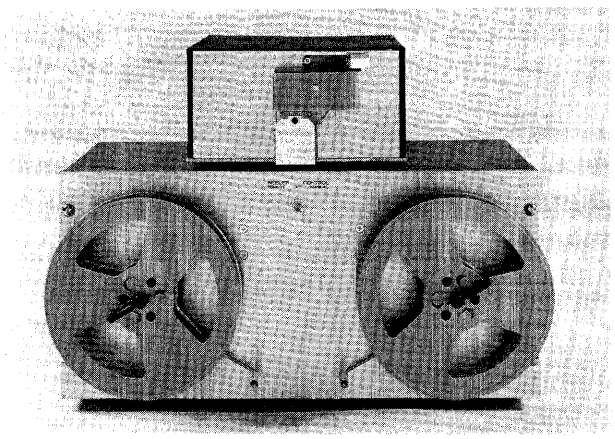
COMMUNICATIONS: These transmitters can be separated into three groups based on transmission speed: 60 char/sec, 72 char/sec, and 120 char/sec. All models can transmit over a voice-band facility, either a leased line or the public telephone network.

The 60-char/sec models transmit data in a parallel mode; i.e., all bits of a character are sent at the same time. The interface is compatible with the Bell System 402A, 402C, and 402C-2 Data Sets. The 402C series provides for unattended operation; the 402C-2 provides reverse-channel capability.

The 72-char/sec models also operate in a parallel mode and can utilize the same data sets as the 60-char/sec models.

The 120-char/sec model transmits data serially; i.e., one bit at a time. Transmission is asynchronous using a 10-unit code, which includes a start and stop bit. For codes read from tape containing less than 8 levels, zero bits are added to bring the number of data bits to 8. Speed Selection is available and permits switching between 120 and 60 char/second. ➤

Tally Punched Tape Transmission Terminals



The 60- and 72-char/sec parallel transmitters (top) are surprisingly compact units which are dwarfed by the optional reel-handling facilities available for use with them.

May 25, 1973, has now been concluded and signed. Mr. James V. Navarre, president of Tally, stated that the agreement assures the company of adequate cash resources for its operations throughout at least the remainder of the calendar year. □

TALLY TRANSMISSION TERMINALS

Operational Mode	Tally System Operating At: 60 cps, Parallel	72 cps, Parallel	120 cps, Serial
Manual Only	T600*	–	–
Unattended	–	T750*	–
Unattended and Retransmission Capability	–	T750*	111** 311**

*Has integral modem.
**Can also send at 60 cps serial with option.

DEVICE CONTROL: With the right data set, certain models (see chart) can operate unattended; i.e., a call is answered automatically, data is transmitted, and the call is automatically terminated without operator attention.

After the call is answered, and before the data transmission is begun, the communications line is monitored to see if a carrier signal is present (to ensure that the call is a true data call and not a misdialed voice call).

Models without the unattended feature operate completely under manual control. After the call is established by dialing and voice coordination, the data set is switched to the data mode and the transmitter start button is pushed.

On all models, the terminal will automatically disconnect if the end of the tape is reached.

ERROR CONTROL: With data sets that provide the reverse-channel facility, certain models (see chart) will automatically back up and retransmit a block of data if signalled by the receiver. The reverse channel is a low-speed data path furnished in the direction opposite to transmission. This capability is available for all 60- and 72-char/sec transmitters.

To control retransmission, block characters (any customer-specified bit configuration) are inserted in the data on tape when it is prepared. For proper operation, blocks must be between 30 and 720 characters long. The Record Form feature permits the System 111 to insert block characters at 128-character intervals into the transmitted data stream.

When a signal is received over the reverse channel, the reader halts, backspaces to the previous block character, and continues transmission. The reader will repeat this operation every time an error signal is received, thus putting control of retransmission at the receiver.

None of the transmitter models, except System 111, is equipped with parity generation; therefore, character parity must be punched into the tape during preparation. Parity generation is optional on System 111.

TAPE READER: Accepts standard 5-level (11/16-inch), 6-level (7/8-inch), or 7/8-level (1-inch) tape interchangeably.

The readers used are from the Tally 400 Series line and are operated at the transmission speed. A mechanical, star-wheel-actuated contact arrangement is used to sense the holes in the tape.

Paper, paper-Mylar sandwich, or aluminum-Mylar sandwich tape can be used. Because a mechanical hole-sensing mechanism is used, there are no restrictions on tape color or opacity.

A tape reeler is available for all 60- and 72-char/sec transmitters.

Reel-to-reel operation is optional for parallel models; the basic models read strips of tape. Serial models include reel-to-reel facilities for up to 750 feet of tape.

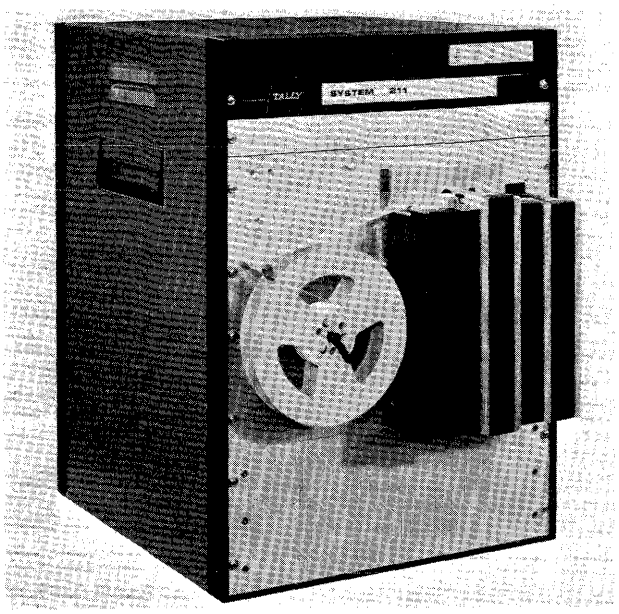
PRICING: Tally Paper Tape Transmitters are available for purchase or on a rental basis. Rental prices include maintenance. A separate maintenance contract is available for purchased units. The Tally Transmitters are priced as follows:

System	Rental	Purchase	Maintenance
T600	$ 40	$ 925	$ 7
T750	60	1,390	8
111	125	2,990	25
311	265	5,780	50
Options–			
Tape Reeler***	25	438	3
Retransmit*	10	160	2
Floor Console**	10	180	–
Speed Selection, 60/120 cps**	5	100	1
Parity Form**	30	720	8
Record Form**	35	720	8

*For System T750 only.
**For System 111 only.
***For System T600 or T750.

In addition, a one-time installation charge of $150 is made for System 311 and $100 for System 111. ■

Tally Punched Tape Receiving Terminals



The Tally System 211 punches data received over communication lines into tape at 120 characters per second. (System 228 is quite similar in appearance.)

Tally's line of punched tape receiving terminals includes models for receiving data transmitted at 60 or 72 characters per second in a parallel mode and at 120 characters in a bit-serial mode. Models are available with capabilities for unattended operation and simple but effective error correction.

MANAGEMENT SUMMARY

The Tally line of punched tape communication terminals is primarily oriented toward off-line, point-to-point data transmission. The company's line of receiving terminals complements the transmitting terminals described in the preceding report.

Models are marketed for receiving data from Tally Terminals transmitting in parallel mode at 60 or 72 characters per second and serially at 120 characters per second. The serial model can be equipped to alternately receive from parallel transmitters.

The number of receiver models now totals three. Two models without error detection and retransmission capability were dropped. The System 311 is a combination send/receive unit; its transmission capabilities are described in Report 70D-822-01.

The models with the unattended operation feature monitor the line after the connection has been established to verify that the call is not just a misdialed voice call.

In the Tally plan for unattended data communications, the call can originate from either the sending or receiving station with automatic answering and operation at the other end.

CHARACTERISTICS

MANUFACTURER: Tally Corporation; 8301 180th Street; Kent, Washington 98031. Telephone (206) 251-5500.

MODELS: The three Tally Receivers are:

System 228–60/72 char/sec parallel; unattended operation; error correction.

System 211–120 char/sec serial; unattended operation; error correction.

System 311–120 char/sec serieal; send/receive.

Compatibility among various Tally punched tape transmitters and receivers is fairly easy to determine. This rule will serve as a guide:

> A parallel transmitter sends to a parallel receiver with the same or higher speed rating. Serial transmitters send to a serial receiver with a matched speed rating. Options permit one receiver model (System 211) to receive in either 120-char/sec serial or 60/72-char/sec parallel mode.

Special features such as unattended operation and error correction do not prevent communication between dissimilarly equipped units. The error checking facility in the receiver must be turned off when receiving from a transmitter not equipped with error correction.

COMMUNICATIONS: These receivers operate at three different transmission speeds: 60, 72, or 120 char/sec. All models operate via a voice-band facility, which can be either a leased line or the public telephone network.

The parallel models (60 and 72 char/sec) are compatible with the Bell System 402D Data Set. System 228 with error correction provisions requires the 402D-2 Data Set or equivalent, which provides a reverse channel.

The serial model (120 char/sec) is compatible with the Bell System 202C-2 (public telephone network) or 202D-2 (leased line) Data Set. Transmission is asynchronous and is based on a 10-unit code structure. An option permits this model to alternately receive from the Tally 60 or 72 char/sec transmitters; a second data set is required.

Any line code from 5 to 8 levels can be received. The punched codes are binary images of the received codes.

Tally Punched Tape Receiving Terminals

The error correction feature provided in two models includes character parity checking and signaling the remote transmitter that an error has occurred. The receiver then expects that the next data received will be a retransmission of the previous block. The Tally line of punched tape transmitters includes models with the capability to backspace to a block character and retransmit a block.

When the receiver detects an error, a flag character is punched; the punch does not backspace and punch delete codes in the data already recorded on tape. A resultant tape typically contains good blocks of data along with partially punched blocks of data obtained when errors occurred during transmission. The flag character permits the partially punched blocks to be identified by a computer system using the tape for input.

If the tape prepared at the sending station is not rewound before transmission, the data is actually sent backwards, and the tape at the receiving station is then in correct order without the need for rewinding. This has the added advantage of putting the error flag characters at the front of the bad blocks, making editing easier.

The flag and block characters can be any bit configurations specified by the user. Tally recommends the use of a skip or non-print code for the flag character and a skip or print-restore character for the block character to facilitate editing in those devices that can respond to such codes.

Users express general satisfaction with the Tally punched tape terminals; some, in fact, say that the reliability of this equipment persuaded them to install other Tally products.

The company first delivered the receiving terminals in late 1960. Over 1000 units are estimated to be in operation at the present time.

A tentative relationship between Tally and the Ball Corporation of Muncie, Indiana, which was announced on May 25, 1973, has now been concluded and signed. Mr. James V. Navarre, president of Tally, stated that the agreement assures the company of adequate cash resources for its operations throughout at least the remainder of the calendar year. □

DEVICE CONTROL: All models except the System 200 are capable of unattended operation. In this mode, the terminal, in conjunction with the appropriate data set, can answer an incoming call, monitor the line to determine if the call is a data call or a misdialed voice call, receive the data, and automatically disconnect. All data is punched as received (except a character with a parity error in those models with error correction).

The System 200 requires the connection to be established manually; once a connection is established, a prolonged reception of space signals turns the punch on. Space signals can be generated at the transmitter by reading a foot or so of blank tape.

ERROR CONTROL: Two models (Systems 211 and 228) are equipped for error correction retransmission. A detected character parity error causes the unit to punch a flag character and signal the transmitting unit via the reverse channel provided by the data set. The receiver then continues to punch the next data received, which will be a retransmission of the previous block if the transmitter is equipped to do this. Timing and synchronization problems are circumvented by keying off the block characters in the input tape at the transmitter. The punch continues to punch only after receiving a block character.

A counter is included that keeps track of the number of retransmissions; the fourth time the same data block is transmitted, error checking is suspended, and the block is punched as received.

TAPE PUNCH: Can accommodate 11/16-, 7/8-, or 1-inch paper tape interchangeably. Tape Can be any color or opacity. Any code of 5 to 8 levels can be punched.

Supply and take-up reels are provided that hold up to 1000 feet of tape. Options permit handling of 3000 feet of tape.

These punches employ the Tally P-120 Perforator and operate asynchronously at up to the rated speed of 120 char/sec.

PRICING: These units are available from Tally on a purchase basis or on rental. The prices are:

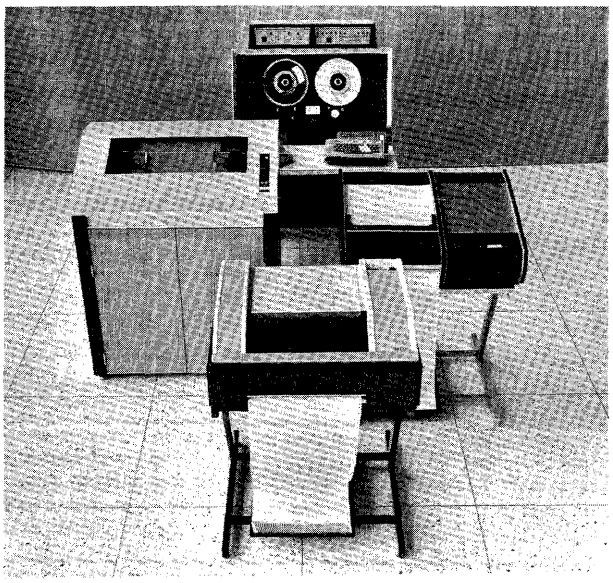
System 228–$5,000 purchase; $205 per month rental.
System 211–$3,990 purchase; $190 per month rental.
System 311–$5,780 purchase; $265 per month rental.

The rental arrangement is on a month-to-month basis and includes maintenance. A yearly service contract is available from Tally for maintenance of purchased equipment. The cost of the service is about 10 percent of the purchase price. A one-time charge of $150 is made for the installation of System 311; a similar charge of $100 is assessed to install Systems 211 and 228.

A free-standing floor console option is available for all models at a $180 purchase price or a $10 per month rental.

The System 211 can be equipped to switch to an alternate data set to receive parallel transmission; the cost is $100 (or $5 per month) for the 60 char/sec speed or $200 (or $15 per month) for the 60/72 char/sec speeds. ■

Tally Datascribe System



Arrayed in front of the basic Datascribe unit are the three line printers that offer printing speeds of 125, 200, or 600 lines per minute.

MANAGEMENT SUMMARY

Tally visualizes the principal role of the Datascribe as a remote terminal for the transmission of entered data rather than as a simple keypunch replacement. To this end, the company has developed a family of communications devices that operate at various rates. More than 500 Datascribe installations are now in operation. Deliveries began in July 1969 with the 9-track model. Current system capabilities include data entry at the keyboard, pooling of cassette tapes, and printing, as well as communications. Data transcription from both a paper tape reader and a card reader is also possible. All such auxiliary devices, including an adding machine, are installed by the company.

A major feature of the system is the availability of impact line printers that operate at 125 or 200 lpm. These printers fill an important application need where output volumes do not justify a high-speed printer. A printer operating at 600 lpm is also offered.

The Tally tape drive, which operates at 32 inches/second, is quite adequate for the pooling and search operations of the system. Neither data preparation nor verifying throughput is significantly affected by tape speed. Tally also provides communications interfaces for transmission at up to 4800 bits per second to match the high-speed data sets now on the market.

USER REACTION

Users reported a variety of reasons for selecting the Datascribe over competing key-to-tape devices. One user had confidence in Tally hardware and service through prior experience with the company's paper tape termi-▷

The various components of the Datascribe system are designed to facilitate the entry and transmission of data in accordance with application requirements. The key-to-tape data stations employ 7- or 9-track industry-compatible magnetic tape drives and are supported by various auxiliary devices.

CHARACTERISTICS

MANUFACTURER: Tally Corporation, 8301 180th Street, Kent, Washington 98031. Telephone: (206) 251-5500.

MODELS: The Datascribe product line includes the basic Datascribe unit plus combinations of the basic unit and an input or output device, a communications interface, or a pooler control. The product line is divided between 7-track models and 9-track models, with corresponding models in each group. The V-600 and V-800 are the basic models of the 7-track and 9-track series, respectively. Other models include a pooler control, communications interface, card reader interface, line printer, or concentrator. Models that include an adding machine, paper tape reader, and a 300-cpm card reader are presently available.

TAPE OUTPUT: The V-600 produces 7-track IBM 729-compatible tape; the V-800 produces IBM 2400-compatible tape. Functionally, tape drives in both models are identical. Tape movement is reel-to-reel at 32 inches/second via a single-capstan drive. Both models accommodate up to 10.5-inch reels, which hold 2400 feet of tape; these reels can be mounted on conventional computer tape drives.

Recording density for the 7-track V-600 is 556 (standard), 200 (optional), or 800 (optional) bits/inch. Recording density for the 9-track V-800 is 800 bits/inch. Record length is manually selectable; 80- and 100-character buffers are standard. As an option, record lengths from 80 to 200 character in seven lengths can be written.

DEVICE CONTROL: Programs for controlling data format and certain automatic functions such as duplicating, skipping, and left zero fill are stored in an independent integrated-circuit buffer. Second (alternate) program storage is standard. Programs can be entered from the keyboard and from magnetic tape. Operation is facilitated by display of the program code stored in the current location.

During data/program entry/verification, the following data is displayed on the display panel for the current location: memory position (decimal display), alphanumeric character in data buffer (English display), program code in program buffer (discrete indicator per code), active program number, and device status. The operating mode is clearly indicated by the five mode switch positions.

Operating modes are Program Entry/Verify, Data Entry/Verify, and Search. The Search mode permits the operator to find a data record with an identifier identical to that keyed in; any portion of a record can be used as an identifier. The Program Entry and Verify modes permit programs to be entered in the program buffer and verified as in the Data Entry and Verify modes. A record counter for keeping track of the number of records processed is a standard feature.

ERROR CONTROL: Conventional read-after-write checking is performed as tape records are written. Character parity is produced for each character keyed and accompanies the character as it is written on tape. Longitudinal ►

Tally Datascribe System

nals. Others were attracted by various aspects of Datascribe's transmission characteristics, such as the transmission rate of 4800 bits/second, the availability of appropriate internal interfaces for various system components, and techniques such as data compression for improving transmission efficiency. Several users said that Tally's maintenance terms seemed more economical than those of its competitors. One user stated that the 125-lpm printer, which competitors do not offer, was imperative in his application.

Concerning performance, those interviewed expressed satisfaction with the equipment operation. Naturally, some downtime has been encountered, but users evidently regard it as within normal bounds. Less than complete satisfaction, however, was expressed with respect to service. User attitude here was spotty and depended on where the installation was located. The inconsistencies probably arose because most Tally servicemen are operating out of their homes as a consequence of the company's current austerity program, and a facility that is tolerably close to the residence of its service representative usually receives effective support.

COMPANY INFORMATION

The financial straits of Tally Corporation have been well publicized in the media, and have been punctuated by both unfavorable earning statements and the acknowledgment of Mr. James V. Navarre, president of Tally, that the company's survival depends on obtaining new sources of credit. This predicament, of course, is disturbing to present and potential users of Tally products.

Accordingly, the company on May 25, 1973, issued a welcome release stating that a preliminary agreement subject to "certain conditions" has been reached with the Ball Corporation of Muncie, Indiana, a diversified manufacturer of glass containers and metal, rubber, plastic, aerospace, and electronic products. Under the agreement, Ball would furnish Tally with collateral financing and in return would receive warrants for the purchase of 1,600,000 shares of Tally at $3 a share. A Tally spokesman asserted that this arrangement would provide the company with funding adequate for its current programs. □

parity is generated and recorded at the end of each 7-track or 9-track record; a cyclic redundancy check character is generated and recorded at the end of each 9-track record.

Following the writing of each record, the tape is backspaced and the record is read and compared bit for bit with the data retained in the buffer. This feature applies equally in the Verify mode when a record is corrected.

KEYBOARD: 51-key keypunch-style keyboard can produce any of 64 character codes that include 26 alphabetics, 10 numerics, and 28 special characters. The keyboard can be positioned to suit the operator. A total of 16 control keys implement functions such as tape movement, manual duplication and skipping, error correction, left zero, etc. Any configuration of bits can be generated via the Multiple Code key. Tally provides keyboard compatibility with Honeywell and IBM equipment.

COMMUNICATIONS: The Data Communicator employs synchronous, half-duplex communications supported by error control techniques over voice-grade telephone lines. Data is transmitted from magnetic tape at one Datascribe location and recorded on magnetic tape at another, with or without an operator. Transmission rates range from 1200 to 4800 bits/second.

Both serial and parallel compression takes place automatically. Serial compression ensues when consecutive duplicate characters occur in the current record; parallel compression is performed when duplicate information exists between elements of the current record and elements in the same positions of the previous record. In each case, the duplicate data characters are counted and a compression code is transmitted instead of the data. Serial and parallel expansion takes place in the receiver, where the compression control codes are interpreted so that all missing characters can be inserted.

POOLING: Allows short tapes to be consolidated onto one tape for computer processing. Up to seven pooler models can be interconnected. Only one station can transfer data at a time; the five other stations can be performing other operations while pooling is in process. Conversion from 7- to 9-track tapes is optional.

HIGH-SPEED PRINTER: Permits off-line tape-to-printer transcription or printing of data received directly from a remote Datascribe unit via a communications facility. Both operations are controlled by stored programs. The printer, a drum-type unit, is rated at 600 lines/minute and provides 132 print positions; its character set contains 64 ASCII characters. Accommodates fanfold forms from 4 to 20 inches wide and up to 22 inches long. Horizontal spacing is 10 characters/inch; vertical spacing is 6 to 8 lines/inch.

MEDIUM-SPEED PRINTERS: Two other printers, one operating at 125 lines/minute and the other at 200 lines/minute, are offered. Printed output can be either 80 columns or 132 columns, depending on the model selected. Forms can be either 9-7/8 or 14-7/8 inches wide.

CARD READER: Datascribe models that include a card reader can also be used to perform off-line card-to-tape transcription; records can be modified under control of the stored programs. Card code is automatically translated to BCD or EBCDIC tape code at 300 cpm.

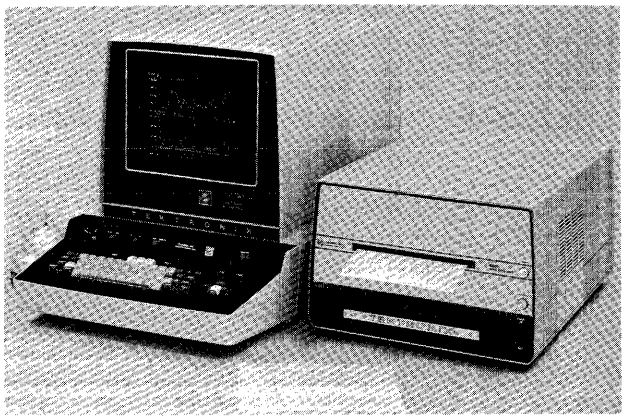
PRICING: The Datascribe is available for purchase or rental, and rental costs include maintenance. A separate maintenance contract is provided for purchased units.

Device	Monthly Rental*	Purchase*	Monthly Maint.
Mag. Tape Data Entry Station (80-100 char. record)	$175 (195)	$ 8,060 (9,260)	$20
Pooler (features same as mag. tape station; up to 3 slave units)	220 (240)	10,360 (11,560)	30
Communicator (1200 bits/second)	255 (275)	10,610 (11,810)	30
Communicator (2400/3600 bits/second)	280 (300)	11,870 (13,070)	30
Communicator (4800 bits/second)	295 (315)	12,000 (13,700)	30
Concentrator (100 to 300 or 1200 bits/second, serial transmission)	275 (295)	10,900 (12,000)	25
Data Station (parallel communicator, 72 char/sec)	312 (332)	11,010 (12,200)	33
Card Reader	175	1,000	10
Printer:			
600 lpm**	560	21,500	105
200 lpm**	350	10,500	25
125 lpm**	275	8,250	25

* Figures standing alone are for 7-track tape; figures in parentheses are for 9-track tape.
** In a Datascribe system, the printers perform as on-line receive-only devices; they can also act as peripherals for minicomputers.

Options range from $4 to $35/month, with corresponding sales prices of $250 to $1,200. ■

Tektronix 4002a and 4010 Graphic Computer Terminals



The 4002A Terminal is shown adjacent to a 4601 Hard Copy Unit, a device for capturing an image of what is displayed on the screen of the terminal. The funny-looking device at the far left is a 4951 Joystick unit for moving the graphic cursor about.

With these low-cost terminals and software support, Tektronix is enabling graphic manipulation of data to be used as a tool by business as well as by engineers and scientists. Featuring a storage tube as the display medium, these terminals eliminate the need for a large buffer to store alphanumeric data and plotting commands.

MANAGEMENT SUMMARY

Interactive graphics is one of the key concepts employed to demonstrate the usefulness of computers to lay personnel and to convince computer professionals that we have achieved modern utilization of computers. It is truly a marvelous concept. Sitting at a display terminal, a user can see a picutre of a part he is designing. Using a magic wand (light pen), he can extend or modify the design. Performance can be computed by the computer and displayed in graph form. In essence, this is an automated version of the engineer/designer team long used successfully by engineering firms – when good designers were available. (Here, a designer is the individual capable of taking the engineer's ideas and converting them to drawings quickly.)

Interactive graphics has not been very successful so far. The reason was amply described by a spokesman for the Ford Motor Company at a presentation a few years ago; when questioned about the programming effort required for the very sophisticated interactive design application the company was doing, the spokesman declined to state specific numbers, but did mention that the programming effort was measured in *man-centuries.* Few organizations can see enough of a pay-off to dedicate resources of this magnitude to interactive graphics.

At the opposite end of the scale, CRT terminals capable of displaying only alphanumeric data have gained widespread use.

Graphic applications can be divided into two broad categories: picture drawing (including three-dimensional representations and drafting) and graphing (representations of data as a curve rather than a series of tabular values). The primary thrust of Tektronix's software development and marketing efforts has been towards the latter, which is much simpler to do.

The Tektronix T4002, when announced in 1969, represented a breakthrough in the cost of graphic terminals. ➢

CHARACTERISTICS

MANUFACTURER: Tektronix, Inc., Information Display Products Division, P.O. Box 500, Beaverton, Oregon 97005. Telephone (503) 292-2611.

MODELS: The salient characteristics of the four models of the 4002A and 4010 terminals are shown in the accompanying table (next page). Each model can be equipped with a communications interface or an interface for connection to the Teletype port of many popular minicomputers.

COMMUNICATIONS: The 4010 and 4010-1 units include a basic communications capability in the basic terminal; it permits half-duplex transmission at 150, 300, 600, 1200, 2400, 4800, or 9600 bits per second. Speed changes are made by changing wires (strappable). The optional Communications Interface for the 4010 and 4010-1 terminals adds a 110-bit-per-second speed capability and permits speed changes to be made via switches; this interface supports half- or full-duplex operation, and sending and receiving speeds can be different. The optional interface also adds several functions such as a local-echo facility that provides simultaneous transmission and display of keyed data.

The communications Interface option for the 4002A and 4002A-1 is essentially similar to the optional interface for the 4010.

Transmission code is 7-level ASCII. Code structure is 8 data bits and unity start and stop bits (10 bits per character). The eighth bit can be odd or even parity or a mark or space.

DIRECT CONNECTION: For any of the four Tektronix models, interfaces are available for the following minicomputers: Digital Equipment Corporation (DEC) PDP-8, -8E, -8I, -8L, -11, and -12; Hewlett-Packard 2100 series; Varian 620 series; and Data General Nova series. In addition, interfaces are available for the DEC PDP-9 and -15 and the Honeywell 316 and 516 for the 4002A/4002A-1. For the 4010/4010-1, interfaces are also available for the Raytheon 703/706 and 704. Each interface allows alternate use of a Teletypewriter at 110 bits per second or the Tektronix terminal at rates up to 125,000 bits per second. Software routines are provided to assist programming applications using the Tektronix terminals.

CRT DISPLAY: Via a direct-view bi-stable storage tube. All models use essentailly the same tube, which has a diagonal measurement of 11 inches, but with different data layouts and viewable areas.

The basic principle of any CRT device is to excite phosphorous compounds with a stream of electrons to create a visible image. In conventional tubes, the image is transient and must be repeated 30 to 60 times per second; this requires a memory of some sort, as repetive transmission of data from the originating source would be prohibitively demanding in terms of resource utilization. In a storage tube, a secondary source for electrons is provided to maintain the excited state of the phosphorous compounds after the writing beam of electrons has created a ➤

Tektronix 4002A and 4010 Graphic Computer Terminals

PRINCIPAL CHARACTERISTICS OF THE TEKTRONIX TERMINALS

Model	Graphic Capability	Alphanumeric Capability	Scratch Pad Display	Hard Copy Device	Auxiliary Devices	Basic Cost, $ per month*
4002A	Vector; incremental point; 1024 x 760 matrix	Upper/lower case; normal or italic; normal or double size; 39 lines; 85 char./line; 3315 char. total; full curser movement controls	Yes; character	4601	Joystick crosshair graphic input cursor	$411
4002A-1	Same as 4002A	Same as 4002A	No	4601	Same as 4002A	$394
4010	Vector; 1024 x 780 matrix	Upper case; 35 lines; 72 char./line; 2520 char. total; limited cursor movement controls	No	No	Thumbwheel crosshair graphic input cursor standard; punched tape reader/punch; tape cassette reader/recorder	$200
4010-1	Same as 4010	Same as 4010	No	4610	Same as 4010	$210

*Rental for first 12 months; rental decreases for second and third years. Rental includes basic graphic terminal and communications interface; a hard copy unit would add $185 per month.

The storage tube employed (which maintains a line once it has been drawn, in contrast with a refreshed tube, which requires constant redrawing of each line) permitted a great reduction in the amount and cost of circuitry. Slower circuitry could be used because the amount of data (or number of lines) that could be displayed was not a function of circuit speed, as it is in a refreshed display. An important feature of the original T4002 terminal was a single refreshed display line that permitted editing of data before transmission. A storage tube normally is not equipped for selective erasure of portions of the screen because of cost; instead, the whole screen is erased at once.

In May 1971, Tektronix announced the 4002A terminal, an improved version of the T4002. One of the principal improvements was permitting the one-line data buffer to be addressed by the computer, which provided convenient conversational data exchange. In October 1971, Tektronix announced the 4010, at less than half the cost of the 4002A, but without the edit buffer and with reduced graphic capabilities.

The great majority of Tektronix installations have been for engineering and scientific users—personnel already accustomed to using graphic representation of data. However, the company continues to conduct an educational marketing campaign in hopes of attracting business users.

Tektronix is an old-line supplier of oscilloscopes and other electronic instrumentation. (The storage tube is used effectively in this environment to conveniently capture one-time signals.) It is no surprise to see the company breaking into the lucrative (sometimes) computer peripheral arena. Tektronix's instruments have always carried an extremely high reputation for quality. The 4002A and 4010 are no exception. They are made well. The Characteristics section of this report discusses the characteristics of each model. In this section of the report,

charged condition that will attract the electrons from the secondary source; non-written areas do not attract electrons from the secondary source. The secondary source (the flood electrons) is not of sufficient intensity to charge the phosphorous compounds to a state that will trigger the "storage" phenomenon. An important operational result of using a storage tube is that data cannot be recovered (read) from the tube. To maintain the capability for manipulating displayed data, some record of the displayed data must be stored in digital form within the computer; this entails some "housekeeping" to assure the correspondence between stored and displayed data, which can be complicated if interactive modifications are made.

In the Tektronix tube, a low-level writing beam can also cause a visible image without triggering the storage phenomenon. This is the meaning of the term bi-stable. It is used to provide a non-storing cursor (alphanumeric and graphic) and, in the 4002A, a strip of alphanumeric display that serves as a convenient "scratch pad" for data entry. The screen is erased by "washing", or flashing the whole surface with electrons; this appears as a momentary flash to the operator. Erasure requires only 0.5 second; while this is a significant achievement and one that makes storage tubes practical, it still requires special consideration for programming.

In all models, an alphanumeric mode as well as a graphic mode is provided. In the alphanumeric mode, a dot matrix is used to form characters. In the graphic mode, illuminated points or lines are used to form images. Although a matrix of points is used for addressing purposes in the graphic mode, any line drawn (vector) is continuous; i.e., vectors are not formed from a series of dots, and lines are not formed by going from dot to dot across the tube.

The 4002A utilizes a viewable area measuring 8.3 inches wide and 6.1 inches high. Within this area, the alphanumeric data layout is 39 lines of 85 characters each; in addition, one line of 84 characters at the bottom of the area is implemented as non-storage (refreshed) display. A buffer used in conjunction with the bottom scratch pad display line is accessible by the operator for data entry and editing or by the remote computer; this facility provides a convenient, if limited, conversational capability. The graphic data layout is oriented around a matrix of 1024 by 1024 points, with each point being addressable. However, only the lower three-quarters (1024 by 760 points) is viewable.

Tektronix 4002A and 4010 Graphic Computer Terminals

we will concentrate on one key question: "Are graphic techniques useful in a business environment?"

The answer to this question is in two parts: theoretically, yes; practically, maybe. This ambiguous reply is due to the nature of graphic representation and to the background of those using it.

Graphic representation is a large part of the background of any engineer or scientist. There are two reasons for this. One is that complex relationships between parameters are often easier to grasp when pictorially displayed than with a complex, abstruse analytical equation. Secondly, a large part of the data base that makes up the information governing our knowledge of physical processes and relationships is empirical in nature; i.e., it is the result of experimentation. Here too, graphical representation portrays the information in an easier-to-recognize form than a tabular compilation. So the engineer and scientist is well prepared to utilize graphic data processing techniques.

Not so with personnel having business backgrounds. Beyond an elementary plotting of sales, which is often more used as a decoration or as a record rather than an active information tool, the experience of most business-oriented people has been a few statistics courses which left bad tastes in their mouths for anything resembling mathematics and graphs. This is a shame. Graphic presentation of information can be of immense value in business planning.

Speaking philosophically, two factors have hindered widespread use of graphic representation to show business information in an understandable manner. One is the management-by-exception principle, in which singularities, not the whole information base, are of importance. For this, tabular representation is easier and quicker. The second reason is that business data is almost invariably linked to the clock of the real world. The engineering world normally treats time as just another variable with no special properties. In the business world, time does have special properties; e.g., the month of June is emphatically not the same as the month of April, even though they both have 30 days. This includes the concept of seasonal variations. And each business has its own seasonal variations, so there is no one standard way of handling information presentation. Predicting a year's performance is not the same as predicting inventory needs for the next month. There are standard techniques for manipulating time-related business data, but they are esoteric and do little to encourage acceptance by business personnel not familiar with them.

Graphical presentation of business data is a feasible tool for added understanding of the performance of a business, but it is by no means the only tool that should be used. □

A full upper/lower-case set of alphanumeric characters can be displayed within a 7-by-9 dot matrix. A total of 96 displayable characters and symbols are provided. Two character sizes can be displayed. The normal size has a matrix that measures 0.07 by 0.09 inches, which is equivalent to about 6.5-point type (or about 20 percent smaller than the type you are now reading). The second size is twice the size of the normal size; data streams calling for double-size characters must follow each data character with a space to prevent overlapping of the characters.

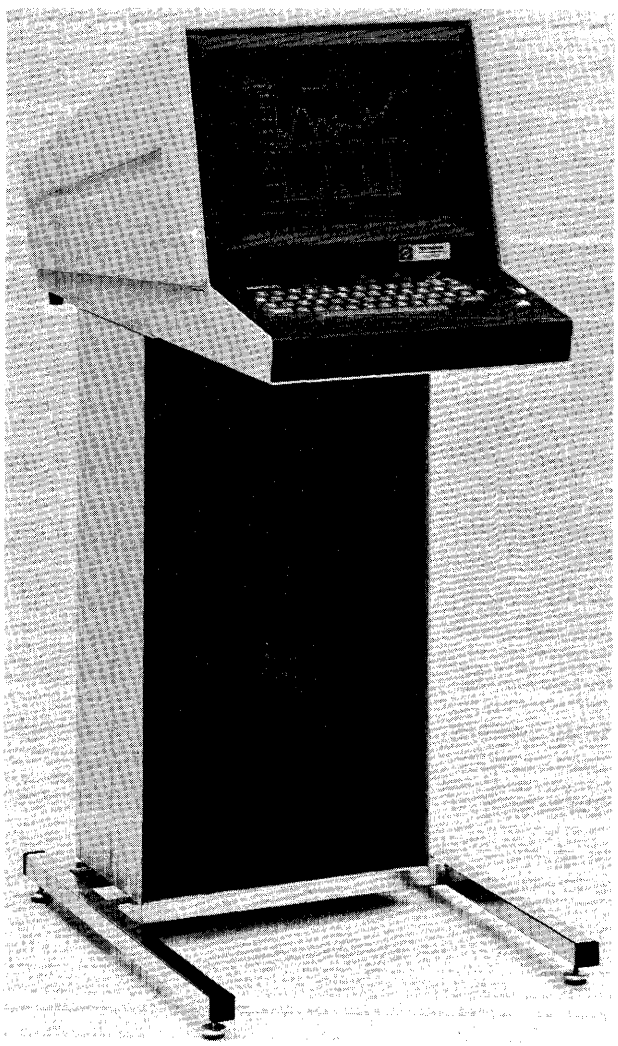
The display characteristics of the 4002A-1 are exactly the same as those of the 4002A, but without the scratch pad display line at the bottom.

The 4010 uses a viewable area of 7.5 inches by 5.6 inches. Within this, the terminal can display 35 lines of 72 characters each, a total of 2520 characters. The graphic layout also provides a 1024-by-1024 addressable-point matrix, of which the bottom three-quarters (1024 by 780) is viewable.

Alphanumerics are formed with a 5-by-7 dot matrix. A total of 63 characters (upper-case alphabetics only) are displayable. Character size is stated as 0.2 inch high by 0.1 inch wide, but actually appears to be about the same size as the normal size for the 4002A. However, since only upper-case alphabetics are used, the effective type size is about 10-point, or the size of the type in the Management Summary of this report.

The display characteristics of the 4010-1 are identical with those of the 4010.

In discussions of the type sizes of the various models, keep in mind that this refers to the alphanumeric mode only. In the graphic mode, characters of any size can be created.



The 4010 Graphic Computer Terminal is a simpler, lower-cost version of the 4002A with slight differences in data layout on the screen.

Tektronix 4002A and 4010 Graphic Computer Terminals

However, only one data character needs to be transferred in the alphanumeric mode to cause a character to be written on the screen; internal circuitry automatically controls the writing. In the graphic mode, a draw operation must be performed for each segment of the character. For example, the lower case "g" within the 7-by-9 dot matrix of the 4002A requires illumination of some 27 points; this would require the transfer of one byte (incremental point plot) for each point at a minimum. Drawing characters via graphic means is a laborious process.

DEVICE CONTROL: Any of the models can operate in a data entry mode or in a data receiving mode. Within each mode, provision is made for alphanumeric or graphic operation. The display provisions of each model greatly affect what can be done.

The 4002A is the most sophisticated of the models. The modes of data entry can be summarized as follows:

- Direct alphanumeric. Data entered from the keyboard is displayed in the main portion of the display as indicated by a pulsating cursor. Separate controls for the cursor enable rapid positioning anywhere in the viewable area. Data may or may not be transferred over the direct or data communications interface. If data is written in the local mode (i.e., not transferred), it may not be transmitted later.
- Sratch pad alphanumeric. Data can be entered in the buffer and displayed in the special refreshed area (bottom line) of the display. Data can be edited freely. At any time all or a portion of the scratch pad can be transferred to the computer; alternatively, the data can be transferred to the main storage display area. The scratch pad area uses an independent cursor.
- Graphic input. Through optional units (see Graphic Inputs) a crosshair cursor can be displayed which extends to the limits of the viewable area. Upon depressing a key, the four-byte data segment representing the coordinates of the intersection of the crosshairs is transferred to the computer. No feedback of the coordinates is provided automatically. This is of small consequence, because graphical data can be displayed only as input from the computer, and the graphic input mode is useful primarily to indicate points of interest rather than to digitize an original curve.

A corresponding selection of receive modes is available in the 4002A as summarized below:

- Alphanumeric direct. Received data is displayed directly on the main storage portion of the display area.
- Scratch pad alphanumeric. Received data is entered in the buffer and displayed on the bottom line. Once in the buffer, the data can be edited if desired, transferred to the main screen, and even sent back to the computer by entering one of the data entry modes.
- Graphic plot. Incoming data is interpreted as a series of coordinate locations and plotting commands. There are three basic graphic plot modes: vector, point, and incremental point. In the vector mode (also called linear interpolate mode), straight lines are drawn (displayed) between two points. To identify a point, 10 bits of information are required for each axis. This is accomplished by putting the high-order five bits and the low-order five bits for each axis into separate bytes–four bytes are required to identify one point. Two of the remaining three bits in each byte are used to identify high and low order, "x" and "y" axes; the third bit is parity. Economy of transmission can be achieved for plotting points close together (within about 0.25 inch) by eliminating the high-order bytes; the same high-order bytes as used for the previous point will then be assumed for the current point. Control characters preceding coordinate locations determine the type of vector to be drawn: dark (nonvisible), single intensity, or double intensity (double width). The dark vectors are required to locate the beginning point of a line without drawing a trace to it. A point plot intensifies a single point anywhere on the screen in response to control characters and coordinate locations. The incremental point plot intensifies points one point away from the previous point in any of eight directions; only a single byte is required for each point, and the points can be dark if desired. The incremental point plot would be the quickest means for plotting special characters, for example.

When entering data from the keyboard, mode shifts are controlled by keys. When receiving data from the computer, mode shifts and other functional operations are controlled by control characters imbedded in the data stream; a total of 17 of the possible 32 ASCII control characters have functional meanings. Any function can be assigned to any of the 32 codes by changing wired connections.

The 4002A-1 is identical with the 4002A except that the scratch pad buffer and display area are not implemented.

The 4010 employs a reduced subset of the capabilities of the 4002A. The scratch pad, point plot, and incremental point plot features are not implemented. In the alphanumeric mode, cursor control is provided entirely by use of the line feed/carriage return and space functions in addition to a Home position key (upper left position). In both the 4002A and the 4010, a provision is made for establishing the margin at the left or center of the screen for alphanumeric data entry. A crosshair cursor is provided on the 4010 for graphic input as a standard feature; it is controlled by two thumbwheels.

Two display modes, View and Hold, are used to increase the life of the storage tube. After being written, the display will be allowed to fade to a lower intensity if 60 to 120 seconds elapse before data is entered. Normal intensity is resumed if additional data is added or if a View key is depressed.

An exact copy of the displayed image can be produced by a hand-held Tektronix Trace Recording Camera (C-10) or the optional Hard Copy Units, which use a photographic process to produce a picture of the display. The terminal is interlocked during copying and data cannot be sent, entered, or received.

A 4911 punched tape reader/punch or a 4912 cassette unit can be used with the 4010 to record data off-line for later transfer.

ERROR CONTROL: The eighth bit of the data code structure can be used for even or odd parity, or it can be wired to be permanently a "1" or a"0". These options apply to all models and are strapping options; i.e., wire-changing. In any case, shifting to the Teletype mode inhibits parity generation or recognition; the eighth bit is ignored. In the ASCII mode, a received character in which a parity error is detected will cause that character to be displayed in italics; if in a graphic mode, the point will not plot. There are no provisions for automatic retransmission from the terminal or for requesting a retransmission from the computer automatically. Manual procedures will have to be worked out on an individual basis.

Because of the nature of a storage tube, data entry errors assume a more significant position in systems design than with a conventional buffered CRT terminal. If you are entering data into the scratch pad area of the 4002A, then it is a simple matter to edit the line. However, once data has been written on the storage portion of the screen, it's a different ball game. The usual procedure is to somehow identify a line as an invalid line and key it again as a different entry. The applications program interfacing the terminal takes care of deleting the incorrect line and inserting the new line.

KEYBOARD: All models use a typewriter-style keyboard. The 4002A/4002A-1 keyboard can generate any of the 128 ASCII characters and control codes. Most of the function keys are incorporated in the basic keyboard layout at either side. Cursor controls are grouped to the right. Home

Tektronix 4002A and 4010 Graphic Computer Terminals

position and Screen Erase keys are by themselves in a prominent position at the upper right. Mode keys are arrayed along the top edge of the keyboard. The 4010/4010-1 keyboard contains few function keys and is very similar to a typewriter terminal keyboard; mode switches are along the upper edge. Character generation is limited to the 63 displayable characters.

PERORMANCE: Evaluating performance of a storage-tube graphic device is very different from evaluating a conventional refreshed CRT graphic device. Normally, the concern with a conventional tube is the size of the buffer and the beam positioning speed, because this determines how much can be stored and how much can be displayed. The constraint is the time between refresh cycles (typically 1/30 or 1/60 second). With a storage tube such concerns are not evident because no resources are used (other than power) once the data is displayed; you could fill the entire screen with lines connecting each and every possible point pair, and the terminal would be ready for more. This is the real strength of a storage-tube display. However, there are time constraints, involved essentially with the arrival rate of data.

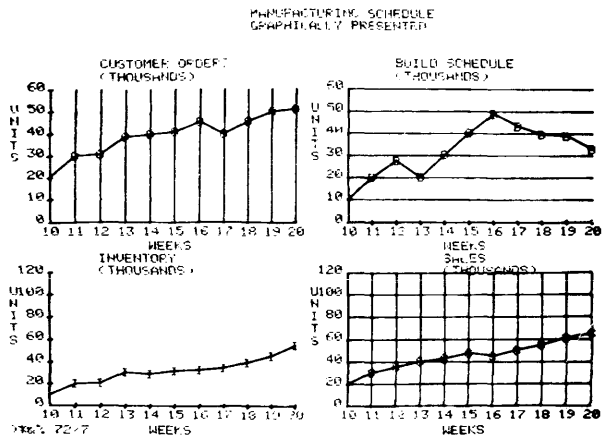
If the terminal is over-driven (i.e., if data is arriving faster than it can be written), the current operation is aborted and the new operation begun. This results in non-completed lines, partial characters, and loss of "place" if the discontinued operation is a dark vector to locate a new starting point. There are no provisions in any of the terminals for handling overrunning. However, actual overrunning is not likely to occur. All models are capable of handling linear interpolation (the slowest operation) at speeds up to 15,000 bits per second. As the highest communications speed provided as a standard option is 9600 bps, data communications usage presents no problem. Direct connection to a minicomputer is normally accomplished through a Teletype port and data is normally handled one byte at a time. Typically, this arrangement will not strain the capabilities of the terminal. But, if the maximum speed of 125,000 bits per second were coupled with block transfers, then the terminals would not be able to keep up in any mode.

GRAPHIC INPUT: The crosshair cursor used for graphic input has the appearance of a vertical line and a horizontal line extending entirely across the screen from top to bottom and from left to right. The cursor is displayed at the lower intensity and therefore does not store. It is controlled by analog voltages from an external device; the signals are converted into digital form by the same circuitry used by the terminal for display generation to eliminate the problems of calibration present when separate converters are used.

For the 4002A, the controlling device is a joystick, a small, gimballed lever with two degrees of freedom. With the joystick, the intersection of the two cursor lines can be moved to any point on the screen. Upon command, the counters used in generating the cursor display can be read and transferred to the computer in standard four-byte format. To connect the 4951 Joystick, a 4901 or 4902 Interactive Graphic Unit is required, which contains the necessary cursor generation circuitry. The 4902 IGU includes provision for connection of two inputs in addition to the 4951 Joystick. Other analog input devices are not available from Tektronix at this time; this provision is for future devices or user experimentation.

PRINTERS: The 4601 Hard Copy Unit used with the 4002A/4002A-1 and the 4610 Hard Copy Unit used with the 4010-1 are photographic printers that produce a copy of the displayed image in about 18 seconds (11 seconds for subsequent copies). Copies are produced on 3M Type 777 Dry Silver Paper by electronically scanning the image displayed on the storage tube via its target electrode, reproducing the scanned image on a small-screen CRT within the printer unit, and projecting the reproduced image onto the photographic paper via a fiber-optics CRT faceplate. Following exposure, a thermal development process produces the visual image.

The photographic paper is supplied by Tektronix as an 8.5-inch wide, 500-foot roll, which is contained within the printer. Copy length can be adjusted from 6 to 14 inches.



This illustration is a half-size reproduction of a copy produced by a 4610 Hard Copy Unit attached to a 4010 Terminal. All four graphs were displayed simultaneously. Normal practice would separate legends and titles for better readability. This was the output of a demonstration program. About 2000 bytes of data had to be transferred to the 4010 to draw the grid, draw the curves, and display the alphanumeric characters. Exclusive of titles and legends, this data could be represented in tabular form by 44 pairs of two-byte numbers. This is the principal "cost" of outputting data in graph form.

The maximum length of the image is the 6.1- or 5.6-inch height of the display area.

PUNCHED TAPE: The 4911 Reader/Perforator can be used with the 4010/4010-1 terminals to record alphanumeric data off-line for later transmission. It consists of an independent paper tape reader and punch mounted in a single desk-top cabinet. The reader operates at up to 200 characters per second, and the punch at up to 75 characters per second. Paper, paper-Mylar, and Mylar-aluminum tapes can be punched. Tape format is 1-inch wide, 8 channels. Rolls up to 100 feet in length can be handled, and fan-fold tape can be handled optionally.

MAGNETIC TAPE CASSETTE: The 4912 Digital Cassette Tape Unit can also be used with the 4010/4010-1 terminals to capture data off-line for later transmission. It uses a standard Philips-type cassette with 300 feet of tape. Recording format is essentially ECMA standard – 800 bpi, phase encoded. Up to 350,000 characters can be stored in variable-length blocks. Data transfer rate is 400 characters per second maximum.

SOFTWARE: Tektronix offers a group of software routines under the family name PLOT-10. There are four distinct packages in the PLOT-10 software. One package gives basic graphic support to users of a variety of minicomputers. Another package provides multi-terminal and graphic support for IBM System/360 and 370 users. The other two packages, written in FORTRAN IV, are available on many commercial time-sharing systems to provide extensive software support for graphic applications including x-y array plotting. Tektronix also has a plan for distributing software developed by users.

PLOT-10/Minicomputers is a package consisting of several routines designed to provide basic data transfer between a minicomputer and Tektronix Graphic Computer Display Terminals. Versions are available for each of the minicomputers listed under Direct Connection. The routines are written in the assembly language of the respective minicomputer. Routines are included for drawing dark vectors, drawing intensified vectors, plotting points, and enabling and inputting coordinate pairs via the graphic input cursor. Alphanumeric transfers are handled as if the terminal were a teletypewriter. The package requires only about 150 to 200 words of storage in the minicomputer.

PLOT-10/360-370 is a group of routines designed to control multiple Tektronix terminals operating through an IBM 270X communications control unit. Routines are

Tektronix 4002A and 4010 Graphic Computer Terminals

included for drawing vectors, drawing and labeling axes, and for graphic input. Interfaces to all System/360-370 languages are available. The package operates under OS MFT or MVT and functions much the same as IBM's BTAM software for data communications processing. Connection to the IBM system is through a Telegraph Adapter Type II, which limits terminal speed to 110 bits per second (10 characters per second); however, replacement oscillator cards are available from Tektronix to allow the IBM 2701 to operate at up to 9600 bits per second. The package occupies up to 13,000 bytes plus about 300 bytes for each terminal. The package is modular, and various subsets can be implemented.

The PLOT-10/Terminal Control System is a basic graphic support package for the Tektronix terminals. It is written in FORTRAN IV and can be installed on most systems. In addition to the basic functions for special alphanumeric data handling and elementary plotting commands, the PLOT-10/TCS package includes a virtual display provision. In this mode, the graphic data exists as a plot of arbitrary size. Portions of this plot can be viewed by establishing a "window" defined by specific ranges of the plotting variables themselves; scaling is handled automatically. Provision is included for locating a display on the screen and for outputting several independent displays on the screen simultaneously. The programmer can also work directly with screen coordinates if he wishes. This software package will serve as the base for applications software generated by Tektronix.

The PLOT-10/Advanced Graphing package is a group of 20 routines written in FORTRAN IV to assist a programmer in converting tabular data into a graphic plot. The programmer has a choice of cartesian (linear x, y), semi-log (one axis plotted as the logarithm of the data values, the other linear), log-log, and polar coordinate systems. Scaling can be user-specified or automatic. Multiple curves can be plotted on one set of axes, or multiple plots can be displayed simultaneously. Plots can be annotated with alphanumeric titles and legends. Various functional subroutines are included for polynomial curve fitting, histograms, pie charts, etc. The Advanced Graphing package utilizes the PLOT-10/Terminal Control System package for basic support.

The PLOT-10/CMX-II Business Data Analysis Package is based on the Census Method X-II developed by the U.S. Bureau of Census and the National Bureau of Economic Research. It is not available directly from Tektronix, but is operational on the GE time-sharing network. In essence, the package enables raw data in the form of a file of sales, orders, inventories, etc., to be analyzed with allowance for seasonal and short-term variations to establish trends significant to the operation of a business. Reduced data is displayed in the form of graphs. Detection of trends can be useful in scheduling production, inventory purchases, and product-line emphasis.

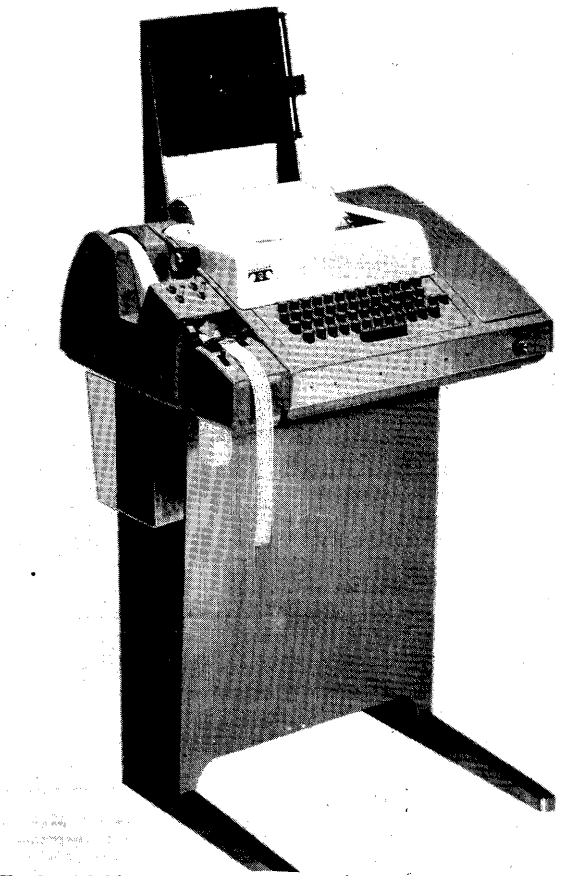
All software is unbundled. However, the PLOT-10/Minicomputer package will be available free of charge for the 4002A/4002A-1 terminals until October 1972.

PRICING: The Tektronix terminals are available for purchase or lease. Lease arrangements are provided for a minimum of 12 months and are automatically extended in 30-day increments. Lease charges are on a sliding scale with decreased payments for the second and third years. Conversion from lease to purchase is available through a purchase credit arrangement; 75 per cent of all lease payments can be applied against the purchase price up to a maximum of 90 per cent of the purchase price. Lease prices include maintenance. Maintenance for purchased units is available under a separate contract.

Component	Monthly Rental*	Purchase Price	Monthly Maint.
4002A Terminal	$384	$8,800	$44
4002A-1 Terminal	367	8,400	42
Options for 4002A/4002A-1			
Option 1 (key-operated on/off security lock)	–	20	–
Option 2 (Character Rotator Card)	8	150	1
Option 3 (Programmable Horizontal Tab)	15	300	2
Communications Interface	27	600	3
Minicomputer Interface	33	750	4
4901 Interactive Graphic Unit	23	525	3
4902 Interactive Graphic Unit	33	750	4
4951 Joystick	14	300	2
4601 Hard Copy Unit	185	3,750	40
4010 Terminal	190	3,950	30
4010-1 Terminal	200	4,250	30
Options for 4010/4010-1			
Communications or Minicomputer Interface	10	300	–
Multiplexor Card (for operating up to 3 independent slave displays)	–	195	–
4911 Reader/Perforator	190	2,950	15
4912 Digital Cassette Tape Unit	130	1,950	10
4610 Hard Copy Unit (4010-1 only)	185	3,550	40
Multiplexor (for sharing a 4610 among up to 4 terminals)	15	400	–
Paper for 4601/4610–			
1 roll	–	40	–
4 rolls	–	143	–
Software			
PLOT-10/Minicomputer	–	50	–
PLOT-10/Terminal Control System	–	325	–
PLOT-10/360-370	–	500	–
PLOT-10/Advanced Graphing	–	250	–

* Rentals shown are for the first 12 months; reduced rentals apply for the second and third 12-month periods. In general, units are reduced and features are not. For the 4002A, rental reductions for the second year range from $30 to $47 per month and for the third year, an additional $38 to $56 per month. Corresponding reductions for the 4010 show a range of $10 to $35 per month for the second year and an additional $10 to $20 per month for the third year. ■

Teletype Model 33 Terminals



The Model 33 ASR (Automatic Send/Receive) terminal, with tape reader and punch at left.

The Teletype Model 33 communications terminals are low-cost, low-speed devices for transmission and reception of data from paper tape or a keyboard. Basic models include RO (printer only), KSR (keyboard/printer), and ASR (keyboard/printer/paper tape). A wide range of options can be included to facilitate operations. These units are designed for moderate usage in contrast to the heavy-duty Model 35 line.

MANAGEMENT SUMMARY

The Teletype Model 33 teleprinters have long been the most popular communication terminals in the country. The primary reason is their outstandingly low cost. For less than twice the cost of an electric office typewriter, a user can have a terminal with a keyboard and printer. Add 50 percent to that cost and you can have punched tape reading and punching capability as well.

The natural question, then, is why should anyone think of using any other terminal? Aside from applications requiring higher speed than 10 characters per second or specialized input/output facilities, the answer is simply that the Model 33 terminals were not designed for "heavy-duty" applications. Model 33 units are rated for what Teletype calls "standard-duty" usage. This used to be defined as two hours a day or less, but the time now appears to be up to about 4 hours a day. For about three times the cost of the Model 33 units, the Model 35 units, which are rated for heavy-duty usage, can be acquired.

Though not as plentiful as in the Model 35 line, many options are available for the 33 line to increase the flexibility of operation and the line-control capability. Unattended transmission and reception, parity checking, polling, and other capabilities are available.

CHARACTERISTICS

MANUFACTURER: Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2000.

MODELS: Marketed in three basic models:

RO (Receive Only)–printer only.

KSR (Keyboard Send/Receive)–printer and keyboard.

ASR (Automatic Send/Receive)–printer, keyboard, and punched tape reader and punch.

COMMUNICATIONS: Transmission is half- or full-duplex asynchronous at 110 bits/second (10 char/second). The code used is 11-unit, 8-level ASCII, including one parity bit, one start, and two stop bits.

Either of two communications interfaces can be specified: a dc current interface or a Bell System-compatible modem interface. The dc current interface, for use on a 20 ma or 60 ma dc signal line, is wired for 60 ma operation as received from the factory, but can be changed to 20 ma operation through strapping. The modem interface contains a modem compatible with Bell System Data Sets 101, 103, 108, and 113 and can be used on the dial network (DDD) or on a leased or private line. The modem is designed to interface a Bell System Data Access Arrangement (DAA); depending on the choice of DAA, the modem can be used to manually originate or answer calls or to manually originate and automatically answer calls. As an option, an EIA Standard RS-232C interface can be attached to an existing dc current interface to allow the use of an external user-supplied modem. The RS-232C interface option (Data Set Coupler) is available with or without an automatic answer feature.

When the 4210 Magnetic Tape Data Terminal is used on-line with the Model 33, transmission rate is 2400 bits/second (240 char/second).

DEVICE CONTROL: The basic models are manually controlled at the sending terminal, with function codes initiating operations such as carriage return/line feed and reader/punch control at the receiving terminals. Options permit automatic unattended transmission or reception when signalled by a remote location.

The 9100 Series Station Controllers (Stuntronic Accessories) are available in several models for improved signal recognition and station control. Some models can be equipped to generate and recognize terminal addresses. A wide variety of options is available for these units. In

Teletype Model 33 Terminals

The Model 33 user can elect to combine the teletypewriter with a Teletype 4210 Magnetic Tape Data Terminal, which records up to 150,000 characters of data on one cartridge tape and transmits up to 240 characters per second. The 4210 physically butts against the teletypewriter to present the appearance of a single unit.

USER REACTION

In Datapro's 1975 survey of typewriter terminal users, 64 users responded on their experience with a total of 1,752 Teletype Model 33 ASR and KSR terminals. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	15	40	8	1	3.1
Ease of use	17	31	16	0	3.0
Keyboard feel and usability	10	23	24	7	2.6
Print quality	8	31	19	6	2.6
Hardware reliability	18	34	11	1	3.1
Maintenance service	20	27	12	4	3.0

*Weighted Average on a scale of 4.0 for Excellent.

The users cited Teletype's traditional virtues—low cost, reliability (with moderate usage), ease of maintenance, and the availability of nationwide service (through the telephone companies or leasing brokers)—in support of their continued use of the Model 33 equipment. The comparatively low ratings given to keyboard feel and usability and print quality, along with specific mentions of low speed, noisy operation, narrow carriage, and inflexibility, reflect the users' growing awareness of other products that provide superior performance in one or more of these categories. The Model 33 units' low price and wide availability, however, will keep them popular in spite of their shortcomings. This is by no means a profound prediction; in September 1974 Teletype gold-plated the *500,000th* Model 33/32 unit to be manufactured. (The 32 is a 5-level Baudot-code version of the 33.) One user's comment summarizes the opinion of most: "The Model 33 is a cheap, basic workhorse."□

general, the electronic circuits fit within the case-work of the teletypewriter, with a control panel conveniently available to the operator.

The Teletype 4210 Magnetic Tape Data Terminal, via its own control panel, provides search, send, and receive modes, in addition to tape functions including fast forward and reverse at 4000 characters/second and rewind. The search mode permits forward or backward searching on any of four preselected characters plus, as an option, three programmable characters at 400 characters/second. A digital counter references the tape position. Error and tape-position indicator lamps are provided. On-line and local mode controls permit tape data to be received or transmitted, printed, punched into paper tape, or received from paper tape or the keyboard. Calls can be answered manually or automatically, and the 4210 automatically swtiches to the receive mode at the end of a transmission.

ERROR CONTROL: The basic models generate and transmit even character parity, but do not check incoming data. Various models of the 9100 Series Station Controllers are available that do check incoming data for character parity and either cause a lamp to light or insert a substitute character for the character in error.

KEYBOARD: 4-row typewriter-like keyboard can generate 96 codes out of the full 128-character ASCII set.

PRINTER: Can print 63 characters, including numerics, upper-case alphabetics, punctuation marks, and special symbols. Rolls of paper (400 feet) are normally friction-fed, but pin-feed is optional. The friction feed accepts paper 8.5 inches wide.

Printing is at 10 characters per inch. Vertical spacing is 6 lines/inch; automatic double spacing can be used.

A variety of type styles can be selected.

PUNCHED TAPE: The reader and punch operate at the speed of the communications interface, which ranges up to 10 char/sec. Tape is 8-level, 1-inch-wide, oiled paper tape.

The punched produces chadded (fully punched) tape.

MAGNETIC TAPE: The Teletype 4210 Magnetic Tape Data Terminal uses a 3-inch-square Teletype magnetic tape cartridge that contains about 100 feet of 0.5-inch-wide magnetic tape. Cartridge capacity is rated at 150,000 characters. Maximum read/write speed is 240 characters/second. Searching is performed at 400 characters/second. Fast forward and reverse (rewind) tape speeds are rated in excess of 4,000 characters/second. Data is recorded in ASCII code in a 9-track format that includes control and character parity, at a density of 125 characters/inch.

PRICING: Model 33 equipment is available from Teletype on a purchase-only basis. The range of purchase prices is:

RO—$584 to $997.
KSR—$693 to $1,056.
ASR—$938 to $1,363.

The 9100 Series Station Controllers range in price from $244 to $1,057.

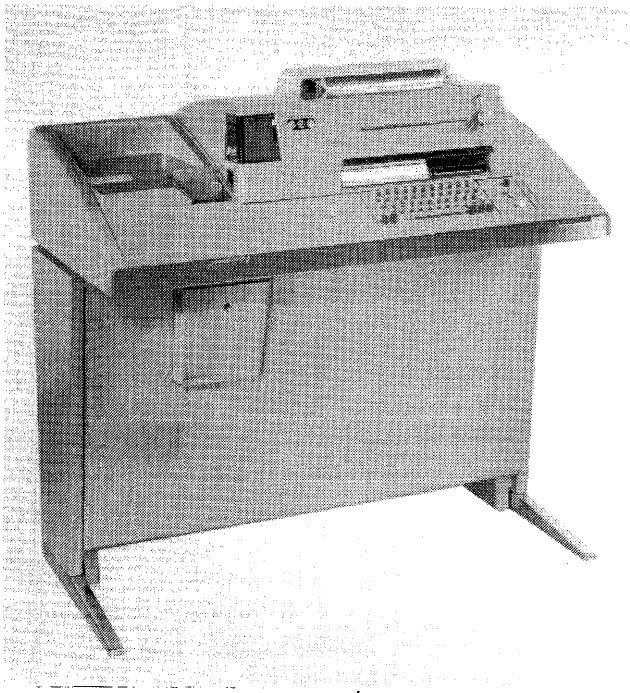
The 4210 Magnetic Tape Data Terminal ranges in price from $2,551 to $2,650.

Delivery time varies widely, depending on the options desired, quantity ordered, and source.

Teletype equipment is available for leasing from almost all telephone companies and from numerous brokers. Leased equipment normally includes a maintenance agreement.

Service for Teletype equipment is available from independent companies in most metropolitan areas. Teletype recently instituted a company-sponsored maintenance program. Offices have been established and additional ones will be opened. Teletype also operates a free maintenance training school in the Chicago area.■

Teletype Model 35 Terminals



The Model 35 ASR (Automatic Send/Receive) terminal is substantially larger and more ruggedly built than its moderate-duty Model 33 counterpart.

Printer-only (RO), printer/keyboard (KSR), and printer/keyboard/punched tape (ASR) models of the Teletype Model 35 line are widely used for low-speed data communications. Designed for "heavy-duty" usage, the Model 35 offers a wide variety of options to make operation of the terminal more flexible and facilitate line control.

MANAGEMENT SUMMARY

Products of Teletype Corporation have long been widely used in computers—as console typewriters, paper tape punches and readers, and remote terminals. Teletype products have also been long familiar to the business community through their use in the TWX and Telex teletypewriter business communication networks.

With the advent of time-sharing, a whole new range of marketing applications opened up. Most of the time-sharing services now operating offer either a Model 33 or 35 teleprinter as the basic communication terminal. Another fruitful area is the use of Model 33 or 35 equipment as computer console typewriters for the rash of minicomputers now on the market.

The Model 33 equipment is designed for "standard" duty usage (apparently up to about 4 hours a day). Model 35 equipment is designed for heavier usage—and carries price-tags about three times as high.

The primary reasons for the popularity of these units are availability and low cost. Though the units are not readily available from Teletype in small quantities, most telephone companies and several brokers offer leases for Teletype terminals, and so do Western Union and the RCA Service Company. Teletype is beginning to respond to the demand for small quantities, and the future will probably see Teletype becoming more involved with the end-user market.

CHARACTERISTICS

MANUFACTURER: Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2000.

MODELS: Three basic models constitute the Model 35 product line:

RO (Receive Only)—printer only.
KSR (Keyboard Send/Receive)—printer and keyboard.
ASR (Automatic Send/Receive)—printer, keyboard, punched tape reader, and punched tape punch.

The RO units are available as floor consoles, table models, or wall-mounted models. On special order Teletype will configure the basic components into almost any arrangement desired, including additional tape readers and punches.

COMMUNICATIONS: Transmission is half- or full-duplex, asynchronous at 110 bits/second (10 char/second). The code used is 11-unit, 8-level ASCII, including one parity bit, one start, and two stop bits.

Either of two communications interfaces can be specified: a dc current interface or a Bell System-compatible modem interface. The dc current interface, for use on a 20 ma or 60 ma dc signal line, is wired for 20 ma operation as received from the factory, but can be converted to 60 ma operation via a replacement 60 ma dc interface card. The modem interface contains a modem compatible with Bell System Data Sets 101, 103, 108, and 113 and can be used on the dial network (DDD) or on a leased or private line. The modem is designed to interface a Bell System Data Access Arrangement (DAA); depending on the choice of DAA, the modem can be used to manually originate or answer calls (Bell System CDT) or to manually originate and automatically answer calls (Bell System CBT). As an option, an EIA Standard RS-232C interface can be attached to an existing dc current interface to allow the use of an external user-supplied modem.

When the 4210 Magnetic Tape Data Terminal is used on-line with the Model 35, transmission rate is 2400 bits/second (240 char/second).

DEVICE CONTROL: Highly variable, depending on the arrangement and options included. Basic models are controlled manually by sending operator, with the receiving unit responding to control codes in the data stream for horizontal tabulation, carriage returns, reader and punch control, etc. Every model of the 35 line is equipped with a "stunt box" for controlling these functions. In addition, the stunt box can send signals to devices external to the teletypewriter. Options include unattended transmission or reception, answer-back for automatic transmission of terminal identification, and a host of other control features.

Teletype Model 35 Terminals

If one were limited to a one-word characterization of the Model 35 product line, that word would have to be "versatility." The Model 35 can be equipped with a large array of options designed to make operation of the terminal and line control more flexible.

The only noteworthy limitations, at present, seem to be no automatic retransmission due to detected errors and no lower-case alphabetic printing. Many installations will not be disturbed by these limitations.

USER REACTION

In Datapro's 1975 survey of typewriter terminal users, 21 users responded on their experience with a total of 160 Teletype Model 35 ASR and KSR terminals. Their ratings are summarized below:

	Excellent	Good	Fair	Poor	WA*
Overall performance	5	11	5	0	3.0
Ease of use	4	8	9	0	2.8
Keyboard feel and usability	2	6	7	6	2.2
Print quality	4	9	7	1	2.8
Hardware reliability	8	9	3	1	3.1
Maintenance service	9	7	5	0	3.2

*Weighted Average on a scale of 4.0 for Excellent.

The rather low ratings assigned to the operational aspects of the Model 35 (ease of use, keyboard feel and usability, and print quality) are apparently outweighed in the minds of most users by the high ratings given to hardware reliability and maintenance service, leading to a satisfactory rating for overall performance, which can be looked at as a summary. Specific comments supporting the Model 35 included low cost, reliability, and availability of nationwide service. Comments about low speed, noisy operation (a perennial complaint), and operating inflexibility reflect the growing user awareness of more sophisticated typewriter terminals from other vendors.□

In the basic half-duplex models, minimum selective control of components is possible. For example, data keyed or read from tape is also printed, and accidental keying while receiving can interfere with the incoming data stream. The punch can be selectively activated to prepare input or duplicate tape in a local mode or for reception of transmitted data.

The full-duplex models separate the transmitting components (reader and keyboard) from the receiving components (punch and printer) to permit simultaneous activities.

Optionally, half-duplex models can be equipped for automatic printer or keyboard suppression. Several models of the 9100 Series Station Controllers (Stuntronic Accessories) are available that provide increased line control, including address recognition, answer-back responses, and polling.

The Teletype 4210 Magnetic Tape Data Terminal, via its own control panel, provides search, send, and receive modes, in addition to tape functions including fast forward and reverse at 4000 characters/second and rewind. The search mode permits forward or backward searching on any of four preselected characters plus, as an option, three programmable characters at 400 characters/second. A digital counter references the tape position. Error and tape-position indicator lamps are provided. On-line and local mode controls permit tape data to be received or transmitted, printed, punched into paper tape, or received from paper tape or the keyboard. Calls can be answered manually or automatically, and the 4210 automatically switches to the receive mode at the end of a transmission.

ERROR CONTROL: Even character parity is generated and transmitted. No checking is performed on incoming data in the basic models.

Several models of the 9100 Series Station Controllers provide character parity checking on received data. Some of these units substitute a fixed character when a parity error is detected.

KEYBOARD: 4-row typewriter-like keyboard can generate 96 characters out of the full 128-character ASCII set. Control codes are generated by depressing combinations of keys.

PRINTER: Can accept friction-fed forms from an 8.5-inch-wide, 400-foot-long roll. Horizontal spacing is 10 char/inch; vertical spacing is 6 lines/inch (automatic double-spacing is possible).

A total of 63 characters can be printed, including numerics, upper-case alphabetics, and special symbols. Optionally, a pin-feed mechanism can be fitted for forms up to 9.5 inches wide. A two-color ribbon (red and black) and different type styles are optional.

PUNCHED TAPE READER: Reads 8-level, 1-inch-wide punched tape. Operating speed is adjusted to the transmission speed and ranges up to 10 char/sec.

PUNCHED TAPE PUNCH: Punches 8-level, 1-inch-wide, oiled paper tape. Operating speed is adjusted to the transmission speed and ranges up to 10 char/sec.

MAGNETIC TAPE: The Teletype 4210 Magnetic Tape Data Terminal uses a 3-inch-square Teletype magnetic tape cartridge that contains about 100 feet of 0.5-inch-wide magnetic tape. Cartridge capacity is rated at 150,000 characters. Maximum read/write speed is 240 characters/second. Searching is performed at 400 characters/second. Fast forward and reverse (rewind) tape speeds are rated in excess of 4,000 characters/second. Data is recorded in ASCII code in a 9-track format that includes control and character parity, at a density of 125 characters/inch.

PRICING: Model 35 units can be obtained from Teletype on a purchase basis only. The range of purchase prices is:

RO–$1,779 to $2,639.
KSR–$2,102 to $2,988.
ASR–$3,530 to $4,967.

The 9100 Series Station Controllers range in price from $244 to $1,057.

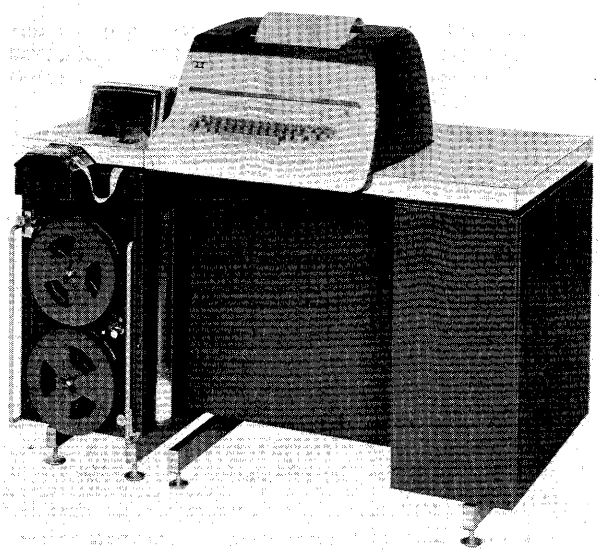
The 4210 Magnetic Tape Data Terminal ranges in price from $2,551 to $2,650.

Telephone companies offer Teletype equipment for lease, sometimes in combination with various communications services. Numerous brokers also offer Teletype terminals on a lease basis, with maintenance normally included.

Delivery time varies widely, depending on options desired, quantity ordered, and source. It can range from one week to over a year.

Service for Teletype equipment is available from independent companies in most metropolitan areas. Teletype recently instituted a company-sponsored maintenance program and has already opened several service offices, with more promised. Teletype also provides a free maintenance instruction school in the Chicago area.■

Teletype Model 37 Terminals



This Model 37 ASR (Automatic Send/Receive) terminal is equipped with the optional large-capacity tape reels.

Teletype's answer to typewriter terminals, the Model 37, provides upper and lower case printing and transmission at 15 char/sec. Half-line forward and reverse spacing permits convenient printing of equations and a limited graphic capability for complex presentations outside the range of normal teleprinters.

MANAGEMENT SUMMARY

The Teletype Model 37 line, with its higher speed, standard provisions for error detection, expanded printing control, and upper-lower case printing, represents a marked advance over previous Teletype teleprinters such as the Model 28, 32, 33, and 35 lines.

Though first announced in 1965, the Model 37 was not delivered to customers until the middle of 1968. During this period, mockups and prototypes drew much attention at trade shows.

In addition to its conventional use as a teleprinter, the Model 37 also provides a practical choice for use as a console typewriter, particularly for small computer companies without peripheral manufacturing facilities. The Model 37 as a time-sharing terminal is particularly attractive to those desiring to do copy preparation and editing or to those who have complex presentation problems such as graphs, equations, formulas, etc.

There are three models: ASR, KSR, and RO. The RO (Receive Only) contains only a printer; the KSR (Keyboard Send/Receive) adds a keyboard; and the ASR (Automatic Send/Receive) adds a punched tape reader and punch. Unattended operation is available on all models.

Direct, local data transfer between send and receive components of the same terminal is possible; this permits local preparation of punched tape (ASR only) with hard-copy monitoring.

CHARACTERISTICS

MANUFACTURER: Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2000.

MODELS: ASR—contains keyboard, page printer, punched tape reader, and punched tape punch; KSR—contains keyboard and page printer; RO—contains page printer only.

COMMUNICATIONS: Transmits half- or full-duplex, asynchronously, using full 10-unit, 7-level ASCII code plus character parity at 150 bits/sec; interface is standard EIA RS-232-B.

DEVICE CONTROL: Primarily manual, but unit can respond to control codes in received data, allowing unattended operation. A full range of controls is provided for controlling positioning of printing on forms; full or half line advance either forward or reverse, horizontal tab (each character position) or vertical tab (each line), red or black printing, and character backspace can be initiated from the keyboard or from control codes in the received data.

The 9100 Series Station Controllers (Stuntronic Accessories) are available in several models for improved signal recognition, speed conversions, and line control. Some models can be equipped to generate and recognize terminal addresses. A wide variety of options is available for these units. In general, the electronic circuits fit within the case-work of the teletypewriter, with a control panel conveniently available to the operator.

The Teletype 4210 Magnetic Tape Data Terminal, via its own control panel, provides search, send, and receive modes, in addition to tape functions including fast forward and reverse at 4000 characters/second and rewind. The search mode permits forward or backward searching on any of four preselected characters plus, as an option, three programmable characters at 400 characters/second. A digital counter references the tape position. Error and tape-position indicator lamps are provided. On-line and local mode controls permit tape data to be received or transmitted, printed, punched into paper tape, or received from paper tape or the keyboard. Calls can be answered manually or automatically, and the 4210 automatically switches to the receive mode at the end of a transmission.

ERROR CONTROL: Limited to manual retransmission. Character parity is generated and sent; character parity is checked on received data. A parity failure is indicated by a lamp. A data character with a parity error is printed; a code indicating a control operation that is received with a parity error is obeyed.

Teletype Model 37 Terminals

If desired, a full-duplex arrangement can be specified that permits independent operation of sending and receiving components. One effect of this arrangement is that the operator "keys blind" (i.e., what is keyed is not printed). This permits one of the surest error control procedures available: the remote station, typically a computer, sends back each character received (called echo checking). The operator, by comparing what is received with what was supposed to be sent, can detect errors and verify that the remote station got what it was supposed to. The method, of course, sometimes encounters errors on the echo transmission, but many of these can be detected by the automatic parity checking. Those detected can be noted by observing the lamp used to indicate parity errors.

Aside from the expanded print control and the new keyboard layout with expanded graphics, the most significant development of the Model 37 line is the printing mechanism. Teletype calls the new feature "aggregate motion." This title simply means that the print mechanism can move directly from one character to another in the type box without returning to a home position first. This change is the principal reason for the increased speed of the Model 37 Line.

The range of form-movement controls provides a great deal of flexibility in the type of material that can be printed. Half-line forward and reverse line-advance facilitates printing of subscripts and equations. Graphs can be presented, but the maximum grid density of 12 by 10 per square inch complicates the scaling and presentation programming. The optional 12-pitch escapement, due for future announcement, would provide a 12 by 12 per inch grid and facilitate programming.

According to a recent Datapro user survey on typewriter terminals, the market penetration of the Model 37 teleprinters to date is very small compared with that of the ubiquitous Model 33. With respect to performance, there is no question that the Model 37 outperforms all other members of Teletype's teleprinter family. Model 37 users believe the 37 is about as rugged as the 35, but far more complicated because of its additional capabilities. Because of its increased complexity and lower popularity, users report that few service organizations other than Teletype or the Bell System currently provide good, solid support for the Model 37. It should not be treated as just another Teleprinter, and the independent service organizations should take advantage of Teletype's training program to beef up their weak support. Failures that users reported include mechanical timing and clutch failures, which they say occur more frequently than on the Model 35 because of the 37's increased speed. Users reported electronic failures as minimal.

The Model 37 user can elect to combine the teletypewriter with a Teletype 4210 Magnetic Tape Data Terminal, which records up to 150,000 characters of data on one cartridge tape and transmits up to 240 characters per second. The 4210 physically butts against the teletypewriter to present the appearance of a single unit. □

KEYBOARD: A 4-row typewriter arrangement. All 128 graphics and control codes of the ASCII character set can be generated from the keyboard. Prefix, Control, and Shift keys are used in conjunction with character keys to generate the full range. Any character can be automatically repeated by depressing the key below the normal depressed position.

TAPE READER: Accepts 7- or 8-level, 1-inch-wide, chadless tape. Data density is 10 rows per inch. Character parity is not checked when reading. Nominal operating speed is 15 characters per second. Low-tape lamp lights within 25 feet from the end of a reel. Supply/takeup options provide reel-to-reel feeding of 1000 or 3000 feet of tape.

TAPE PUNCH: Produces 8-level, 1-inch-wide chadless tape with parity punched. Paper or Mylar tape can be punched. Nominal operating speed is 15 char/sec. Low-Tape lamp lights when less than 25 feet of tape remain. Supply/takeup options provide reel-to-reel feeding of 1000 or 3000 feet of tape.

The reader and punch are contained in a separate module placed adjacent to the keyboard/printer. A KSR can easily be converted to an ASR.

PRINTER: Can print 94 (standard), 110, or 126 symbols of the ASCII graphic set. Horizontal pitch is 10 char/inch (12 char/inch will be a future option). Vertical spacing is 6 lines/inch, and operator can select double spacing.

Standard platen is 8.5 inches wide, with friction feed. Pin-fed platen 9.5 inches wide is optional. Options to be announced include platens specifically designed to accommodate forms 3.625 to 9.5 inches wide, edge to edge. Rear loading is standard; front loading is optional. Continuous forms can be accommodated and stacked in the rear.

MAGNETIC TAPE: The Teletype 4210 Magnetic Tape Data Terminal uses a 3-inch-square Teletype magnetic tape cartridge that contains about 100 feet of 0.5-inch-wide magnetic tape. Cartridge capacity is rated at 150,000 characters. Maximum read/write speed is 240 characters/second. Searching is performed at 400 characters/second. Fast forward and reverse (rewind) tape speeds are rated in excess of 4,000 characters/second. Data is recorded in ASCII code in a 9-track format that includes control and character parity, at a density of 125 characters/inch.

PRICING: The range of purchase prices is as follows:

ASR–$4,191 to $4,954.
KSR–$2,526 to $2,989.
RO–$2,197 to $2,709.

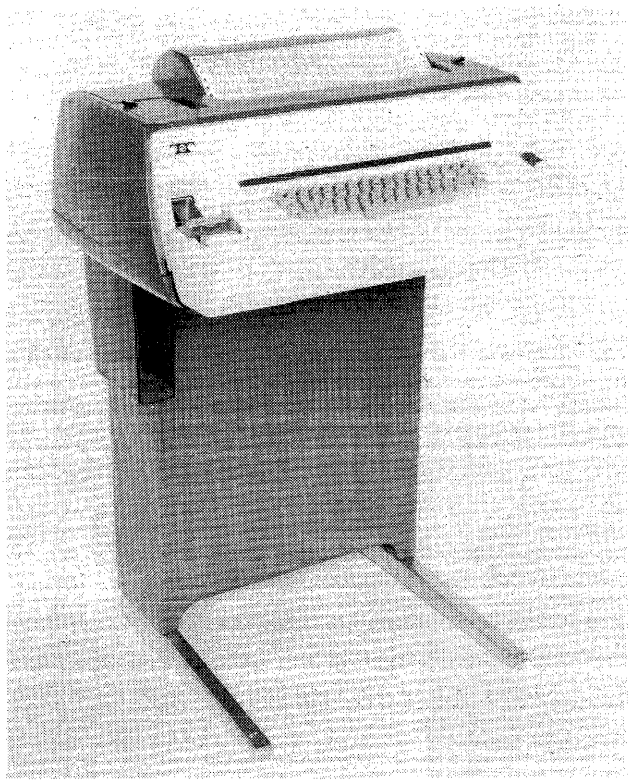
The 9100 Series Station Controllers range in price from $365 to $826.

The 4210 Magnetic Tape Data Terminal ranges in price from $2,407 to $2,500.

Leases are not currently available through Teletype Corporation. The Model 37 line is now also being offered within many services, available on a monthly basis, provided by the Bell Telephone System, Western Union, and many independent telephone companies.

Teletype recently instituted a company-sponsored maintenance program by opening several service offices, with the promise of more to come. ■

Teletype Model 38 Terminals



The Model 38, Teletype's newest family of teletypewriters, exhibits Model 33 quality and compatibility combined with several new features. Pricing falls just above that of the Model 33 line. First deliveries were made in August 1972.

MANAGEMENT SUMMARY

Teletype, having scored a huge success with its ubiquitous Model 33 family of teletypewriters, unveiled at the 1971 Spring Joint Computer Conference a new family of teletypewriters that combine the 33's low-cost design concepts with several new features and modern casework design at prices just below those of the Model 33 line.

Salient features of the Model 38 family include:

- A 15-inch pin-feed platen.
- A 132-character print line.
- A 94-character set of ASCII graphics.
- Upper and lower case printing.
- Two-color printing.
- A full ASCII keyboard.
- An integral punched tape reader with punch with the ASR configuration.
- An integral modem compatible with the Bell System 103 at extra cost.

The Model 38 exhibits transmission compatibility with the Model 33 and 35 families of teletypewriters. An ▷

CHARACTERISTICS

MANUFACTURER: Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2000.

MODELS: ASR–contains keyboard, page printer, punched tape reader, and tape punch; KSR–contains keyboard and page printer; RO–contains page printer only.

COMMUNICATIONS: Transmits half- or full-duplex, asynchronously, using full 11-unit, 7-level ASCII code plus character parity at 110 bits/second (10 char/second). Three interface options provide: (1) an EIA Standard RS232C interface, (2) a 20 or 60 ma. teletypewriter interface for private line facilities, or (3) an integral modem compatible with the Bell System 103 series data sets. The Model 38 ASR, when combined with the Teletype 4210 Magnetic Tape Data Terminal, transmits at up to 240 char/second.

DEVICE CONTROL: Primarily manual, but unit can respond to control codes in received data, allowing unattended operation. A full range of controls is provided for controlling positioning of printing on forms.

The 9100 Series Station Controllers (Stuntronic Accessories) are available in several models for improved signal recognition and station control. Some models can be equipped to generate and recognize terminal addresses. A wide variety of options is available for these units. In general, the electronic circuits fit within the casework of the teletypewriter, with a control panel conveniently available to the operator.

The Teletype 4210 Magnetic Tape Data Terminal, via its own control panel, provides search, send, and receive modes in addition to tape functions including fast forward and reverse at 4000 characters/second and rewind. The search mode permits forward or backward searching on any of four preselected characters plus, as an option, three programmable characters at 400 characters/second. A digital counter references the tape position. Error and tape-position indicator lamps are provided. On-line and local mode controls permit tape data to be received or transmitted, printed, punched into paper tape, or received from paper tape or the keyboard. Calls can be answered manually or automatically, and the 4210 automatically switches to the receive mode at the end of a transmission.

ERROR CONTROL: The basic models generate and transmit even character parity, but do not check incoming data. Various models of the 9100 Series Station Controllers are available to check incoming data for character parity and either cause a lamp to light or insert a substitute character for the character in error.

KEYBOARD: A 4-row typewriter arrangement. All 128 graphics and control codes of the ASCII character set can be generated from the keyboard. Escape, Control, and Shift keys are used in conjunction with character keys to generate the full range. Characters can be automatically ➤

Teletype Model 38 Terminals

11-unit transmission code is used, and the transmit speed is fixed at 10 characters per second. The user can opt for the conventional 20 or 60 milliampere current interface, an EIA Standard voltage interface, or (at extra cost) an integral modem that is transmission-compatible with the Bell System 103 series data sets.

The Model 38 user can elect to combine the Teletypewriter with a Teletype 4210 Magnetic Tape Data Terminal, which records up to 150,000 characters of data on one cartridge tape and transmits at up to 240 characters per second. The 4210 physically butts against the teletypewriter to present the appearance of a single unit.

Those familiar with the Model 33 family of teletypewriters know that the units were designed for limited-usage applications; heavy usage requires the rugged Model 35 units, which are priced at about three times the equivalent Model 33 units. Teletype's use of the phrase "Model 33 economy" when describing the new Model 38 family suggests the same quality and usage limitations that characterize its Model 33 line.

Initial Model 38 deliveries were made in August 1972.

USER REACTION

In Datapro's 1975 survey of typewriter terminal users, 8 users reported on their experience with a total 46 Teletype Model 38 ASR and KSR terminals. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	7	0	1	0	3.8
Ease of use	3	4	0	1	3.1
Keyboard feel and usability	3	3	1	1	3.0
Print quality	2	4	1	1	2.9
Hardware reliability	1	6	1	0	3.0
Maintenance service	2	4	1	1	2.9

*Weighted Average on a scale of 4.0 for Excellent.

Low cost, reliability, ease of maintenance, and the availability of nationwide service (through the telephone companies or leasing brokers) are criteria cited by these users that led them to select Teletype's terminals over competitive products. The huge success scored by Teletype's ubiquitous Model 32/33 line (over 500,000 units produced) is an obvious reflection of this. With regard to the Model 38, users liked the unit's "good solid construction," its good print quality, the full ASCII keyboard, the provision of upper and lower case alphabetics, and the wide print carriage; these are features that keep the Model 38 competitive in today's teleprinter market. However, several users were disenchanted with the unit's slow operating speed, a severe limitation by comparison with the print speeds of many competitive products. □

repeated by depressing a key below its normal depressed position.

TAPE READER: Accepts 7- or 8-level, 1-inch-wide, chadless tape. Data density is 10 rows per inch. Character parity is not checked when reading. Nominal operating speed is 10 characters per second.

TAPE PUNCH: Produces 8-level, 1-inch-wide chadless tape with parity punched. Paper or Mylar tape can be punched. Nominal operating speed is 10 char/sec. Low-tape lamp lights when less than 25 feet of tape remain.

The integral reader and punch are located to the left of the keyboard.

PRINTER: Can print 94 symbols of the ASCII graphic set (including upper- and lower-case alphabetics) and up to 132 characters per line. Horizontal pitch is 10 char/inch. Vertical spacing is 6 lines/inch, and operator can select double spacing. The standard platen is 15 inches wide, with pin feed.

MAGNETIC TAPE: The Teletype 4210 Magnetic Tape Data Terminal uses a 3-inch-square Teletype magnetic tape cartridge that contains about 100 feet of 0.5-inch magnetic tape. Cartridge capacity is rated at 150,000 characters. Maximum read/write speed is rated at 240 characters/second. Data is recorded in ASCII code in a 9-track format that includes control and character parity, at a density of 125 characters/inch.

PRICING: Model 38 units can be obtained from Teletype on a purchase basis only, and are available in all three standard equipment configurations with a 14-7/8 inch wide pin-feed platen. The range of purchase prices is as follows:

ASR–$1,538 to $1,787.
KSR–$1,281 to $1,527.
RO–$992 to $1,288.

The Teletype 4210 Magnetic Tape Data Terminal ranges in price from $2,574 to $2,672.

The 9100 Series Station Controllers range in price from $244 to $1,057. ■

Teletype Model 40 Display/Printer Terminal

MANAGEMENT SUMMARY

The joint introduction of the Teletype Model 40 and AT&T Dataspeed 40 Service spread waves of apprehension that penetrated the very foundation of the communications terminal industry, largely composed of small, independent manufacturers. The Model 40 offers an impressive collection of capabilities and features at very competitive prices. With AT&T's backing, it can be expected to have a major impact upon the already-crowded CRT terminal market.

The new Teletype communications terminal was initially introduced by AT&T at the 1973 conference of the International Communications Association in May and exhibited on a grander scale by both AT&T and Teletype at the 1973 National Computer Conference in June. The terminal is available on a purchase-only basis from Teletype, a subsidiary of AT&T's Western Electric Company, and as the Dataspeed 40 Service, a tariffed service offered by AT&T and its Bell System operating companies.

The Model 40 is a family of interactive terminal modules that can be arranged in various configurations ranging from a receive-only printer to a full-blown terminal including keyboard, display, and printer. Four modules form the basic building blocks of the Model 40: keyboard, display, printer, and terminal logic. The modules can be arranged to allow the printer and keyboard to be combined as a single module or separated between two modules, in which case the terminal logic can be located within the keyboard module. Table-top or pedestal mount can be specified.

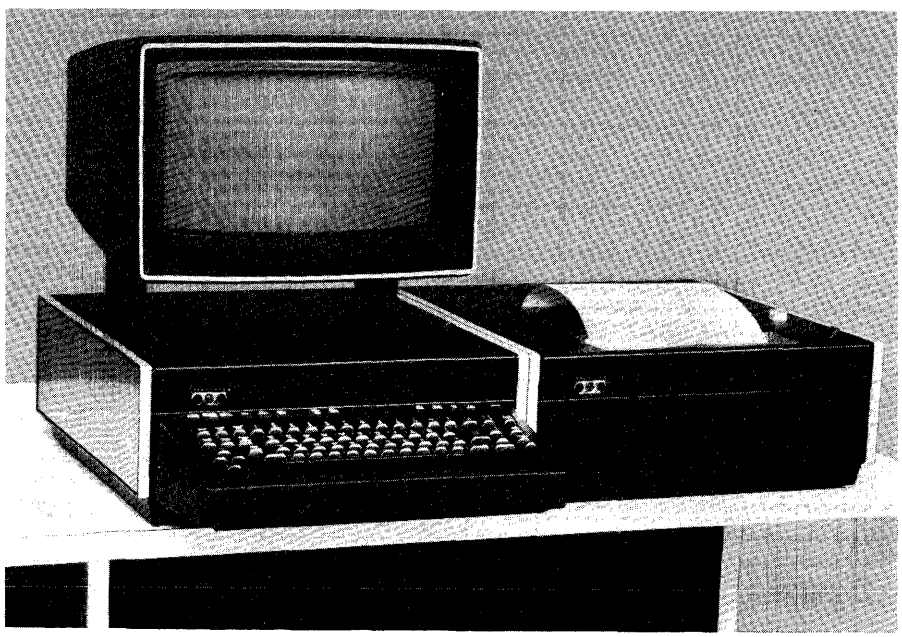
This modular terminal features various combinations of display and printer arrangements, an impact printer rated at 314 lines/minute, and a 1920-character screen with an optional paging capability of up to 3 times the screen capacity. Loaded with features, the Model 40 also boasts a self-diagnostic capability to quickly isolate and visually locate faulty components.

CHARACTERISTICS

MANUFACTURER: Teletype Corporation 5555 Touhy Avenue, Skokie, Illinois 60076. Telephone (312) 982-2000.

MODELS: There are three basic equipment configurations: KDP–includes keyboard, display, and printer; KD–includes keyboard and display; and RO–includes printer only. The KD and KDP configurations are each available in different physical arrangements that include table-top and pedestal mounts. In the table-top arrangement, the KDP is available with a combined keyboard/printer module and separate logic module, or with a separate printer module that can be located up to 50 feet from the keyboard/display unit. In the pedestal arrangement, keyboard and printer are combined and the logic module is located in the base of the pedestal. The Model 40 can accommodate the Teletype Model 4210 Magnetic Tape Data Terminal, which can be used in both on- and off-line models.

COMMUNICATIONS: Asynchronous in the half-duplex mode at 1050 or 1200 bits/second (105 or 120 char/second). The 8-level (with parity) ASCII transmission code is used; the unit code structure is 10 bits/character, including unity start and stop bits. The modem interface



Included in this compact table-top KDP configuration are all of the current Model 40 functional modules: display, keyboard, printer, and terminal logic. The printer can be located up to 50 feet away from the keyboard/display unit.

Teletype Model 40
Display/Printer Terminal

The Model 40 features MOS construction and boasts a self-diagnostic capability that will serve as a powerful aid to the user for quickly locating a faulty component through visual inspection. Component failures are identified by lighted neon lamps concealed behind access panels and by printed or displayed test patterns activated by keyed diagnostic sequences. To minimize down-time, Teletype encourages the user himself to replace faulty components (easily done thanks to a high degree of component interchangeability), but still maintains strong service support to satisfy user requirements.

Salient features of the Model 40 include:

- 1920-character screen arranged in 24 lines of 80 characters.
- A full set of cursor controls that permit local or remote cursor manipulation. (Character addressability, however, is not provided.)
- A full set of ASCII characters, including upper-and-lower-case alphabetics, that can be displayed or keyed.
- A complete editing capability, including character and line insertion and deletion.
- A formatting option that features protected fields for format descriptors.
- A paging option that increases the size of display memory to 48 or 72 80-character lines (2 or 3 pages) and, through scrolling, displays any consecutive 24 lines or complete 24-line memory segments.
- A horizontal tab option that permits any number of tab positions to be established.
- A highlighting capability that flashes selected segments of data between half and full intensity.
- A high-speed impact page printer that prints up to 314 80-character lines per minute on ordinary teleprinter roll paper. Upper-case-only or upper-and-lower-case alphabetics can be specified.
- A transmission speed of 1050 or 1200 bits per second. (No other transmission speeds are offered, and this could seriously limit the Model 40's role in the current CRT terminal market.)
- The capability to interface with a Teletype Model 4210 Magnetic Tape Data Terminal.

The Model 40's page printer sharply contrasts with conventional teleprinter design and construction. In contrast to the single print actuator technique used by Teletype's family of teleprinters, the Model 40 printer employs 80 is compatible with EIA Standard RS-232C. A Bell System 202C or 202R or an equivalent modem can be used.

CRT DISPLAY: Via a 13-inch (diagonal measurement) CRT with a viewing area 11.25 inches wide by 5.25 inches high. The screen is arranged in 24 lines of 80 characters each to total 1920 character positions. A character set of 127 ASCII characters, including upper and lower case alphabetics, numerics, and special symbols, is displayed in white against a dark background. Characters are formed by a 7-by-9 dot matrix. The viewing screen can be viertically tilted through 20 degrees of rotation.

DEVICE CONTROL: Model 40 is an interactive stand-alone terminal that transmits and receives data in block or message mode, provides an extensive editing capability, and features, as options, paging and split-screen operation with format protection. Transmission is performed on a block or message basis; the entire contents or a selected part of the display memory is transmitted upon operator command. Messages are composed and edited prior to transmission.

Manual cursor controls position the cursor in any of four directions: up, down, left, or right. Repetitive operation is provided for these functions; however, cursor movement in any one direction is inhibited when the cursor reaches the edge of the screen. In addition, the cursor can be returned to Home, or to the first character position of the line occupied by the cursor or the next line, and spaced forward or backward. The cursor can also be moved to any character position by a received two-character sequence of cursor commands that correspond to the cursor functions provided by the manual controls.

Split-screen operation, an optional feature, permits the use of fixed formats for data entry applications that require the operator to key pertinent data into blank spaces within a displayed format. The field protection feature provides protection for format descriptors by restricting key entry to variable fields within the displayed format. Formats can be received from the remote computer, from magnetic tape (via the Teletype 4210), or from the keyboard; the field protection feature can be initiated manually from the keyboard or remotely via a computer message. The field protection feature, when initiated, permits only variable data to be cleared or transmitted.

Edit functions include both character and line insertion and deletion. Character insertion and deletion affects all data to the right of the cursor up to the end of the line or the beginning of a protected field. The displayed text expands (to the right) for each character entered and contracts for each character deleted. Line insertion and deletion affect all lines of text from the cursor to the end of display memory or a line occupied by a protected field. An attempted line insertion is inhibited when display memory has been filled with partial or complete lines of data, or when the insertion is attempted into a segment preceding a protected field where all lines are occupied; i.e., the line containing the protected field will not move downward.

Erasure is restricted to screen erasure only. The entire contents (excluding protected fields when the protected format feature is activated) of display memory are erased, beginning at the first character position to the right of the cursor.

Scrolling Memory, an optional feature, adds one or two additional 1920-character (24-line) segments to the basic

Teletype Model 40
Display/Printer Terminal

print actuators, one for each print position. It produces printed copy by means of a continuous moving belt that contains imbedded metal type pallets, and a commercially available ribbon. The printer is designed to average 2500 hours of operation between failures.

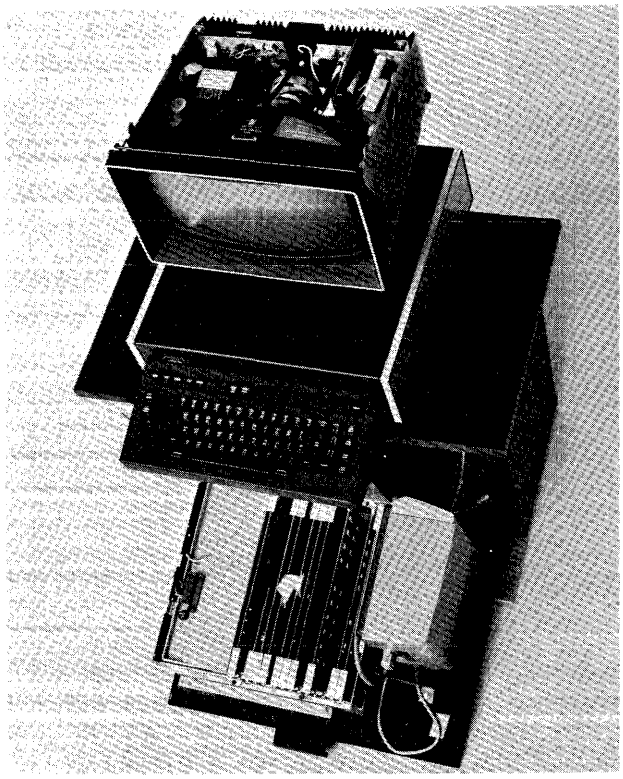
The Model 40 is not designed, nor intended as, a direct replacement for Teletype teletypewriters. Although the Model 40 Display/Printer Terminal and the Model 33 and 35 teletyperwiters exhibit partial transmission compatibility (both are asynchronous ASCII devices), they differ greatly in transmission speed. The Model 40 is a medium-speed terminal, while Models 33 and 35 are low-speed terminals. However, the Model 40 can communicate with Models 33 and 35 via the Teletype 4210 Magnetic Tape Terminal, which can act as a buffer.

The Model 40 is basically transmission-compatible with existing communications software that supports other medium-speed asynchronous ASCII terminals, but the special features provided by the Model 40 must be user-implemented via modifications to existing applications software. IBM currently does not provide support for this breed of terminals as a standard feature for any of its 270X or 370X communications controllers. If the market for medium-speed terminals gobbles up the Model 40 as rapidly as it can be produced, as Teletype anticipates, user pressure may eventually lead to IBM support—but not without IBM's full awareness that the Teletype Model 40 could severely impact its own 3270 market.

Teletype is by no means a neophyte in the CRT terminal industry. Though long dedicated to the production of teleprinters and punched tape equipment, Teletype gained experience with CRT terminals in the late 1960's, when development began on communication display terminals which were produced and used within the AT&T organization for in-house applications such as order entry.

During the last few years, Teletype's revenues have steadily declined. During this period, CRT terminals designed for Teletype compatibility and marketed as replacements for teletypewriters have greatly proliferated. Other companies are producing page printers with speeds substantially greater than that of the Teletype units, and the demand for faster terminals is steadily increasing. This intense pressure from the industry that has been responsible for a sizeable portion of Teletype's revenues became the impetus for the firm's efforts to change its image from that of a supplier of low-speed message-oriented equipment to that of a sophisticated terminal manufacturer.

Initial customer deliveries of the Model 40 terminal are scheduled for August 1973, with full production deliveries beginning during the first quarter of 1974.



This overhead view of a pedestal-mounted keyboard/display terminal illustrates the accessibility of the Model 40 circuitry. All of the controller logic is located on the easily replaceable circuit cards in the pedestal.

1920-character display memory to provide storage for a total of 48 or 72 lines of data. Data storage is divided into two or three consecutive but continuous 24-line segments. By means of the Scroll Up and Scroll Down key functions, any consecutive 24 lines of memory can be displayed at one time; data is moved continuously on one line from each key depression. The Display Advance key function displays each consecutive 24-line segment of the display memory through successive key depressions.

Horizontal Tab, also an option, provides a keyboard- or computer-controlled tab function. Tab stops, each displayed as a dot, are line-independent; i.e., individual tab stops can be located at different positions on each line. When setting tab stops, all stops are simultaneously set in a column, at and immediately below the cursor, in a manner analogous to setting tabs on a typewriter. When clearing, all tab stops immediately below and to the right of the cursor are cleared.

Highlighting, another optional feature, directs the operator's attention to significant information by blinking a character or field of data between full and half intensity once every second.

The printer operates in either on- or off-line mode when used in the KDP configuration. When operating on-line, all received messages are printed; since printing is performed from the display memory, the received messages are also displayed. When operating off-line, the printer is under operator control as a local-copy printer. Displayed messages are printed only when the Print Local key is depressed.

Teletype Model 40
Display/Printer Terminal

```
*BRIGHTNESS
   OPERATOR ADJUSTABLE

*ALL CHARACTERS DISPLAYED
   UPPER CASE ABCDEFGHIJKLMNOPQRSTUVWXYA
   lower case abcdefghijklmnopqrstuvwxyz
   NUMERICS 1234567890
   GRAPHICS !@#$%^&*()_+~`=-¦/][" '}{:;?\<>

   CONTROL CODES
```

This sample output from the Model 40 printer (left) illustrates its ability to produce high-quality printing in both upper and lower case.

Teletype plans to announce enhancements for the Model 40 printer that will be available during the second quarter of 1974. The new features will include sprocket feed, 132 print positions, and adjustable platen width.

The Teletype Model 40 will also be available from RCA Service Company and from Western Union Data Services Company. Both promise availability during the first half of 1974. RCA quotes 30-day lease prices ranging from $90 per month for a buffered keyboard/printer unit to $190 per month for a keyboard/display unit with printer and 3 pages of display memory. Western Union has not established its pricing to date, but says its prices will be lower than those of AT&T. □

ERROR CONTROL: Character parity is generated for each keyed character and accompanies the transmitted characters. Parity checking is performed on received data. A character found to be in error is replaced with a special symbol, which is printed and/or displayed on the screen in place of the incorrect character.

KEYBOARD: The typewriter-style keyboard can generate any of 127 ASCII characters, including upper and lower case alphabetics, numerics, specials, and control codes. Control codes are printed on their respective keytops. A character repeat function can be user-implemented to permit repetitive entry of data or control functions.

PRINTER: The impact page printer prints up to 80 char/line, spaced at 10 char/inch with a vertical spacing of 6 lines/inch. The printer operates at speeds up to 314 lines/minute using a 64-character subset of ASCII symbols (upper case alphabetics only) and at speeds up to 220 lines/minute using a full complement (127 characters) of ASCII symbols, including upper and lower case alphabetics.

Printing is performed by means of a row of 80 print actuators, one per print position, and a continuous arrangement of type pallets which are imbedded into a moving belt. When energized, each actuator strikes its respective pallet, which impacts the paper through a ribbon. The 64-character set is repeated 3 times around the belt; the full ASCII set is repeated 2 times.

Standard teleprinter roll paper is contained within the printer, and standard ribbons are used.

PRICING: The Model 40 can be obtained from Teletype on a purchase basis only. Pricing is preliminary. The following price quotations are average OEM prices of basic-equipment configurations only. Pricing for options is not available at this time.

The Keyboard Display Printer (KDP) for table-top mounting with combined printer/keyboard module is priced at $3,850. The Keyboard Display (KD) for table-top mounting is priced at $2,500. The RO Printer with logic module in pedestal is priced at $2,450. The Teletype 4210 Magnetic Tape Data Terminal is priced at $2,400.

Dataspeed 40 Service, offered by AT&T through its individual Bell System operating companies, is priced below. The price ranges reflect the differentials among the tariffs written by the various operating companies. The approximate range of lease prices, excluding all options, is as follows:

RO–$105 to $120/mo.
KD–$110 to $125/mo.
KDP–$175 to $195/mo.

The prices do not include the cost of a modem or communications facility.

Each additional 24 lines (or page) of display memory is priced at $8/month. Options including protected format, horizontal tab, and highlighting total $15/month. The Send/Receive option is priced at $8/month. A 1000-character buffer for the RO version is priced at $20/month.

The 4210 Magnetic Tape Data Terminal for use with the Dataspeed 40 Service is available for $100 to $110/month. ■

Telex 5403/5821 Printer Subsystem

This printer subsystem is a plug-to-plug replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit. The Telex subsystem offers substantial savings in cost over the equivalent IBM configuration, plus a number of noteworthy new features.

MANAGEMENT SUMMARY

The Telex 5403/5821 Printer Subsystem is no longer in production, but is still being actively marketed by Telex at this writing. Returned subsystems are refurbished and made available for immediate delivery.

The 5403/5821 subsystem, which includes the 5403 Train Printer and 5821 Printer Control Unit, is a plug-to-plug replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit. Salient features of the Telex subsystem include:

- On- and Off-Line Operation–With an added tape adapter feature, printed copy can be produced from magnetic tape via one or two Telex tape drives. On- and off-line operation can be combined to simultaneously produce printed copy on two or three independent printers from data transferred from the computer and/or the two tape drives.
- Universal Character Set–Provides buffering for two user-specified character sets that correspond in sequence to the codes assigned to the graphics on the train cartridge. The stored character sets can be independently selected by the operator and individually loaded from the computer or an IBM 2540 Card Read Punch.
- Buffered Format Tape–Provides buffer storage for the contents of the format tape loop to safeguard the printer from breakage of the tape loop.
- Increased Print Speed–The 5403 Printer with a standard 48-character set is rated at 1200 lines per minute, compared to 1100 lines per minute for the IBM 1403 Model N1 Printer. This rating is increased to 1500 lines per minute when using the exclusive ▷

CHARACTERISTICS

MANUFACTURER: The Telex Corporation, Computer Products Division, 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111.

PRINTER: Telex Model 5403.

PRINTER CONTROLLERS: Six models, compatible with the IBM 2821 Series Control Units, are designated as Telex Models 5821-1 through 5821-6.

COMPATIBILITY: The Telex Printer Subsystem, which includes a 5403 Train Printer and 5821 Controller, is designed as a plug-compatible replacement for the IBM 1403 Model N1 Printer and 2821 Control Unit, Models 1, 2, 3, and 5. Telex does not provide a replacement for the IBM 2821 Model 4 (a controller for the IBM 1404 Printer) but has introduced two additional models that correspond to IBM 2821 Models 3 and 5 with the Third Printer Control feature. Three of the Telex controllers, like their IBM counterparts, include provisions for an IBM 2540 Card Read Punch.

The six Telex controller models are listed below with the equivalent IBM 2821 models and their characteristics.

IBM 2821 Model	Telex 5821 Model	Peripheral Attachments
1	1	Printer and IBM 2540
2	2	Printer only
3	3	Two printers
4	–	IBM 1404 and 2540
3*	4	Three printers
5	5	Two printers and IBM 2540
5*	6	Three printers and IBM 2540

* IBM model with Third Printer Control feature added.

The Telex Printer Subsystem can be used with IBM System/360 Models 25 through 195 or with System/370 Models 115 through 195.

Telex and IBM train cartridges are not interchangeable. The IBM 1416 Interchangeable Train Cartridge contains a 240-character type array. while the Telex cartridge contains a 288-character array.

The Universal Character Set feature, optional on the IBM 1403 Printer, is a standard feature on the Telex 5403 Printer. Unlike the IBM 1403, the Telex 5403 provides buffering for two 288-character train images; operator controls permit switch selection of either buffer. The buffers can be loaded from the computer of the IBM 2540 Card Read Punch.

The Telex 5403 also includes a format tape buffer that stores format information read from the 12-channel tape loop or loaded from the computer via a utility program. The tape loop can be removed after its contents have been stored. The IBM 1403 Printer does not include this feature.

Other standard features include the capability to print the complete contents of the type array and automatic print ▶

REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

Telex 5403/5821 Printer Subsystem

Telex 36-character print set and to 2500 lines per minute (for periods of several minutes) with a 16-character print set.

- Automatic Power Stacking—This optional feature provides improved forms stacking capabilities through the use of an enclosed and powered platform, which can accommodate a full box of paper (approximately 15 inches).

Telex purchases its train cartridges from Control Data Corporation under an exclusive end-user agreement. The Telex train cartridge used in the Telex 5403 Printer is not interchangeable with IBM's 1416 Interchangeable Train Cartridge. Telex provides 288 characters in its train, compared with IBM's 240 characters. This amounts to an additional character set on the 48-character basic train; and besides an increase in printing speed, the extra character set promotes increased reliability.

Although it exhibits complete compatibility with the IBM 1403 Printer, the Telex 5403 does not include the Selective Tape Listing Feature availlable with IBM printers. Telex believes that the market for this feature is limited.

The Telex 5821 Control Unit incorporates a Telex 16-bit microprogrammed minicomputer that employs both MSI and LSI construction. The controller is equipped with microprogrammed diagnostics contained in core storage.

Telex provides its own service and has service offices in over 60 metropolitan areas.

The Telex Printer Subsystem was initially exhibited at the 1970 FJCC in Houston. First deliveries were made in August 1971.

USER REACTION

Datapro conducted telephone interviews with six users of the Telex 5403/5821 Printer Subsystem. These six users, who have had the Telex subsystems for at least two years and operate on a 24-hour-per-day, 6- or 7-day-per-week basis, reported on their experience with a total of seven of the 5403/5821 subsystems. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	0	5	1	0	2.8
Ease of operation	1	5	0	0	3.2
Hardware reliability	0	4	2	0	2.7
Maintenance service:					
Promptness	3	1	1	1	3.0
Quality	0	4	1	1	2.5

*Weighted Average on a scale of 4.0 for Excellent.

Most of these users were well satisfied with the Telex subsystem. As compared with the IBM 1403, users were enthusiastic about the increase in speed, the print quality (which some said was as good as the 1403's, but not with multiple copies), and especially the Power Stack Feature, which the 1403 does not have. Two users, however, reported excessive wear on the print trains. The poor ratings for both promptness and quality of maintenance service were supplied by the same user, whose installation is located in a major city. This user liked the printer, but complained of a 2- to 3-hour response time to service calls (the service center is only 10 minutes away) and a lack of qualified CE's.□

retry. The print retry feature automatically attempts to reprint a line following an error condition.

The Telex 36-character print set increases the rated printing speed to 1500 lines/minute. The 16-character print set increases the rated printing speed to 2500 lines/minute, though operation at this speed can continue only for periods of several minutes.

The Telex Printer has a skipping speed of 70 inches/second, which is maintained from 2 lines after the beginning until 2 lines before the end of each skip. Although the IBM 1403's top skipping speed is 75 inches/second, it is used only on skips of 8 lines or more; shorter skips are performed at 33 inches/second. Telex recommends use of the Automatic Power Stacker for ease of paper handling during lengthy skipping operations.

The Telex Printer Subsystem is designed to operate in an on-line mode, but with the optional Off-Line Capability and optional Tape Adapter, the subsystem can also operate off-line. The Tape Adapter is designed to interface with a combination of any two Telex 7- or 9-track tape drives. The Printer Subsystem will accommodate tapes written at any standard recording density ranging from 200 to 1600 bits/inch.

When the Concurrent Printer Capability feature is incorporated, two or three printers can be operated simultaneously on- and off-line.

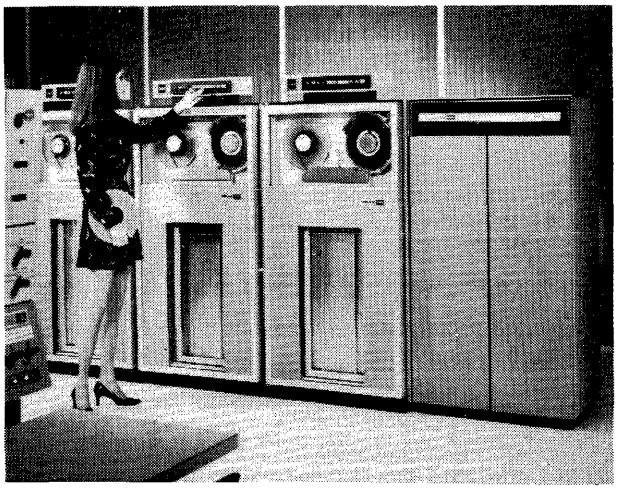
PRICING: The Telex 5403/5821 Printer Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit agreement. Leases are available for two- or three-year terms. Lease rates include all cables, installation, diagnostic performance checks, and maintenance, which is provided on a 24-hours/day, 7-days/week basis.

Telex provides servicing for purchased units under one of three service contracts: Basic Service provides service for 9 hours/day, 5 days/week; Preferred Service provides service for 16 hours/day, 5 days/week plus Saturday; Complete Service provides 24-hours/day service, 7 days/week.

	Monthly Rental (1)			
	2-Year Lease	3-Year Lease	Purchase	Monthly Maint. (2)
5403 Printer	$ 795	$ 745	$25,770	$225
Controller–				
5821-1	750	695	30,880	90
5821-2	555	515	21,885	90
5821-3	1,020	950	38,455	175
5821-4	1,345	1,255	53,385	200
5821-5	1,180	1,100	45,820	200
5821-6	1,470	1,370	59,115	(5)
5416 Print Train (3)	92	88	3,500	0
Off-Line Capability	75	70	3,475	0
Concurrent Capability	200	190	9,205	0
Automatic Power Stacker	25	20	1,025	0
Raise Bonnet Command	20	15	820	0
Tape Adapter (4)–				
5822-1	275	255	11,875	25
5822-2	275	255	11,875	25
5822-3	305	280	13,105	30
5822-4	355	325	14,945	35
5822-5	355	325	14,945	35
5822-6	445	405	18,425	50

(1) Includes maintenance for 24 hours/day, 7 days/week.
(2) Basic maintenance; Preferred and Complete maintenance are priced at about 1.5 and 2 times the rate for basic maintenance, respectively.
(3) Not part of print price; must be ordered with printer.
(4) This feature also includes an on-/off-line switch for on- or off-line printing; numbers correspond to controller numbers.
(5) Time and materials; applies to purchased units only. ■

Telex 6420/6803 Magnetic Tape Subsystem



A plug-compatible replacement for IBM's 3420/3803 Magnetic Tape Subsystem, the Telex 6420/6803 includes a model that provides complete compatibility with IBM's 6250-bpi GCR recording scheme, offers additional models, and boasts price/performance advantages over its IBM counterpart.

MANAGEMENT SUMMARY

The Telex 6420/6803 Magnetic Tape Subsystem is a plug-to-plug replacement for IBM's 3420/3803 Magnetic Tape Subsystem. The various models provide replacements for IBM's earlier 1600-bpi drives as well as its latest 6250-bpi drives. Besides providing all the features that characterize the counterpart IBM subsystem, Telex offers two additional drives with performance characteristics that fall above and below those of the IBM 3420 Model 5 tape drive. Telex replacements for IBM's GCR-encoded 6250-bpi drives include two models equivalent to IBM's low- and medium-speed 3420 Models 4 and 6. Telex began deliveries of its 1600-bpi tape subsystem in November 1971, but the newer 6250-bpi tape subsystems, announced in April 1975, are not scheduled for delivery until January 1976.

The Telex 6420 drives, like the company's earlier 5420 drives, feature automatic threading of conventional tape reels or tape cartridges, power window, pneumatic reel latching, and dual density (an optional feature that allows the user to read or write either phase-encoded tapes at 1600 bits per inch or NRZI-encoded tapes at 800 bits per inch, or to read/write at either 6250 or 1600 bits per inch). Telex drives utilize a single capstan with vacuum drive and a prealigned fixed-head assembly to minimize head-to-tape alignment errors.

The Telex tape controllers, half the physical size of their IBM counterparts, incorporate MSI and LSI circuitry and are equipped with microprogrammed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive in the off-line mode.

Telex lease prices for the 6400 Series drives range from 8 percent more to 17 percent less under a two-year lease, and from 10 to 28 percent less under a three-year lease, than the cost of the equivalent IBM drives under IBM's Extended Term Plan. Purchase prices range from 36 to 50 percent less than the IBM purchase prices. Telex controllers lease for 10 to 14 percent (two-year lease) and 19 to 21 percent (three-year lease) less than their IBM equivalents under the ETP. Purchase prices for the Telex controllers are 51 to 55 percent below IBM's controller prices.

CHARACTERISTICS

MANUFACTURER: The Telex Corporation, Computer Products Division, 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111.

TAPE DRIVES: Seven models that are compatible with the IBM 3420 Series Magnetic Tape Units: Telex Models 6420-3, 6420-4, 6420-5, 6420-6, 6420-7, 6420-44, and 6420-66.

TAPE CONTROLLERS: Telex Models 6803-1 and 6803-11 Tape Control Units.

COMPATIBILITY: The Telex 6420 Series Magnetic Tape Drives are designed as plug-compatible replacements for the IBM 3420 Series Magnetic Tape Units. Telex has added two members to its line that fall between the characteristics of IBM's medium-speed and high- and low-speed models. This point is clarified in the following table, which lists the Telex models and their characteristics along with those of the corresponding IBM models.

IBM 3420 Model	Telex 6420 Model	Tape Format, tracks	Tape Speed, ips	Tape Density, bits/inch	Transfer Rate, K bytes/sec
3	3	7	75	556/800	41.7/60
3	3	9	75	800/1600	60/120
–	4	7	100	556/800	55.6/80
–	4	9	100	800/1600	80/160
5	5	7	125	556/800	69.5/100
5	5	9	125	800/1600	100/200
–	6	7	150	556/800	83.4/120
–	6	9	150	800/1600	120/240
7	7	7	200	556/800	111.2/160
7	7	9	200	800/1600	160/320
4	44	9	75	6250/1600	460/120
6	66	9	125	6250/1600	780/200
8	–	9	200	6250/1600	1250/320

Note: 7-track drives and dual-density operation, where indicated above, are both optional features for either the IBM or Telex drives.

The Telex 6420 Series drives, Models 3 through 7, can be used with IBM System/360 Models 30 through 195 or with IBM System/370 Models 135 through 195 via the Telex 6803-1 Tape Controller. Telex 6420 Series drives, Models 44 and 66, interface with IBM System/360 Models 50 through 195 or System/370 Models 135 through 195 via the Telex 6803-11 Tape Controller. A selection of models and a determination of their mix depends on the maximum data transfer rates of the available I/O channels of the System/360 or 370 computer. The practice of restricting the tape drive's transfer rate to 20 percent below that of the computer's I/O channel may be advisable.

Telex 6420/6803 Magnetic Tape Subsystem

Telex manufactures its own tape drives and controllers. As of May 1, 1975, the company had delivered more than 4,000 6420 Series drives and 1,000 6803 Controllers. Lead time on orders is currently quoted at 30 to 45 days. Telex provides its own maintenance service through service centers in more than 60 metropolitan areas.

USER REACTION

In Datapro's 1975 survey of plug-compatible tape drive users, 19 users reported on their experience with a total of 171 Telex 6420 Series tape drives. Their ratings are presented in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	3	10	6	0	2.8
Ease of operation	11	8	0	0	3.6
Hardware reliability	3	7	7	2	2.6
Maintenance service	3	7	7	2	2.6

*Weighted Average on a scale of 4.0 for Excellent.

More than two-thirds of the users reported either no problems or only minor problems in installation and in diagnosing malfunctions and obtaining the necessary service. This is a somewhat better result than the ratings summary above would lead one to expect. It may well reflect increasingly high user standards for plug-compatible drives. □

The Telex 6420 Series drives, Models 3 through 7, like their IBM counterparts, are 7- or 9-track drives employing NRZI encoding at selectable densities of 556 or 800 bits/inch, or 9-track drives employing either NRZI encoding at 800 bits/inch or phase-encoding at 1600 bits/inch, as shown in the table. This dual-density feature is optional, as noted; single-density drives of the user's choice are also available.

Similarly, Telex 6420 Series drives, Models 44 and 66, are available with the optional dual-density feature, which in this instance combines 6250 bits/inch with 1600 bits/inch, or as units with only a 6250-bits/inch capability. These drives and the associated 6803-11 Controller are offered as a plug-compatible replacement for the IBM 3420/3803 Magnetic Tape Subsystem, Models 4 and 6, which read and write data by means of the new Group-Coded Recording (GCR) method.

Standard features of all the 6420 Series drives include automatic threading, power window, cartridge-handling capability, single-capstan vacuum drive, visual load-point indicator, and read-backward capability.

The Telex 6803-1 Tape Controller is designed as a plug-compatible replacement for the IBM 3803-1 Tape Control and as a controller for the Telex 6420 drives, Models 3 through 7. Like its single-channel IBM counterpart, each Telex 6803-1 and its tape drives operate as a tape subsystem for a System/360, Models 30 through 195, or a System/370, Models 135 through 195. The 6803-1 provides control and data-handling capability for up to sixteen 9-track tape drives, including those employing phase-encoding.

Dual Density and Seven Track features are required for the 6803-1 Controller when operating with drives incorporating these features. The Seven Track feature also includes translation and data conversion functions. When selected, the translator function writes 8-bit EBCDIC-coded bytes as 6-bit, BCD-coded equivalents on 7-track tape; the converse translation is performed when reading. When selected, the data conversion function writes three 8-bit bytes as four 6-bit characters on 7-track tape; the converse function is performed when reading.

Corresponding properties hold for the Telex 6803-11 Tape Controller, which is a plug-compatible alternative to the IBM 3803-2 and which controls the 6420 Model 44 and 66 drives.

The Two-Channel Switch feature provides a second channel interface as an alternate path to the controller and attached tape drives.

Pooling options permit up to 16 tape drives to be switched among two, three, or four 6803 Controllers to allow simultaneous operation of two, three, or four tape drives over as many Selector Channels.

The physical characteristics of the Telex tape drives are virtually the same as those of the equivalent IBM tape drives, but the Telex Tape Controllers are only half the size of the IBM Tape Controls. The Telex drives and controllers operate in the same environment as the equivalent IBM equipment, with essentially the same power requirements.

PRICING: The Telex 6420/6803 Magnetic Tape Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Leases are available for two- or three-year terms. Lease rates include all cables, installation, diagnostic performance checks, and maintenance, which is provided on a 24-hour/day, 7-day/week basis.

Telex provides servicing for purchased units under one of three service contracts: Basic Service provides service for 9 hours/day, 5 days/week; Preferred Service provides service for 16 hours/day, 5 days/week plus Saturday; Complete Service provides 24-hours/day service, 7-days/week.

	Monthly Rental (1)			
	2-Year Lease	3-Year Lease	Purchase	Monthly Maint.(2)
Tape Drives				
6420-3	$430	$360	$11,000	$60
6420-4	430	360	11,600	60
6420-5	435	365	12,900	65
6420-6	470	410	13,700	65
6420-7	505	450	14,900	75
6420-44	600	525	13,500	90
6420-66	685	590	16,000	90
Controllers				
6803-1	525	485	13,000	50
6803-11	925	830	20,000	140
Drive Options				
Dual Density	20	15	820	0
Compatibility (3):				
7-Track, 200/556 bpi	0	0	0	0
9-Track, 200 bpi	25	20	820	0
Manual Mode Switch	25	20	820	0
Controller Options				
Dual Density (4)	45	40	2,045	0
Compatibility:				
7-Track, 556/800 bpi	60	50	2,450	0
7-Track, 200 bpi	137	127	5,600	7
9-Track, 200 bpi	30	25	1,025	0
Asterisk Insert	30	25	2,000	0
Two-Channel Switch	100	90	2,210	5
Controller Switch:				
Two controllers	140	120	3,900	10
Three controllers (5)	170	150	4,250	15
Four controllers (5)	200	180	4,500	20

(1) Includes maintenance for 24 hrs./day, 7 days/week.
(2) Basic maintenance. Preferred and complete maintenance are priced at 1.5 and 2 times the rates for Basic maintenance, respectively.
(3) For 6420 Models 3 through 7 only.
(4) For 6803-1 controller: dual density is a no-cost feature of the 6803-11 controller.
(5) For 6803-1 controller only. ■

Telex 6330 Disk Storage Subsystem

MANAGEMENT SUMMARY

The Telex 6330 Disk Storage Subsystem is a plug-to-plug replacement for the IBM 3330 Disk Storage Facility. The Telex subsystem and its channel-attached IBM counterpart have identical interface logic, power and signal cable connections, and operating characteristics.

The 6330 subsystem is available for use on IBM System/370 Models 135 through 195 and System/360 Models 50 through 195. Both standard-density (100-million-byte) and double-density (200-million-byte) drives can be combined in a 6330 subsystem installed on a System/370 Model 135 through 195 or a System/360 Model 195; only the standard-density drives are supported on System/360 Models 50, 65, 67, and 85. The 6330 subsystem is supported under OS/VS1, OS/VS2, and VM/370, and also under OS and DOS (Model 50) for System/360 computers. Changes to the operating system are required only when attaching the 6330 subsystem to a System/360 Model 50, 65, 67, or 75. The changes are minor and are incorporated by means of a sysgen, using Telex-supplied software.

The 6330 subsystem is currently limited to 16 spindles per controller, whereas a channel-attached IBM 3330 subsystem can include as many as 32 spindles in strings of up to 8 spindles each, for a total subsystem capacity of up to 6.4 billion bytes. However, Telex provides a dual port feature (a standard feature for System/370 installations only), which permits two controllers to share two strings of up to 16 drives. The two controllers can simultaneously access and perform read or write operations on any two drives within the same string. By contrast, IBM's String

A plug-compatible replacement for the channel-attached IBM 3330 Disk Storage Facility, the 6330 subsystem is available for System/360 Models 50 through 195 in addition to System/370 Models 135 and above. Limited to 16 spindles, the subsystem includes standard and double-density drives and offers price/performance advantages over its IBM counterpart.

CHARACTERISTICS

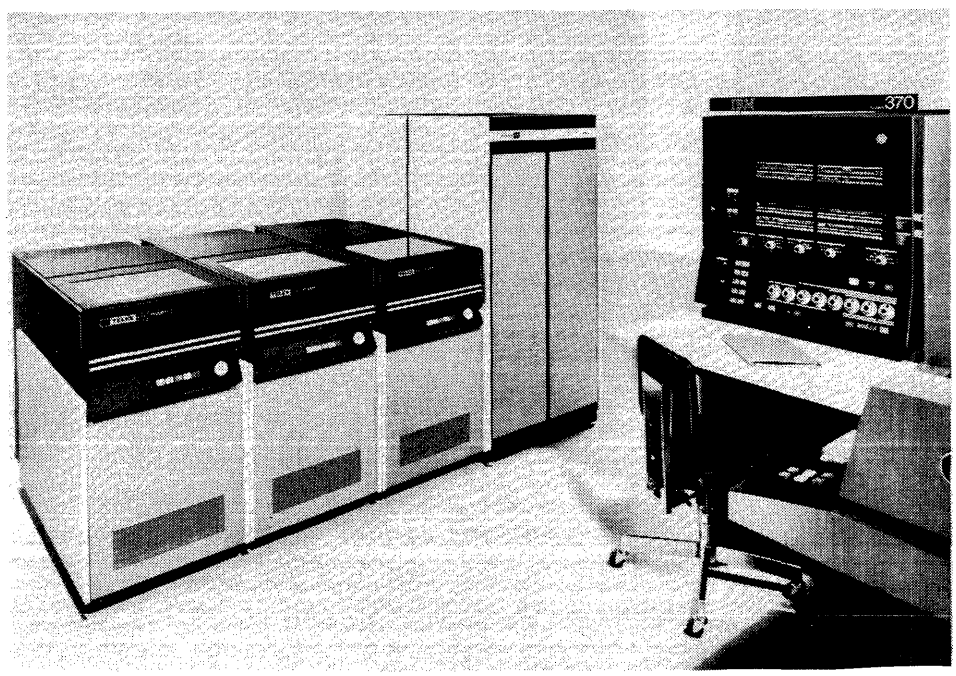
SUPPLIER: Telex Computer Products, Inc., 6422 E. 41st Street, Tulsa, Oklahoma 75135. Telephone (918) 627-1111.

MANUFACTURER: Information Storage Systems (ISS), Inc. (a Sperry Univac subsidiary), 10435 North Tantau Avenue, Cupertino, California 95104. Telephone (408) 257-6220. (Also see the "Management Summary" section of this report.)

DISK DRIVES: Model 6316-1, a single-port, standard-density drive; Model 6316-2, a dual-port, standard-density drive; Model 6316-11, a dual-port, double-density drive; and Model 6316-50, a single-port, standard-density drive for use with the IBM 360/50. All models of the disk drives are single-spindle, top-loaded units.

DISK CONTROLLERS: Model 6830-1, a single-port, standard-density controller; Model 6830-50, a single-port standard-density controller for use with the IBM 360/50; Model 6833-1, a dual-port, standard-density controller; and Model 6833-11, a dual-port, double-density controller.

CONFIGURATION: The Telex 6330 Disk Storage System can include: 1) a 6830-1 controller and a string of up to 8



In contrast to the IBM 3330 packaging, each of the Telex 6316 disk drives is housed in a separate cabinet. The Telex controller is in the center.

Telex 6330 Disk Storage Subsystem

Switch option permits a string of up to eight drives to be shared by two controllers, with only one spindle within a string transferring data at any given time.

Optional channel switching is provided for two or four channels. Switching is performed under program control.

The performance characteristics of the Telex 6316 drives are modestly improved over those of their IBM counterparts, offering the user a 10 (average) to 30 (track-to-track) percent advantage in positioning time over the IBM drives. Rotational speed, data transfer rate, and storage capacity are identical with those of the IBM units.

Like its IBM counterpart, the 6330 subsystem features Rotational Position Sensing (RPS), Command Chaining, and Multiple Requesting. The 6316-11 double-density drives are also equipped with Write Format Release, a feature introduced with the IBM 3330-11 and 3333-11.

The Telex controllers feature microprogrammed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive off-line.

The Telex 6330 subsystem offers attractive savings under a three-year lease in comparison to the monthly cost of a 3330 subsystem under IBM's Extended Term Plan. But only modest savings can be realized under a two-year lease. For example, a standard-density, 8-spindle 6330 subsystem leases for $6,400 or $5,900 per month under a two- or three-year lease, respectively. The equivalent 8-spindle IBM 3330 subsystem leases for $6,848 per month under the ETP. This represents a saving with Telex of $448 per month (or 7 percent) under a two-year lease or $858 per month (13 percent) under a three-year lease. However, a 16-drive 6330 subsystem leases for $11,600 or $10,670 per month under a two- or three-year lease, respectively, while its IBM counterpart leases for $11,861 per month under the ETP. This represents a cost saving of just $261 per month (2 percent) under a two-year lease or $1,191 per month (10 percent) under a three-year lease. Substantial savings of 50 and 68 percent can be realized on purchased 8- and 16-drive subsystems, respectively.

All components of the 6330 subsystem are currently manufactured by Information Storage Systems (ISS), but Telex plans to swing over to Ampex for its disk drives and controllers. According to Telex, improved serviceability and maintainability are advantages of the Ampex equipment, which facilitates the changing of microprograms via floppy disk. By contrast, the ISS controllers employ ROM for microprogram storage.

First deliveries of the Telex 6330 subsystem were made in September 1972. Telex has delivered more than 6,000 of the 6316 drives and about 266 of the 683X controllers as of May 1, 1975. Deliveries of the double-density version are scheduled to begin in July 1975. Telex provides its own maintenance service through service centers in more than 60 metropolitan areas nationwide.

or 16 (optional) 6316-1 drives, 2) a 6830-50 controller and a string of up to eight 6316-50 drives; 3) a 6833-1 controller and a string of up to 8 or 16 (optional) 6316-2 drives; or 4) a 6833-11 controller and a string of up to 8 or 16 (optional) drives consisting of any mix of 6316-2 and 6316-1 standard-density and 6316-11 double-density drives. The 16-Drive Addressing feature is required to equip the controller to accommodate more than eight drives.

The optional Two- or Four-Channel Switch features provide two or four channel interfaces, respectively, which serve as alternate data paths to the 6830 or 6833 Controller and its attached disk drives.

COMPATIBILITY: The 6330 Disk Storage Subsystem is designed for connection to an IBM System/360 computer, Models 50 through 195, or a System/370 computer, Models 135 through 195, as a plug-compatible replacement for the IBM 3330 Disk Storage Facility. The 6330-1/6316-1 subsystem can be used with System/360 Models 65 through 195 and System/370 Models 135 through 195. The 6330-50/6316-50 subsystem is designed specifically for use with the System/360 Model 50. The 6833/6316-2/6316-11 subsystem is designed for use with System/370 Models 135 through 195 (via the Block Multiplexer Channel).

The 6330 Disk Storage Subsystem provides complete compatibility with the IBM 3330 command structure and, except when used with System/360 Models 50 through 75, requires no changes to the existing IBM software.

System/360 Models 50 through 195 can accommodate the Telex 6330 subsystem via selector channels (2860 Selector Channels on Models 65 and above). The 6330 subsystem is supported under DOS, OS/MFT, or OS/MVT on the 360/50 and under both versions of OS on the 360/65 and above. Minor software changes to the IBM operating system are required to operate the 6330 subsystem. These changes are implemented via a sysgen using a Telex-supplied software package.

STORAGE CAPACITY: The storage capacity of each 6316 Model 1, 2, or 50 drive is identical with the per-spindle capacity of the IBM 3330-1/2 Disk Storage module: 100.018 million bytes. The storage capacity of each 6316 Model 11 drive is identical with the per-spindle capacity of the IBM 3330-11 Disk Storage module: 200.036 million bytes.

ACCESS ARRANGEMENT: Each Telex 6316 Model 1, 2, or 50 drive provides access to 404 recording cylinders; each Telex 6316 Model 11 drive provides access to 808 recording cylinders. The cylinder capacities are identical with those of the counterpart IBM 3330 drives. Like their IBM counterparts, the Telex drives provide 19 tracks per cylinder; each cylinder is accessed via a comb-type access mechanism with 20 vertically aligned read/write heads, one per disk surface. Each cylinder position provides access to 247,570 bytes of storage.

DISK PACK: Each Telex 6316 Model 1, 2, or 50 disk drive accommodates one IBM 3336-1 Disk Pack or an equivalent pack. Each Telex 6316 Model 11 disk drive accommodates one IBM 3336-11 Disk Pack or an equivalent pack. Each of these packs contains 12 disks and provides 19 recording surfaces. However, the IBM 3336-11 pack is equipped with a mechanical interlock to prevent inadvertent use of the double-density packs on standard-density units, and the converse.

FILE ORGANIZATION: Each 100M-byte or 200M-byte disk pack corresponds to one logical file, as in the IBM 3330 subsystem. Module select (file identification) plugs, one per drive, are interchangeable and specify the logical address of each drive.

Telex 6330 Disk Storage Subsystem

USER REACTION

In Datapro's 1975 survey of plug-compatible disk drive users, 7 users reported on their experience with a total of 87 Telex 6316 drives. A summary of their ratings is presented in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall performance	0	6	0	1	2.7
Ease of operation	3	4	0	0	3.4
Equipment reliability	1	3	2	1	2.6
Maintenance service	2	1	1	3	2.3

*Weighted Average on a scale of 4.0 for Excellent.

These ratings are generally lower than the ones reported in our previous surveys of user experience with Telex plug-compatible disk drives. This may be caused, in some measure, by higher user standards becasue there is a smaller difference between the Telex 3330-style drives and IBM's with regard to both price and performance than in the case of the earlier 2314-style drives.

This viewpoint is supported to some extent by the answers given by the current users to our questions about the problems, if any, they experienced during installation and operation of the drives. Three users reported "major problems" in installation—yet only one of these users said that it took more than two days to install the drives. (The one exception required some *eight weeks* for installation.) The other four users reported either no problems or minor problems in installation, and also reported a total installation time of only one or two days. In response to the query about diagnosing malfunctions and obtaining the necessary service, three users reported major problems, and the other four users reported either no problems or minor problems. The three "major problems" reports accounted for two of the three Poor ratings and the one Fair rating in the maintenance service category above; the other Poor rating stemmed from dissatisfaction with parts availability.

In summary, it appears that users are demanding more from plug-compatible equipment than in the early days. □

PERFORMANCE: The performance characteristics of the Telex 6316 drives are compared with those of the IBM 3330 drives in the following table.

Head Positioning Time, msec

Disk Drive	Track to Track	Average	Maximum	Tracks per Inch
Telex 6316-1/-2/-50	7	27	50	192
IBM 3330-1/-2	10	30	55	192
Telex 6316-11	7	27	50	384
IBM 3330-11	10	30	55	384

Average rotational delay (8.33 milliseconds) and data transfer rate (806,000 bytes/second) are identical with those of the IBM 3330. Head positioning is controlled electromagnetically in both the Telex and IBM drives.

PHYSICAL CHARACTERISTICS: The physical arrangement of the Telex 6330 subsystem is quite different from that of the IBM 3330. Unlike the 3330, the Telex subsystem consists of discrete components, which have the following cabinet dimensions:

	Width, inches	Depth, inches	Height, inches*	Weight, pounds
6316 Drives	20	32	40	490
6830 Controller	41	32	60	700
6833 Controller	41	32	60	700

***Disk pack access height is 36 inches.**

PRICING: The Telex 6330 Disk Storage System is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit agreement. Leases are available for two- or three-year terms. Lease rates include all cables, installation, diagnostic performance checks, and maintenance, which is provided on a 24-hours/day, 7-days/week basis.

Telex provides servicing for purchased units under one of three service contracts: Basic Service provides service for 9 hours/day, 5 days/week; Preferred Service provides service for 16 hours/day, 5 days/week plus Saturday; Complete Service provides 24-hours/day service, 7 days/week.

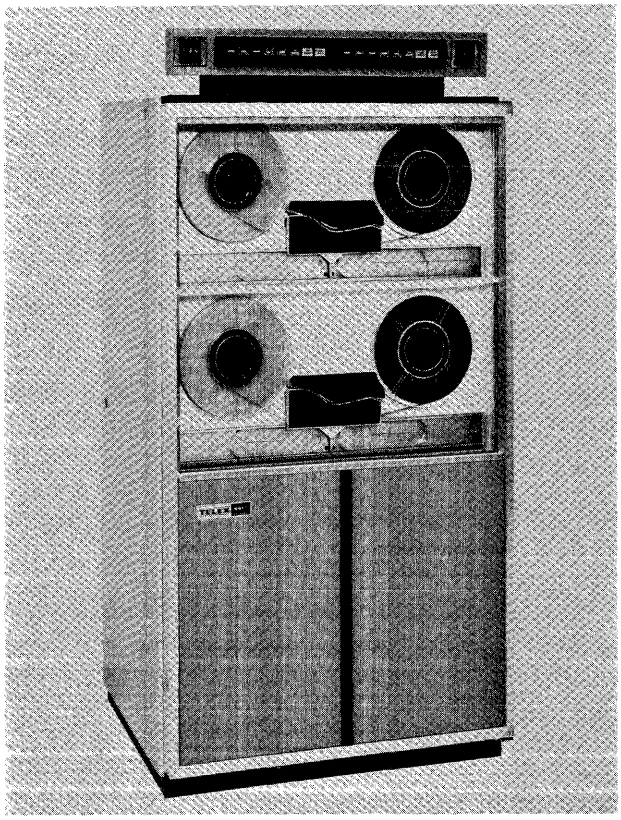
	Monthly Rental*			
	2-Year Lease	3-Year Lease	Purchase	Monthly Maint.**
Controllers, single port				
6830-1 (std. density)	$1,780	$1,645	$30,000	$170
6830-50 (360/50 only)	1,820	1,685	30,000	210
Controllers, dual port				
6833-1 (std. density)	1,660	1,550	35,000	190
6833-11 (double density)	1,880	1,685	43,000	230
Disk Drives				
6316-1 (single port, std. density)	470	440	13,000	100
6316-2 (dual port, std. density)	605	555	14,500	110
6316-11 (dual port, double density)	815	740	18,000	130
6316-50 (360/50 only)	485	455	13,500	110
Options				
16-Drive Addressing	260	240	6,500	0
Two-Channel Switch:				
For 6830	135	125	3,000	10
For 6833	NC	NC	NC	NC
Four-Channel Switch (for 6830 or 6833)	260	240	5,000	25

* Includes maintenance for 24 hours/day, 7 days/week.

****Basic maintenance; Preferred and Complete maintenance are priced at about 1.5 and 2 times the rate for basic maintenance, respectively.**

NC—No charge.■

Telex 6410/6411 Magnetic Tape Subsystem



This low-priced tape subsystem, designed as a plug-to-plug replacement for the IBM 3410/3411 Magnetic Tape Subsystem, offers distinct advantages over its IBM counterpart in both performance and pricing.

MANAGEMENT SUMMARY

The Telex 6410/6411 Magnetic Tape Subsystem is a plug-to-plug replacement for IBM's 3410/3411 Magnetic Tape Subsystem. Telex offers three drive models that correspond to IBM's three models but exhibit increased performance at a lower cost. Like its IBM counterpart, the Telex subsystem is designed for use with the IBM System/360 Models 22, 25, 30, 40 and 50; the IBM System/370 Models 115, 125, 135, 145, 155, and 158; and the IBM System/3 Model 10.

The Telex 6410/6411 subsystem is obviously not an exact copy of its IBM counterpart; in fact, it bears little resemblance to the IBM subsystem. The IBM drives are mounted horizontally, one drive per cabinet, in waist-high cabinets that are cable-connected to one another at the front corners. This construction enables them to be placed side by side or at any angle up to 90 degrees with respect to one another. The Telex drives are mounted vertically, one or two drives per cabinet (one above the other), in standard 60-inch-high cabinets. The tape controller occupies the lower portion of one of the tape cabinets as in the IBM subsystem. The Telex arrangement has the advantage of saving floor space: a six-drive Telex subsystem requires only about half as much floor space as a six-drive IBM subsystem.

CHARACTERISTICS

MANUFACTURER: The Telex Corporation, Computer Products Division, 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111.

TAPE DRIVES: Three models, compatible with the IBM 3410/3411 Magnetic Tape Subsystem: Telex Models 6410-1, 6410-2, and 6410-3.

TAPE CONTROLLERS: Telex Models 6411, 6412, 6413.

COMPATIBILITY: The Telex 6410/6411 Magnetic Tape Subsystem is designed as a plug-compatible replacement for the IBM 3410/3411 Magnetic Tape Subsystem. The two tape subsystems, however, are distinctly different from one another; Telex drives currently cannot be interchanged with IBM drives on either the Telex or IBM controllers. Both subsystems are designed to interface the IBM System/360 Models 22, 25, 30, 40, and 50; the IBM System/370 Models 115, 125, 135, 145, 155, and 158; and the IBM System/3 Model 10.

The Telex 6410 drives are 9-track, phase-encoded drives that read and write at a single density of 1600 bits/inch. The Dual Density feature, available for all models, also permits reading and writing at a density of 800 bits/inch using NRZI encoding. (This feature is not available for the IBM 3410/3411 Model 1 drives.)

The Telex drives operate faster than their IBM equivalents. The tape speed and data transfer rate is 1.2 or 1.6 times that of the IBM drives. Start-up time has also been reduced by 5 or 6 milliseconds in two of the Telex models. The differences between the IBM 3410/3411 drives and the Telex 6410 drives are presented in the table.

The Telex 6410/6411 Subsystem is composed of a control unit and one to six tape drives. The control unit is designed to accommodate any combination of tape drive models provided the control unit model designation corresponds with that of the faster drive. (Control units can be upgraded in the field.) The Telex drives are connected to the control unit via the radial attachment technique, also used by IBM. Construction is modular. A single cabinet can contain one or two tape drives with or without a control unit.

PRICING: The Telex 6410/6411 Magnetic Tape Subsystem is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement.

Space limitations preclude a detailed explanation of the various Telex lease, maintenance, and purchase-credit plans in this report; please see the Pricing section of Report 70D-831-06 for details of these plans.

Telex permits an initial 30-day, cost-free usage period for evaluation and acceptance of any of its products.

Telex 6410/6411 Magnetic Tape Subsystem

COMPARISON OF THE IBM 3410/3411 AND TELEX 6410/6411 SUBSYSTEMS

	Model No.	Drives per Cabinet	Drives per Controller	Tape Speed, ips	Rewind Speed, ips	Start Time, msec.	Tape Density, bits/inch	Transfer Rate, bytes/sec.
IBM 3410/3411	1	1	1 to 4	12.5	160	15	1600	20,000
	2	1	1 to 6	25	160	12	1600/800*	40,000/20,000*
	3	1	1 to 6	50	260	6	1600/800*	80,000/40,000*
Telex 6410/6411	1	1 or 2	1 to 6	20	260	9	1600/800*	32,000/16,000*
	2	1 or 2	1 to 6	40	260	7	1600/800*	64,000/32,000*
	3	1 or 2	1 to 6	60	260	6	1600/800*	96,000/48,000*

*Requires Dual Density feature.

The Telex drives are faster by a factor of 1.2 or 1.6 than their counterpart IBM tape drives. Two models of the speeded-up drives also exhibit a faster start time. These models record the same interblock gap length (0.6 inches) as the counterpart IBM drives, but are ready to read or write tape 5 or 6 milliseconds sooner. The saving of time is appreciable where many blocks are recorded.

The Telex 6410/6411 subsystem is also substantially more flexible than its IBM counterpart. The Telex 6411 tape controller can accommodate any mix of 6410 drive models, whereas all drives connected to IBM's controller must be identical.

The Telex drives also employ the radial attachment technique for connecting tape drives to the controller that characterizes the IBM 3410/3411 subsystem. With this technique, each tape drive is connected independently to the control unit instead of in the conventional "daisy chain" or series arrangement where all drives are connected in sequence, beginning at the controller and ending with the last drive. The radial technique is superior to daisy-chaining because it permits a drive to be switched off-line and executed by diagnostic routines without interrupting or affecting the operations of the remaining drives.

The Telex drives feature a single capstan with vacuum drive and air-bearing tape guides. The drives include all features available with the IBM 3410/3411 drives, such as automatic threading, power window, and Dual Density, an optional feature that allows the user to read or write either phase-encoded tapes at 1600 bits per inch or NRZI-encoded tapes at 800 bits per inch. The Telex controller is equipped with microprogrammed diagnostics designed to help the service engineer isolate and diagnose malfunctions by exercising the faulty drive in the off-line mode.

Rental and purchase prices for the Telex subsystem are typically 9 to 10 percent below those for an equivalent-size IBM subsystem.

First deliveries of the Telex 6410/6411 Magnetic Tape Subsystem were made in 1972. Telex services its own equipment, its effort now concentrated in over 60 metropolitan areas. Leases are provided by Telex, which has financial arrangements with Transamerica Computer Corporation (San Francisco), Hudson Leasing Company (New York), and other leasing firms.

USER REACTION

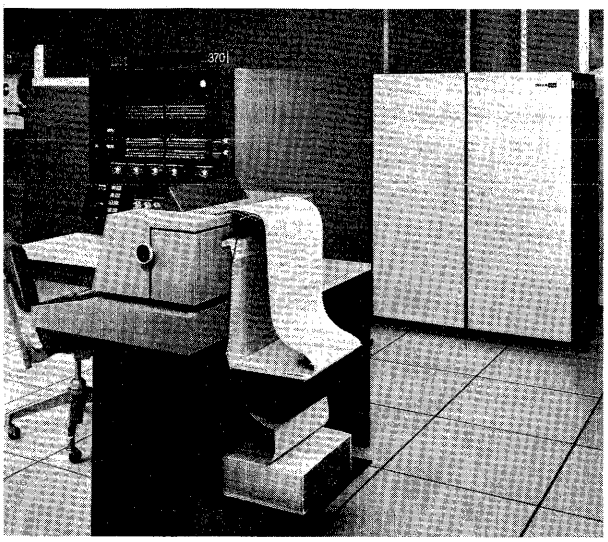
Among the Telex 6410/6411 users interviewed by Datapro, the consensus was that the subsystem operates reliably and encounters only occasional downtime. Moreover, when Telex maintenance service was called, it was judged prompt and effective. (Note: Our queries were directed mainly to installations in large metropolitan areas; a prospective user in a small population center should confirm the availability of local service.)

The Telex subsystem's higher tape speed than that of the comparable IBM 3410/3411 subsystem was said to yield a useful gain in throughput. (Ironically, those users who had not previously operated a 3410/3411 called for still greater speed.) There also was agreement that the 6410/6411 physical construction saves space, but the low position of the bottom tape drive was considered a loading and operational hindrance to tall men. □

Device	Basic Lease*	Purchase	Monthly Maintenance Basic	Pref.	Comp.
Tape Drive:					
6410-1	$165/mo.	$ 8,250	$50	$75	$100
6410-2	210	10,500	60	90	120
6410-3	260	13,000	65	95	130
Control Unit:					
6411 (for 6410-1)	300	15,000	35	60	70
6412 (for 6410-2)	340	17,000	40	60	80
6413 (for 6410-3)	380	19,000	45	65	65
6410 Features:					
Dual Density	15	1,000	N/C	N/C	N/C
Auto Threading	12	800	3	5	7

*To include maintenance, add the Basic maintenance charge, which provides service for leased units on a 24-hours/day, 7-days/week basis.
N/C–No Charge. ■

Telex Processor Storage Systems for IBM System/370



Telex, a leading supplier of IBM-compatible disk and tape drives, also offers semiconductor memory for System/370 Models 145-1, 155, and 165. The Telex memories feature substantial reductions in floor space, power, and cost as compared with their IBM equivalents.

MANAGEMENT SUMMARY

Telex, best known for its IBM-compatible disk and tape drives and its long court battle against the industry giant, also offers a line of semiconductor replacement memory for the IBM System/370 Model 145-1, 155, and 165 computers. The Telex memories are offered as exact replacements for their counterpart IBM memories on a one-to-one replacement basis. Telex has conveniently provided model numbers for its memories that correspond to those of the IBM-equivalent memories, thereby eliminating any guesswork in configuring the systems.

On IBM System/370 Models 155 and 165, all processor storage is external to the central processing unit and can be easily replaced. On the Model 145-1, all processor storage up to CPU Model 3145H (256K bytes) resides in the processing unit. However, the 3145H can be enhanced with 128K or 256K bytes of additional storage to provide a maximum storage capacity of 512K bytes. IBM's 3345 Main Storage Frame, an external memory unit for which Telex offers a replacement, provides the additional main storage for the 3145H processing unit. The IBM 3345, however, requires a separate power unit (IBM 3046) at extra cost, which the user can ignore when he selects the Telex replacement. (In IBM's newer Model 145-2 systems, all main memory up to 1024K bytes resides in the CPU, and the IBM 3345 is not used.)

Telex memories offer the user substantial savings in cost and significant reductions in floor space. On a one-year lease, Telex memories are priced about 15 percent below IBM's monthly rental prices; further savings can be realized by extended lease terms. In respect to space requirements, the Telex memories require 16 percent less floor space per memory cabinet than their IBM equivalents.

CHARACTERISTICS

MANUFACTURER: Telex Computer Products, Inc., 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111.

MODELS: Telex Processor Storage Systems are available in two basic models, the 6345 and 6360, for IBM System/370 Models 145-1, 155, and 165.

COMPATIBILITY: The Telex Processor Storage Systems employ semiconductor construction and are designed as add-on or replacement main memory for IBM System/370 Models 145-1, 155, and 165.

The Telex 6345 is designed as a direct replacement for the IBM 3345 Main Storage Frame, used with the System/370 Model 145-1, and is available in two models that correspond directly to the two IBM 3345 models as shown below. As a prerequisite to using the Telex 6345 on the 370/145, the IBM processor model must be either an HG or an I, as indicated in the following table.

IBM Processor Model	Total Main Memory, bytes	IBM Memory Model	Telex Replacement Memory	Add-on Capacity, bytes
3145 HG	384K	3345-1	6345-1	128K
3145 I	512K	3345-2	6345-2	256K

No hardware or microcode changes are required when replacing an IBM 3345 with a Telex 6345 having the same storage capacity; however, hardware and microcode changes are necessary when upgrading from a Model 3145 HG to a Model 3145 I. The Telex Processor Storage is field upgradable, hence a Telex 6345-2 can be added to a 6345-1 to increase the mainframe capacity from 384K to 512K bytes provided the necessary changes are made to the IBM processor. The IBM 3046 Power Unit is not required by the Telex 6345 System.

The Telex 6330 is designed as a direct replacement for IBM 3360 Processor Storage, used with IBM System/370 Models 155 and 165, and is available in five models that correspond directly to the five IBM 3360 models as shown in the following table.

IBM Processor Model	Total Main Memory, bytes	IBM Processor Storage	Telex Processor Storage	Number of Units	Storage per Unit, bytes
3155 H	256K	3360-1	6360-1	1	256K
3155 HG	384K	3360-2	6360-2	1	384K
3155 I	512K	3360-3	6360-3	1	512K
3155 IH	768K	3360-1&-3	6360-1&-3	1 each	256, 512K
3155 J	1024K	3360-3	6360-3	2	512K
3155 JI	1536K	3360-3	6360-3	3	512K
3155 K	2048K	3360-3	6360-3	4	512K
3165 I	512K	3360-4	6360-4	2	256K
3165 J	1024K	3360-5	6360-5	2	512K
3165 JI	1536K	3360-4&-5	6360-4&-5	2 each	256, 512K
3165 K	2048K	3360-5	6360-5	4	512K
3165 KJ	3072K	3360-5	6360-5	6	512K

Telex Processor Storage Systems for IBM System/370

The Telex memories are software-transparent and provide all the error detection and correction features of the counterpart IBM memories, as well as an off-line diagnostic capability that permits the use of memory diagnostics without the need for on-line checking. This feature does not preclude the use of standard IBM on-line diagnostic procedures.

Telex has received IBM certification for service continuance on each of its models.

First customer deliveries of the Telex semiconductor memories were made in November 1972, when the 6330 was initially installed. Deliveries of the Telex 6345 began in March 1973. Current lead time on orders is 2 to 3 months.

Service is provided by Telex through its worldwide service organization.

USER REACTION

The results of a recent Datapro survey of users employing add-on main memory from independent suppliers (Report 70D-010-60) show Telex users to be well pleased, as indicated by the predominant ratings of excellent or good for overall performance, equipment reliability, maintenance service, and ease of installation. One user reported serious problems during the installation of 256K bytes of Telex memory combined with 256K bytes of IBM memory on a 370/145, which took 50 hours to complete. This user, however, reports that only minor problems have occurred since the installation was completed. □

No hardware or microcode changes are required when replacing IBM 3360 storage with a Telex 6360 storage unit having the same storage capacity; however, hardware and microcode changes are necessary when upgrading processor storage. All Telex models can be upgraded in the field provided the necessary changes are made to the IBM processor.

Physical specifications and power requirements of the Telex memories are presented in the following table:

Model	Storage, bytes	Depth, inches	Width, inches	Height, inches	Weight, lbs.	Power, watts
6345-1	128K	31.25	48	60	?	3,800
6345-2	256K	31.25	48	60	1,200	6,100
6360-1	256K	31.25	48	60	1,200	6,200
6360-2	384K	31.25	48	60	1,350	8,700
6360-3	512K	31.25	48	60	1,500	10,900
6360-4	256K	31.25	48	60	1,200	?
6360-5	512K	31.25	48	60	1,500	?

All Telex memories are equipped with integral power supplies that satisfy the memory power requirements and with diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode. The memories are powered from a 208-volt, three-phase source.

PRICING: The Telex Processor Storage Systems are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement.

Telex provides lease contracts for 30 days, 1 year, or 2 years. Its Thirty-Day Agreement permits equipment to be discontinued 30 days after the initial 90-day installation period and can be converted at any time to an extended-term lease. The Telex Fixed Commitment Lease Plan provides lease periods of 1 or 2 years. These contracts can be extended at time of expiration in increments of 6 months with retention of the original monthly lease charge.

Lease rates include all cables, installation, diagnostic performance checks, and maintenance, which is provided on a 24-hour/day, 7-day/week basis. Telex protects its customers from price increases during the term of the lease.

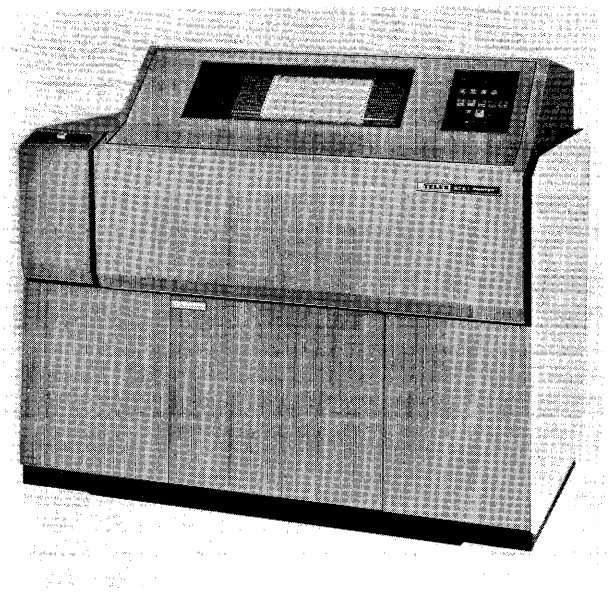
Telex provides servicing for purchased units under one of three service contracts: Basic Service provides service for 9 hours/day, 5-days/week; Preferred Service provides service for 16 hours/day, 5 days/week plus Saturday; Complete Service provides 24-hours/day service, 7-days/week.

The Telex memories are priced as shown below. The effective monthly rental under the Extended Term Agreement is calculated from the Basic Lease Price and the accrued credits for the term of the lease.

Model	Basic Lease*	Purchase	Monthly Maintenance Basic	Pref.	Comp.
6345-1	$2,670/mo.	$109,225	$120	$180	$ 240
6345-2	4,775	195,350	220	330	440
6360-1	2,620	107,175	290	435	580
6360-2	3,885	158,925	435	650	870
6360-3	5,120	209,450	580	870	1,160
6360-4	2,620	107,175	290	435	580
6360-5	5,120	209,405	580	870	1,160

***To include maintenance, add the Basic maintenance charge, which provides service for leased units (only) on a 24-hours/day, 7-days/week basis.** ■

Telex 6721 Train Printer System



The Telex 6721 Printer, a direct replacement for IBM's 1403 Model N1 Printer and 2821-2 Control Unit, boasts higher printing speeds and substantial savings in cost and floor space.

MANAGEMENT SUMMARY

The Telex 6721 Train Printer System is designed as a plug-to-plug replacement for the single-printer IBM 1403 Printer Model N1 and 2821 Control Unit Model 2 configuration. The 6721 uses the same printer mechanism as Telex's 5403 (Report 70D-831-05) and shares some of the same features, including:

- Increased print speed—the 6721 Printer with a standard 48-character set is rated at 1200 lines per minute, compared to 1100 lines per minute for the IBM 1403 Model N1 Printer. This rating is increased to 1500 lines per minute when using the exclusive Telex 36-character print set and to 2500 lines per minute (for periods of several minutes) with a 16-character print set.
- Universal Character Set—provides buffering for two user-specified character sets that correspond in sequence to the codes assigned to the graphics on the train cartridge. The stored character sets can be independently selected by the operator.
- Buffered format tape—provides buffer storage for the contents of the format tape loop to safeguard against breakage of the tape loop.
- Automatic Power Stacking—this optional feature provides improved forms stacking capabilities through the use of an enclosed and powered platform, which can accommodate a full box of paper (approximately 15 inches).
- Diagnostics—the 6721 utilizes IBM 1403 printer diagnostics in addition to Telex diagnostic software; manual controls provide for operator checks.

CHARACTERISTICS

MANUFACTURER: Telex Computer Products, Inc., 6422 East 41st Street, Tulsa, Oklahoma 74135. Telephone (918) 627-1111.

COMPATIBILITY: The 6721 Train Printer System, which includes a 132-column printer mechanism and controller in a single cabinet, is designed as a plug-compatible replacement for the IBM 1403 Model N1 Printer and 2821 Model 2 Control Unit. It can be used with IBM System/360 Model 22 through 195 or System/370 Model 135 through 195 computers via a selector or multiplexer channel in either byte or burst mode.

Telex and IBM train cartridges are not interchangeable. The IBM 1416 Interchangeable Train Cartridge contains a 240-character type array, while the Telex cartridge contains a 288-character array.

The Universal Character Set feature, optional on the IBM 1403 Printer, is a standard feature of the Telex 6721 Printer. Unlike the IBM 1403, the Telex 6721 provides buffering for two 288-character train images; operator controls permit switch selection of either buffer, which is loaded from the computer.

The Telex 6721 also includes a format tape buffer that stores format information read from the 12-channel tape loop or loaded from the computer via a utility program. The tape loop can be removed after its contents have been stored. The IBM 1403 Printer does not include this feature.

Other standard features include the capability to print the complete contents of the type array, an automatic print retry feature, exclusive Telex 36- and 16-character print sets, and high-speed skipping.

The print retry feature automatically attempts to reprint a line following an error condition.

The Telex 36-character print set increases the rated printing speed to 1500 lines/minute. The 16-character print set increases the rated printing speed to 2500 lines/minute, though operation at this speed can continue only for periods of several minutes.

The 6721 has a skipping speed of 70 inches/second, which is maintained from 2 inches after the beginning until 2 lines before the end of each skip. Although the IBM 1403's top skipping speed is 75 inches/second, it is used only on skips of 8 lines or more; shorter skips are performed at 33 inches/second. Telex recommends use of the optional Automatic Power Stacker for ease of paper handling during lengthy skipping operations.

The 6721 accommodates pin-fed continuous forms from 4 to 18-3/4 inches wide and from 7 to 14 inches long.

PHYSICAL CHARACTERISTICS: The specifications of the Telex 6721 Printer are listed below, together with those of the counterpart IBM printer subsystem.

Telex 6721 Train Printer System

The 6721 System lacks the multiple printer/card read punch configuration possibilities of the 5403; neither can the 6721 be configured as an off-line printer. It is priced, however, substantially below the 5403 single-printer configuration.

Telex purchases its printer mechanisms and train cartridges from Control Data Corporation under an exclusive end-user agreement. The Telex train cartridge used in the 6721 is not interchangeable with IBM's 1416 Interchangeable Train Cartridge. Telex provides 288 characters in its train, compared with IBM's 240 characters. This amounts to an additional character set on the 48-character basic train and allows an increase in printing speed.

The Telex 6721 System is priced substantially below the equivalent IBM printer subsystem. Telex lease prices for one- and two-year leases are 20 percent below IBM's prices for the combined 1403-N1 Printer and 2821-2 Control Unit and range from 10 to 15 percent below IBM's lease prices for the combined 1403-N1 Printer and Integrated Printer Adapter (IPA) for System/370 Models 125 and 135. Further savings can be realized through the Telex Earned Rental Accrual Plan. Telex also provides considerable savings on purchased 6721 Systems, which range from 25 to 30 percent below IBM's prices for integrated and channel-attached printers, respectively.

The Telex 6721 provides a reduction in floor space of about 6.4 square feet with respect to the combined physical dimensions of its IBM counterparts; however, when the Automatic Power Stacker feature is added to the Telex printer, the space reduction is only 1.6 square feet. On the other hand, the Telex 6721 weighs about 200 pounds more than the combined weight of its IBM counterparts.

Telex maintains service operations in more than 60 metropolitan areas. It provides an on-site, full-shift customer engineer for installations with maintenance contracts that equal or exceed $1,500 per month, in addition to providing on-site spare parts.

The Telex 6721 System is scheduled for production deliveries during the first quarter of 1973. □

	Width, inches	Depth, inches	Height, inches	Weight, pounds
Telex 6721	63	35	53	1,500
IBM 1403-N1	57	29	53.5	825
IBM 2821-2	32	46	60	454

PRICING: The Telex 6721 Train Printer System is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement.

Telex provides lease contracts for 30 days, for 1 or 2 years, and for 12 to 36 months in one-month increments. Its Thirty-Day Agreement permits equipment to be discontinued 30 days after the initial 90-day installation period, and can be converted at any time to an extended-term lease under the Earned Rental Accrual Plan. Under this plan, customers accrue credit which covers machine rental (excluding maintenance) in accordance with the extent of the lease term; additional credit can be accrued by keeping equipment past the original contract period by a minimum of 6 months. Accrued credit, used at the end of a contract term, ranges from 30 days under a 12-month lease through 120 days under a 24-month lease to 210 days under a 36-month lease. The Extended Term Agreement can be terminated on 30 days' notice at any time after an initial 12-month period without penalty, but without credits for contracts terminated prior to their original expiration date. Upgrading to new Telex products is allowed; earned accruals can be used at the time of conversion.

The Telex Fixed Commitment Lease Plan provides lease periods of 1 or 2 years. These contracts can be extended at time of expiration in increments of 6 months with retention of the original monthly lease charge.

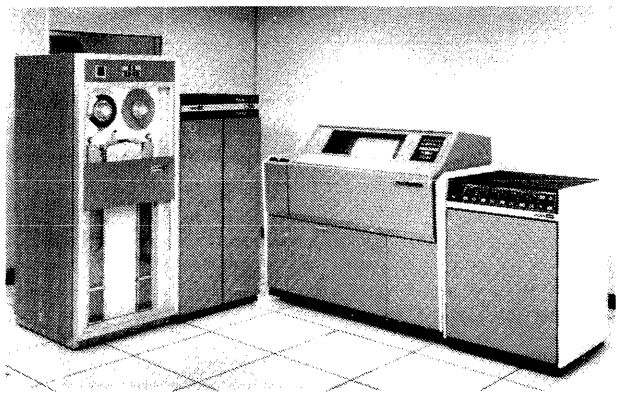
Telex permits an innitial 30-day, cost-free usage period for evaluation and acceptance of any of its products.

Lease rates include all cables, installation, diagnostic performance performance checks, and maintenance, which is provided on a 24-hour/day, 7-day/week basis. Telex protects its customers from price increases during the term of the lease. Telex provides servicing for purchased units under one of three service contracts: Basic Service provides service for 9 hours/day, 5-days/week; Preferred Service provides service for 16 hours/day, 5 days/week plus Saturday; Complete Service provides 24-hours/day service, 7-days/week.

	Monthly Rental (1)				
	Basic Lease	1-Yr. Lease	2-Yr. Lease	Purchase	Monthly Maint.
6721 Printer System	$945	$870	$767	$38,770	$210(2)
5416 Print Train(4)	100	92	88	3,500	(3)
Automatic Power Stacker	25	25	25	1,200	0

(1) To include maintenance, add the indicated maintenance charge, which provides service for leased units (only) on a 24-hours/day, 7-days/week basis.
(2) Basic Service; Preferred and Complete Service are priced at $315 and $420, respectively.
(3) Time and materials; applies to purchased units only.
(4) One 5416 is included with each 6721 Printer. ■

Telex 5848 Off-Line Printer System



This off-line printer system includes one or two Telex 5403 Train Printers and features programmed operation. Telex provides list-program generators that run under IBM 360/370 OS or DOS, plus a standard off-line program for listing OS or DOS print tapes.

MANAGEMENT SUMMARY

The Telex 5848 is no longer in production, but is still being actively marketed by Telex at this writing. Returned systems are refurbished and made available for immediate delivery.

Off-line printing is an important alternative to on-line printing. Essentially, off-line printing relieves the computer from the burden of servicing one or more low-speed I/O devices—a burden that can be substantial in applications that require large volumes of printed output, such as checks, labels, invoices, etc.

The Telex 5848 Off-Line Printer System, composed of a programmable controller, one or two tape drives, and one or two train printers, is not restricted to conventional tape listing operations but can also perform more sophisticated functions such as reformatting, calculations (totals on columns), selection of individual records, etc. The user generates his own application programs using a Telex-provided assembly language which is available in two forms as Compiler I and III. (Alternatively, if his needs are simple, he can just load a tape list program called the Standard Off-Line Program.)

Compiler I includes two macros and is actually nothing more than a list-program generator that uses user-specified parameters or, by default, built-in parameters to generate straightforward listing programs for specific applications. Compiler III is composed of macros and BAL-like instructions and includes a more extensive set of macros which adds considerable power and flexibility to program generation. Although Compiler I and III both permit the use of macros, neither is capable of generating its own.

This assembly-language-like programming facility runs under OS or DOS on an IBM System/360 or 370 computer to create a program tape that is loaded into the controller prior to operation. One of the most significant advantages of this facility is that it permits one-shot report generation directly from existing files.

Telex purchased its printer mechanisms and train cartridges from Control Data Corporation under an ➢

CHARACTERISTICS

MANUFACTURER: Telex Computer Products, Inc., 6422 East 41st Street, Tulsa Oklahoma 74135. Telephone (918) 627-1111.

MODELS: The Telex Off-Line Printer System is available in two models. Model 5848-1 accommodates one Telex 5403-1 Printer and one Telex 4800 Series Magnetic Tape Drive. Model 5848-2 accommodates two Telex 5403-1 Printers and two Telex 4800 Series Magnetic Tape Drives.

TAPE INPUT: Provided by the Telex 4800 Series Magnetic Tape Drives, which handle 7- or 9-track magnetic tape in industry-compatible formats at all standard densities. The Telex 4800 Series drives are listed below together with their characteristics.

Telex 4800 Model	Tape Format, Tracks	Tape Speed, ips	Tape Density, bits/inch	Transfer Rate, char/sec
4883*	7	75	200/556/800	15,000/41,700/ 60,000
4883*	9	75	800/1600	60,000/120,000
4887	7	75	200/556/800	15,000/41,700/ 60,000
4889	9	75	1600/800**	120.000/60,000
5999	9	100	1600	160,000

*Includes both 7- and 9-track capabilities via switch selection.
**Optional Dual Density feature is required for 800 bpi operation.

The 7-track and 9-track (800 bpi only) formats use the standard NRZI recording technique; the 9-track format with a 1600-bpi recording density uses the phase-encoding technique. The Dual Density feature, which also permits operation at 800 bpi using the NRZI technique, is available for Model 4889 only. Model 4883 incorporates all 7- and 9-track capabilities in one drive; 7- and 9-track modes are switch-selectable. All drives are restricted to read-only operation; the write capability is not provided.

PRINTED OUTPUT: Printing is performed by a train printer with 132 print positions. A character set of 48 characters is standard and includes upper-case alphabetics, numerics, and specials; optional character sets are available with 36 and 16 characters. Print speed is rated at 1200 lines/minute using the standard 48-character set.

Telex and IBM train cartridges are not interchangeable. The IBM 1416 Interchangeable Train Cartridge contains a 240-character type array, while the Telex cartridge contains a 288-character array.

The Universal Character Set feature, optional on the IBM 1403 Printer, is a standard feature on the Telex 5403 Printer. Unlike the IBM 1403, the Telex 5403 provides buffering for two 288-character train images; operator controls permit switch selection of either buffer. The buffers are loaded from the off-line controller.

The Telex 5403 also includes a format tape buffer that stores format information read from the 12-channel tape loop or loaded from the off-line controller. The tape loop ➤

REFERENCE EDITION. This is a mature product line, and no significant further developments are anticipated. Because of its importance, coverage is being continued, but no future update is planned.

Telex 5848 Off-Line Printer System

exclusive end-user agreement. The Telex train cartridge used in the 5403 is not interchangeable with IBM's 1416 Interchangeable Train Cartridge. Telex provides a total of 288 characters in its train, compared with IBM's 240 characters. This amounts to one additional repetition of the character set on the 48-character basic train and allows an increase in printing speed.

Telex provides its own maintenance and maintains service operations in more than 60 metropolitan areas.

USER REACTION

Datapro conducted telephone interviews with seven users of the Telex 5848 Off-Line Printer System, who reported on their experience with a total of 14 systems (one user had 8 systems). These users had been using the Telex 5848 for 1½ to 2 years and were operating on a 24-hour-per-day, 6- or 7-day-per-week basis. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	0	5	1	1	2.6
Ease of operation	0	6	1	0	2.9
Hardware reliability	0	3	2	2	2.1
Maintenance service:					
Promptness	2	2	2	1	2.7
Quality	1	0	5	1	2.1
Software & technical support	0	6	1	0	2.9

*Weighted Average on a scale of 4.0 for Excellent.

Four of these users (including the one with eight systems) were well satisfied with the 5848, but the other three were not. One user, who rated overall performance and hardware reliability as poor, has had his first printer replaced with a second because of "excessive failures." He reported that the second printer, like the first, is "down 50 percent of the time," but said the print quality and performance are good when the unit is operable. This unhappy user plans to replace the 5848 with IBM 1403 Printers. Another user who rated hardware reliability as poor said he's been plagued with a multitude of printer failures after the system ran well for the first six months following installation. He also rated maintenance promptness and quality as poor, sometimes having to wait up to 12 hours for service. Another user, who rated reliability and maintenance promptness and quality as fair, reported more frequent failures than with the IBM 1403 and said that the average level of maintenance competence was less than desirable.

Most of the users were enthusiastic about the Power Stacker feature. The user with eight printer systems reported the print quality to be comparable to that of the IBM 1403 and said it was good enough to be read by his OCR equipment; however, this user complained of excessive print train wear. The two users who rated maintenance promptness as excellent had resident CE's.□

can be removed after its contents have been stored. The IBM 1403 Printer does not include this feature.

Other standard features include the capability to print the complete contents of the type array, an automatic print retry feature, exclusive Telex 36- and 16-character print sets, and high-speed skipping.

The Telex 36-character print set increases the rated printing speed to 1500 lines/minute. The 16-character print set increases the rated printing speed to 2500 lines/minute, though operation at this speed can continue only for periods of several minutes.

Horizontal spacing is 10 char/inch; vertical spacing is selectable at 6 or 8 lines/inch. The printer accommodates up to 6-part, pin-fed, continuous fanfold forms from 4 to 18-3/4 inches wide.

The Telex Printer has a skipping speed of 70 inches/second, which is maintained from 2 lines after the beginning until 2 lines before the end of each skip. Telex recommends use of the Automatic Power Stacker for ease of paper handling during lengthy skipping operations.

DEVICE CONTROL: Provided manually through switches on the off-line controller and automatically via program control. Programs are loaded from tape prior to operation and are stored in the controller's core memory, which provides up to 4096 18-bit storage locations.

Programs are generated via the Telex Compiler I or Compiler III assembly language, which runs under System/360 or 370 OS or DOS. Programs generated by Compiler I perform the essential functions of tape listing such as data translation, deblocking, carriage control, etc. Programs generated by Compiler III significantly extend the range of capabilities and include an additional macro facility consisting of I/O, arithmetic, logical, branch, move, and compare macros.

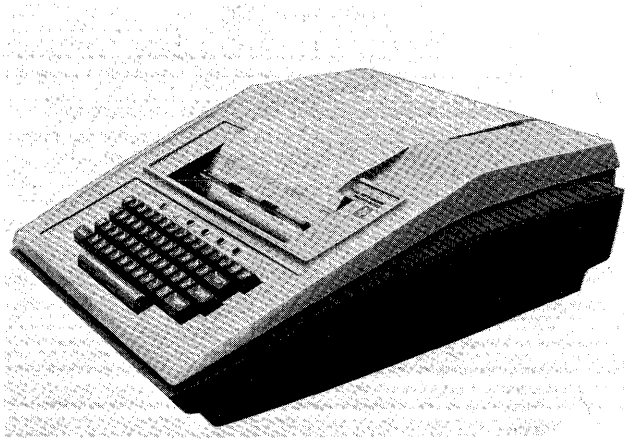
PRICING: The Telex 5848 Off-Line Printer System is available for lease or purchase; conversion from lease to purchase is available through a purchase-credit agreement. Leases are available for two- or three-year terms. Lease rates include all cables, installation, diagnostic performance checks, and maintenance, which is provided on a 24-hours/day, 7-days/week basis.

Telex provides servicing for purchased units under one of three service contracts: Basic Service provides service for 9 hours/day, 5 days/week; Preferred Service provides service for 16 hours/day, 5 days/week plus Saturday; Complete Service provides 24-hours/day service, 7 days/week.

	Monthly Rental (1)			
	2-Year Lease	3-Year Lease	Purchase	Monthly Maint. (2)
Control System				
5848-1 System (3)	$ 975	$ 885	$35,000	$200
5848-2 System (4)	1,570	1,445	59,000	295
5403-1 Printer	795	745	25,770	255
5416 Print Train	92	88	3,500	(6)
Replacement Drives				
4887 Tape Unit	(5)	(5)	(5)	0
4883 Tape Unit	240	200	8,000	0
5999 Tape Unit	100	75	10,000	0
Options				
Dual Density Tape Unit)	30	25	1,200	0
Automatic Power Stacker (per printer)	25	20	1,025	0
Manual Stacker (per printer)	25	20	1,000	0
Software				
Standard Program (off-line)	15	15	360	0
Compiler I (7)	30	30	900	0
Compiler III (7)	50	50	1,440	0

(1) Includes maintenance for 24 hours/day, 7 days/week.
(2) Basic maintenance: Preferred and Complete maintenance are priced at about 1.5 and 2 times the rate for basic maintenance, respectively.
(3) Includes Controller, Tape Adapter, and 4889-1 Tape Unit.
(4) Includes Controller, two Tape Adapters, and two 4889-1 Tape Units.
(5) A 4887 Tape unit can replace a 4889-1 Tape Unit at no additional cost.
(6) Time and materials; applies to purchased units only.
(7) User must specify OS or DOS and tape format as 9-track PE or NRZI.

Texas Instruments Silent 700 Electronic Data Terminals



TI's attractive Silent 700 family of desk-top teleprinter terminals features non-impact printing, transmission speeds up to 30 characters per second, full 128-character ASCII generation, and compact, low-profile styling. Family members are tailored to meet the needs of various applications, including compatibility with IBM and Teletype units, general-purpose data communications, and direct connection to computers.

MANAGEMENT SUMMARY

"Machines should be seen, but not heard"—so say those who decry noise pollution. Texas Instruments subscribes to this philosophy, as witnessed by its Silent 700 family of electronic teleprinter terminals. The terminals feature a non-impact printer that uses the electrothermal printing technique, long indigenous to the facsimile domain, and MOS large-scale integrated circuitry (LSI).

TI announced the Silent 700 family at the 1969 Spring Joint Computer Conference. The first production units were delivered in May 1970. Current lead time on orders varies from 10 to 90 days. Texas Instruments provides it own service through a growing nationwide network of sales and service offices.

Two members of the Silent 700 family, Models 710 and 715, exhibit operational comparability (but not direct compatibility) with the IBM 1050 and 2741 communications terminals, respectively. The 710, like the IBM 1050, provides both automatic EOB and error checking, and, in addition, has an optional 100-character transmit buffer. Automatic blocking is contingent to buffered operation. The 715 includes message interrupt (break) and parity generation as standard features.

Other members, Models 720 through 731 (excluding Model 725), include KSR and RO versions of the basic terminal that differ only in interface design and available options. Interfaces include a serial data communications interface, a parallel interface for connection to existing equipment such as computers and CRT terminals, and a Teletype-compatible interface designed for a telegraph-grade communications facility. These general-purpose terminals all use the ASCII code. Texas Instruments provides an optional plug-in modem for those terminals with a data communications capability.

Model 725 is a portable typewriter terminal. Weighing just under 40 pounds and encased in an attache-like case with removable lid, the 725 features an integral, Bell System 103-compatible acoustic telephone coupler and can be attached to any conventional telephone handset ▷

CHARACTERISTICS

MANUFACTURER: Texas Instruments Inc., Digital Systems Division, 12203 Southwest Freeway, P.O. Box 1444, Houston, Texas 77001. Telephone (713) 494-5115.

MODELS: Nine models, all variations of the same basic design, are as follows:

- 710—Buffered IBM 1050-comparable inquiry/response terminal.
- 715—Unbuffered IBM 2741-comparable inquiry/response terminal.
- 720—KSR configuration with communications interface.
- 721—RO configuration with communications interface.
- 722—RO configuration with parallel interface.
- 723—KSR configuration with parallel interface.
- 725—Portable terminal with integral acoustic coupler.
- 730—KSR configuration with serial dc-signal interface for connection to telegraph-grade lines.
- 731—RO configuration with serial dc-signal interface for connection to telegraph-grade lines.

COMMUNICATIONS: Models 710 and 715 transmit asynchronously in the half-duplex mode at 14.8 characters per second (134.5 bits/second). The transmission code used is 9-unit, 6-level IBM Paper Tape Transmission Code (PTTC/BCD); the code structure consists of six data, one parity, and unit start and stop bits. A transmission speed of 30 characters per second is optional for both models. Transmission characteristics are compatible with the IBM 2701 Data Adapter Unit, the 2702 and 2703 Transmission Controls, the 2712 Remote Multiplexer, and the Integrated Communications Attachment for the System/360 Model 25. Models 710 and 715, via one of these line controllers, are designed for communicating with an IBM System/360 computer, Models 25 through 195. Both models are designed for operation over a leased or privately-owned narrow- or voice-band facility or over the public telephone network via a modem equivalent to the Bell System 103F or 103A Data Set, respectively.

Models 720, 721, and 725 operate asynchronously in the half- or full-duplex mode at switch-selectable speeds of 10, 15, or 30 characters per second. The transmission code used is 10- or 11-unit, 8-level ASCII, including parity. The 10-unit code includes one start and one stop bit, while the 11-unit code includes one start and two stop bits. The 10-unit code is available for speeds of 10, ▶

Texas Instruments Silent 700 Electronic Data Terminals

for communication with a remote computer. Although portable, the unit is not battery-operated and must be connected to a standard 115-volt power source. The 725 features speed selection, a print set of 94 characters (upper and lower case), and a full 128-character ASCII keyboard. A 20-character answer-back memory is optional.

Operating speeds are 14.8 or 30 (optional) characters per second for the standard IBM-compatible members. The other terminals are available with switch-selectable speeds of 10,15, and 30 characters per second.

The printer can operate at speeds up to 30 characters per second, but is limited to a teleprinter line length of 80 characters. The special paper required for printing is supplied by Texas Instruments at a cost per page of about 1.5 cents. A 300-foot roll of thermographic printing paper fits conveniently inside the terminal. Upper/lower-case printing is optional for all terminals. The keyboard on the non-IBM terminals can generate any of 128 ASCII characters.

Late in 1972, TI extended the Silent 700 line by introducing Models 732 and 733, which feature a redesigned printing mechanism and magnetic tape cassettes. These new models are described in Report 70D-840-03. □

15, and 30 characters per second; the 11-unit code is available for the 10-character-per-second speed only.

The EIA Standard RS232C interface is provided on models 710, 715, 720, and 721. An integral modem constructed as a plug-in printed circuit card is available as an option for these models.

Models 730 and 731 provide a dc-signal interface compatible with the Teletype teletypewriters that operate at 10 characters per second over telegraph-grade communications facilities. Speeds of 10, 15, and 30 characters per second can be switch-selected.

Model 725 contains an integral acoustic coupler compatible with the Bell System 103 Series modems. Interface options include a bit-parallel or RS232C interface.

DIRECT CONNECTION: Models 722 and 723 contain a parallel interface for connection to a data source. Both models can operate at speeds up to 30 characters per second, as determined by the controlling source.

DEVICE CONTROL: Model 710 operates in a polling/addressing environment under control of the program stored at the remote computer. Its optional 100-character buffer memory stores keyed data prior to transmission. The 710, when addressed or polled, responds to a discrete selection code; it can also respond to a broadcast code.

Model 710 automatically generates an end-of-address (EOA) code preceding the stored message and an end-of-block (EOB) code at the end; without the buffer, these characters must be generated manually to respond to polling. The last character keyed into the buffer or the entire buffer can be erased prior to transmission; without the buffer, the erase function produces a delete code.

A break or interrupt feature that transmits a 140-millisecond space signal is provided in Models 715, 720, 725, and 730. This signal is used to interrupt a transmission from the remote computer so that an impending message can be transmitted. Full-duplex operation is required.

A 20-byte answer-back memory that can be activated either remotely or locally is provided on Models 720, 725, and 730. Data stored in the memory is transferred to the communications facility only.

ERROR CONTROL: Odd character parity and longitudinal parity (710 only) are generated and accompany all messages transmitted by Models 710 and 715, and are checked on all messages received by Model 710. The 710 prints an error symbol and lights an indicator lamp as the result of a detected parity error. Even character parity is generated for each character keyed on Models 720 and 730, but is not checked on received data.

KEYBOARD: 55-key (Models 710 and 715) or 61-key (Models 720, 723, and 730) typewriter-style. The Model 710 and 715 keyboards can produce any of 72 upper-case alphabetics, numerics, special symbols, and control codes. The Model 720, 723, and 730 keyboards can produce any of 128 ASCII characters that include upper- and lower-case alphabetics, numerics, special symbols, and control codes.

PRINTER: Non-impact, using an electrothermal printing technique. Characters are formed within a 5-by-7 dot matrix; character size is 0.105 inch high by 0.080 inch wide. Lower-case characters 0.0715 inch high by 0.080 inch wide are formed by an optional 5-by-5 dot matrix. Without the option, received upper- and lower-case characters are printed in the upper-case form.

The printer has a friction-feed platen and accommodates TI thermographic printing paper, which is provided in roll form; a 300-foot roll is contained within the teleprinter. Line length is 80 characters (8 inches). Horizontal spacing is 10 characters/inch and vertical spacing is 6 lines/inch.

PRICING: The Silent 700 Electronic Data Terminals are available for lease or purchase. Leasing arrangements are provided for 90 days to three years. Lease prices include maintenance; a separate maintenance contract is available for purchased equipment. The higher price for each model includes all available options, such as Upper/Lower-Case, Answer-Back Memory, 100-Character Buffer, 30-char/sec operation, integral modem, copylighting, and auxiliary RS232C connector.

Prime-shift maintenance for purchased units within 25 miles of a TI Service Center is priced at $120 for the first year following delivery. Separate maintenance contracts are available for subsequent years. Contracts for Models 710, 715, and 725 are priced at $20/month while other models below are $15/month. The maintenance price is increased by $5/month per 25 miles for units located more than 25 miles from a service center.

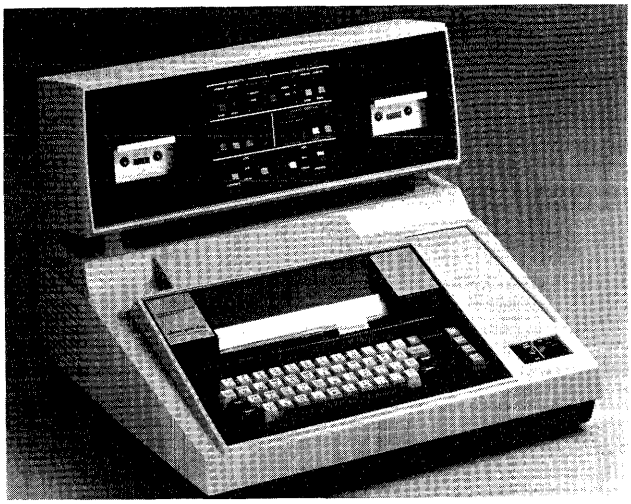
Integral modems rent for $13/month and sell for $240 to $300.

The TI thermographic printing paper sells for $5 per 300-foot roll in quantities of less than 12 rolls. Case lots (12 rolls/case) sell for $4.75 per roll; pallet load lots (528 rolls/pallet) sell for $4.25 per roll.

Model	Monthly Rental*	Purchase
710	$115 to $147	$2,950 to $3,660
715	$ 95 to $127	$2,540 to $3,250
720	$ 85 to $116	$2,250 to $2,820
721	$ 85 to $106	$1,795 to $2,235
722	$ 85 to $ 93	$1,660 to $1,860
723	$ 85 to $ 93	$2,115 to $2,265
725	$125 to $148	$2,780 to $3,160
730	$ 85 to $103	$2,300 to $2,570
731	$ 85 to $ 93	$1,795 to $1,995

*Basic lease prices are for 12-month period and include prime-shift maintenance. ■

Texas Instruments Silent 700 Models 732 and 733



These modern teleprinters can serve as attractive alternatives to the ubiquitous Teletype line of teletypewriters. Key features include silent printing at speeds up to 120 characters per second and the use of magnetic tape cassettes in place of paper tape.

MANAGEMENT SUMMARY

Models 732 and 733 are significant extensions to the established Silent 700 family of terminals described in Report 70D-840-02. TI offers KSR and ASR versions of both members, and the ASR version is available with either one or two cassette tape recorders. Both models are designed as replacements for Teletype teletypewriters; though more expensive than their Teletype counterparts, they offer greater flexibility and represent attractive alternatives. Model 732 employs the 5-level Baudot code and is designed as a replacement for Teletype Models 28 and 32. Model 733 employs ASCII code and is designed as a replacement for Teletype Models 33, 35, 37, and 38.

The new members of the Silent 700 family employ essentially the same basic components, including keyboard and printer, as the other family members; however, the printer has been redesigned to provide greater reliability for heavy usage.

TI has substituted magnetic tape cassettes for the paper tape used in most teletypewriters. The ASR versions of both models are available with one or two cassette recorders. Keyed or received data is recorded at line speed and can be "played back" any number of times to produce several printed copies or retransmitted an unlimited number of times. Two cassette recorders permit duplicating or editing of original tapes. Editing can be performed via key entry or on selected blocks on tape using the optional search function. Two cassette recorders also permit full-duplex communications; i.e., data can be read from one tape and transmitted while the other records received data.

Printing is virtually noiseless, as implied by the tradename "Silent 700." TI's non-impact printing technique lends itself well to quiet environments and to sensitive ▷

CHARACTERISTICS

MANUFACTURER: Texas Instruments, Inc., Digital Systems Division, 12203 Southwest Freeway, P.O. Box 1444, Houston, Texas 77001. Telephone (713) 494-5115.

MODELS: Model 733, an ASCII terminal, and Model 732, a Baudot terminal. Both models are available in either a KSR or ASR configuration; the latter includes one or two integral cassette tape recorders.

COMMUNICATIONS: Model 733 transmits asynchronously in the half- or full-duplex mode at switch-selectable speeds of 10, 15, 30, or 120 (optional) char/second. The transmission code is 10- or 11-unit, 8-level ASCII, including parity. The 11-unit code includes one start and two stop bits and is used at speeds of 10 and 15 char/second; the 10-unit code includes one start and one stop bit and is used at speeds of 30 and 120 char/second. Model 733 is transmission-compatible with Teletype teletypewriter Models 33, 35, and 38 at 10 char/second and Model 37 at 15 char/second.

The 733 contains an EIA Standard RS-232C interface, which can be replaced with a Teletype interface for direct attachment to a telegraph-grade line, or with an integral hard-wired modem for direct connection to a voice-grade line. The modem operates at speeds up to 300 bits/second.

Model 732 transmits asynchronously in the half- or full-duplex mode at switch-selectable speeds of 50, 75, or 100 bits/second. The transmission code is 5-level Baudot; each character includes 5 data bits, a start bit, and a stop bit which can vary in length. Model 732 is transmission-compatible with Teletype teletypewriter Models 28 and 32.

DEVICE CONTROL: Both models perform the same basic functions. The KSR version is unbuffered; data is transmitted and/or printed as keyed and printed as received. The buffered ASR version records data from keyboard, line, or tape and reads data from tape, which is transmitted or recorded on a second tape (in dual-cassette units). A printed copy can be produced from keyed or received data or from data read from tape; however, when operating in the full-duplex mode, only received data can be printed.

The dual-cassette unit provides identical controls for each cassette recorder; these include Rewind, Load (move tape to beginning of recording), Fast Forward, and Stop Tape. Indicator lamps define the operating mode, tape ready, and end-of-tape conditions.

Mode selection defines the operating mode. On the dual-cassette unit, the operating mode is established for both cassette recorders via a common control, which assigns the Record mode to one cassette recorder and the Play- ➤

Texas Instruments Silent 700
Models 732 and 733

eardrums. The printer operates at line speed and provides up to 80 print columns, which is in keeping with conventional teleprint parameters. The Model 733 printer also prints both upper- and lower-case alphabetics. Special paper is required for printing and is supplied by TI at a cost per page of about 1.5 cents. The 300-foot roll of thermographic printing paper fits conveniently inside the terminal. The major disadvantage of non-impact printing techniques is, of course, the inability to produce duplicate copies. This limitation is not as restrictive on ASR versions, which can produce an unlimited number of printed copies by "replaying" a recorded tape.

Keyboards on all standard models are Teletype-compatible. As an option, Model 733 is available with a full ASCII keyboard, which can generate both upper- and lower-case alphabetics as well as all ASCII control codes.

Production deliveries began in January 1973. Deliveries of 1200-bps Model 733 ASR's with high-speed file search are scheduled to begin in May 1973.

Texas Instruments provides its own nationwide service. □

back mode to the other, or the converse. Both recorders can operate simultaneously, but only in opposite modes.

Data is recorded in either of two modes, Continuous or Line. Both modes record data in a fixed, 86-character block format. The Continuous mode can record several "print lines" per block, while the Line mode records only one print line per block. Partial lines are terminated with a carriage-return control character when keying in the Continuous mode and filled with NULL characters in the Line mode. Continuous and Line formats can be mixed on the same tape, but are automatically separated during playback. Blocks written in the Line mode are automatically stripped of NULL characters and transmitted in the Continuous mode.

Data read from tape in the Playback mode can be read continuously (block by block), one block at a time, or one character at a time. Block and character playback allows editing to be performed when creating a new tape from an original. Tape can be backspaced on a block-by-block basis to permit re-reading a previous block.

Options include:

- Automatic Record Locator – a search mode, which reads and compares tape data with a keyed identifier of up to 16 sequential characters.
- Automatic Device Control – establishes recognition of received control codes to permit remote operation.
- Answerback – a 21-character answerback memory that can be activated locally or remotely via a received control code.

ERROR CONTROL: Odd, even, or mark character parity, as selected, is generated and accompanies all transmitted messages. Parity checking is not performed on received data.

KEYBOARD: 56-key Teletype-style keyboard can produce any of 64 characters, including upper-case alphabetics, numerics, control codes, and special symbols. An optional full-ASCII keyboard, available for Model 733 only, provides both upper- and lower-case alphabetics.

PRINTER: Non-impact, using an electrothermal printing technique. Characters are formed within a 5-by-7 dot matrix; character size is 0.105 inch high by 0.080 inch wide. Model 733 also prints lower-case characters, 0.0715 inch high by 0.080 inch wide, formed by a 5-by-5 dot matrix.

The printer has a friction-feed platen and accommodates TI thermographic printing paper, which is provided in roll form; a 300-foot roll, contained within the teleprinter, measures 8-1/2 inches wide by 3-5/8 inches in diameter.

Line length is 80 characters (8 inches). Horizontal spacing is 10 char/inch; vertical spacing is selectable at 3 or 6 lines/inch. Carriage return/line feed is performed automatically at column 81; no code is recorded or transmitted.

Printer timing in milliseconds is 195 per carriage return, 33 per single-space line feed, and 67 per double-space line feed.

CASSETTE TAPE RECORDER: Records data on a "Philips-type" cassette, which contains 300 feet of 0.15-inch magnetic tape recorded at 800 bits/inch using the phase-encoding technique. Data is recorded in fixed blocks of 86 characters each. The cassette storage capacity is rated at 155,000 char/track, or 310,000 characters maximum.

PRICING: TI Models 732 and 733 are available for purchase or on a 90-day or one- through five-year lease, which includes maintenance. A separate maintenance contract is available for purchased units.

Model	Monthly Rental *	Purchase
732 KSR	$80	$1,575
732 ASR**	125	2,825
733 KSR	75	1,500
733 ASR**	120	2,750
Model 733 Options		
120 Char/Second Speed	7	175
Full-ASCII Keyboard	5	100
Integral Modem (300 bps)	13	300
Teletype Interface:		
Neutral	5	100
Polar	6	150
Answerback	10	170
Automatic Device Control	5	110
Automatic Record Locator	7	175
Table	–	110

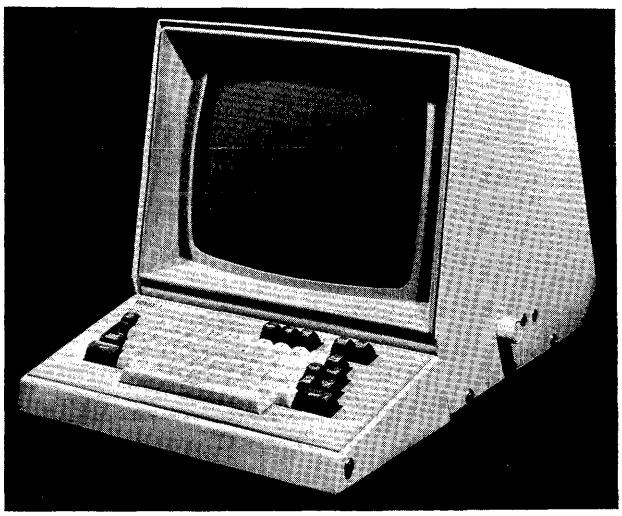
* Rental under a one-year lease; includes maintenance.

** ASR configurations are priced with dual cassette recorders; ASR versions having only one cassette recorder are priced $10 per month lower for leased units and $240 lower for purchased units.

The TI thermographic printing paper sells for $5 per 300-foot roll in quantities of less than 12 rolls. Case lots (12 rolls) and pallet load lots (528 rolls) are available at $4.75/roll and $4.25/roll, respectively.

Tape cassettes sell for $6.95 each; discounts are not provided. ■

Trivex 40/80 Display System



The Trivex 40/80 Display System is a fully compatible replacement for the IBM 2260/2848 display subsystem. The Trivex system features significant enhancements over its IBM counterpart as well as lower prices.

MANAGEMENT SUMMARY

The Trivex 40/80 Display System offers multistation and single-station replacements for the IBM 2260/2848 Display Station for communication with IBM System/360 or System/370 computers. The 40/80 System is designed for operation either in a communications environment as a remote terminal or in a computer environment as a peripheral subsystem; it provides both hardware and software compatibility with the IBM terminals. Like its IBM counterpart, the 40/80 System is supported by standard IBM software and remote terminals operating under the full Operating System (OS) or the Disk Operating System (DOS) via BTAM, QTAM, or other IBM telecommunications programs. Although offered in a single-station version like the IBM 2265, the 40/80 system is not marketed as a 2265 replacement since it is not totally compatible with the IBM 2265.

As an IBM replacement, the 40/80 provides all standard IBM 2260 features and, in addition, offers some noteworthy enhancements, including a substantially improved print capability and twice as many 960-character CRT's as are permitted with IBM's 2260/2848 subsystem. Highlights of the Trivex 40/80 System are described in the following paragraphs.

- Display Capacity—The 40/80 is available with the same three screen capacities as the IBM 2260: 240, 480, and 960 characters. But Trivex offers two screen sizes, 960 or 480 characters, for its stand-alone terminals, whereas the IBM 2265 has a fixed screen size of 960 characters.

- Total Displays—The 40/80 controller can accommodate 16 960-character display units (twice as many as can be accommodated by the IBM 2848) and 32 240-character displays (one-third more than the allowable number of IBM 2260's). However, the ▷

CHARACTERISTICS

MANUFACTURER: Trivex, Inc., Information Systems Division, 3180 Red Hill Avenue, Costa Mesa, California 92626. Telephone (714) 546-7781.

MODELS: The Trivex 40/80 Display System is available in three models of multistation terminals and four models of stand-alone terminals. The 40/80 System provides both hardware and software compatibility with the IBM 2260 Display Station.

MULTISTATION CONFIGURATION: Includes one of three models of display controllers, 1 to 16 960- or 480-character keyboard/display units, and 1 to 12 printers. Printers are assigned to one of three fixed operating modes: local, remote, or local/remote. A printer operating in the local mode prints displayed data only. A printer operating in the remote mode has a device address and prints data received from a remote computer. The three multistation models and their characteristics are listed below.

40/80 Model	Screen Size, chars.	Maximum Displays	Maximum Printers Local	Remote	Loc/Rem
812	960	16	4*	1	2
412	480	16	4*	1	2
406	240	32	4*	0**	0**

* Up to 12 local printers can be attached; each additional group of 4 printers reduces the maximum number of displays by 2 (Models 812 and 412) or 4 (Model 406).

** One printer can operate in a remote mode, or one or two printers can be switched between local and remote modes, but the maximum number of 240-character displays is reduced by four for each remote printer.

Printers operating in the local mode can be accessed via one of two specified methods. All printers can be shared by all display units on a "first-come, first-served" basis, or each printer can be assigned to and shared by a specific group of display units.

All models of the multistation 40/80 System are designed either for remote operation in a communications environment or for local operation in a computer environment as a computer peripheral subsystem.

When operating in a computer environment, the controller is directly attached to the multiplexer or selector channel of an IBM System/360 (Model 22 and above) or System/370 computer. The data transfer rate in this mode is 125,000 characters per second.

SINGLE-STATION CONFIGURATION: Includes one of four models of display controllers, one or two 960- or 480-character keyboard/display units, and one or two printers. Print modes can be specified as either local mode only, in which only displayed data is printed, or switched local and remote, in which either displayed data or re- ▶

Trivex 40/80 Display System

maximum number of 480-character 40/80 displays is limited to 16, as in the the IBM 2848.

- Display Arrangement–The Trivex arrangements are identical with those provided by the IBM 2260 and 2265, except for the additional 480-character screen size available for the Trivex stand-alone terminals.

- Printed Output–Trivex's printing capability is far superior to that of the IBM 2260 and considerably improved over that of the IBM 2265. The 40/80 System can accommodate up to 12 printers operating in a local mode. The printers can be shared by all display units attached to the controller, or each printer can be assigned to a group of displays. Priorities can be established. One or two printers can operate as communications printers to print computer messages, or they can operate locally to print displayed data and remotely to print computer messages. The 40/80 uses the Memorex 1250 printer, which prints at 30, 60, or 120 cps, compared with the slow 14.8-cps print speed of the IBM 1053 Model 4 Printer.

- Editing–The 40/80 features character insert and delete features not available with the IBM terminals.

- Communications–The 40/80 features a high-speed communications interface capable of operating at data rates up to 9600 bits per second, whereas IBM does not support operation above 4800 bps for its 2260 and 2265 terminals.

The Trivex 40/80 was introduced in early 1971, with customer deliveries beginning in April 1971. Current lead time on orders is 45 to 60 days. To date, Trivex boasts over 1500 units installed.

Service is provided by Trivex and supplemented by Raytheon via 26 service locations nationwide.

A Datapro survey of installations using the Trivex 40/80 terminals found the users to be quite satisfied with the terminals' overall performance, price/performance advantages, and reliability.

One interesting "case history" involves a user who is replacing a large IBM 2260 installation, operating remotely into back-to-back IBM System/370 Model 165's, with Trivex terminals as the result of an evaluation that included the wares of six other CRT terminal manufacturers (including IBM). According to his findings, Trivex offered the best price, included some worthwhile enhancements, and was more reliable than some of the competitive products. Currently, this user has 93 Trivex terminals installed and plans to grow to 120 terminals by mid-1973. Most of the Trivex equipment has been operating in a severe factory environment since October 1971, where it is subject to heavy equipment vibration,

ceived data can be printed. The four single-station models and their characteristics are listed below.

40/80 Model	Screen Size, Chars.	Maximum Displays	Maximum Printers*
812M	960	1	2
812MA	960	2	2
412M	480	1	2
412MA	480	2	2

* Print mode is specified as local-only or switched local/remote.

COMMUNICATIONS: Asynchronous or synchronous in the half-duplex mode at data rates up to 9600 bits/second. Internal clocking is provided for speeds up to 1200 bps. The 8-level (including parity) ASCII transmission code is used. When operating asynchronously, the unit code structure is 10 bits/character, including unity start and stop bits.

The 40/80 System is connected to a voice-band communications facility via a modem compatible with the Bell System 201 or 202 Data Sets. Transmission compatibility is provided with the IBM 2701 Data Adapter Type III at 1200 or 2400 bps or with the IBM 3705 Communications Controller operating in the Emulation mode at speeds up to 7200 bps.

CRT DISPLAY: A 12-inch (diagonal measurement) CRT provides a viewing area of 9 inches wide by 6 inches high. A character set of 64 ASCII characters, including uppercase alphabetics, numerics, and specials, is displayed in white against a dark background. Characters are generated by a 5-by-7 dot matrix.

The following screen capacities and display arrangements are available:

Characters/Display:	240	480	960
Lines/Display:	6	12	12
Characters/Line:	40	40	80

DEVICE CONTROL: The 40/80 System is designed to operate in an addressing and polling environment under control of the program stored in the remote computer. Operation is compatible with IBM telecommunications software, including BTAM and QTAM under OS/360 or DOS/360. The 40/80 terminals are compatible with the IBM four-byte addressing sequence, command code structure, and line discipline employed by the IBM 2260/2848 Display Stations.

The cursor, displayed as a full matrix, is nondestructive. Cursor control keys move the cursor right, left, up, or down by one position or to the "home" position (first screen location). A repeat function provides repetitive cursor movement. The cursor moves from the last character position of a line to the first character position of the next line, and the converse (wraparound).

Character insert and delete functions allow the insertion or deletion of characters into or from displayed text. The text expands or contracts to accommodate the inserted or deleted data. Insert and delete functions affect displayed text from the cursor to the end of the line or to the New Line symbol.

The Tab function moves the cursor to the character position following a Tab Stop character with each depression of the Tab key. Tabbing can continue line by line until the cursor moves from the last display position to the first (home) position, an automatic tab stop.

Trivex 40/80 Display System

a dirty atmosphere, changing temperatures, and heavy usage by factory workers for data entry and inquiries concerning production components. Under these severe conditions, the Trivex equipment has withstood the punishment without any major failures and is performing excellently. This user also commented that service has been exceedingly good and that Trivex has provided a resident customer engineer with its installation. On the other hand, he was not initially satisfied with the Memorex Printers and complained about noise, print quality, and hard-to-replace ribbons; he added, however, that Memorex has been responsive to his needs and that the equipment is now operating satisfactorily. □

Erasure functions permit erasure of displayed data from the cursor to the end of a line or to the end of the screen, or erasure of the entire screen.

The New Line code can be used to construct a fixed format by using the symbol to separate a variable data field (to the left of the symbol) from a fixed field containing a format descriptor. Only the variable data to the left of the New Line symbol is transmitted; the fixed data remains displayed for the following data entry operation.

The Print function initiates the execution of a printed copy of a displayed page. All displayed data is immediately transferred to the print buffer and the terminal is available for further data entry.

ERROR CONTROL: Character and longitudinal parity generation is performed on all commands and messages transmitted to and received from the remote computer. A message is automatically retransmitted from a terminal when a negative acknowledgement to a just-transmitted message is received. An error symbol is displayed in place of a character received in error. The terminals respond to detected errors by transmitting a negative acknowledgement. A Cancel character is transmitted following text when a buffer parity error is detected.

KEYBOARD: Any of three keyboards is available as an option: 56-key alphanumeric, 26-key numeric, or 56-key data entry. The keyboards are identical with those available with the IBM 2260 except for the additional special functions provided by the 40/80 System.

PRINTER: Memorex 1250. This impact-type unit prints any of 94 ASCII symbols, including upper- and lower-case alphabetics, numerics, and specials, at a speed of 30, 60, or 120 char/second. The unit prints up to 120 characters per line, spaced at 10 char./inch. Vertical spacing is 6 lines/inch. The printer accommodates six-part continuous forms or single sheets up to 14-7/8 inches wide. See Report 70D-625-04 for details.

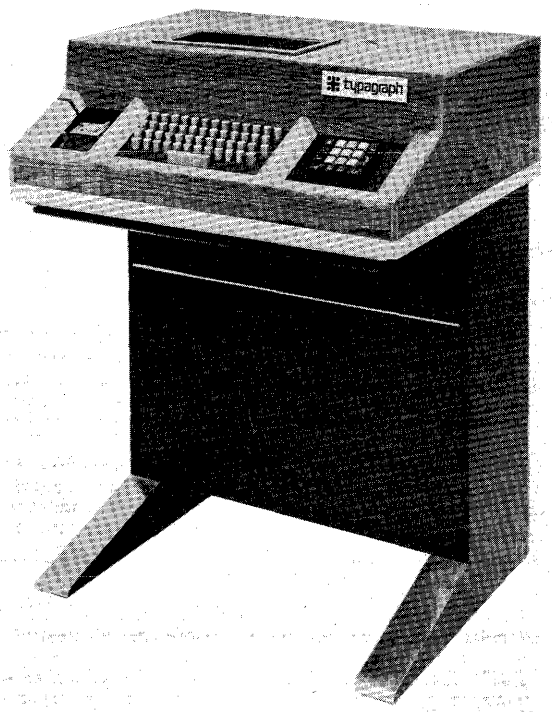
PRICING: The 40/80 System is available for purchase or on a one- or three-year lease, which includes maintenance. A separate maintenance contract is available for purchased units. The three-year lease allows for cancellation at 18, 24, and 30 months.

	Monthly Rental* 1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
CRT Display Unit (without keyboard)	$24	$21	$580	$4
Keyboard	19-29	17-26	425-700	4
Controllers				
One or two 960-char. displays**	428	377	10,330	72
One or two 480-char. displays**	359	317	8,330	72
One to four 240-char. displays**	383	338	9,030	72
Display Adapter				
One or two 960-char. displays	85	75	2,400	2
One or two 480-char. displays	61	54	1,700	2
One to four 240-char. displays	85	75	2,400	2
Local Interface				
For 960-char. controller	161	142	3,800	30
For 480- or 240-char. controller	135	119	3,040	30
Printer Interface				
One 30 or 60 cps printer (for local or remote operation)	60	53	1,650	3
Two printers (for local or remote operation)	84	74	2,350	3
Two printers (for local use only)	40	36	1,050	3
Four printers (for local use only)	58	52	1,600	3
Printer				
30 char./sec	155	142	4,800	30
60 char./sec	180	165	5,600	30
120 char./sec	210	193	6,400	30
Stand-Alone Terminals				
Model 812M (single 960-char. display)	173	153	4,300	25
Model 812MA (dual 960-char. display)	287	253	7,200	40
Model 412M (single 480-char. display)	151	133	3,660	25
Model 412MA (dual 480-char. display)	260	229	6.400	40

* Includes maintenance.

** Controller prices include cost of basic controller, a remote interface. and one display adapter. Each controller can accommodate up to eight display adapters. ■

Typagraph Model 3 Plotting Teleprinter



An unusual blend of printing and plotting capabilities is provided by replacing the paper and type-carriage drive mechanisms in a Teletype Model 33 ASR with incremental motors. The Typagraph Model 3 terminal is designed primarily for use by time-sharing users and comes complete with supporting software.

MANAGEMENT SUMMARY

Typagraph is among the few computer companies that have survived bankruptcy proceedings. The company filed for bankruptcy under Chapter 11 on August 18, 1970, and on July 1, 1971, it cleared the courts with all debts settled in addition to an infusion of new financing. It has continued to actively market the Model 3, its original product, but has discontinued the Models 0 and 2, which were adaptations of the Teletype Model 33 ASR without the Model 3's graphic capbility. New orders are filled from existing stock, however, since Model 3 production had been terminated with bankruptcy. To date, Typagraph claims to have sold 17 units and leased 85. First deliveries were made in April 1969.

Typagraph is currently in production with a 30-cps typewriter terminal, the DP-30, that was initially delivered in February 1972.

The Typagraph Model 3 Plotting Teleprinter is designed to provide time-sharing users with graphical plots of data values. In essence, the Model 3 is a combination of a specially modified Teletype Model 33 ASR and proprietary software packages developed by Typagraph. The software is installed in the time-sharing computer, and the Model 3 user doesn't really have to bother with it if he doesn't want to.

Typagraph has replaced the paper and type-carriage movement mechanisms in the teletypewriter with incremental stepping motors capable of relatively high resolution. The whole unit is then mounted in a teak ▷

CHARACTERISTICS

MANUFACTURER: Typagraph Corporation, 7547 Convoy Court, San Diego, California 92112.

COMMUNICATIONS: Transmission is half- or full-duplex at 110 bits/sec, using 11-unit, 8-level USASCII. Transmission characteristics are identical to those of Teletype Model 33 and 35 equipment. Connection to the communications line can be made via a data set with an EIA RS232-B or -C interface, via an acoustical coupler, or directly.

PRINTED OUTPUT: Most plots will be produced within a 6-inch by 6-inch square, but the size is actually limited only by the paper length. Any symbol can be used to generate a curve, and more than one curve can be plotted on the same set of axes. Scaling can be left up to the program, or maximum and minimum values can be entered from the terminal.

Input to the program can be a data file stored at the time-sharing center or a data file entered at the terminal from either the keyboard or paper tape reader. Plotted points and text (annotations for curves and axes) can be intermixed.

DEVICE CONTROL: There are two modes of operation: text and plot. Text mode is for conventional data printout; plot mode is for creating graphical representations.

In the text mode, the Typagraph functions just like a Teletype Model 33 teletypewriter (including an answerback drum) that is normally used in commercial time-sharing services.

In the plot mode, the terminal responds to the incoming data stream by positioning the type carriage left or right, moving the paper up or down, and printing a character.

In normal operations, the terminal is essentially controlled by a remote time-sharing computer, based on programs stored at the computer and commands entered at the terminal.

Four principal software aids are provided: two complete programs EZGRAF and BZGAF, and two subroutines, QUIKPLOT and EZSUB. Both are written in FORTRAN. A version of the EZGRAF program written in BASIC is also available. The software is proprietary to Typagraph and is furnished without additional charge.

The EZGRAF and BZGRAF programs are furnished to the time-sharing service. Installation is arranged by Typagraph, and as far as the user is concerned, is a part of the time-sharing service; i.e., the user does not have to load the program from his terminal. The user calls the program just like any other standard time-sharing software program offered by the company.

The QUIKPLOT and EZSUB subroutines are designed to be incorporated into a FORTRAN program for point-by-point output. ➤

Typagraph Model 3 Plotting Teleprinter

cabinet with special provisions for cooling. Any type of presentation ranging from bar graphs to complex wave forms can be permanently displayed on paper.

In concept, the plotting teleprinter works much like the Calcomp drum plotters, with a typing mechanism replacing the pen. Character codes transmitted from the remote computer are interpreted as incremental positioning commands. Several types of software are provided by Typagraph to assist in programming the plots. In general, the Model 3 Plotting Teleprinter types a character at a location that corresponds to the values of two variables. A listing or table of these pairs of values describes the outline of the plot.

There is one significant difference between the Model 3 and a conventional X-Y plotter. The plotted output from the Model 3 is a series of discrete points rather than the solid lines drawn by X-Y plotters. Typagraph emphasizes that this removes the smoothing effect of a continuous plot.

As to the matter of precision and accuracy, the incremental drive works in steps of 0.02 inch, or just about the width of a period on a typewriter. Typagraph states that the accuracy of positioning is ±0.005 inch. The small steps easily allow solid lines to be drawn for axes or other purposes. The standard automatic-scaling software fixes graph size at 6 inches by 6 inches, but plots of any length can be produced. The 0.02-inch interval represents 0.3% of "full scale," which is most acceptable for typical engineering plots; indeed, few people will be able to interpolate the legends of the axes and read the plotted values anywhere near that closely. The Model 3 uses a pin-feed platen to ensure accurate registration; this is particularly important because the paper moves up and down during the course of a typical plot.

Conventional printing and plotting can be intermixed to produce an annotated graph. Multiple curves can also be plotted on the same grid. Although the unit is capable of a high degree of accuracy, Typagraph does not feel that the production of "engineering drawings" will be a major use for this device. It represents an economical way to produce a pictorial representation of relationships that are difficult to obtain by looking at a typical computer printout of tables of numbers.

When not plotting, the Model 3 can be used in the same way as a conventional Teletype Model 33 teleprinter—with one exception. Due to the incremental drive, the horizontal pitch can be varied at will. Standard provision is made for 20 to 120 characters per line by varying the spaces between characters. An elite type face is used, which is normally spaced at 12 characters per inch or 90 characters per line.

Typagraph emphasizes that the advantage of the wood cabinet, aside from aesthetic considerations, is the reduced sound level it provides. Special cooling provisions have been made to eliminate the heat build-up Typagraph says is common to other sound-deadening enclosures for teletypewriters.

Service is handled on a contract basis with service organizations, including Communications Repair (headquartered in Washington, D.C.) and SirVess (headquartered in Saddlebrook, N.J.). □

ERROR CONTROL: No error checking is performed at the terminal, although character parity is generated and transmitted.

In the plotting mode, the terminal is particularly sensitive to transmission errors because each point is plotted at specified distances from the last point. Thus, an error in one command causes all subsequent points to be shifted. Normally, this can easily be spotted visually.

To implement effective error detection/correction provisions, a complete buffer would have to be added in addition to the error detection circuitry. The conventional low-cost method of substitution for characters with parity errors would be inadequate, again because of the incremental nature of the plots.

KEYBOARD: Teletype Model 33 keyboard with a 10-key auxiliary numeric keyboard and control keys added.

PRINTER: Standard Teletype Model 33 page printer with pin-feed platen, except that the drives for the type carriage and forms are replaced with incremental motors. Standard rolls of 8.5-inch-wide paper are used. Incremental spacing is 0.02 inches in both the horizontal and vertical directions.

In plot mode, characters in the incoming data stream position the paper and type cylinder; horizontal, vertical, and compound motions can be specified by one command.

In text mode, horizontal and vertical pitch are controlled by the remote program. Standard software allows a horizontal pitch of 20 to 120 characters per line (2.7 to 16 characters per inch), and the vertical pitch is fixed at six lines per inch.

PUNCHED TAPE I/O: Standard Teletype Model 33 punched tape reader and punch. Accepts 1-inch tape (8-level) and operates at 10 characters per second.

PRICING: The Model 3 Plotting Teleprinter is available for purchase or on a one-, two-, or three-year lease. A separate maintenance contract is available for units purchased or leased.

	Monthly Rental*			
	1-Yr. Lease	2-Yr. Lease	3-Yr. Lease	Purchase*
Model 3 Teleprinter	$180	$165	$150	$6,000
Acoustic Coupler (originate only)	30	20	15	570
Acoustic Coupler (answer or originate)	35	25	20	695

*** Maintenance is priced separately at $30/month. Installation is priced at $50. All arrangements include complete software.** ■

Ultronic Videomaster 7000 Display Terminal

The Videomaster 7000 is a single-station video display terminal designed to replace the IBM 2265 Display Station as a remote terminal for System/360 and System/370 computers. The terminal performs under existing IBM software.

MANAGEMENT SUMMARY

Ultronic Systems' original Videomaster Display Terminal, the Model 7000, has become the low-priced member of the Videomaster product line. The line now includes the 7700, a replacement for the IBM 2260/2848 Display Terminal, and the new 7100, an IBM 2265/2845 replacement that features several enhancements which are not available with the 7000. The two newer models are described in Report 70D-874-02.

The Videomaster 7000 was announced at the 1969 Spring Joint Computer Conference, and first customer deliveries were made in December 1969. The 7000 is still available, but production has been discontinued.

The Videomaster 7000 is designed as a single-station display terminal for communication with an IBM System/360 or System/370 computer as a replacement for the IBM 2265/2845 Display Station. The videomaster 7000 offers both hardware and software compatibility with the IBM 2265 and, like the 2265, is supported by IBM standard software as a remote terminal operating under the full Operating System (OS) or the Disk Operating System (DOS) through either BTAM or QTAM.

Like its IBM counterpart, the Videomaster 7000 is available in only one screen size, 960 characters, which can be arranged in either 15 lines of 69 characters each or 12 lines of 80 characters each.

Either of two printers can be added to the 7000 configuration to provide a local or remote hard-copy capability. Both printers are rated at 30 characters per ▷

CHARACTERISTICS

MANUFACTURER: Ultronic Systems Corporation, Data Communication Products Division, GTE Information Systems, Inc., Mount Laurel Industrial Park, Moorestown, N.J. 08057. Telephone (609) 235-7300.

CONFIGURATION: The Videomaster 7000 Display Terminal includes a 12-inch display monitor, an alphanumeric keyboard, and a control unit. The control unit contains a communications interface, a 960-character buffer memory, and character generation and control logic. A buffered printer is optional.

COMMUNICATIONS: Asynchronous in the half-duplex mode at 1200 or 2400 bits/second (120 or 240 characters/second). Transmission speeds can be field-interchanged. The 8-level (including parity) ASCII transmission code is used; the unit code structure is 10 bits per character, including unity start and stop bits.

The control unit is connected to a voice-band communications facility via a modem compatible with the Ultronic Model 1200 or 2400 Data Pumps or Bell System 201 or 202 Data Sets.

The Videomaster 7000 is designed to operate in an addressing and polling environment where all communication is under control of the stored program in the remote computer. Up to 16 Videomaster 7000 Display Terminals can be connected to a single leased or private line to operate in a party-line arrangement.

The Videomaster 7000 is compatible with the IBM 2701 Data Adapter Unit equipped with an IBM Terminal Adapter Type III.

CRT DISPLAY: Via a 12-inch (diagonal measurement) CRT. Either of two display arrangements can be specified by the user: 15 lines of 64 characters each or 12 lines of 80 characters each. Both display arrangements provide a nominal viewing area 9.5 inches wide by 7.5 inches high and total 960 characters per display. Display arrangements cannot be field interchanged.

A character set of 64 ASCII characters, including uppercase alphabetics, numerics, and special symbols, generated via a 5-by-7 dot matrix, is displayed in white against a gray background.

DEVICE CONTROL: The Videomaster 7000 operates under the control of the program stored in the remote computer. Under program control, the terminal can execute any of eight read and write commands.

Read commands initiate transfer of a displayed message, print status (if a printer is attached), display and/or print status, or the entire contents of the buffer memory. ►

Ultronic Videomaster 7000 Display Terminal

second, but one is a thermal printer while the other is an impact type. The advantages and disadvantages of both techniques are well known: the thermal printer, although silent, is incapable of producing multiple copies; the impact printer provides multiple copies but is not silent.

The Videomaster 7000 does not provide the more flexible format feature that is standard with the 7100. Formatting can, however, be performed according to IBM's technique, using New Line codes to separate variable data from format descriptors. Line addressing, optional for the IBM 2265, is a standard feature with the 7000. The tab feature, a standard feature of the IBM 2265, is also standard with the Videomaster 7000.

The Videomaster Terminal is packaged as three separate units: a 12-inch monitor, alphanumeric keyboard, and control unit. The keyboard and monitor are connected to the control unit by separate 10-foot cables. Optional cable lengths of up to 100 feet are available.

Ultronic Systems, also a modem supplier, provides modems for its Videomaster 7000 Series terminals as an alternative to Bell System modems.

Service for the Videomaster terminals is provided by Ultronic Systems, a part of GTE Information Systems, through service locations in more than 50 U.S. cities. □

Write commands condition the display or the printer to receive a message from the remote computer. Depending on the type of write command, the computer message can be displayed in one of three ways: (1) the screen is erased and the message is written beginning at the initial screen location; (2) the message is written beginning at the current cursor location; or (3) the message is written beginning at the initial character position of the addressed line.

Cursor controls provide a wraparound capability and include Advance, Backspace, Down, and Up. Advance and Backspace functions space the cursor one position to the right and left, respectively, moving the cursor to the beginning of the next line or to the end of the previous line when the right or left margin of a line is reached. The Down and Up functions move the cursor forward or backward by one line; the cursor remains at the same character position within the line. Horizontal cursor movement can be made repetitive by holding the Advance or Backspace key depressed.

The Tab feature permits the operator to initiate a tab function via the keyboard. Once initiated, the keyboard is disabled and the cursor searches line by line for a tab-stop character. The cursor halts at the tab stop and the keyboard is enabled.

Formatting can be performed via the use of New Line codes, which are used to separate variable data fields, to the left, from format descriptors. All data up to the New Line symbol is transmitted.

Line addressing permits a computer message to be written beginning at the initial character position of the addressed line.

Keyboard erase functions include Display Erase (which erases the entire screen), Line Erase (which erases a line, starting at the cursor), and Screen Erase (which erases the screen, starting at the cursor).

Keyboard operation is inhibited once message composition has been completed, and is enabled only after completion of a successful transmission.

With the printer option, a single printer can service up to four display units; each has its own print buffer in addition to the display buffer. A print operation can be initiated from the display unit or from the computer.

ERROR CONTROL: Character and longitudinal parity generation and checking are performed on all messages transmitted to and received from the remote computer. A message is retransmitted in response to a received negative acknowledgement. A buffer-parity error detected prior to transmission causes the insertion of the cancel (CAN) character prior to the ETX character at the end of the message block. The Terminal displays a special symbol (check) in place of a character received with a parity error.

KEYBOARD: 52-key typewriter-style. A row of ten keys located above the 52-key group provides special functions. The keyboard can be operated in the keypunch mode; shaded keys identify the numeric set. Any of 64 ASCII characters, including upper-case alphabetics, numerics, and special characters, can be generated from the keyboard.

The keyboard can be positioned flush to or physically separated from the display monitor. A cable connects the keyboard to the control unit.

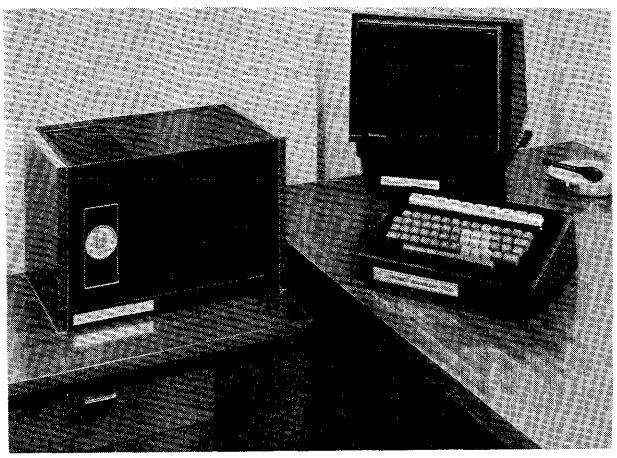
PRINTER: Two printers are available, offering a choice of non-impact (thermal) or impact printing techniques; both printers are rated at 30 char/second. The thermal printer employs the printing mechanism used in the Texas Instruments Silent 700 Series printers (Report 70D-840-02), while the impact printer employs the printing mechanism used in the UNIVAC DCT 500 Terminal (Report 70D-877-02).

PRICING: The Videomaster 7000 Display Terminal is available for lease or purchase. Leases are available for 1, 2, and 3 years and include a 30-day cancellation period effective 12 months from the date of installation. Lease arrangements also provide for full payback. Lease prices include full maintenance and installation costs. A separate maintenance contract is available for purchased units.

	Monthly Rental (1-Yr. Lease)*	Purchase	Monthly Maint.
Videomaster 7000	$153	$4,880	$40
Printers:			
Thermal	135	3,820	25
Impact	150	4,390	30

*Includes full maintenance, installation, and cost of controller. ■

Ultronic Videomaster 7700 and 7100 Display Terminals



The Videomaster 7100 is shown here with its control unit. The multi-station Videomaster 7700 system employs the same CRT display unit, but its controller measures six feet in height.

The Videomaster 7700 and 7100 are designed as fully compatible replacements for the multi-station IBM 2260/2848 and the single-station IBM 2265/2845 Display Stations, respectively. The 7700 can also operate as a local terminal with an IBM System/360 or 370 computer.

MANAGEMENT SUMMARY

The Videomaster 7700 and 7100 Display Terminals are designed as multi-station and single-station replacements for IBM's 2260/2848 and 2265/2845 Display Stations, respectively, for use as remote terminals with IBM System/360 or 370 computers. The Videomaster 7700 can also operate as a local terminal in an IBM System/360 or 370 environment with a direct channel interface. The Videomaster terminals provide both hardware and software compatibility with the IBM terminals. Operation is controlled by the program residing in the remote computer. Like their IBM counterparts, the Videomaster terminals are supported by standard IBM software as remote terminals operating under the full Operating System (OS) or the Disk Operating System (DOS) via either BTAM, QTAM, or other IBM telecommunication programs.

The Videomaster 7700 and 7100 Terminals provide all the features that are offered with their counterpart IBM terminals plus several significant features not available from IBM. The salient features of the Videomaster terminals as compared with those of the counterpart IBM terminals include:

- Display Capacity–The Videomaster screen sizes range from 240 to 1920 characters; IBM 2260 screen sizes range from 240 to 960 characters, while the IBM 2265 has a fixed screen size of 960 characters.
- Total Displays–The 7700 controller can accommodate the same number of 240-character display units as the IBM 2848 controller–24; however, the 7700 ▷

CHARACTERISTICS

MANUFACTURER: Ultronic Systems Corporation, Data Communication Products Division, GTE Information Systems, Inc., Mount Laurel Industrial Park, Moorestown, New Jersey 08057. Telephone (609) 235-7300.

MODELS

Videomaster 7100: A stand-alone display terminal compatible with the IBM 2265/2845 Display Station.

Videomaster 7700: A multi-station display terminal compatible with the IBM 2260/2848 Display Station.

CONFIGURATION

MULTISTATION: The Videomaster 7700 includes a control unit, 1 to 24 keyboard/display units, and 1 to 12 printers. All units are buffered; the capacity of printer buffers corresponds to the screen capacity of the associated display units.

The Videomaster 7700 is available with a local interface for direct connection to the Selector Channel of an IBM System/360 or System/370 computer.

The maximum number of display units of each screen capacity that can be accommodated by the Videomaster 7700 controller is compared with that of the IBM 2260/2848 in the following table.

Screen Size, characters	Total Display Units: Videomaster 7700	Total Display Units: IBM 2260/2848
240	24	24
480	24	16
960	16	8
1920	8	0

The Videomaster 7700, unlike the IBM 2848, can accommodate a mixture of different screen sizes. The following table presents the allowable mixes for two screen sizes; a mixture of three or more sizes is available on special request to Ultronic Systems.

Total Display Units per Screen Size, chars. 240	580	960	1920	Total Display Units
16	8	–	–	24
16	–	8	–	24
–	16	8	–	24
8	16	–	–	24
16	–	–	4	20
–	16	–	4	20
–	–	8	4	12

Ultronic Videomaster 7700 and 7100 Display Terminals

controller can accommodate eight more 480-character displays and twice as many 960-character displays as the IBM 2848.

- Display Arrangement–Both Videomaster terminals offer display arrangments identical with those of their IBM counterparts, as well as other display arrangements not provided by IBM.

- Printed Output–The Videomaster terminals offer a far greater hard-copy capability than that available with the IBM 2260 and 2265 terminals. The IBM terminals support a single printer, as compared to 12 printers for the Videomaster 7700 and 1 or 2 printers for the 7100. In addition, the user can specify any mix of two printer types, impact and non-impact, for the Videomaster terminals; both are rated at 30 characters per second.

- Editing–A character insert and delete feature is standard for the Videomaster terminals, but is not available for their IBM counterparts.

- Format Operation–The Videomaster terminals provide greater formatting flexibility than the IBM display terminals. Unlike the IBM technique in which format discriptors are restricted to the right of all variable fields for data entry, the Videomaster terminals permit format descriptors to be displayed at any display location. The terminals also provide compatibility with the IBM formatting technique.

- Communications–Videomaster transmission speeds range from 1200 to 9600 bits per second, compared with 1200 or 2400 bits per second for the IBM terminals.

First customer deliveries of the Videomaster 7700 were made in April 1971, while customer deliveries of the Videomaster 7100 began in April 1972. Lead time on orders is quoted at 30 days.

Service is provided by Ultronic Systems, a part of GTE Information Systems, through offices in more than 50 U.S. cities. □

Printer/display-unit assignments can be specified for local printer operation (printed copy of a displayed message). All printers can operate either as local printers or as communications printers under control of the remote computer.

SINGLE-STATION: The Videomaster 7100 includes a controller, a keyboard, and a display unit. The controller can accommodate one or two printers. Only one printer can operate as a local printer to provide a printed copy of a displayed message; however, both printers can operate as communications printers under control of the remote computer. Print-buffer capacity corresponds to screen capacity.

COMMUNICATIONS: Asynchronous in the half-duplex mode at 1200, 2400, 4800, or 9600 bits/second. The 8-level ASCII transmission code is used; the unit code structure is 10 bits per character, including single start and stop bits.

Transmission characteristics are compatible with those of the IBM 2701 Data Adapter equipped with an IBM Terminal Adapter, Type III. Both the 7700 and 7100 controllers provide an EIA Standard RS-232B interface for connection to an external modem.

Modems are available from Ultronic Systems for all transmission speeds specified for the Videomaster Display Terminals.

CRT DISPLAY: A 12-inch (diagonal measurement) CRT provides a viewing area 7.5 inches high by 9.5 inches wide. A character set of 64 ASCII characters, including upper-case alphabetics, numerics, and special symbols, is displayed in white against a dark background. Characters are generated via a 5-by-7 dot matrix.

The following screen capacities and display arrangements are available:

Char./Display:	240	480	960	1920
Lines/Display:	6	12	12/15	24
Char./Line:	40	40	80/64	80

DEVICE CONTROL: The Videomaster 7700 and 7100 Display Terminals are designed to operate in an addressing and polling environment under control of the program stored in the remote computer. Operation is compatible with IBM telecommunications software including BTAM and QTAM under OS/360 or DOS/360. The 7700 and 7100 terminals are compatible with the IBM four-byte addressing sequence, command code structure, and line discipline employed by the IBM 2260/2848 and 2265/2845 Display Stations.

The terminals respond to the IBM addressing sequence by executing any of the eight associated commands. These commands interrogate the status of an addressing printer or display terminal and read an awaiting message in the display buffer (Specific Poll); interrogate the status of all devices common to the addressed controller, sequentially reading each pending message and the corresponding display buffer address (General Poll); read the entire contents of an addressed display buffer (Read Addressed Full Buffer); or write a computer message to the addressed display terminal or printer. Write commands directed to a display terminal include three types. The Erase/Write command erases the contents of the display buffer and writes the message beginning with the first display position; messages that follow are written beginning at the current cursor position. The Write Line Address command writes the first message following the command, beginning at the initial character position of the addressed line.

All commands and messages are acknowledged, and acknowledgment of computer-directed messages is anticipated.

The cursor, displayed as a solid matrix, can be specified as destructive or nondestructive. Cursor control keys move the cursor right, left, up, or down by one position. Repetitive cursor movement results when key pressure is sustained. The cursor moves from the last display position to the first, and converse, and from the last character position of a line to the first character position of the next line, and the converse (wraparound).

Character insert and delete functions allow the insertion or deletion of characters into or from a displayed line of text. The text expands or contracts to accommodate the inserted or deleted data. Insertions or deletions affect a

Ultronic Videomaster 7700 and 7100 Display Terminals

line of text up to the end of the line or, when operating in the Format mode, the end of a variable field; text expanded beyond this is lost. Repetitive character insertions result when key pressure is sustained. The insertion function is identified by a blinking cursor.

The Tab function moves the cursor to the character position occupied by a tab stop character (colon) with each depression of the Tab key. Tabbing can continue line by line until the cursor moves from the last display position to the first, an automatic tab stop.

Two erasure keys permit erasure of data within all variable data fields or the entire screen. Erasure is terminated with the cursor placed at the first format-designated data entry position or at the initial display position (home).

Three additional special symbols are displayed besides the cursor: Start-of-Message, End-of-Message, and New Line. The control codes corresponding to the symbols can be keyed or received within a computer message and are stored in the display buffer. The Start-of-Message symbol identifies the beginning of a message to be transmitted following a General or Specific Poll; the End-of-Message symbol identifies the end of the message. These control codes are not transmitted. When transmitting or receiving, the cursor is positioned at the beginning of the next line whenever the cursor encounters the position occupied by the New Line symbol. When transmitting a message to the remote computer, New Line codes are transmitted as line feed codes; data to the right of a New Line symbol on the same line is not transmitted.

The Format mode is program-generated and can be initiated by a keyed request. The format, received from the remote computer, contains fixed and variable fields. Fixed fields are protected from inadvertent key entry and contain format descriptors. Variable fields, preceded by a displayed Tab Stop (colon) character, are used for data entry. Only variable fields are transmitted; fixed data remains displayed for the next data entry operation. Tabbing is used to skip to the beginning of the next variable field after partial entry into a variable field.

The New Line code can also be used to construct a fixed format by using the symbol to separate a variable data field (to the left of the symbol) from a fixed field containing a format descriptor. Only the variable data to the left of the New Line symbol is transmitted; the fixed data remains displayed for the following data entry operation.

Following message composition and any necessary editing, a keyed End-of-Message symbol is inserted. A received Specific Poll or General Poll command will initiate transmission of all displayed data between Start-of-Message and End-of-Message symbols. Protected fields or data to the right of New Line symbols are not transmitted. Keyboard entry is inhibited once the End-of-Message symbol is keyed and remains inhibited until a successful transmission is completed.

A keyed message is erased and replaced by a computer message when an Erase/Write command is received prior to a poll command. A Read Full Buffer command received prior to a poll command will initiate the transmission of a complete display buffer contents, but a pending message will remain displayed until a poll command is received and successfully executed.

The Copy function initiates the execution of a printed copy of a displayed page. All displayed data is immediately transferred to the print buffer and the terminal is available for further data entry.

ERROR CONTROL: Character and longitudinal parity generation is performed on all commands and messages transmitted to and received from the remote computer. A message is automatically retransmitted from a terminal when a negative acknowledgement to a just-transmitted message is received. An error symbol is displayed in place of a character received in error. The terminals respond to detected errors by transmitting a negative acknowledgement. A Cancel character is transmitted following text when a buffer parity error is detected.

KEYBOARD: Either of two keyboard arrangements can be specified: block or typewriter style. Both are identical with respect to keyboard characters and character and control code generation. The keyboards can generate any of 64 ASCII codes, including upper-case alphabetics, numerics, and special characters. The keyboards, although discrete units, can be positioned against the display unit. A set of 10 function keys is available as an option.

PRINTER: Two printers are available, offering a choice of non-impact (thermal) or impact printing techniques; both printers are rated at 30 char/second. The thermal printer employs the printing mechanism used in the Texas Instruments Silent 700 Series printers (Report 70D-840-02), while the impact printer employs the printing mechanism used in the UNIVAC DCT 500 Terminal (Report 70D-877-02).

PRICING: The Videomaster 7700 and 7100 Display Terminals are available for lease or purchase. Leases are available for 1, 2, and 3 years and include a 30-day cancellation period effective 12 months from the date of installation. Lease arrangements also provide for full payback. Lease prices include full maintenance and installation costs. A separate maintenance contract is available for purchased units.

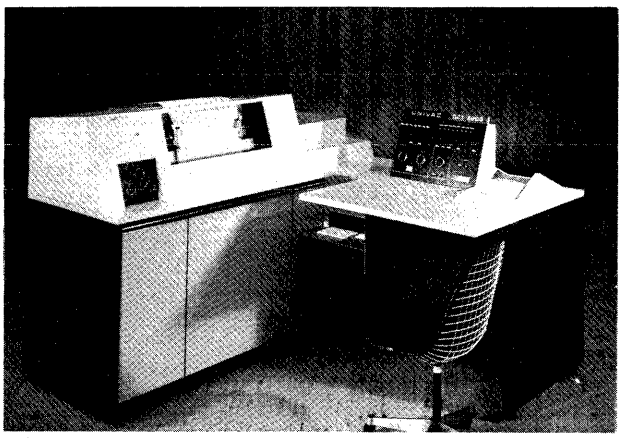
		Monthly Rental (1-Yr. Lease)*	Purchase**
VIDEOMASTER 7100:			
Screen size, characters			
240		$ 125	$ 4,680
480		135	4,780
960		153	4,880
1920		165	4,980
VIDEOMASTER 7700:			
Screen size, characters	Display Units		
240	4	525	17,480
240	8	776	24,344
240	16	1,280	39,952
240	24	1,776	55,560
480	4	525	17,480
480	8	846	26,232
480	15	1,512	42,015
480	20	1,935	52,480
960	4	680	19,372
960	8	1,091	30,016
960	12	1,479	40,656
960	16	1,867	51,296
1920	4	680	23,152
1920	6	897	30,360
1920	8	1,112	37,576
Printers:			
Thermal		135	3,820***
Impact		150	4,390***

*Lease prices include full maintenance, installation, and cost of controller.

**Maintenance for purchased units is priced at $40 per display unit per month.

***Maintenance for purchased units is priced at $25 (Thermal Printer) and $30 (Impact Printer) per month. ■

UNIVAC DCT 2000
Data Communications Terminal



MANAGEMENT SUMMARY

The UNIVAC DCT 2000 was one of the first units widely marketed as a batch terminal, designed for the transmission of large volumes of data between outlying points and a central computer location. Although the DCT 2000 is no longer in production and is available only on an "as returned" basis, the terminal proved to be quite a success for UNIVAC during its active marketing life; more than 500 were produced.

The DCT 2000 is primarily intended for communication with UNIVAC computers, but it is an ASCII terminal and can be used with other computers, including the IBM System/360. Normally, the user must write the additional coding for interfacing the terminal with a non-UNIVAC computer's operating system.

UNIVAC promoted several concepts when the DCT 2000 was introduced in the middle of 1966. Among these were: (1) computer control of communications, (2) a family of compatible terminals with graduated performance, and (3) multi-device terminals.

UNIVAC maintains that inefficient operation results from letting the remote terminals drive the central computer. This can happen when a terminal forces the computer to either receive data when the terminal is ready to transmit or risk loosing data or causing a disconnection–with the attendant difficulties of re-establishing the connection and finding the right place again. With the DCT 2000, the computer can suspend data transmission simply by not replying; the terminal will continue to retransmit until directed not to. This capability permits the computer to maintain control of communications in an environment that places heavy temporary demands on the computer which otherwise would interfere with data transmission.

Originally a family of DCT terminals was conceived, with graduated performance. To the user, there would be no difference when he replaced a unit with one of higher performance. This concept was to reduce the amount of operator training required at the user's installations. Although other DCT terminals have been ➢

The DCT 2000 is a remote batch terminal capable of printing at speeds up to 250 lines/minute. It can communicate on a point-to-point basis with another DCT 2000, a UNIVAC 1004, or a remote computer. A card reader/punch and a paper tape reader/punch can be added.

CHARACTERISTICS

MANUFACTURER: UNIVAC Division, Sperry Rand Corporation, P. O. Box 500, Blue Bell, Pennsylvania 19422. Telephone: (215) 542-2011.

MODELS: Two versions of the DCT 2000 are available to provide compatibility either with the ASCII transmission code or with the UNIVAC 1004, which employs the UNIVAC XS-3 transmission code.

CONFIGURATION: The DCT 2000 includes a basic line printer with integral controller, an optional card reader/punch, and an optional paper tape reader/punch.

COMMUNICATIONS: Synchronous in the half-duplex mode at a transmission speed of 2000 or 2400 bits/second (250 or 300 characters/second). The transmission code is either 8-level ASCII or 7-level XS-3 code, depending on the DCT 2000 version specified; both codes include parity.

The DCT 2000 is connected to a voice-band communications facility via a modem compatible with the Bell System 200 Series Data Sets. The DCT 2000 is designed to communicate with another DCT 2000 or a remote computer on a point-to-point basis.

DEVICE CONTROL: The basic DCT 2000 operates in one of two modes: receive or transmit.

With the Offline Listing option, the device can be used to print the data from a deck of cards or paper tape. Prerequisite to this option is the Transmit/Receive Monitor, which provides the capability to obtain a printed copy of the data transmitted or received.

As an option, the DCT 2000 can operate as an attended or unattended terminal. In the unattended mode, a call from the remote terminal or computer is automatically answered, a message is either received or transmitted from the DCT 2000, and the call is disconnected.

When voice communication is desired, the Telephone Alert option allows the operator to signal the remote operator, via a special message, to switch his modem from data to talk mode. Data transmission is halted during voice communication.

Communications between the DCT 2000 and the remote terminal or computer take the form of a sequence of data and acknowledgement messages. An acknowledgement message is automatically transmitted for each received message block and expected for each transmitted block. Without the Error Detection and Retransmission feature, the DCT 2000 only recognizes a positive acknowledgement; no response from the receiving device within a fixed time interval causes the DCT 2000 to retransmit the last block. Retransmission continues until a positive acknowledgement is received or until the operator intervenes.

Block length is established at 80 or 128 characters, as selected at the operator console. Block length can be set ➤

UNIVAC DCT 2000
Data Communications Terminal

announced, the "family" concept has not been followed. UNIVAC found that the requirements of users desiring units of varying performance were different and necessitated different terminal designs.

The idea behind a multi-device terminal was to build a unit and provide a selection of peripheral units, such as paper tape readers and punches, keyboards, magnetic tape units, OCR readers, etc., that could be connected to the unit. But aside from the printer and punched card components that form the basic terminal, only punched tape units have been announced. UNIVAC states that the demand from users for additional types of peripherals has not been high enough to support the development of these devices. □

independently for transmitted and received messages. A variable block length of 1 to 120 characters can be manually selected with the Short Block feature. This feature is standard for the 1004-compatible controller, but with modifications; the unit can receive variable-length blocks, but can only transmit fixed-length blocks.

Under normal operation, the receiving peripheral is manually selected before the transmission begins. The optional Select Character capability can automatically select the receiving peripheral when the transmission begins via a special character in the message heading. This feature can also be manually overriden at the receiving terminal.

When operating in the unattended mode, the DCT 2000 responds to a "polling" message with a transmission or a message identical to the polling message to signify it has no data to transmit.

A transmission is terminated by an end-of-transmission message, automatically initiated in the unattended mode and manually initiated in the attended mode.

The Peripheral I/O channel is required for the paper tape subsystem and any three additional I/O devices that are to be connected to the DCT 2000.

Card codes other than Hollerith are optionally accommodated through a translator and print-bar combination. UNIVAC provides a variety of translator/print-bar combinations.

Printing is performed via a pair of 128-character toggle buffers. Toggle buffers permit independent operation of the printer and message reception and assembly. The buffers are switched or "toggled" at the completion of each operation.

ERROR CONTROL: Character and longitudinal parity are generated for all transmitted messages. Error Detection and Retransmission is a standard feature with the 1004-compatible controller and is optional with the ASCII controller.

A message block is automatically retransmitted in response to a negative acknowledgement or a time-out resulting from the non-receipt of an acknowledgement within a fixed time interval (4.5 seconds). Automatic retransmission continues until a positive acknowledgement is received or the operator intervenes. The second retransmission alerts the operator both aurally and visually.

Character parity is checked on data read from paper tape; characters read in error are substituted with a user-specified flagging character. Manual controls provide a stop-on-error capability when selected. Character parity is punched into paper tape. As an option, an echo check is performed by the card punch; a detected error causes the card to enter the reject stacker.

PRINTER: The bar printer prints data received from the communications facility via a buffer, or, as an option, lists data read from cards or paper tape in an off-line mode. Printing speed is rated at 250 lines per minute. The basic printer provides 80 print positions; a 128-character print line is optional. A character set of 64 print symbols, including upper-case alphabetics, numerics, and 27 special symbols (including space), is compatible with either the ASCII or XS-3 character set.

The printer accommodates pin-fed continuous fanfold forms up to 22 inches wide and up to 14 inches long. A form control option provides multiple-line spacing and form feeding, implemented by a tape loop and vertical tab and form-feed control characters within the received message. The forms can be manually advanced to the beginning of the following form. Horizontal tabulation is not provided. Horizontal spacing is 10 characters per inch; vertical spacing is 6 lines per inch.

CARD READER/PUNCH: The optional reader/punch unit reads and punches standard IBM 80-column cards at a rated speed of 200 cpm when reading or 75 cpm when punching. The unit can either read or punch, but not both simultaneously. Reading is performed photoelectrically. The unit contains a 1200-card input hopper and an 850-card output stacker. An optional 850-card reject stacker is available with the optional echo-check feature. Automatic translation between Hollerith and ASCII or XS-3 code is standard.

PAPER TAPE READER/PUNCH: The optional reader/punch unit reads fully punched or chadless 11/16-, 7/8-, or 1-inch tape and punches 11/16- or 1-inch tape. The unit accommodates any 5- through 8-level code. Reading is unidirectional and is performed photoelectrically at 300 characters/second. Punching speed is 110 characters/second. Reader options include a tape spooler and 5-inch reels.

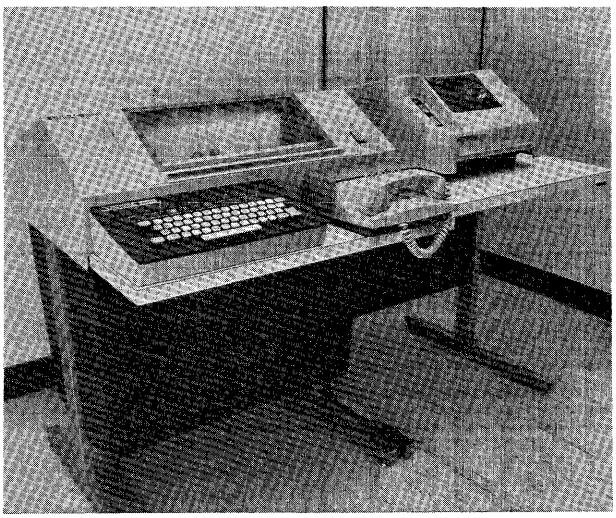
The various paper tape codes are accommodated via a patchboard translator. The translator provides the user with the capability to interchange the code levels of data transferred between the paper tape subsystem and the DCT 2000 interface.

PRICING: The UNIVAC DCT 2000 is available for purchase or on a one-year lease. A separate maintenance contract is available for both arrangements. Maintenance charges are included in the monthly rentals quoted below.

	Monthly Rental	Purchase	Monthly Maint.
Basic DCT 2000 with 80-column printer and ASCII controller	$438	$10,510	$48
Basic DCT 2000 with 80-column printer and 1004-compatible controller	493	11,870	53
Wide Print Carriage (128 positions)	83	1,750	18
Card Reader/Punch, including punch check and alternate stacker features	286	5,785	74
Paper Tape Subsystem with options	396	9,895	73

Adding Error Detection and Retransmission and Short-Block options to the basic ASCII unit (options which are included in the basic 1004-compatible controller) increases its price to that of the 1004-compatible controller. With all controller options plus the printer form control, the DCT 2000 is priced at $675 per month or $16,280 purchase; maintenance is increased to $72 per month. ■

UNIVAC DCT 500
Data Communications Terminal



UNIVAC's answer to Teletype teleprinters, the popular DCT 500 provides printing and transmission at 10, 15, or 30 characters per second, 132 print positions, full 128-character ASCII generation, automatic operation, and Teletype compatibility.

MANAGEMENT SUMMARY

The DCT 500 represents the UNIVAC approach to low-cost, high-performance communications terminal design. The product is intended to satisfy a general-purpose market (including time-sharing applications) and is compatible with Teletype Corporation's Model 33, 35, and 37 teleprinters.

UNIVAC is touting the reliability and rugged design of its incremental printer mechanism. Printing is performed by a helical printwheel, single actuator, and ink roll. Single actuator design greatly simplifies the printing technique and should result in fewer failures–in addition to the ease of replacing just one instead of several. The ink roll eliminates fiddling with messy ribbons and allows the user to quickly replace the roll if necessary.

A significant advantage over most competitively priced printers is the wide print line–132 positions. The unit is restricted to a 63-symbol print set, but the user can specify any one of several graphic sets that include ASCII, EBCDIC, UNIVAC A/H (business/scientific), and an international graphic set, ECMA/ISO (RPQ only).

Error control is a standard feature of the DCT 500; the operator is alerted to any detected errors in the received data by both character substitution and an error lamp. The DCT 500 also generates and transmits parity for each character entered.

Direct local data transfer between send and receive components of the same terminal is possible; this permits local preparation of punched tape (ASR only) with hard-copy monitoring.

Featuring automatic operation as an option, the DCT 500 can operate in a polling environment where the ➢

CHARACTERISTICS

MANUFACTURER: UNIVAC Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

MODELS: ASR–contains keyboard, page printer, and punched tape reader and punch; KSR–contains keyboard and page printer; RO–contains page printer only.

COMMUNICATIONS: Transmits half- or full-duplex, asynchronously, using 10- or 11-unit, 7-level ASCII code plus character parity at switch-selectable rates of 110, 150, or 300 bits/second (10, 15, or 30 char/second); transmission rate is not selectable for the RO Version and must be specified. The EIA Standard RS-232C interface is used.

The DCT 500 is transmission-compatible with the Teletype Model 33, 35, and 37 teleprinters and accommodates a Bell System 103-type modem or equivalent.

Options include an internal modem (for attended operation only), a Bell System 113A modem interface, and automatic answer. An acoustic telephone coupler is available for OEM units. The DCT 500 operates in the Originate Only mode when using the Bell System 113A modem.

DEVICE CONTROL: Primarily manual; but with options the unit can respond to control codes in received data, allowing unattended operation. Controls provide speed selection, on/off line operation, keyboard, printer, paper-tape reader and paper-tape punch selection; optional controls provide transmit/receive monitoring and master/slave modes.

When in the off-line mode, keyed data can be printed and/or punched; data read from paper tape can be punched and/or printed.

In the on-line mode, data read from paper tape or entered from the keyboard is transmitted; punching and/or printing of transmitted data is permitted. Received data can be printed and/or punched.

Automatic Operation, an optional feature, (required for paper tape operation) provides terminal selection, I/O device selection, status polling, and motor control for the paper tape device.

With Automatic Operation, the Master Station and Print Monitor options can be included.

The Master Station option permits the operator to select station status (i.e., "master" or "slave") and is used for a party-line environment. A station operating in the Master mode transmits to an addressed station in the ➤

UNIVAC DCT 500
Data Communications Terminal

remote computer controls communication between it and several DCT 500's on a party line. In addition, the processor program can select a specific I/O device, determine the status of the DCT 500, and switch the motor on or off in the paper tape subsystem. As an extension of this feature, stations on a multipdrop line can intercommunicate via a "master/slave" technique. Normally, all stations remain in the slave mode, which means each station is receptive to any commands directed to it. A station enters the master mode to poll a specific station and to transmit data.

Another interesting feature is the built-in modem designed by UNIVAC. The feature not only eliminates the need for an extra "box", but allows UNIVAC to provide service for the entire terminal. A major drawback in the use of the modem, however, is that it restricts the terminal to attended usage; the Automatic Answering feature cannot be incorporated.

You may be surprised to learn that the DCT 500 is not compatible with either the DCT 2000 or the DCT 1000; all three UNIVAC terminals are designed to meet different market requirements.

The DCT 500 requires minimal (if any) changes in existing software handlers for Teletype teleprinters in a point-to-point communications environment. The DCT 500 is supported under all standard UNIVAC computer systems, including the 418-III, 494, 1100 Series, and 9000 Series.

The DCT 500, DCT 1000, and Uniscope 100 were the first products to come out of UNIVAC's Communications and Terminal Division, which operates out of Salt Lake City, Utah. The DCT 500 was announced in October 1969, and deliveries began in July 1970. The unit has found widespread acceptance, particularly among time-sharing users.

Users interviewed by Datapro rate the overall reliability of the DCT 500 as ranging from good to excellent, with little or no downtime. In the cases where service was required, UNIVAC's response was reported as good. Minor problems were reported in some instances, such as difficulties with the integral modem on dialup lines and quick-wearing ink rollers. In general, users are well pleased with the unit's overall performance. □

Slave mode; all stations remain in Slave mode except the one attempting transmission.

The Print Monitor option permits the printer to monitor data transmitted or received via paper tape.

Unattended operation is provided through the option Automatic Answering feature.

ERROR CONTROL: Limited to manual retransmissio Character parity is generated, accompanies each tran mitted character, and is checked on received data. detected parity error causes a visual indication via lamp and a printed asterisk in place of the charact received in error. Odd, even, or no parity can t selected.

KEYBOARD: A 4-row typewriter arrangement that ca generate 128 ASCII graphics and control codes. Contr and shift keys are used in conjunction with charact keys to generate the full range. Three keyboards a available that provide keytop symbols for ASCI EBCDIC, or A/H character sets.

TAPE READER/PUNCH: The self-contained, desk-to device reads and punches 5-, 6-, or 8-level, 1-inch wic strips of paper tape. In the off-line mode, the un operates at speeds of up to 30 characters/second; th speed capability is increased to 50 character/second i the on-line mode. A supply reel under the device pr vides tape for the punch.

PRINTER: The incremental printer uses a helical prin wheel with a single print-hammer actuator and ink roll to print 63 symbols of the user-specified ASCI EBCDIC, A/H (UNIVAC business and scientific 8-lev codes) or ECMA/ISO (8-level international cod graphics set. The standard unit prints up to 132 colum per line. Horizontal pitch is 10 char/inch, and vertic spacing is 6 lines/inch.

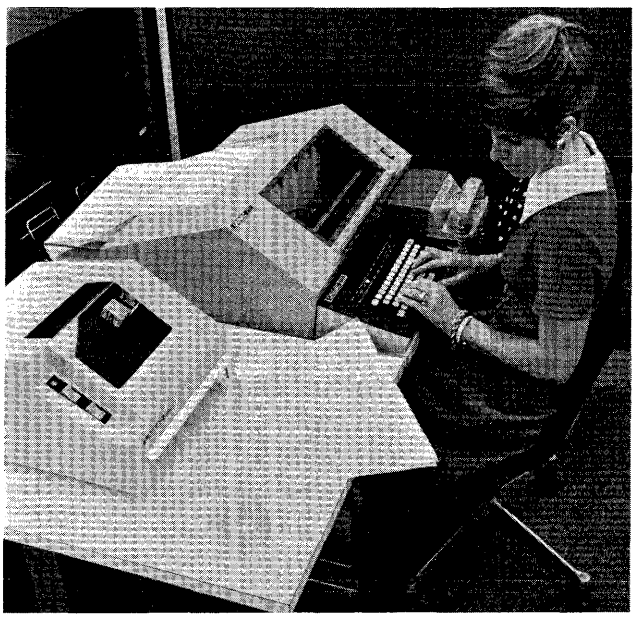
The printer accommodates six-part continuous forms (c three-part carbonless forms) from 3-7/8 inches to 14-7/ inches wide. Forms are fed at 30 lines per secon (manual feed). Skipping speed is 12 inches or 72 lin per second. Black ink is standard; red, green, or viol inks are available.

PRICING: The DCT 500 Data Communication Termin is available for purchase or on a one-year lease. separate maintenance contract is available for bot arrangements.

DCT 500	Monthly Rental*	Purchase	Monthly Maint.
ASR model	$207	$6,495	$47
KSR model	116-126	3,705-4,095	26
RO model	101-111	3,320-3,710	21
Options			
Internal Modem	15	480	0
Auto Answer**	5	195	0
Bell 113A Interface	2	60	0
Table (for paper tape device)	–	125	–

* Includes maintenance.
** Cannot be used with Internal Modem. ■

UNIVAC DCT 1000
Data Communications Terminal



The basic DCT 1000 with optional paper tape reader/punch (at left). The printer and keyboard are the same units used in the UNIVAC DCT 500.

The UNIVAC DCT 1000 is a modular, low-priced, batch and/or interactive terminal that can be configured in a single- or multiple-station arrangement. The basic terminal contains a printer; a keyboard and various I/O devices are optional. Several communications interfaces handle transmission rates up to 4800 bits per second.

MANAGEMENT SUMMARY

The DCT 1000 is a logical extension of the popular UNIVAC DCT 500. With more sophisticated operation and control procedures, the DCT 1000 is a tailored for operation in a computer environment.

The DCT 1000 looks just like what it is—an assembly of existing components—and gives the same impression as the IBM 1050, with various units sitting here and there. The result is a terminal with a lot of flexibility in configuration and one that occupies a lot of physical space. The DCT 1000 was announced in October 1969, with customer deliveries beginning in May 1971.

Compatible with the Uniscope 100, but not with the DCT 500 or 2000, the DCT 1000 (like the Uniscope 100) can be configured in a multiple-station arrangement with up to 31 stations sharing a computer I/O channel or common communications line.

Other configurations can be devised, such as single- and multiple-station arrangements of both Uniscope 100's and DCT 1000's in a party-line environment where communication between the terminals and the computer is under the control of the stored program in the computer. The DCT 1000 can also be used on the dial network with an automatic-answering capability.

The double-buffering technique is borrowed from the DCT 2000. The two 160-character buffers allow I/O device operation and message transmission or reception to overlap.

Both batch and conversation modes are provided. Operation in the batch mode is much the same as with the DCT ➢

CHARACTERISTICS

MANUFACTURER: UNIVAC Division, Sperry Rand Corporation, P. O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

CONFIGURATION: The DCT 1000 is a composite of devices that includes a basic terminal controller with an integral 30-cps input printer, an optional keyboard, and any mix of up to three of the following I/O devices: a paper tape reader/punch, a card reader, an auxiliary 30 cps printer, and a card punch (the UNIVAC 1701 Verifying Punch or 1710 Verifying Interpreting Punch).

The DCT 1000 can be used in a single-station or multiple-station arrangement, with up to 31 units connected to a computer I/O channel or a communications line via a multiplexer. The basic multiplexer provides eight channels, and can be expanded in increments of four channels. Each terminal can be located up to 5,000 cable-feet from the multiplexer.

COMMUNICATIONS: Asynchronous or synchronous in the half-duplex mode at transmission speeds up to 300, 1200, or 1800 bits/second (asynchronous) or up to 4800 bits/second (synchronous). The transmission code is 8-level ASCII (including parity). When operating asynchronously, a 10-unit code structure is used.

The DCT 1000 can be equipped with an EIA Standard RS-232C interface for connection to a modem when operating as a single terminal or with a multiplexer interface for connection to the multiplexer when operating in a multi-terminal arrangement. Connection to a voice-band communications facility is established via a Bell System 100 or 200 Series Data Set or an equivalent modem.

The DCT 1000 is designed to communicate with another DCT 1000 or a remote computer on a point-to-point basis or with a remote computer in a polling and addressing environment. Several DCT 1000's sharing a common line can operate in a contention mode.

DEVICE CONTROL: The DCT 1000 operates in one of two computer-selected modes: batch or conversation. The significant difference between the two modes is the transmission technique.

When operating in the batch mode, communications between the DCT 1000 and the remote computer or another DCT 1000 take the form of a sequence of text messages and acknowledgement messages. Message length can range from 1 to 160 text characters.

When operating in the conversation mode, communication between the DCT 1000 and the remote computer is initiated by the computer in the form of polling messages.

The DCT 1000 contains two 160-character buffers, which are alternated between input/output and transmission.

Off-line operation permits the terminal to be used for local data transfer between input-output devices; such operation includes local preparation of punched tape with printed output.

Transmitted or received data can be monitored by the ➢

UNIVAC DCT 1000
Data Communications Terminal

2000 and is tailored to the transmission of large quantitites of data. The conversation mode is designed for a computer environment where all communication between the terminals and the computer is under control of a stored program.

Operation is restricted to the batch mode for point-to-point communication with another DCT 1000. In a computer environment, the batch or conversation mode is selected by the computer programs.

The 30-character-per-second, 132-column incremental printer is the same printer used in the UNIVAC DCT 500. An auxiliary incremental printer of the same type can also be included in the DCT 1000 configuration. The basic and auxiliary printers are program-addressable. The paper tape reader/punch unit is also the same unit used in the DCT 500 configuration.

The card punch used in the DCT 1000 configuration is UNIVAC's 1701 Verifying Punch or 1710 Verifying Interpreting Punch. Either punch can be operated as a free-standing unit when not in use as a subsystem component.

The DCT 1000 is intended to satisfy a general-purpose market, as is the Uniscope 100. UNIVAC provides software support for both units for use with the UNIVAC 1106, 1108, 9000 Series, 418 III, and 494 computer systems. UNIVAC also supports the terminals for operation with the IBM System/360 under BTAM; UNIVAC's software extension to BTAM (for synchronous operation only) makes both the Uniscope 100 and the DCT 1000 turnkey subsystems.

A basically low-priced terminal, the DCT 1000 can quickly climb to a relatively high-priced position when the optional I/O equipment is added.

Users' experience with the DCT 1000 spans the range from good to poor. Overall reliability and performance has been generally acceptable, but in environments where heavy usage is normal, equipment failures are not too infrequent. One user reported card reader and printer failures that caused punched holes to be skipped and overprinting to occur; this user reported excessive downtime ranging up to one full week as the result of poor response to service calls and parts shortages. The card keypunch, however, has received a good rating. □

printer. The DCT 1000 provides an unattended answering capability.

ERROR CONTROL: Character and longitudinal parity is generated, transmitted, and checked on received data. A negative acknowledgement is returned in response to a detected message error. The response is not returned until the unit is polled when in the conversation mode. Message retransmission is automatic upon reception of a negative acknowledgement or poll for retransmission. Optional parity and positive hole checks are provided for the paper tape unit.

KEYBOARD: A 4-row typewriter arrangement. All 128 graphics and control codes of the ASCII character set can be generated from the keyboard. Control and shift keys are used in conjunction with character keys to generate the full range.

PRINTER: The incremental printer uses a helical print-wheel with single print-hammer actuator and ink roller to print 63 symbols of the user-specified ASCII, EBCDIC, A/H (UNIVAC business and scientific 8-level codes) or ECMA/ISO (8-level international code) graphics set. The standard unit prints up to 132 columns per line. Horizontal pitch is 10 char/inch; vertical spacing is 6 lines/inch.

The printer accommodates six-part continuous forms (or three-part carbonless forms) from 3-7/8 inches to 14-7/8 inches wide. Forms are fed at 30 lines/second (manual feed); skipping speed is 12 inches or 72 lines per second. Black ink is standard; and red, green, or violet inks are available. Forms control, available as an option, features horizontal and vertical tabulation and accommodates forms of varying length.

TAPE READER/PUNCH: The self-contained, desk-top device reads and punches 5-, 6-, or 8-level, 1-inch-wide strips of paper tape. In the off-line mode, the unit operates at speeds up to 30 characters/second; the speed capability is increased to character/second in the on-line mode. A supply reel under the device provides tape for the punch.

CARD READER: Reads standard 80-column cards coded in EBCDIC, ASCII, A/H (Univac business and scientific codes), Hollerith, or binary (optional) at a rated speed of 40 cards/minute. Cards are read column by column; feeding and stacking hoppers have a capacity of 500 cards.

CARD KEYPUNCH: Punches standard 80-column cards in EBCDIC, ASCII, A/H (Univac business and scientific codes), Hollerity, or binary (optional) at a rated punching speed of 40 columns/second. The input stacker and output magazine each have a 600-card capacity. An auxiliary input allows single-card entry. Stacker selection is provided to segregate program, master, or error cards. The keypunch can be operated as a free-standing unit or under control of the DCT 1000.

PRICING: The DCT 1000 is available for purchase or on a one-year lease. A separate maintenance contract is available for both arrangements. The basic DCT 1000, including a 132-column, 30 char/second incremental printer, keyboard, controller, and a data communications, multiplexer, or direct (interfaces a UNIVAC line controller) interface is priced at $176 per month (including maintenance) or $5,900 for purchased units; maintenance is $31 per month. Corresponding rental for a fully expanded DCT 1000 terminal is just over $600 per month.

The Forms Control option is priced at $12 per month or $360 for the purchased feature; maintenance is $2 per month.

The basic multiplexer (which provides 8 channels) is priced at $45 per month or $1,600 for a purchased unit. Maintenance is $5 per month. Expansion units (each providing 4 channels) are priced at $10 per month or $320 for purchased units.

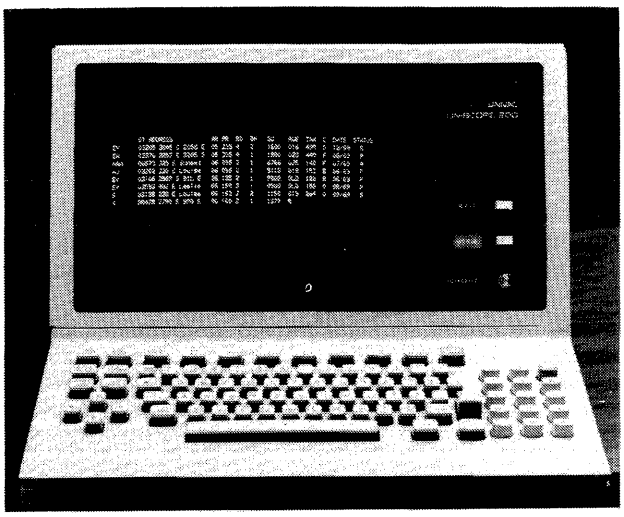
A synchronous or asynchronous communications interface for the modem side of the multiplexer is priced at $10 per month ($320 purchase); a computer interface for the UNIVAC 490, 1100, or 9000 Series computers or an IBM System/360 computer is priced at $10 per month ($320 purchase).

Input-output options are priced as follows:

Device	Rental*	Purchase	Maint.
Card Reader	$61- 71	$2,160- 2,640	$16/mo.
Paper Tape Unit	81- 91	2,400- 2,880	21
Keypunch (1701)	114-244	3,945-10,975	32-58
Keypunch (1710)	168-295	5,760-13,565	48-74
Auxiliary Printer	81	2,400	21

*Includes maintenance. ■

UNIVAC Uniscope 100 and 200 Alphanumeric Display Terminals



UNIVAC offers a wide choice of keyboard arrangements for the Uniscope terminals. The Uniscope 200 shown here has both a typewriter-style alphanumeric keygroup and a separate numeric keygroup (at right).

The popular Uniscope 100 and its large-screen companion, the Uniscope 200, are stand-alone display terminals that can also be configured in a multi-station arrangement, with as many as 31 display stations sharing a computer I/O channel or a common communications line. Auxiliary devices include a dual cassette unit, an impact printer, and a non-impact printer.

MANAGEMENT SUMMARY

In September 1974, UNIVAC introduced a large-screen successor to its earlier Uniscope 100, which was introduced in early 1969 with initial customer deliveries in May 1970. Billed as the Uniscope 200, the new terminal provides a screen capacity of 1920 characters—double that of the Uniscope 100 and comparable to the screen capacity of the IBM 3270. The hard-wired Uniscope 200 is a large-screen version of the Uniscope 100 and is operationally identical and communications compatible with its medium-screen counterpart. Both terminals are descendants of the discontinued Uniscope 300, once referred to as the "Cadillac" of display terminals for its elegance and sophistication. Many of the features exhibited by the Uniscope 100 and 200 terminals were first introduced on the Uniscope 300.

The Uniscope 100 and 200 are general-purpose display terminals designed for use as computer peripheral subsystems in local environments or as communications terminals in remote environments. As a remote terminal, either Uniscope is designed to operate in a polling/addressing environment and respond to UNIVAC line protocol. The units can be used either as stand-alone terminals or in a cluster arrangement where as many as 31 Uniscope terminals share the same communications facility or channel on a UNIVAC CTMC or DCS line controller via a UNIVAC-supplied multiplexer.

The salient features of the Uniscope 100 and 200 can be described and compared as follows:

- *Display capacity*—The Uniscope 200 is available with screen capacities of 1920 or 1536 characters, depend- ▷

CHARACTERISTICS

MANUFACTURER: UNIVAC Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

MODELS: Uniscope 100 and Uniscope 200; both models are stand-alone display terminals.

CONFIGURATION: The Uniscope 100 and 200, both stand-alone display terminals, can be used in a single-station or multiple-station arrangement with up to 31 display units connected to a computer I/O channel or a communications line via one or two multiplexers. The basic multiplexer provides 8 channels and can be expanded up to 16 channels in increments of four channels. A communications modem is required for operation over a communications facility.

Each display unit in a multiple-station configuration can operate up to 5000 cable-feet from the multiplexer.

The keyboard is optional; without it, the Uniscope 100 or 200 functions as a display monitor. Several keyboard arrangements are available.

Optional auxiliary devices include the Communications Output Printer, a 30-cps impact printer; the Model 800 Terminal Printer, a 300-cps non-impact printer; and the Model 610 Tape Cassette System. The Uniscope 100 or 200 accommodates auxiliary devices via its auxiliary interface channel, which can handle up to 12 device addresses. Each Model 610 requires 4 device addresses, and each printer requires one device address.

COMMUNICATIONS: Asynchronous or synchronous in the half-duplex mode at data rates ranging from 300 to 9600 bits/second (1200 char/second). Transmission speed is determined by the internal clock of the specified modem. The transmission code is 8-level ASCII (including parity); asynchronous transmission uses a 10-unit code structure.

The Uniscope 100 and 200 are each equipped with an EIA Standard RS-232C interface and operate over a voice-band communications facility via a modem. Integral modems are available from UNIVAC that provide compatibility with the Bell System 201 or 202 Data Sets. When operating in a party-line environment, both single-station displays and multiple-station display configurations can share a common communications line. Transmission compatibility with the IBM 2701 and 2703 line controllers is available.

CRT DISPLAY: The display characteristics of the two models are presented in the following table. ➤

UNIVAC Uniscope 100 and 200
Alphanumeric Display Terminals

ing on display format. By comparison, the Uniscope 100 is available with screen capacities of 1024 or 960 characters.

- *Displayed output*—The Uniscope 100 and 200 are each available with a 64- or 96-character set of ASCII symbols. UNIVAC offers any of six additional character sets at no extra cost for the Uniscope 200. The display clarity of the Uniscope 200 is superior to that of the Uniscope 100 as a result of the 200's 7-by-9 dot matrix character formation technique as compared with the 100's stroke technique for forming characters.

- *Editing capability*—The Uniscope 100 and 200 both provide a full editing capability, including character and line insertion and deletion and character, line, and screen erase.

- *Formatting capability*—The Uniscope 100 and 200 are both available with a protected formatting capability for "fill-in-the blanks" applications. Format descriptor fields are protected from inadvertent operator entry, and the descriptor fields can be made to blink for ease of identification. Only the keyed (variable) data is transmitted when operating in the Protected Format mode, thus providing line economy.

- *Printed output*—The Uniscope 100 and 200 are each available with both impact and non-impact printers, which can be mixed on the same terminal in quantities of up to eight printers. The printers include a one-line buffer and print directly from the display buffer under manual or program control. Rated speeds and maximum print positions are 30 cps and 132 characters for the impact printer, and 300 cps and 80 characters for the non-impact printer.

- *Auxiliary storage*—The Uniscope 100 and 200 are each available with the Model 610 Tape Cassette System, a dual-drive cassette unit. The Model 610 provides a remote batch capability as well as off-line data and format storage for the Uniscope terminals. The basic unit responds to computer- or operator-initiated commands and features address search and paging functions, which permit a block to be located via its address and the tape to be reversed to the beginning of the previous block, respectively. With options, the cassette unit can perform off-line listing of single or multiple blocks or the entire tape, edit specific blocks, and search for data via a search key that corresponds to data within the initial 16 characters of a block. As many as three dual cassette units can be used on one display unit. The Model 610 Tape Cassette System was introduced in March 1973.

- *Key entry*—Both the Uniscope 100 and 200 are available with any of five basic keyboard arrangements, ranging from numeric only to upper and lower case alphanumeric with numeric pad. Each keyboard provides four program function keys.

Uniscope Model	Viewing Area Width, inches	Viewing Area Height, inches	Display Format Char/ Line	Display Format Lines/ Display	Screen Capacity, Chars.
100	10	5	80	12	960
100	10	5	64	16	1024
200	10	7	64	24	1536
200	10	7	80	24	1920

Both models display a standard character set of 64 symbols, including upper case alphabetics, numerics, and special symbols. As an option, both models are available with a 96-character set of displayable symbols that includes lower case alphabetics and 6 additional special symbols. Data is displayed in green. Characters are formed via the stroke technique on the Uniscope 100 and via a 7-by-9 dot matrix on the Uniscope 200.

DEVICE CONTROL: The Uniscope 100 and 200 are designed to operate in a polling and addressing environment where all communications traffic is under control of the stored program in the remote computer.

Data is transmitted to the remote computer when the terminal is interrogated via a polling message following operator initiation of the transmit function. Data entry is not interrupted by an unsolicited computer message; however, the operator is alerted to the pending message and can respond when ready by initiating the Message Writing function. Via program control, the remote computer can override any operator action and display an urgent message without waiting. Data can be transferred to an auxiliary device (printer or cassette unit) via manual initiation (Print key) or automatically under program control.

Cursor direction controls move the cursor in any of four directions (left, right, up, and down) and are designed for either step-by-step or repetitive operation. The cursor can also be returned to home position (initial display position) or to the beginning of the next line (carriage return). Horizontal tabulation allows the cursor to be advanced to the position immediately following a stored horizontal tab character, or to the home position if a horizontal tab character is not located between the cursor and the end of the screen. The cursor and the character located at the cursor position blink so that the cursor position can be easily located.

Protective Format, a standard feature, permits a terminal- or computer-generated format to be displayed. Format descriptors can be made to blink and are protected from inadvertent entry by the display operator. The cursor moves between non-protected fields by tabbing or automatically when the end of a field is reached.

Edit controls provide insert, delete, and erase functions. Both character and line insert and delete functions are standard. Character insertion or deletion affects all data to the right of the cursor up to the end of the line occupied by the cursor. Line insertion or deletion affects all data to the right of the cursor up to the last displayable position of the screen. When formatted data is displayed, these functions affect only the variable fields; the fixed fields (format descriptors) are protected from inadvertent alteration. The standard erase functions include character, line, and screen erase. Character erase erases the character at the cursor position. Line erase erases all data from the cursor to the end of the line. Screen erase erases all data from, and including, the cursor position to the end of the screen. Space characters are inserted in all erased character positions.

Other standard functions include Cycle, a character repeat feature, Selective Blink, and Roll. Selected fields within a

UNIVAC Uniscope 100 and 200 Alphanumeric Display Terminals

- *Communications*–The Uniscope 100 and 200 are each available with transmission speeds ranging from 300 to 9600 bits per second. Integral modems are available for asynchronous or synchronous transmission.

- *Software support*–The Uniscope 100 is supported by standard IBM software as a remote terminal operating under System/360 OS or DOS via BTAM, which is modified by a UNIVAC-supplied "BTAM modifier" routine. The Uniscope 200 is supported under DOS versions 26 and 27, OS 21.8, VS 1.6, and DOS/VS 30 via extended BTAM.

UNIVAC has no current plans to support the Uniscope terminals under IBM's new Systems Network Architecture (SNA), which includes the SDLC communications protocol as a key element. It is doubtful that it ever will. If UNIVAC does enter this market in competition with the IBM 3270 and other IBM SDLC devices, it will most likely be with an entirely new product rather than an existing one.

USER REACTION

In Datapro's 1975 survey of alphanumeric display terminal users, 10 users reported on their experience with a total of 668 Uniscope 100 display terminals. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	6	4	0	0	3.6
Ease of operation	6	4	0	0	3.6
Hardware reliability	6	3	1	0	3.5
Maintenance service	6	3	1	0	3.5
Software & technical support	1	7	1	1	2.8

*Weighted Average on a scale of 4.0 for Excellent.

These user ratings were among the highest received by any display terminal in the 1975 survey and earned the Uniscope 100 a position on the Datapro Display Unit Honor Roll.

All 10 of the responding users were generally well pleased with the Uniscope 100. Specific advantages noted by the users included high reliability (by 2 users), good cost/performance (by 2 users), readability of display, and flexible cursor controls. Three users listed the Uniscope 100's limited display capacity as a significant disadvantage (which is overcome by the newer Uniscope 200), and complaints about software limitations, poor support, fan noise, and "odd line protocol" were registered by one user each. □

message to be displayed can be made to blink by bracketing the fields with special characters. Block lengths are variable up to screen capacity. The Roll feature is implemented via software using line insert and delete functions. Special function keys can be software-designated to perform the Roll function.

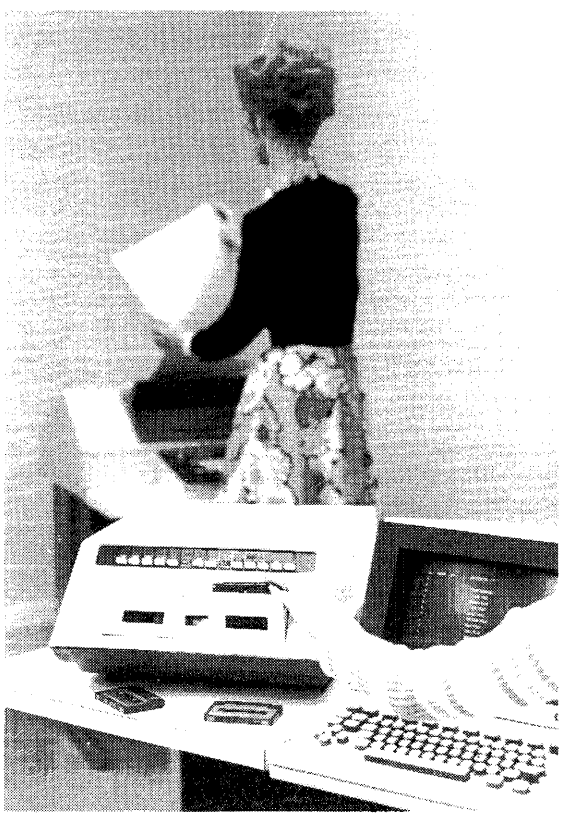
The basic Model 610 Tape Cassette System features paging, which reverses the tape by one block to permit editing recorded data, and Search, a bidirectional address search performed at 120 inches/second. Two Feature Group options are available for the Model 610; Feature Groups A and B for a Model 610 used with the Uniscope 100, and Feature Groups D and E for a Model 610 used with the Uniscope 200. Feature Groups B and E combine the features of Groups A and D, respectively, with their own. A conversion option, Feature Group C, converts a Model 610 with Feature Group A to a Group B unit.

Feature Groups A and D add Read-After-Write, Protected Format (which allows fixed formats to be recorded for later use), List, and Edit. List permits off-line printing of a single block, multiple blocks, or all recorded data on the cassette. Edit allows the operator to selectively edit single blocks of data or to copy an entire tape on a second cassette.

Feature Groups B and E combine two additional features with those of Group A or D. ASCII Record Separators can be used as file delimiters, blink characters, and cursor indication sequences. Alphanumeric Identifier Search permits the use of a search key that corresponds to data within the initial 16 characters of a tape block. In addition, Feature Group E permits copying to an address.

ERROR CONTROL: Character and longitudinal parity accompany each message transmitted and are checked for each received message. A detected parity error inhibits further acceptance of data, and the operator is alerted to the error condition. As a result of this situation, a partial message remains displayed.

The Uniscope 100 and 200 each reply with a negative or positive acknowledgement to each received message, and will respond to a retransmission request from the remote computer. The number of automatic retransmissions is determined by the computer program.



UNIVAC's Model 610 Tape Cassette System adds useful remote batch or off-line data handling capabilities to the Uniscope 100 or 200.

UNIVAC Uniscope 100 and 200 Alphanumeric Display Terminals

Errors that occur during message composition are corrected by the operator via the edit controls.

KEYBOARD: Any of nine keyboards can be specified. These include four key arrangements with or without the Protected Format feature and one key arrangement, numeric-only, without the feature. The key arrangements are: numeric-only, upper case alphanumeric, upper and lower case alphanumeric, upper case alphanumeric/numeric, and upper and lower case alphanumeric/numeric. Four Program Function keys are standard with all key arrangements. The combined numeric keygroup includes 15 keys arranged in an adding machine format and is located at the right of the alphanumeric keygroup. The keys include three keys for the Protected Format feature. Cursor, edit, and other functions are implemented via up to 24 additional keys.

PRINTED OUTPUT: Two printers are available for the Uniscope 100 or 200: the non-impact Model 800 Terminal Printer and the impact-type Communications Output Printer.

Model 800 provides 80 print positions and prints up to 300 char/second using an electrostatic technique. The printer provides the full upper and lower case ASCII character set and forms each character via a 7-by-9 dot matrix. Horizontal pitch is 10 char/inch, and vertical spacing is 6 lines/inch.

The Communications Output Printer is the same printer used in the UNIVAC DCT 500. Printing is performed at 30 char/second using a 63-symbol print set. The print set is specified by the user from available sets that include ASCII, EBCDIC, A/H (UNIVAC business or scientific), or ECMA/ISO (international). The unit prints 132 columns per line. Horizontal pitch is 10 char/inch, and vertical spacing is 6 lines/inch. The printer accommodates six-part continuous forms (or three-part carbonless forms) from 3-7/8 inches to 14-7/8 inches wide. Forms are fed at 30 lines/second (manual feed); skipping speed is 12 inches or 72 lines per second.

CASSETTE TAPE INPUT/OUTPUT: The Model 610 Tape Cassette System features two independent cassette tape recorders with shared electronics and a common interface to the auxiliary interface channel of the Uniscope unit. Each drive accommodates a Philips-type cassette containing 300 feet of 0.15-inch-wide magnetic tape. Phase-encoded data is recorded serially at 800 bits/inch. On-line data storage is rated at 700,000 characters per cassette (1.4 million characters per system). Tape speeds are: read/write, 6 inches/second; search, 6 or 120 inches/second; rewind, 120 inches/second.

PRICING: The Uniscope 100 and 200 are available for purchase or on a one-year lease. A separate maintenance contract is available for both arrangements.

	Monthly Rental (1)	Purchase	Monthly Maint.
Uniscope 100 (2)			
64 display symbols	$124	$4,047	$41
96 display symbols	140	4,803	41
Uniscope 200 (2)			
64 display symbols	142	4,797	41
96 display symbols	158	5,576	41
Keyboards (3)			
Numeric only	9	303	2
Upper case alphanumeric	14	331	2
Upper/lower case alphanumeric	14	331	2
Upper case alphanumeric with numeric pad	21	547	2
Upper/lower case alphanumeric with numeric pad	21	547	2
Special Function Keyset B	4	120	1
Auxiliary Interface (4)	10	346	0
Multiplexers (5)			
For use with UNIVAC modems:			
8 channels	59	2,036	6
12 channels	70	2,392	6
16 channels	81	2,748	6
For use with non-UNIVAC modems:			
8 channels	60	2,137	6
12 channels	71	2,493	6
16 channels	82	2,849	6
Modems (integral)			
Bell 201 compatible	54	1,781	11
Bell 202 compatible	39	1,202	9
Auto Answer	5	178	1
Printers			
Communications Output Printer	87	2,596	23
Variable Forms Length	6	195	1
Model 800 Printer	75	2,320	17
Dual Cassette Unit (Model 610)			
For Uniscope 100:			
Basic unit	75	1,947	22
With Feature Group A	83	2,259	22
With Feature Group B	91	2,531	22
Feature Group C (Converts Group A unit to Group B unit)	7	273	0
For Uniscope 200:			
Basic unit	75	1,947	22
With Feature Group D	89	2,524	22
With Feature Group E	98	2,853	22

(1) Includes maintenance.

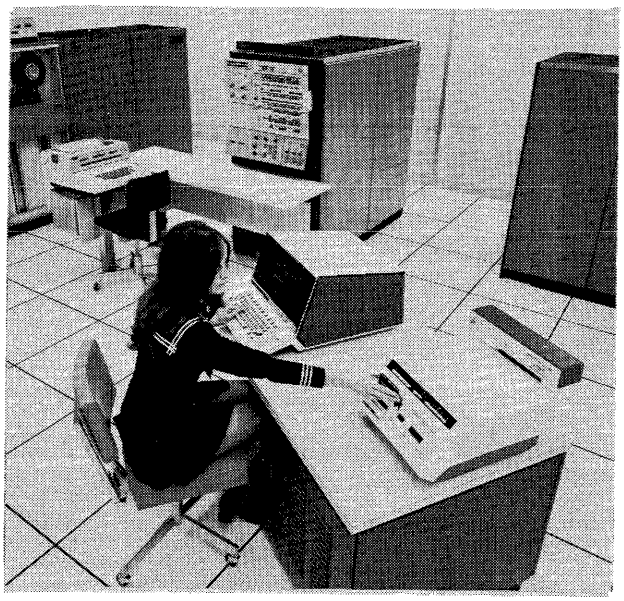
(2) Does not include a keyboard, but includes one of the following interfaces: a direct channel interface for the UNIVAC CTMC (a line controller for UNIVAC 1108, 494, and 418 computers), a direct channel interface for the UNIVAC DCS (a line controller for UNIVAC 9000 Series computers), or a synchronous or asynchronous communications interface with or without IBM System/360 and 370 compatibility.

(3) All keyboards except the numeric-only keyboard are available with Protected Format keys for use with the Protected Format feature. Special Function Keyset B provides terminal disconnect under computer control or by depressing Function Key 4; for single-station operation on the dial network only.

(4) A parallel interface required to attach one or more printers and cassette units to the display buffer of the Uniscope terminal.

(5) Includes a synchronous or asynchronous communications interface or a direct channel interface (as described in the preceding footnote). ■

UNIVAC 3760 Communications Controller



The UNIVAC 3760 (foreground) is shown in a typical IBM System/360 installation. Communications activity can be monitored and operations altered via the console, which consists of a Uniscope 100 display and Tape Cassette System (TCS) and is an integral part of the basic 3760. An expansion cabinet is shown at the far right.

UNIVAC's 3760, a direct replacement for the IBM 3704 and 3705 Communications Controllers, functionally emulates the IBM 270X controllers and accommodates most IBM terminals as well as UNIVAC terminals.

MANAGEMENT SUMMARY

UNIVAC's 3760 Communications Controller was the first programmable communications processor to be introduced by a leading mainframe manufacturer as a direct replacement for IBM's 3705. IBM introduced the 3705 in March 1972 as a programmable communications controller for its System/370 and 360 computers to supersede its 360-vintage 270X hard-wired controllers; the smaller, program-compatible IBM 3704 was unveiled in February 1973. Production deliveries of the UNIVAC 3760 began in April 1973.

Designed as a replacement for IBM's 370X or 270X communications controllers on IBM System/370 and 360 computers, the UNIVAC 3760 accommodates the more prominent IBM remote terminals (except for those that respond to SDLC line protocol) and Teletype's line of ASCII terminals via software emulation, as well as UNIVAC's own line of terminals. The 3760 is compatible with most IBM telecommunications programs, including BTAM, QTAM, and the more general TCAM under OS or DOS for both System/360 and 370 computers and under OS/VS and DOS/VS for System/370 computers. Compatibility with IBM's VTAM under DOS/VS, OS/VS1, and OS/VS2, however, is not currently provided.

Salient characteristics of the UNIVAC 3760 include:

- A maximum line capacity of 384 half-duplex lines or 192 full-duplex lines.
- A maximum throughput rate of 10K bytes per second for voice-grade lines and 37.5K bytes per second for wideband lines.

CHARACTERISTICS

MANUFACTURER: UNIVAC Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-4011.

MODELS: The UNIVAC 3760 is available in five models. All models include a basic 3760 controller, but they differ in configuration and in capability. The parameters of the five 3760 models are defined in the table on the third page of this report.

CONFIGURATION: The 3760 Communications Controller is composed of:

- The basic 3760, which includes the processor, 16K bytes of main memory, and the necessary interfaces between the processor and memory, processor and local I/O devices, processor and communications lines, and processor and host computer.
- Channel Adapter (ICA), which provides the data path between the 3760 and the selector, block multiplexer, or byte multiplexer channel of an IBM System/360 or System/370 host computer. The optional Dual Channel Switch permits manual switching of the ICA between two channels of a host computer or one channel on each of two host computers.
- Storage Interface, which includes one or two (optional) Storage Bank Chassis, each of which can contain up to 64K bytes of main memory in 16K-byte increments. A four-port memory multiplexer is part of each Storage Bank Chassis to provide a direct memory interface for the processor/ICA and for up to three Type II Scanners.
- Parallel I/O Controller, which interfaces the processor with a Uniscope 100 video display unit and Tape Cassette System (TCS) and provides three additional 16-bit-wide parallel channels for future attachment of disk or tape drives, card readers, and card punches.
- Scanners, which interface the line attachment hardware with the 3760 processor and Storage Multiplexer, a four-part, priority-controller multiplexer through which the processor and attached scanners access main memory. Two scanner types provide different levels of performance. The scanners are independently programmable via their own unique instruction set. Scanner programs are stored in 3760 memory, and programmed procedures are processor-initiated. At the completion of each operation, the scanner interrupts the processor and presents ending status indications.
- Line Bases, each of which interfaces a scanner and one or more line adapters and provides termination for the line adapters.
- Line Adapters, each of which interfaces a communications line (via a modem) and a line base and provides a standard modem interface (EIA Standard RS-232C, CCITT, or MIL-STD-188C). Eight different line adapters, divided between the two scanner types, provide clocking and control for particular types of lines and transmission technques.

UNIVAC 3760 Communications Controller

- Accommodations for up to 6 wideband lines.
- Synchronous transmission rates of up to 9600 bits/second.
- Asynchronous transmission rates of up to 2400 bits/second with program selectable data rates.
- Wideband rates from 19,200 to 50,000 bits/second.
- Automation transmission speed detection.

UNIVAC also provides a variety of software to permit users to develop their own subroutines so that the 3760 communications network can be tailored to satisfy individual needs. The additional software includes:

- System/360 or System/370 Load/Dump–Permits the transfer of UNIVAC 3760 programs between the host processor and the 3760.
- System/360 or System/370 Cross Assembler–Permits users to generate their own 3760 subroutines on the host processor. The Cross Assembler interfaces the Load/Dump program to facilitate loading user-developed subroutines.
- UNIVAC 3760 Debug Routines–Permit users to debug application software on the 3760.
- BTAM On-line Test–Permits users to employ UNIVAC on-line test programs that run under BTAM to test network and terminal operation.

The 3760 operates under control of its own software, which is loaded from cassette tape via the standard Tape Cassette System (TCS) into 3760 main storage. Currently, 3760 software consists of emulation software only, which provides compatibility with existing IBM software as a 270X replacement; this software is not compatible with IBM's latest versions designed to run with the 370X Network Control Program (NCP). UNIVAC's plans for developing a front-end processing package similar to IBM's NCP or support for IBM's SDLC line protocol are indefinite at this time. However, UNIVAC's pending response to IBM's VTAM, NCP, and SDLC will determine the continued viability of the 3760 as a realistic alternative to the IBM 370X line for System/370 users.

Worldwide, UNIVAC has installed about 75 to 80 units to date; about 30 of these are in the U.S. Typically, they are configurations handling about 16 lines. The largest configuration installed to date handles fewer than 100 lines.

USER REACTION

Datapro interviewed six users of the UNIVAC 3760 Communications Controller, who reported on their experience with a total of seven units. Five of the users had had their units installed for more than one year, and the remaining user had his installed for nine months. All used relatively small configurations; the maximum number of lines interfaced was 32. The ratings assigned by these users are summarized below.

Physically, the 3760 consists of a free-standing desk which contains the processor, memory, and all basic interface modules. An operator's console consisting of a Uniscope 100 video display unit and a dual magnetic tape cassette recorder occupies the desk's top surface. Separate expansion cabinets are available for expanded communications capabilities.

Scanners are designated as Type I and Type II. The Type I Scanner, limited to one per 3760 Model 108 or 216, accommodates up to 16 half- or full-duplex communications lines. The Type II Scanner accommodates up to 32 half- or full-duplex lines. An Expansion Scanner doubles the line-accommodation capability of the Type II Scanner to 64 half- or full-duplex lines. Each Type II Scanner or Expansion Scanner can accommodate 64 half-duplex lines when the optional Half-Duplex Expansion feature is included. With this feature, a combined Type II Scanner and Expansion Scanner can accommodate 128 half-duplex lines.

The 3760 accommodates one, two or three Type II Scanners, each with an optional Expansion Scanner, to provide accommodate for a total of 384 half-duplex or 192 full-duplex communications lines. Each Type II Scanner, its Expansion Scanner, Half-Duplex Expansion feature, and related components including Line Bases and Line Adapters, is contained in an expansion cabinet located up to 25 cable-feet from the desk unit.

Line Bases, external to the Type II Scanner only, each accommodate 8 full- or half-duplex communications lines. One to four Line Bases interface each Type II Scanner or Expansion Scanner. The Type I Scanner contains an integral Line Base. The optional Half-Duplex Expansion feature doubles the half-duplex line capacity of a Type II Scanner or Expansion Scanner.

Line Adapters each accommodate a single half- or full-duplex communications line and are divided into three categories: synchronous, asynchronous (both are voice-grade), and wideband (synchronous only). Synchronous operation accommodates transmission rates up to 9600 bits/second; asynchronous, from 45.45 to 2400 bits/second; and wideband, from 19,200 to 50,000 bits/second. A total of eight Line Adapters are equally divided between Type I and Type II Scanners.

Type I Line Adapters accommodated by the Type I Scanner include:

- Type I Dual Synchronous Serial Line Adapter–contains two modem interfaces and can operate in the full- or half-duplex mode under program control. The integral line base of the Type I Scanner accommodates one to eight of these dual adapters.
- Type I Dual Asynchronous Serial Line Adapter–contains two modem interfaces and can operate in the full- or half-duplex mode under program control. The integral line base of the Type I Scanner accommodates one to eight of these adapters.
- Type I Wideband Line Adapter – accommodates two full- or half-duplex wideband communications lines. The Type I Scanner and combined Line Base can service two wideband lines concurrently or one wideband line and up to 14 voice-grade lines, depending on the system load.
- Type I Dual Dial Adapter – interfaces two Bell System 801 Automatic Calling Units (ACU). The Type I Scanner and integral Line Base can accommodate up to eight Dial Adapters; however, each Dial Adapter physically displaces a Type I Dual Synchronous or an Asynchronous Serial Line Adapter.

Type II Line Adapters accommodated by the Type II Scanner and Expansion Scanner include:

UNIVAC 3760 Communications Controller

UNIVAC 3760 MODEL CHARACTERISTICS

3760 Model	Scanner Type and Quantity	Memory, Bytes	Line Adapter Type	Line Adapters and Maximum Quantity (3)	Total Lines (5)
108	1 Type I	16K to 32K	I	4 Dual Asynch; 4 Dual Synch; 2 Wideband; 2 Dual Dial (4)	8
216	1 Type I	32K	I	8 Dual Asynch; 8 Dual Synch; 2 Wideband; 4 Dual Dial (4)	16
232	1 Type II (1)	32K	II	32 Asynch; 32 Synch; 6 Wideband; 16 Dial (4)	32
264	1 Type II (2)	48K to 64K	II	64 Asynch; 64 Synch; 6 Wideband; 32 Dial (4)	64
464 (6)	1 Type II (2)	64K to 128K	II	384 Asynch; 384 Synch; 6 Wideband; 192 Dial (4)	64 full- or 128 half-duplex lines (6)

(1) Includes 4 Line Bases.
(2) Includes Expansion Scanner and 8 Line Bases.
(3) Each 3760 model accommodates any combination of Line Adapters; however, Models 108 and 216 restrict the number of UNIVAC terminal types that each can support to one and two, respectively. Model 108 is limited to one type of communications facility; Models 216, 232, and 264 are limited to two types of communications facilities; Model 464 supports four types.
(4) Displaces one Asynchronous or Synchronous Line Adapter for each attached Dial Adapter.
(5) Total half- or full-duplex communications lines.
(6) Model 464 can be expanded to include three Type II Scanners and Expansion Scanners, 128K bytes of memory, and up to 192 full-duplex or 384 half-duplex lines.

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	0	5	0	1	2.7
Ease of installation	2	3	1	0	3.2
Throughput	1	5	0	0	3.2
Hardware reliability	1	3	2	0	2.8
Manufacturer's maintenance:					
Promptness	0	5	0	1	2.7
Quality	1	3	1	1	2.7
Manufacturer's software	0	3	2	1	2.3
Technical support	0	4	1	1	2.5

*Weighted Average on a scale of 4.0 for Excellent.

Most of the interviewed users were fairly well satisfied with the 3760, as reflected by the majority of Good or Excellent ratings. The key advantages of the 3760, as cited by the users, are the unit's stand-alone capability, its flexibility with respect to adding more lines and terminals, and its diagnostic capabilities. One user commented that the 3760 is probably as good as or better than IBM's 3705/3704, with an edge in diagnostics.

Most of the six users experienced initial hardware and software problems, which have since been resolved. According to the users, many problems are not easily solved because of the unit's complexity, and sometimes require the aid of factory personnel in addition to local service. One user reported that the same failures occur each time lines are added.

The Poor ratings in the above table were supplied by the user with by far the largest number of lines and terminals (32 lines and 180 UNIVAC Uniscope 100 and DCT 1000 terminals). This user has been plagued with excessive downtime and complained about unresponsiveness at the factory level. He rates local support as excellent, but not capable of handling all his problems. Availability of parts was still another difficulty mentioned by this user, whose

- **Type II Synchronous Serial Line Adapter – accommodates one half- or full-duplex communications line via an attached modem. Each Type II Scanner or Expansion Scanner can accommodate up to 32 of these adapters.**
- **Type II Asynchronous Serial Line Adapter – accommodates one half- or full-duplex communications line via an attached modem. Each Type II Scanner or Expansion Scanner can accommodate up to 32 of these adapters.**
- **Type II Wideband Line Adapter – accommodates one half-duplex wideband communications line. Up to six can interface one or more Type II Scanners.**
- **Type II Dial Adapter – interfaces one Bell System 801 Automatic Calling Unit (ACU). Each Type II Dial Adapter physically displaces a Type II Synchronous or Asynchronous Serial Line Adapter.**

DEVICE CONTROL: The 3760 executes all operations under the direction of software contained within the unit's memory. UNIVAC 3760 software includes a Supervisor program, which provides overall system control, several Adapter Emulator programs designed to simulate the control and data-handling functions of the IBM 270X hard-wired communication controllers and the associated Terminal Adapters, and Terminal Emulator programs that permit UNIVAC terminals to emulate counterpart IBM terminals.

The Supervisor includes several control functions or specialized routines that control system initialization, interval timing, interrupt dispatching, command processing, I/O scheduling, communications data transfer, and supervisory access via the 3760 console. The supervisor also interfaces individual emulator programs.

Adapter Emulation programs support most IBM and Teletype terminals that are currently supported by the IBM 270X communication controllers via their hard-wired terminal adapters. These programs provide software emulation for the following IBM Terminal Adapters:

UNIVAC 3760 Communications Controller

installation is located in a major U.S. city. Conceptually, the machine is good, says this user, and a final effort by UNIVAC to resolve his problems is currently in progress.□

- Terminal Adapter Type I – emulation supports communications between the UNIVAC 3760 and IBM 1050, IBM 2740 Model 1, and IBM 2741 terminals.
- Terminal Adapter Type III – emulation supports communications between the UNIVAC 3760 and IBM 2848/2260 and IBM 2845/2265 display terminals, each with or without an attached IBM 1053 printer.
- Synchronous Data Adapter Type II – emulation supports communciations between the UNIVAC 3760 and IBM Binary Synchronous terminals, including the IBM 2780 and 3780 batch terminals, 3270 display terminal, other IBM terminals that use the BSC technique, and other System/360 or System/370 computers.
- Telegraph Adapter Type II – emulation supports communications between the UNIVAC 3760 and Teletype Model 33 or 35 teletypewriters.

Terminal Emulation programs support the following UNIVAC terminals as direct replacements for the corresponding IBM and Teletype terminals:

- UNIVAC Uniscope 100 – replaces the IBM 2848/2260 Display Station.
- UNIVAC Uniscope 100 and DCT 1000 – replaces the IBM 2248/2260 Display Station and 1053 Printer.
- UNIVAC DCT 1000 – replaces the IBM 1050 Terminal.
- UNIVAC DCT 500 – replaces the IBM 2740 Model 1 or IBM 2741 Communication Terminal.
- UNIVAC DCT 500 – replaces the Teletype Model 33 or 35.

CONNECTION TO HOST COMPUTERS: The Channel Adapter (ICA) provides attachment to the selector, byte multiplexer, or block multiplexer channel of an IBM System/360 or 370 computer. A data transfer rate of 10,000 bytes/second can be maintained when the sum of the transfer rates of all attached lines permits. The transfer rate increases when wideband facilities are attached. The transfer rate is 10,000 + 4,583n bytes/second (n equals 1 to 5) when 1 to 5 wideband lines are in use in addition to lower-speed lines, and 37,500 bytes/second for 6 wideband lines.

A manual two-channel switch can be added to the Channel Adapter to provide a connection to two channels on the same computer or one channel on each of two host computers. Only one data path exists at any one time.

Automatic Baud Rate Detection (ABRD) is available as a hardware option for Models 232, 264, and 464. This option permits detecting and setting asynchronous transmission rates of remote terminals via switched lines.

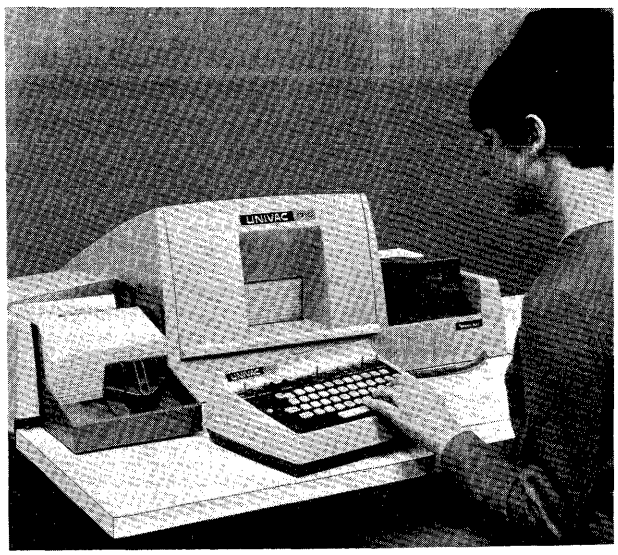
OPERATOR'S CONSOLE: Consists of a UNIVAC Uniscope 100 video display unit and an associated dual magnetic tape cassette recorder. Via console software, the operator can send messages to any remote terminal in the network, display the contents of a control block associated with any line, display the contents of a location or block of memory, alter the contents of memory locations, load or dump program data (via the TCS), monitor the activity of a particular line, etc. Diagnostic routines can also be loaded via the console to aid in isolating network faults.

PRICING: The UNIVAC 3760 Communications Controller is available for purchase or on a one-year or five-year lease. A separate maintenance contract is available for both arrangements. UNIVAC states that the following pricing is subject to change.

	Monthly Rental*	Purchase	Monthly Maint.
3760 Model			
108	$1,201	$ 54,600	$157
216	1,459	66,675	186
232	2,135	96,100	228
264	2,580	114,600	268
464	2,838	124,900	297
Additional Components			
Channel Switch, 360/370	96	4,305	13
Auto. Baud Rate Detection	31	1,077	5
Storage Expansion (16K bytes)	250	10,300	29
Storage Chassis & Multiplexer	247	10,000	22
Scanners:			
Type I	51	2,100	10
Type II	607	28,500	32
Expansion Scanner	188	8,200	13
Line Base	20	675	5
Half-Duplex Expansion	66	2,475	11
Type I Line Adapters:			
Dual Asynchronous	20	630	4
Dual Synchronous	26	900	4
Dual Dial Adapter	26	872	5
Wide Band Adapter	52	1,743	11
Type II Line Adapters:			
Asynchronous	9	315	2
Synchronous	13	450	2
Dial Adapter	15	436	5
Wide Band Adapter	26	872	5
Active Line Indicators:			
First 16 lines	13	528	2
Additional 16 lines	13	528	2

*For a one-year lease; includes maintenance.■

UNIVAC 1700 Series
VP and VIP Card Keypunches



UNIVAC, with little commotion, has substantially penetrated the huge keypunch market. The buffered 1700 Series units offer the user operating flexibility not available with the conventional unbuffered keypunch and verifier equipment.

MANAGEMENT SUMMARY

UNIVAC's awareness of the gigantic keypunch market (estimated at between one-quarter and one-half million units) and its confidence that punched cards "will be around for a long time" is manifested in its 1700 Series Verifying Punch and Verifying Interpreting Punch. UNIVAC made first deliveries of these units in October 1968, three years after Mohawk spawned the "key-to-tape" age with initial deliveries of its 1100 Series Data-Recorders. Despite a curiously low-keyed marketing effort, by mid-1971 UNIVAC had an astounding 36,000 of these units in operation, mainly at IBM and UNIVAC computer installations. UNIVAC is currently quoting a lead time on orders of between 45 and 60 days.

When considering the successful penetration the UNIVAC machines have made in the keypunch replacement market, it should be understood that the UNIVAC equipment offers essentially the same features as stand-alone key-to-tape equipment–except, of course, for the data recording media. The 1700 Series units are naturals for use as IBM keypunch replacements in keypunch service bureaus and tab installations–alien territory for key-to-tape equipment. Then, there are still many in the data processing field who, aware of the advantages of punched cards and complacent with their existing operations, offer strong resistance to attempts to convert them to other media.

The UNIVAC 1700 Series units offer the user combined keypunch, verify, and interpret functions in the same machine, buffered operation, and added flexibility not available with the IBM 29 Card Punch. The 1701 Verifying Punch and 1710 Verifying Interpreting Punch look alike. But the 1710, in addition to the verify and punch functions provided by the 1701, includes an interpret feature which can be used either alone or with the punch or verify operations. The 1710 also has an Early Feed capability that provides increased punching speeds when the last column punched is Column 50 or below.

Both models are buffered and provide separate core stor- ▷

CHARACTERISTICS

MANUFACTURER: UNIVAC Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone: (215) 542-2011.

MODELS: 1701 Verifying Punch; 1710 Verifying Interpreting Punch.

CARD OUTPUT: IBM 80-column cards; 51- or 66-column cards optional. Punches in standard 80-column card code. Input hopper and output stacker capacities are 600 cards each. Select Stacker capacity is 20 cards.

Rated card speeds are as follows. (Note that these are maximum speeds, for operations that require no manual data entry or other operator intervention.)

Device Function	Card Columns	Rated Speeds, Cards/Minute 1701 VP	1710 VIP
Punch	1 to 80	35	35
	1 to 50	35	42
	1 to 22	35	60
Verify	1 to 80	60	60
Verify/Print or Interpret	1 to 75 or 80	–	40
	1 to 35	–	60

DEVICE CONTROL: Programs are stored in an independent core buffer. Provision is made for storing two programs simultaneously, with manual switching between programs. The program controls the format of the data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplicating, right justification (left zero fill within numeric fields and left blank fill within alpha fields), and optional check-digit generation and validation.

New programs are entered automatically from punched program cards; either one or both programs are punched into a card. When two programs are to be entered, both programs must be punched into the same card. The program can be disabled, giving the operator complete control over the format of the recording.

Modes of operation include Load Data/Program, Punch, Verify, and Interpret (1710 only). The 1710 can also print in either the Punch or Verify mode when desired.

In the Load Program mode, programs read from the program card are entered into data and program memory, erasing any prior programs and/or data. The Load Data mode enters the data read from a master card into the data memory. Program and master cards can be entered from either the Input Magazine or the Auxiliary Input. When entered from the Auxiliary Input, the preceding card at the Visible Station is transferred to the Select Stacker, followed by the program or master card (two card cycles).

In the Punch mode, the contents of data memory (which may be keyed in, entered via a master card, or a combination of both), are punched (and also printed by the 1710 if desired). ▶

UNIVAC 1700 Series
VP and VIP Card Keypunches

age for two 80-character records and two individually selectable programs. Programs are entered from punched cards; two programs punched into the same card can be entered simultaneously. Keyed or punched data (in the form of master cards) is entered into the core buffer prior to punching and/or printing. The buffer also retains the image of the card to be verified during the key-verification process.

The Auxiliary Input is a handy UNIVAC feature that makes it easy for the operator to insert individual cards (such as program or master cards) ahead of the deck contained in the Input Magazine. Using this facility, programs and data to be duplicated can easily be changed when necessary. In addition, corrected cards can be punched immediately after each card image has been corrected during key-verification.

These units, because they are buffered, lend themselves toward more efficient operation in the keypunch environment. Summed up, the advantages over conventional keypunches and verifiers include the capability to key and correct records prior to punching, to load new programs quickly and easily without disturbing the deck to be entered, to duplicate or gangpunch from a master card image, and to interpret cards either with or without punching or verifying.

The UNIVAC 1700 Series represents a significant improvement in keypunch capabilities. Although it has favorably (but quietly) competed with the key-to-tape concept, it encountered little direct competition prior to IBM's November 1970 announcement of its buffered 129 Card Data Recorder. Although the IBM 129 is vastly superior to the IBM 29 and functionally similar to the UNIVAC 1700 Series units, the UNIVAC models maintain a significant edge over the 129 in both performance and price. □

In the Verify mode, data read from each card entered from the Input Magazine is compared column-for-column with the contents of the previous card in buffer memory; non-matching columns are automatically noted as the contents of the new card replaces that of the previous one. The card, now at the Visible Station, is key-verified; errors are corrected by depressing the Correction key and rekeying the specified character. Corrections to the card image during key-verification are followed by inserting a blank card in the Auxiliary Input, which is punched with the corrected image and a corrected-punch code (row-one punch in the left-hand margin); the incorrectly-punched card at the Visible Station is automatically transferred to the Select Stacker for removal. A card that has been verified without need for correction is punched with an OK-punch code (row zero and one punches in the left-hand margin). On the 1710, printing, if selected, can also be performed in the Verify mode).

The Interpret mode (1710) is manually selected and deselected. When selected, punched cards loaded in the Input Magazine are fed, printed above the punched columns with the character represented by each punched code, and transferred to the Output Stacker.

Depressing the Eject key in Punch or Verify mode will deliver the card to the Select Stacker without punching and/or printing; the card cycle is returned to column one and error indicators are cleared. The card image in buffer memory remains unchanged.

A two-digit numerical column indicator located below the Visible Station displays the card column to be punched or verified next. Status conditions such as interlock, non-match, and error are provided by indicator lamps on the keyboard.

Options include Interspersed Master Card; Check Digit, Modulo 10 or 11; Short Card Feed; Production Count; and Release/Eject Key.

With the Interspersed Master Card feature, master cards interspersed within a deck of cards are automatically sensed before reading, and program control is automatically switched to the program which controls the entry of master cards. After the master card is loaded, program control automatically reverts back to the alternate program.

The Short Card Feed option applies to keypunching, verifying, and interpreting. The feature allows the operator to adjust the 1701 or 1710 to handle 51- or 66-column punched cards. The Production Count feature accumulates operator production status during punch and verify operations. The Release/Eject function skips the remaining dup fields and clears the remaining variable fields in the Punch mode and initiates verification of the remaining dup fields and testing skip fields for blanks in the Verify mode.

ERROR CONTROL: Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character. The optional check digit feature allows generation and validation of modulo 10 or 11 check digits for numeric fields. The check digit is punched in the column immediately to the right of any designated field.

PRINTER: Model 1710 can print any of 64 characters. Print-wheel graphics are determined by the keyboard arrangement (UNIVAC 9000, 400/1100, or 1004, Honeywell, or ICL 1900 Series).

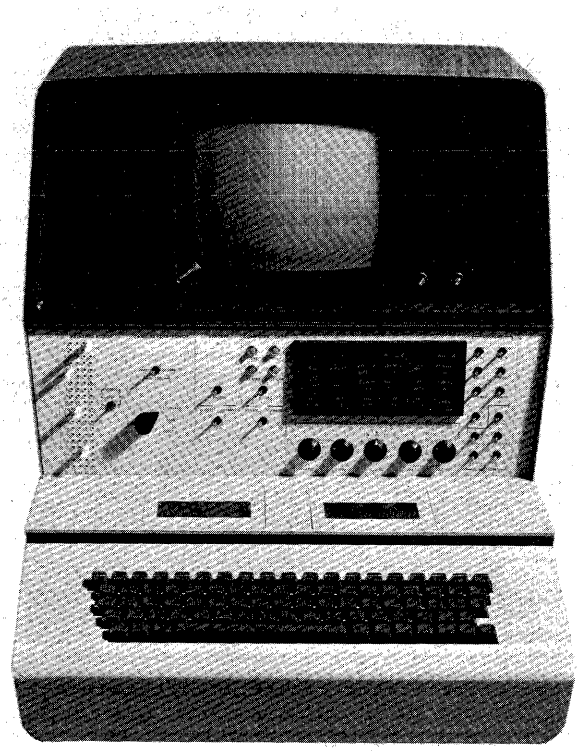
KEYBOARD: 49-key keypunch-style keyboard can produce any of 64 character codes: 10 numerics, 26 alphabetics, and 28 special characters. Up to 16 control keys provide for initiating functions such as manual duplication and skipping, error correction, card ejection, right justification, interpret, etc. Five standard keyboard arrangements are available: UNIVAC 9000 Series, 400/1100 Series, and 1004, Honeywell, and ICL 1900 Series. These arrangements differ only in the special character codes and graphics peculiar to each.

PRICING: The UNIVAC 1701 Verifying Punch and 1710 Verifying Interpreting Punch are available for purchase or on a one-year lease. A separate maintenance contract is available for both arrangements. The following 1700 Series prices include maintenance in the monthly rental prices.

Device or Feature	Monthly Rental	Purchase	Monthly Maint.
1701 VP	$107	$4,970	$32
1710 VIP	158	7,560	48
Short Card Feature (51 or 66 col.)	20	1,040	5
Interspersed Master Card Feature	15	600	4
Check Digit Feature (Mod 10 or 11)	25	1,000	7
Production Count	11	350	3
Release/Eject Key	5	250	–
Sound Suppression	–	125	–
Reading Board Extension	–	65	–

■

Viatron System 21



One tends to think of Viatron in terms of headlines, so: Viatron is down but not out. Users like the System 21. It's an effective device for in-place data capture.

MANAGEMENT SUMMARY

The general public has many national and international calamities with which to mark eras. Each specialized discipline also has its own esoteric set of such calamities. In the EDP world, there was the UNIVAC give-away and IBM take-over of the early 1960's, the GE sell-off in 1970, the RCA give-up in 1971 . . . and the Viatron bomb-out in 1971.

It is probably unnecessary to rehash the financial and technical misadventures that caused this young company to lose more than $40 million during its first three years of operation. Currently it is operating under Chapter X of the Bankruptcy act, so financial details are not available. However, the company is continuing to build and deliver the Viatron System 21.

The overwhelming attraction of the Viatron System 21 when it was announced in early 1969 was its low price. Even before they really knew what the unit was capable of, indeed even before it was completely designed, many computer users said they would like to have one. Unfortunately, production costs and schedules could not be met. Coupled with the general economic decline of 1970, Viatron very nearly submerged. It is down but not out.

CHARACTERISTICS

MANUFACTURER: Viatron Computer Systems Corporation, Third Avenue, Burlington, Massachusetts 01803. Telephone (617) 275-6100.

CONFIGURATION: A basic Viatron System 21 Data Management Station includes one of two Microprocessor models, a video display, an input keyboard, and two Viatape Cartridge Recorders. These components are integrated (as shown in the accompanying photograph) to form a single package. The basic System 21 can be expanded to include any combination of up to 2 input-output devices that include an IBM 29 Card Punch, an IBM Selectric typewriter, and three different Communications Adapters. In addition, either or both of the Viatape units can be replaced by a free-standing 7- or 9-track computer-compatible tape drive.

DEVICE CONTROL: Programs are stored internally in an independent buffer. Provision is made for storing two programs simultaneously, with manual selection. The selected program is displayed.

The program controls the format of the data recorded by delimiting alphabetic and numeric fields and by initiating automatic field skipping, duplication from Read Record or Master Record areas, right justification (left zero fill), and automatic input and output of data records.

New programs are entered manually from the keyboard or from Viatape under keyboard command or automatically. Programs can also be entered from an external source such as punched cards or the communications adapter.

Sequences of programs can be used to handle records of more than 80 characters. Using a System 21 with two Viatape units, a master record tape can be prepared with repeated sequences of master records by duplicating repeatedly; the operator need key the master record sequence only once. Using the master tape, an operator can step through a complex sequence of record formats conveniently.

CARTRIDGE TAPE OUTPUT: Viatape cartridge (a "Philips-type" cassette) contains 300 feet of 0.15-inch magnetic tape. Tape code is 7-level ASCII plus character parity. Viatape is not compatible with any current computer input device.

Recording density is 400 bits/inch. Tape speed is 6.25 inches/second. Data is recorded serially by bit on a single track. High redundancy is used; a total of 23 bits are recorded for each character. Record length is fixed at 80 characters.

Conversion between Viatape and IBM 729 or 2400 Series formats can be achieved on a System 21 with mixed tape units. Duplicate tapes can be made on a System 21 containing two of the same type tape units.

Viatron System 21

The System 21 is in essence a small, fixed-program processor built around a CRT display with inexpensive cassette tape drives as input/output devices. It is designed for data preparation. Although the read-only memory holds a fixed program, many options are available to adapt the unit to specific applications through switches, keys, and codes in the format control record.

Several input/output options are available, including a card reader/punch, printer, computer-compatible tape drive, and communications interfaces. The card reader/punch capability is achieved by adding a Viatron adapter to your IBM 29 Card Punch. Similarly, the printer capability is achieved by a Printer Robot, which is a device that fits over your IBM Selectric typewriter; the logic drives solenoid-actuated "fingers" that depress the typewriter keys. (It may not be fancy, but it works.)

Two models of the microprocessor are available. One includes the capability to accumulate totals, but you have to give up some of the fancier data handling functions contained in the basic model.

In talking with users of the equipment, the Datapro staff found that, universally, the users liked it. Most of the users we talked with had been using it for upwards of 18 months, so they have had plenty of time to see what it can do. Surprisingly, no user thought the System 21 was difficult to learn or use. (One of the chief characteristics of the System 21 is a rather complex set of operating procedures.) In general, the users we talked to are using the basic machine with output to punched cards or computer-compatible tape; this seems to comprise the overwhelming majority of units installed. Of the approximately 1000 units delivered, Viatron says that about 20 percent are used as terminals and about 20 percent use the Printing Robot.

There are several subjective conclusions that the Datapro staff drew from talking with Viatron users. One is that they seem unusually independent and resourceful. None of the users we interviewed received any technical assistance from Viatron other than an initial training session. And the applications they implemented with the System 21 were not all simple; one firm uses it in an environment that requires 17 different record types. A couple of the users mentioned that they do the necessary servicing now or have done it in the past. Throughout the company's difficulties, spare parts were not difficult to obtain. Normally, a user contracts with Viatron for service, with the actual service being performed by Control Data Corporation.

A second subjective conclusion goes a bit further into the general area of data preparation. Most of the users we talked to were not directly a part of the data processing center group; they used the output from the Viatron System 21 as a way of submitting information to the

COMPUTER TAPE OUTPUT: 7-track, 556/800 bits/inch format compatible with IBM 729; or 9-track, 800 bits/inch compatible with IBM 2400 Series. The tape drive is a free-standing unit.

Data is recorded with multiple redundancy: each character is recorded five times. The redundant recording requires a special software routine in the target computer to eliminate the redundancy before the data can be submitted to a user program. The utility routine uses majority logic to interpret the redundant recording; unresolvable characters are replaced with a question mark character. The output from the utility routine is a tape ready to run. Viatron furnishes (without charge) such a routine with the System 21 that also allows pooling, blocking, code conversion, and editing to be performed on the computer when reading tapes prepared on the System 21.

DISPLAY: 9-inch cathode ray tube (CRT) display provides 320 display positions arranged in 16 lines of 20 characters per line. Characters are formed by a 5-by-7 dot matrix.

DEVICE CONTROL (2111 MICROPROCESSOR): The basic control functions and procedures are defined by the microprogram set up in read-only memory. This basic program cannot be changed, but many options exist for adapting the unit to meet specific application needs. These options take two forms: switch settings and record control formats.

The basic orientation of the device is data entry, either creating a new file of transactions or correcting/updating an existing file. The facilities to accomplish these purposes are five interrelated, displayable 80-character buffers, two magnetic tape input/output devices, and up to two additional input and/or output devices.

The buffers are each displayed as two 40-character lines. From the top of the display, they are named Read, Write, Master, and Control. There are two Control buffers; only one can be displayed at any one time.

The normal key entry data flow is as follows: data is keyed into the Write buffer under control of the format displayed in the Control area; data is then transferred to the Read buffer and then out to a magnetic tape unit. The Master buffer contains descriptors identifying the various fields; under switch control, the Write and Master display records can be interleaved to provide closer visual correlation. The second Control record can serve as an alternative format; either of the Control records can be designated as the principal format which is automatically restored after a record is keyed according to the alternative format. Switching to the second format is a manual operation.

To change existing files, records can be read from one magnetic tape unit, modified using essentially the same procedures as for original data creation, and a new file written on the second magnetic tape unit. Use of automatic skipping and duplicating reduces the need to key data to just the new or changed fields.

Records can be shorter than 80 characters, but cannot be longer. Linking together several formats to create long records in 80-character segments can be accomplished, but takes some planning.

On the keyboard, there is a full range of cursor controls including character insert and delete, forward and reverse field tabbing, along with ordinary forward and reverse

Viatron System 21

center in place of a formatted transcript previously used for submission to the keypunch group. (One user went a step further and transmitted data directly to the computer during off hours at night.) The point of this discussion is that the Viatron System 21 is frequently used to record data in places where a keypunch or other data recording equipment would not ordinarily be used. Thus, the System 21 comes on not so much as a keypunch replacement as it does as an added tool.

So, although the pricing is not as attractive as it once was, the System 21 remains an interesting possibility for data entry right at the desk where the data originates. It has more capability than many data entry devices, but not as much as the newer breed of intelligent terminals.□

cursor movement. An option, Field/Position Select, permits direct cursor positioning by field number (1 to 9) or character number (1 to 80). The control keys, however, carry general-purpose identifiers, such as "L1" and "R2", so the operator must be very familiar with the device. This must be considered a deficiency; the principal use for these controls is in the creation of new format control records and in error correction procedures, both of which are sensitive operations.

A five-position switch is provided to select the record (buffer) being keyed into. Use of this switch provides access to all five record buffers.

In general, data can be read from any one I/O device and written on any other I/O device. Two optional modes of operation provide the only means for incorporating multiple devices for input or output unless a complex series of manual operations is followed. Of the two features, Automatic Multiple Input is standard and Automatic Multiple Output is an extra-cost option.

Automatic Multiple Input is controlled by a switch with six positions: Off and A through E. An additional switch allows selection of any one of the four devices connected to the four I/O channels. There is a corresponding output selection switch as well. The five active Multiple Input switch positions automatically set up data input in the following fashion: (A) input from the selected device to the selected record buffer; (B) input two sequential records from Tape Channel 1 to Control 1 and Master record buffers; (C) input three sequential records from Tape Channel 1 to Control 1, Control 2, and Master record buffers; (D) input one record from the selected input into the selected buffer and immediately output it to the selected output channel; (E) input one record from the selected device into the Master buffer. Modes, B, C. and E are oriented toward multiple-format data entry, and Mode D toward duplication of a file or transcription to another medium.

The Multiple Output option provides four automatic modes, one of which is for single-device output. The other three modes permit sequential output to two or three devices; data is always output to a non-magnetic tape channel as well as to the second non-magnetic tape channel and/or the second magnetic tape channel. These provisions permit, for example, recording records on tape, transmitting them over a communications line, and printing a listing.

Several other modes of operation extend the capabilities of the System 21. The four principal ones are verifying, validating, searching, and reformatting.

Verifying is performed by reading in a record from tape and selectively rekeying the fields to be checked. A miscompare locks the machine; data can be changed in the record being checked by manipulating the controls.

Validating involves reading the record just recorded in a data entry operation back into the buffer and checking it bit for bit with the original record. This is a useful technique to ensure accurate recording, but it does slow things down.

Searching involves keying a key field into the Master buffer and passing the tape file while comparing the record field with the Master record key. Manual keying or automatic input and output options can be triggered based on whether the identifier in the record agrees with or is different from the key in the Master buffer.

Reformatting permits the rearranging of data contained in an input record on a character by character basis for output to a different file. Data fields can be dropped if desired.

With appropriate equipment, the System 21 can serve as a data transcription device; e.g., Viatape to computer tape, cards to printer, computer tape to cards, etc.

Send and Receive modes are provided when a Communications Adapter is employed.

DEVICE CONTROL (2113 MICROPROCESSOR): The 2113 Microprocessor functions identically with the 2111 except that some of the functions have been deleted to allow implementation of accumulators. The Master buffer is used to accumulate totals. One control character is required for each accumulator set up, so the range is from forty 2-digit accumulators up to one 79-digit accumulator. The facility can be used manually as an adding machine or automatically to accumulate totals of fields from all records prepared. The Master record containing the accumulators can be output easily with a single key depression. To implement this facility some of the keyboard keys and some of the control codes are usurped, so that several of the facilities of the 2111 microprocessor are deleted. Among these are the keyboard functions of field select, insert, and delete; the control character functions for key verifying and searching; and the special function of reformatting.

ERROR CONTROL: Characters are redundantly recorded on Viatape (23 bits/character).

Following the writing of each record on Viatape the tape is backspaced and the record is read and compared bit for bit with the data retained in the buffer.

Data characters are recorded five times on the computer tape output and processed by the target computer.

Character parity is transmitted, and is checked on data received from a remote source via a communications facility. A question mark is substituted for characters received in error.

Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character.

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KEYBOARD: 73-key combined keypunch and typewriter style; keyboard can produce any of 128 character codes that include 10 numerics, 52 alphabetics, and 66 special characters including space. Additional control keys provide for initiating functions such as editing or cursor control. For data entry under program control, the typewriter numerics (upper row) can be distinguished.

KEYPUNCH: Card input and output can be obtained via a customer-supplied IBM 29 Card Punch; Viatron supplies the 6001 Card Reader/Punch Adapter only. Cards are read or punched at 20 characters (columns) per second. A buffer option permits simultaneous microprocessor and keypunch operation. The keypunch can also be operated independently of the adapter. For short record operation, an option permits the card to be released under control of the keypunch program card. The Space Insertion feature causes a space to be inserted for non-Hollerith codes instead of the Standard question mark.

PRINTER: Printed output can be obtained via a customer-provided IBM Selectric typewriter. Viatron supplies the 6002 Printing Robot, a novel electromechanical attachment that fits over the typewriter keyboard and activates the keys directly. A buffer option permits simultaneous entry of keyboard, tape, or external data during the typing cycle. The Robot operates in a list mode (unformatted printing) or in an execute mode where format control characters initiate formatting. Two execute modes provide either restricted printing (using a 64-character set) or expanded printing that can include both upper and lower case characters.

Printing is performed at 12 characters per second using an 88-character set. Horizontal spacing is 10 char/inch (12 char/inch optional), and vertical spacing is 6 lines/inch (8 lines/inch optional).

COMMUNICATIONS: Provided by one of three Communications Adapters. All operate asynchronously in a half-duplex mode using 8-level, 11-unit ASCII code; provide an optional parity check; and include a 15-second time-out feature for automatic disconnect when the carrier signal goes off. Character parity is normally checked, but can be inhibited. All adapters provide automatic answering capability.

Two adapters allow manual selection between two transmission speeds: 110 or 247.5 bits/second (6003 Adapter) and 600 or 1200 bits/second (6004 Adapter).

The 6005 Adapter will operate at any customer-specified speed up to 1200 bits/second.

Any data set used with a System 21 must be equipped with a reverse-channel feature or, alternatively, a full-duplex facility must be used to accommodate the "next-record request" signal returned by a receiving System 21; this signal is necessary for Viatape timing considerations.

Viatron states that data communication is compatible with the IBM System/360 and can be accommodated under BTAM.

PRICING: The Viatron System 21 is available for purchase only.

Component	Purchase Price	Monthly Maint.**
2111 Data Management Station:	$3,840	$35
2113 Data Management Station:	4,960	35
Microprocessor Options–		
102 Automatic Multiple Output	192	–
103 Short Record (line feed)	480	–
105 Field and Position Select	240	–
106 Short Record (carriage return)	480	–
Peripherals for Data Channel–		
6001 Card Reader/Punch Adapter	1,776	15
601 Record Transfer Buffer	864	–
602 Buffer Short Record	96	–
603 Space Insertion	144	–
6002 Printing Robot	1,200	15
601 Record Transfer	864	–
Communications Adapters:		
6003 (110/247 bps)	768	7
6004 (600/1200 bps)	768	7
6005 (special, up to 1200 bps)	1,248	7
Computer Tape Recorder*–		
5002 (9-track, 800 bpi)	2,880	20
5003 (7-track, 556 or 800 bpi)	2,880	20

* Replaces Viatape units. If purchased originally with System 21, a $384 credit is allowed for each Viatape unit replaced.

**For full parts-and-labor maintenance after the expiration of the one-year warranty at distances up to 30 miles from a Control Data maintenance office. For distances over 30 miles and up to 60 miles add $5 per month per component; for distances over 60 miles, the above rates apply plus travel time and mileage ($15 per hour and $0.15 per mile round trip per call). Between the expiration of the warranty for labor (90 days) and the warranty for parts (one year), a reduced rate is available, which is typically $5 or $10 per month less for each component. Alternatively, systems can be maintained on a time and materials basis. ■

Westinghouse 2550 Satellite Processor

MANAGEMENT SUMMARY

The software problems that delayed the delivery of the first Westinghouse minicomputer are settled. The latest wave of software announcements in February 1972 provide capabilities for emulation of an IBM 2780, an IBM HASP terminal, or a Control Data 200 User Terminal, all widely used terminals for remote batch processing. Westinghouse states that the biggest user interest so far has been in using the 2550 as a HASP terminal. (HASP terminals can range widely–from an IBM 2780 to a System/360 Model 20; the name comes from the software package used in the central processor.)

The 2500 minicomputer forms the nucleus of the 2550 Satellite Processor. Although it does not represent a breakthrough in computer design, it is far stronger than necessary to handle just the emulation task. The company states that emulating a HASP terminal at 9600 bps occupies only about 10 percent of the processor's capabilities, and this estimate does not seem unreasonable.

Price adjustments effective May 1, 1972, changed the competitive picture for the 2550 greatly. Purchase prices were not altered, but lease prices were dropped about 15 percent on the average. This brought the rentals into line with those of other manufacturers and is indicative of the beginnings of an aggressive marketing campaign.

This device offers "intelligent terminal" emulation of an IBM 2780, a multileaving HASP terminal, or a Control Data 200 User Terminal. Westinghouse is stressing, and supporting, off-line processing capabilities.

CHARACTERISTICS

MANUFACTURER: Westinghouse Electric Corporation, Computer & Instrumentation Division, Computer Department, 1200 West Colonial Drive, Orlando, Florida 32804. Telephone (305) 843-7030.

MODELS: As an intelligent remote batch terminal, the 2550 is marketed in three varieties: 2550/2780, 2550/HASP, and 2550/200 User Terminal. All models are built around the Westinghouse 2500 minicomputer and require 4K (2550/2780) or 8K 16-bit words of core memory, a programmable real-time clock, a data communications interface, punched card and printer peripherals, a teletypewriter or CRT console (2550/HASP and 2550/200), and appropriate software for imitating the functions of the corresponding terminal being emulated. Additional memory, peripherals, and software, all at extra cost, permit substantial off-line data processing capabilities.

CONFIGURATION: The basic 2500 processor can be expanded to include up to 64K words (128K bytes) of main memory. Memory above 16K words requires an expansion cabinet. The basic processor also includes 9 slots for adding cards containing the logic for various processor features and I/O controllers. Memory does not use these

A basic HASP terminal configuration of the Westinghouse 2550 Satellite Processor. Components shown include a processor with 8K 16-bit words of memory, a medium-speed card reader and line printer, and a Teletype ASR 33 used as a console.

Westinghouse 2550 Satellite Processor

The first delivery of a 2500 minicomputer system occurred in August 1971. To date about 50 systems have been delivered, with about half being 2550 terminal configurations. Various company facilities for manufacturing, instrumentation, and process control have accounted for most of the current installations. Westinghouse service facilities are maintained in about 20 cities.

The basic 2500 is a full implementation of a minicomputer, and the availability of magnetic tape and disk units provides substantial processing capability for non-communications jobs. Currently announced software includes BASIC compilers, a FORTRAN compiler, RPG, and several assemblers along with several levels of operating systems, all to be available in 1972. It is probable that additional off-line capabilities will be added to the 2550's repertoire in the future through software packages. Possibilities include key-to-disk, data collection, and spooling functions. The power of the 2500 minicomputer suggests the possibility for running multiple tasks simultaneously, but development of a multi-task operating system would be required. The real-time operating systems already developed for the 2500 for process control applications could form the basis for a multi-task operating system. Addition of processing functions normally associated with free-standing business computer systems, such as COBOL and business applications packages, is unlikely but not impossible.

Westinghouse is one of the leaders in the field of process control through digital computers, with well over 500 installations. Through the years the company has "OEMed" main frames from others and has built some of its own; the 2500 is not its first venture. The process control segment of Westinghouse's computer operations is separate from the 2500 segment, but they share the same divisional management. The Systems Department (process control) acts as one customer for the Computer Department's (2500 processor) products. □

slots. The real-time clock occupies one slot and the communications interface occupies two. Each peripheral device occupies one slot except the controllers for magnetic tape drives and fixed-head disk units, which occupy two. An additional 20 slots are provided through an expansion cabinet.

COMPATIBILITY: When the appropriate program is loaded, the 2550 Terminal duplicates the operation of the emulated device, including off-line functions such as card-to-print transcriptions and almost all standard optional features. The emulation is complete except for a few minor limitations and extensions here and there.

The 2550/2780 model does not support IBM's Six-Bit Transcode (SBT). It does permit monitoring transmissions by outputting on the line printer all data transmitted. Suppression of trailing blanks in a punched card is automatic if enabled and does not require an End of Media (EM) code. Normal operation for the 2550/2780 is the IBM Multiple Record mode; switch selection of the standard 2780 mode of two records per block is implemented. Alternating between on-line transmission and off-line transcription operations does not require reloading of programs. Operating controls for the 2550/2780 are quite different from those of the IBM 2780, although functionally they are about the same. The 2550/2780 uses the binary word input switches to set up the operational status of the terminal rather than the rotary switch of the 2780. Potentially, this allows expansion of the 2550/2780 to include more flexibility in use of peripherals.

The 2550/200 model provides only for ASCII transmission, not BCD. It can be used with the Control Data 6000 Series computers operating under SCOPE 3 or KRONOS and Export/Import 200.

The 2550/HASP model appears to include a full implementation of the functions expected of a terminal communicating with an IBM System/360 or 370 operating under HASP II with Remote Job Entry, including Multileaving. Optionally, this configuration can be equiped with an Automatic Restart feature to get things going again in an orderly fashion following a power failure.

COMMUNICATIONS: The communications interface is designed to operate in a half-duplex mode at up to 9600 bits per second, synchronously. Line discipline and transmission code can be EBCDIC or ASCII. Selection is under program control. LRC or CRC checking is performed by the hardware. Data is transferred to the processor a character at a time.

DEVICE CONTROL: All control is exercised through programs stored in the 2500 minicomputer. When operating on-line and emulating a particular terminal, only those functions available to the original terminal are available to the user. When operating off-line, a significant library of software enables programming applications.

The 2500 is a 16-bit, single-address processor using core memory with a cycle time of 750 nanoseconds. The first 16 words of memory are implemented by integrated circuits and serve as working registers, such as 2 one-word index registers, a two-word accumulator, and 10 general-purpose one-word registers.

Direct, relative, and indirect addressing are available. Indirect references can be pre- and post-indexed as well as relative. An extensive interrupt system keyed to external events can be implemented. Several levels of input/output transfer are provided, including transfers through the processor's accumulators and direct transfers to memory.

PERIPHERALS: The following table lists the peripherals available with one of the 2550 emulation configurations. (The teletypewriter and CRT are not supported under 2550/2780.)

Peripheral	Speed	Comments
Card Readers–		
206	300 cpm	–
208	300 cpm	heavy-duty
211	600 cpm	heavy-duty
212	1000 cpm	heavy-duty
217 Card Punch	35 cpm max.	interprets; can be used as keypunch.

Westinghouse 2550 Satellite Processor

Peripheral	Speed	Comments
Line Printers–		
230	300 lpm	132 columns;
235	600 lpm	64-character set;
240	1200/1000 lpm	12-channel vertical format unit
151 33 ASR teletypewriter	10 char/sec	–
170 CRT Display	Up to 1800 bps	20 80-char. lines

Other peripherals for off-line use include magnetic tape drives and moving-head disk drives (replaceable-pack or fixed-disk). One of four 25-ips, 9-track, 800-bpi tape drives can be connected through one controller. The disk units are configured as one to four modules per controller. Each module consists of one drive with a removable disk pack or two drives, one with a removable pack and one with a fixed disk. Each drive contains one disk and can store 1.25 million 16-bit words. Data is stored in tracks of 3,096 words, divided into 24 sectors of 129 words. Data transfer rate is 97.5K words per second. Average access time is 115 milliseconds, including a 20-millisecond average rotational delay.

PRICING: The 2550 Satellite Processors can be purchased or are available on a variety of lease plans. The table below shows prices for a 1-year lease arrangement. Rentals include maintenance; a separate maintenance agreement is available for purchased units.

	Monthly Rental	Purchase Price	Monthly Maint.
2550 Processor (includes 4K words, one emulator package, and communications interface)	$ 410	$16,300	$110
Direct Memory Access	29	1,000	–
Auto Restart (2550/HASP)	12	500	–
Teletype 33ASR with Controller	77	1,900	41
Controller for 33ASR (for user-supplied Teletype unit)	14	500	4
CRT Display	173	4,500	40
Memory–			
4K-word Module (for up to 16K)	80	3,400	20
4K-word Module (for 16K to 32K)	74	2,900	15
4K-word Module (for over 32K)	69	2,700	10
Expansion Chassis (for over 16K)	52	1,825	10
Cabinet (for over 16K)	22	700	–
Punched Card Peripherals–			
206 Card Reader	110	3,000	30
208 Card Reader	140	4,025	35
211 Card Reader	150	4,300	50
212 Card Reader	280	7,100	60
217 Card Punch	285	10,250	80
Line Printers–			
230 Printer	530	15,500	100
235 Printer	700	25,000	?
240 Printer	1,375	45,000	?

Magnetic tape drives run $175 per month (6,500 purchase, $40 per month maintenance) and the controller costs $25 per month (3,000 purchase, $40 per month maintenance). The controller for the moving-head disk units costs $125 per month ($8,000 purchase, $50 maintenance); individual modules cost $250 per month ($6,500 purchase, $50 maintenance) for the single drive and $330 per month ($9,000 purchase, $65 maintenance) for the double drive (one fixed, one removable pack).

Specific HASP configurations range from $1,207 per month (300 cpm, 300 lpm) to $2,782 per month (1000 cpm, 1200 lpm, card punch, and magnetic tape unit).

Stand-alone software packages are available for 4K and 8K environments at extra cost. Included are an assembler, BASIC compiler, operating system, and various utility and I/O routines. The larger package includes such features as a macro facility in the assembler and manipulation in BASIC. The cost of either package is $85 per month $3,400 purchase). ■

Westinghouse 1550/2780 Remote Batch Terminal

MANAGEMENT SUMMARY

Westinghouse has introduced a second remote batch terminal to fill the price/performance gap below its more powerful 2550 Satellite Processor. The Westinghouse 1550/2780 Remote Batch Terminal is designed as a low-cost replacement for the IBM 2780 Model 1 and is available in two models. Both models have similar configurations but differ in printer performance and transmission rates. Like its predecessor, the Westinghouse 2550, the 1550/2780 contains a Westinghouse minicomputer as the nucleus of the terminal. The 1550/2780 simulates all functions of the IBM 2780 via emulation software and provides all features which are optional for the 2780, such as Transparency and Multiple Record Transmission, as standard operating features.

Westinghouse supports the 1550/2780 as a turnkey system only, and currently provides emulation software only for the IBM 2780. As an IBM 2780 replacement, however, the 1550/2780 offers one of the most attractive price/performance values in the industry. Pricing, under a 1-year lease, ranges from 15 to 34 percent below the price of IBM's 2780-1.

The 1550/2780 incorporates the recently introduced Westinghouse Model 1500 minicomputer. The 1500 is the second minicomputer model introduced by Westinghouse and falls into a performance category below that of the larger Model 2500. Initial deliveries of the 1550/2780 included Odec printers, but these were later replaced by CDC and Mohawk line printers to improve reliability.

Initial deliveries of the 1550/2780 were made in September 1972, and production deliveries got under way ➢

The Westinghouse 1550/2780, via software emulation, is a replacement for the IBM 2780 Model 1. Available in two models that differ only in performance, the terminal includes all IBM 2780 features and options at no extra cost and offers substantial dollar savings over its IBM counterpart.

CHARACTERISTICS

MANUFACTURER: Westinghouse Electric Corporation, Computer and Instrumentation Division, Digital Products Department, 1200 West Colonial Drive, Orlando, Florida 32804. Telephone (305) 843-7030.

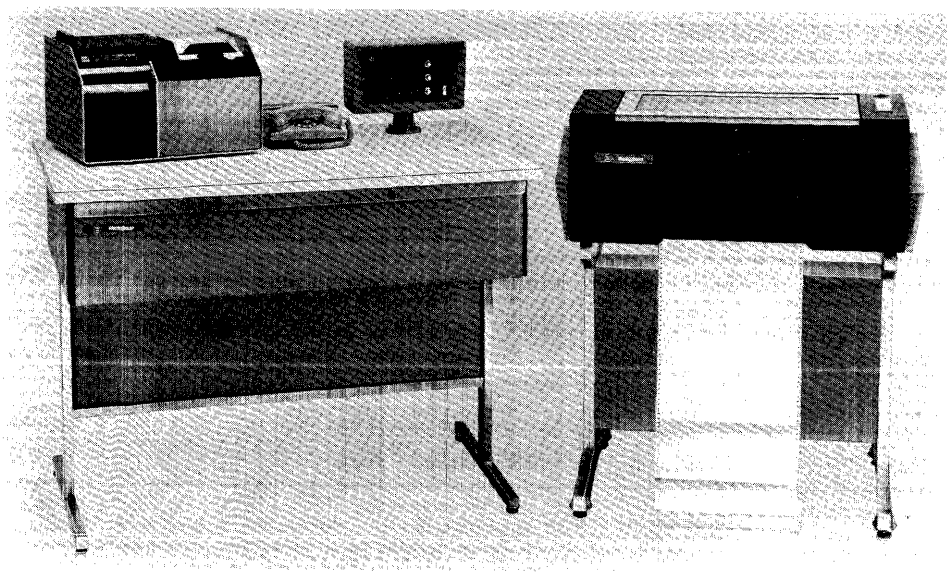
CONFIGURATION: The Westinghouse 1550/2780 Remote Batch Terminal is constructed around a general-purpose minicomputer with a 4096-word core memory and includes a communications interface, line printer, and card reader.

The 1550/2780 is available in two models:

Model	Transmission Speed, char/sec	Printer, lines/min	Card Reader, cards/min
15RBT-01	250/300	200	300
15RBT-03	600	300	300

COMPATIBILITY: The 1550/2780 is designed as a replacement for the IBM 2780 Model 1 and is transmission-compatible with the IBM 2770, IBM 2780, Westinghouse 2550/2780, or another Westinghouse 1550/2780 terminal operating in a point-to-point or multipoint communications environment.

COMMUNICATIONS: Transmission is synchronous in the half-duplex mode at 2000, 2400, or 4800 bits/second (250, 300, or 600 char/second). The transmission code is 8-level EBCDIC. Transmission parameters such as speed, code, ➢



The processor unit, at left, houses a Westinghouse Model 1500 minicomputer, operator's console, and desk-top card reader rated at 300 cpm. At right is the 200-lpm drum printer used in the Model 15RBT-01 terminal. The alternative Model 15RBT-03 uses a 300-lpm chain printer.

Westinghouse 1550/2780
Remote Batch Terminal

in December 1972. To date, about twelve 1550/2780's have been delivered.

Service is provided by Westinghouse, which has service locations in about 20 U.S. cities.

The Computer and Instrumentation Division is an autonomous division of Westinghouse operating under the Process Equipment and Systems Division, which also includes the Westinghouse Industrial Systems and Industrial Equipment Divisions.□

control signals, line discipline, blocking/deblocking, etc., are a function of the communications software. The communications interface is designed to EIA Standard RS-232C.

DEVICE CONTROL: Terminal control is provided by a minicomputer, which forms the nucleus of the 1550/2780 terminal, under the direction of the operating software. Current operating software emulates the IBM 2780 Model 1 Data Transmission Terminal. Software emulation causes the terminal to behave exactly as an IBM 2780-1; i.e., the terminal performs all functions and responds to all commands and communications discipline as an IBM 2780-1 and can operate on-line as a remote terminal to an IBM System/360 or 370 computer.

The emulation software includes all optional IBM 2780 features as standard operating features. These include: EBCDIC Transparency, Multiple Record Transmission, Automatic Answering, Automatic Turnaround, Terminal Identification, Printer Horizontal and Vertical Format Control, and Multi-Point Line Control.

Like its IBM 2780 counterpart, the 1550/2780 can handle variable-length records up to 80 text characters for the card reader and up to 132 characters for the line printer. (IBM print records are 80 characters standard, 120 optional, or 144 optional.) The IBM 2780 recognizes a short record by a detected End-of-Media code punched into the card following the last valid character. The Westinghouse 1550/2780 eliminates this requirement via its exclusive Automatic Short Record feature, an operator-selectable function which automatically inserts an End-of-Media code after the last valid character read. Both techniques eliminate the transmission of trailing blanks.

When operating in the Transparency mode, fixed-length records of 80 characters each are transmitted. Block length is identical with that of the IBM 2780 and can be operator-selected as either two or up to seven records/block.

Operating software, loaded from the card reader, also supports off-line listing operations. Each card is listed as one print line.

ERROR CONTROL: Cyclic redundancy check characters (two) are generated for each EBCDIC transmission, and a cyclic redundancy check is performed on each received EBCDIC message.

CARD READER: Reads 80-column cards at rated speeds up to 300 cards/minute. Input hopper and output stacker capacities are 550 cards each.

PRINTER: Two printers are provided, one for each of the two terminal models. The printer included with Model 15RBT-01 is a drum-type unit rated at 200 lines/minute. Model 15RBT-03 includes a chain-type printer rated at 300 lines/minute. Both printers provide 132-position print lines and accommodate a 64-symbol character set. Horizontal spacing is 10 characters inch; vertical spacing is 6 lines/inch for the drum printer and 6 or 8 lines/inch for the chain printer. Both printers accommodate six-part, continuous pin-fed forms. Form widths are 3-1/2 to 20-5/8 inches (drum printer) and up to 18-3/4 inches (chain printer).

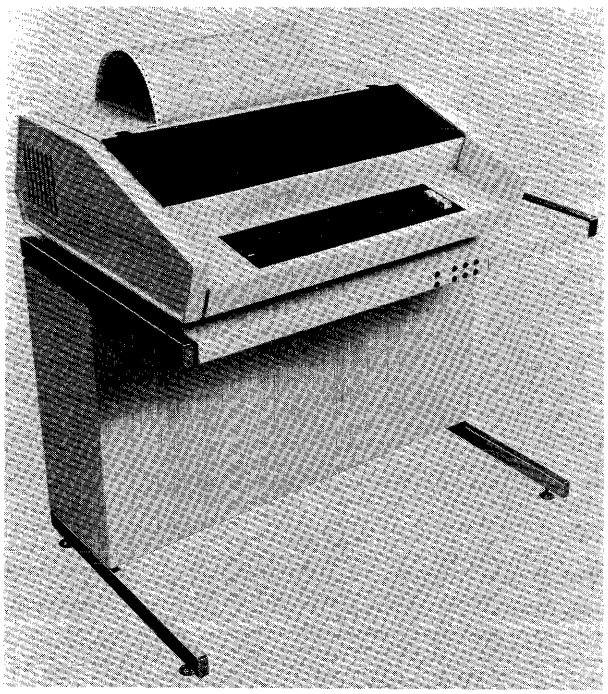
PRICING: The 1550/2780 Remote Batch Terminal is available for purchase or on a one- or three-year lease that includes maintenance. A separate maintenance contract is available for purchased units.

	Monthly Rental**			
Model	1-Year Lease	3-Year Lease	Purchase	Monthly Maintenance
15RBT-01*	$695	$650	$25,200	$170
15RBT-03*	895	850	32,500	200

* Includes a minicomputer with 4K bytes of core memory, operator's console and work table, card reader, line printer, communications interface, and operating software.

** Includes prime-shift maintenance.■

Wiltek Buffered Data Communications Terminals



The Wiltek 330 is just one of the many terminals built around a pair of Wiltek's Digi-Store magnetic tape buffers. The 330 uses a 30-character-per-second printer developed by Wiltek.

Wiltek offers its proven (and unique) magnetic tape buffering units in combination with various I/O devices including teletypewriters, its own 30-character-per-second printer, and CRT units. In effect, the buffer unit divorces the operator from the communications process by serving as intermediate storage for data to be transmitted to and data received from the remote computer.

MANAGEMENT SUMMARY

The Wiltek terminals are unusual in their arrangement—so unusual that the term "buffered" doesn't really do the products justice. The terminals are available with a variety of input/output devices, such as teletypewriters, CRT displays, and card readers. In each terminal, there are one or two buffers consisting of an endless loop of magnetic tape and independent read and write mechanisms. Separate buffer units are used for sending and for receiving data.

The result of this arrangement is that an operator can key in data with no regard for communications procedures at all. Data is transmitted to a remote computer only when the terminal is polled. Data received from the computer is stored on the receive buffer to be printed out at the operator's convenience. In addition, if the traffic load is such that one terminal does not generate enough activity to keep a line busy, multiple Wiltek terminals can share the same communications controller and line. However, there is no connection among the terminals, and data cannot be transferred from terminal to terminal.

The chief advantage of this arrangement is that it permits inexperienced personnel to use the terminal effectively. ▷

CHARACTERISTICS

MANUFACTURER: Wiltek, Inc., 59 Danbury Road, Wilton, Connecticut 06897. Telephone (203) 762-5521.

MODELS: A Wiltek buffered terminal consists of a pair of Digi-Store buffer units, a communications control unit (Master Base), and a peripheral device for inputting and outputting data. Standard models now offered include:

Model 300—includes Teletype Model 33 KSR.
Model 330—includes keyboard and 30-character-per-second printer.
Model 350—includes Teletype Model 35 KSR.
Model 500—includes Hazeltine CRT unit.
Model 820—includes 200-card-per-minute card reader.

Each of these models is also available as an auxiliary unit without the Master Base; multiple auxiliary units can share the Master Base contained in any one terminal.

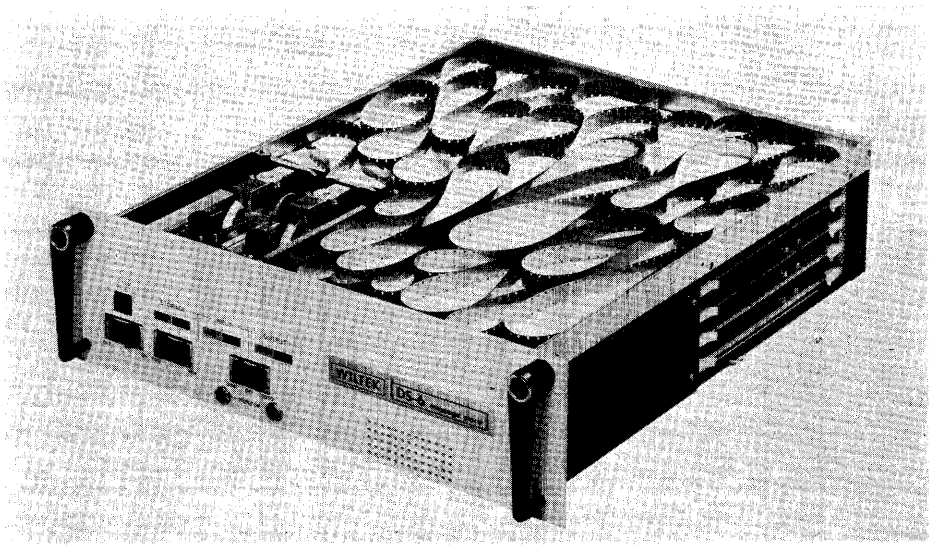
COMMUNICATIONS: Transmission is half-duplex, synchronous at 1200 bits per second using the built-in modem. Optionally, an external modem can be used for transmission at 2400 bits per second. Format and line control procedures are compatible with the IBM bisynchronous (BSC) technique using EBCDIC transparency; i.e., all text characters are framed by specific two-character EBCDIC control sequences and any configuration of 8 bits is a valid data character. Most of the models use an internal ASCII code, with the eighth bit used as a parity bit. The communications control unit automatically generates all required EBCDIC control characters, including the cyclic redundancy check character. The interface is compatible with the Bell 202 Series modems at 1200 bits per second and with the 201 Series at 2400 bits per second.

Operation can be over a leased line or the public telephone network. The built-in modem can be equipped with automatic answering to permit polling via the dial-up network.

DEVICE CONTROL: All Wiltek models operate in a polled environment only. The operator is completely uninvolved in the communications process. This is accomplished through the two tape buffer units. One is used to store data keyed in by the operator until the terminal is polled. The other is used to store received data until the operator is ready to print it out. The storage capacity of each buffer is about 50,000 characters.

Certain terminal models include various features to facilitate editing of data prior to recording in the send buffer. ►

Wiltek Buffered Data Communications Terminals



The Digi-Store tape buffer unit is shown here in a separate configuration including line control features. The random loops of sprocketed 16-mm magnetic tape are clearly shown. The independent tape transports and heads are visible near the front of the unit at left.

Only typing skill is required. One result of this arrangement, which may or may not be a disadvantage depending on your needs, is that conversational or interactive communication cannot be accomplished—there is complete separation between sending and receiving, even though the same terminal may do both. However, an option permits bypassing the buffers for alternate conversational operation.

The buffer units are sizable. Each can hold up to about 50,000 characters, or the output of an average typist working steadily for about four hours. For many places, this will be about all the data that can be generated in a day, and one transmission at the end of the day would suffice. In other locations, several polls per day would be expected. In either case, as long as the on/off switch is left on, the operator does not have to be concerned about when the transmission takes place. Naturally, the operator or someone else must become involved if operational difficulties develop.

Wiltek has delivered several hundred terminals in various configurations and has several hundred more on order. The chief use of these terminals has been as replacements for private teletypewriter arrangements such as the Bell System 83B and 83C used in store-and-forward message switching systems. Simplification of operator procedures is very evident in this application.

Wiltek originally manufactured specialized communications equipment for government and military agencies. The Digi-Store magnetic tape buffers were introduced in 1962. Over the last few years, the company has mounted a successful program to change its principal market from government to commercial users.

The terminals described in this report form a more-or-less standard product line, but the company has interfaced

The facilities provided by the Hazeltine 2000 CRT unit are fully described in Report 70D-471-01. The keyboard/printer models provide a special feature for character and line delete; affected lines and characters are deleted from the magnetic tape.

All operations of each terminal center around the magnetic tape buffer unit. The detailed characteristics of this unit are spelled out under the "Magnetic Tape Buffer" heading. We will discuss the operational aspects here.

The feature of the buffer unit that makes it possible to divorce the operator from the communications process is the implementation of independent read and write mechanisms (heads and tape transports). The tape in the unit is a single loop, and excess tape can build up between the read and the write stations. As data is keyed into the buffer (or transferred from a CRT or a card reader), the tape loop expands between the write head and the read head. When the unit is polled, the read transport is activated and data is transferred to the line. There is no synchronization between the two transport mechanisms, except overrides when a read attempt is made when there is no data to read or when a write attempt is made when the tape is full. The override detection is made by pressure switches located in the pertinent tape loops.

To match the incremental, asynchronous characteristics of the tape units to the block-oriented, synchronous characteristics of BSC transmission, Wiltek incorporates a semiconductor memory exactly one block-length long between the send unit and the communications line. The standard memory is 160 characters long; optionally, the user can expand this to any size up to 390 characters. Blocks shorter than the memory can be handled with no special effort because control characters imbedded in the data stream identify the end of data.

The amount of tape between the read and write mechanisms is about 3 inches minimum (about 250 characters). At the end of data input, the tape is advanced enough so that the last character can be read, and the record is released for transmission (when polled).

The asynchronous arrangement of the two buffers (each with its own tape loop and independent read and write

Wiltek Buffered Data Communications Terminals

other input/output devices in addition to the ones mentioned here. For example, a terminal was built that used the Bell and Howell (formerly Motorola) optical mark card reader. In the future, and on special order, many other peripheral devices are likely to be seen connected to a Wiltek buffer. □

mechanisms) prevents the Wiltek terminals from being used effectively in a conversational mode. The normal mode is to create the data input, transmit it when the computer polls the terminal, and then print out any data transmitted from the computer (collected on the tape in the receive buffer) at one shot. This cycle can be repeated many times a day if the nature of the application calls for it.

ERROR CONTROL: The cyclic redundancy check character in received blocks is checked. If the check fails, a negative acknowledgement sequence is returned. An odd/even block flag is used to prevent duplicating or skipping blocks. If the terminal receives a negative acknowledgement in response to a transmitted block, retransmission is performed from the semiconductor memory; i.e., the tape is not reversed. There is no limit to the number of retransmissions. In a dial-up arrangement, line failures or other problems that completely prevent accurate transmission can be handled by having the remote computer hang up. Loss of the carrier on the line will be detected by the Wiltek terminal, and it will disconnect.

Internally, a parity bit is written and checked when read. Normally, a user-selected substitution character (such as "?") is inserted if the parity check fails. Error recovery procedures must be programmed for the remote computer.

MULTI-STATION CONFIGURATIONS: The Master Base communications control unit can interface a total of 10 send and receive buffers. Each terminal model is available with or without the Master Base, so any combination of capabilities is permitted within the limit of 10 buffers total. Each station operates independently. Each send and receive buffer has an individual address, permitting selective polling and addressing. To the users, there is no apparent connection among the terminals. All data is transmitted over the same line, providing, in effect, a concentrator. Auxiliary units connect through an RS-232 interface and can be up to 100 feet away from the Master Base.

MAGNETIC TAPE BUFFER: The Digi-Store buffer unit contains a continuous loop of 16-millimeter (0.63-inch), sprocketed magnetic tape about 50 feet long. Recording density is only about 83.3 bits per inch, simplifying the electronics required. Data is recorded in parallel tracks, one character per frame. The two independent transport mechanisms drive the tape via spockets in an incremental mode at up to 333 characters per second. Tape does not touch the read/write heads, as a result of the sprocket drive and low recording density, which reduces oxide build-up on the heads and prolongs their life and the life of the tape. Tape motion and recording/reading is performed on a character-by-character basis in response to the signals from the originating source or destination circuitry. Changing the tape is not a difficult task–but no container is provided to hold extra tapes, and normal use would preclude the buffer from being used in the manner of a cartridge unit.

TYPEWRITER MODELS: Model 300 combines a Teletype 33 KSR with the buffer units and Master Base; Model 350 includes a Model 35 KSR. The Teletype units are fully described in Reports 70D-830-01 and 70D-830-02.

Model 330 combines a 30-character-per-second printer developed by Wiltek with a typewriter keyboard, the buffer units, and the Master Base. The printer is an impact type with horizontal and vertical tab features. The line width is 132 characters.

CRT MODEL: Model 500 combines a Hazeltine 2000 CRT unit (sans communications interface, of course) with the buffer units, a 10-, 30-, or 100-character-per-second printer, and the Master Base. The Hazeltine 2000 is described in Report 70D-471-01. The CRT is connected to the send buffer, and the printer is connected to the receive buffer. Optionally, the output of the send buffer can be routed to the receive buffer as well as to the communications line, so that a complete record is maintained of all data received and sent. The CRT is not connected to the receive buffer, and data received from the remote computer cannot be displayed. Neither can data be retrieved and displayed from the send buffer.

Data is transferred to the send buffer a full screen at a time after the data has been entered and edited. The memory unit in the display holds data until the operator wishes to release it.

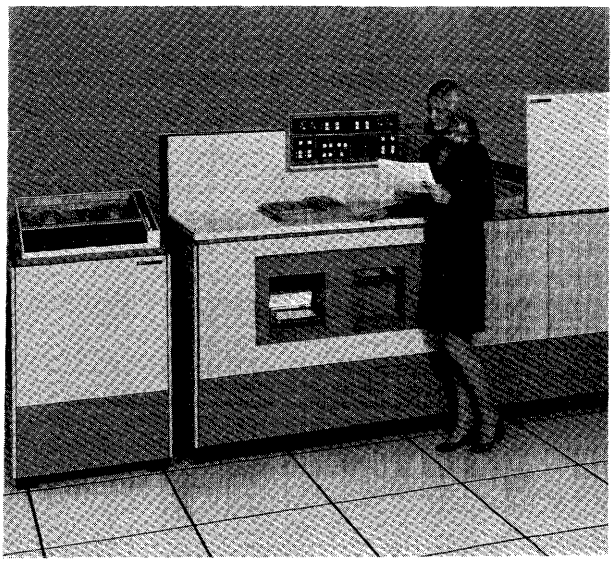
The 10-character-per-second printer is a Teletype RO unit. The 30-character-per-second printer is the same as used in the Model 330. The 100-character-per-second printer can be either a Centronics or Printer Technology unit, as specified by the user.

In addition, a Model 6400 Magnetic Card Reader can be attached to the CRT unit to store format information. This device was built by Wiltek to utilize the 3-by-7-inch cards used with IBM's Magnetic Card Selectric Typewriter. It cannot be connected to the send or receive buffer. It holds 40 tracks of data with 160 characters per track (6400 characters total).

CARD READER MODEL: The Model 820 includes a 200 card-per-minute card reader along with a send buffer and Master Base. The card reader is manufactured by Bridge Data Products and can read either 80-column or 96-column (with an adapter) cards.

PRICING: Wiltek has declined to furnish Datapro with detailed price information. The units are available for purchase or long-term lease. Normal leasing periods are three or five years, but the company states that a two-year or four-year arrangement is also available. In general, the company states that a complete terminal leases for about $200 per month on a five-year lease and $220 per month on a three-year lease. Typical purchase prices are about $10,000. A model to be used as an auxiliary unit without the communications interface costs about $2,500 less than a complete terminal and leases for about $45 (five-year lease) or $55 (three-year lease) per month less. ■

Xerox 1200 Computer Printing System



The off-line version of the Xerox 1200 system is shown here, with its 9-track magnetic tape unit at left.

Available in on- and off-line versions, the Xerox 1200 system utilizes the xerographic non-impact printing technique to provide a high-performance alternative to line printers. Virtually any 9-track tape format can be accommodated via program control. Printing is performed at 4000 lines per minute on ordinary 8½-by-11-inch paper; features include multiple copies, collating, and forms overlays.

MANAGEMENT SUMMARY

Designed as an alternative to conventional impact-type line printers, the new Xerox 1200 Computer Printing System represents a long-awaited and highly promising application of Xerox copier technology in the computer environment. Available in on- or off-line versions, the Xerox 1200 combines xerographic printing and optical character imaging techniques to produce printed copy at rates up to 4000 lines per minute on ordinary 8½-by-11-inch paper stock.

The on-line version of the Xerox 1200 is designed for use with the Xerox Sigma 6 or 9 computers only. The off-line version, shown above and described in this report, includes a computer-compatible, 9-track tape drive and accommodates virtually any computer-generated tape format recorded at 800 or 1600 bits per inch.

The printer, a modified Xerox 3600-I copier, is controlled by a programmable controller under the direction of a Xerox-supplied printer control program, which is loaded from magnetic tape prior to operation. The control program contains file-related parameters for three of the more widely-used tape formats; in addition, the user can create (under Xerox supervision) his own library of up to 33 sets of file-related parameters, any of which is operator-selectable prior to processing each file. Operator controls are also provided to allow the selection of additional job-related functions prior to file processing.

Printing is performed on a line-at-a-time basis, with the printed lines running parallel to the long dimension of the page. Each page can contain up to 66 lines of 132 characters each. Features include multiple-copy selection ▷

CHARACTERISTICS

MANUFACTURER: Xerox Corporation, 701 South Aviation Boulevard, El Segundo, California 90245. Telephone (213) 679-4511.

MODELS: The Xerox 1200 Computer Printing System is available in two models: one for off-line printing from industry-compatible magnetic tape, the other for on-line printing with a Xerox Sigma 6 or 9 computer. This report describes the off-line version.

CONFIGURATION: The Xerox 1200 system for off-line printing includes a single stand-alone tape drive, and a xerographic printer and combined controller in a separate cabinet.

MAGNETIC TAPE INPUT: The read-only tape drive reads tape recorded in 9-track industry-compatible format at 800 or 1600 bits/inch. Dual density is not available. Read and rewind tape speeds are 75 and 300 inches/second, respectively. Reels up to 10.5 inches are accommodated.

PRINTED OUTPUT: Printing is performed by means of the xerographic process at a fixed rate of 3600 pages/hour (one page/second). In terms of lines per minute, the Xerox 1200 prints a maximum of 4000 lines/minute when printing full 66-line pages. The printer accommodates ordinary 11-inch by 8.5-inch paper stock and prints up to 132 characters/line and up to 66 lines/page for a total of 8712 printed characters per page. Printing is performed along the long dimension of the paper, so that a printed page looks like a reduced copy of a conventional computer printout. Horizontal and vertical spacings and 13.3 char/inch and 8 lines/inch, respectively. Any of 95 ASCII symbols, including upper and lower case alphabetics, numerics, and special characters, can be printed.

Forms projection overlays (photographic negatives) can be used as an alternative to preprinted forms. The overlays are prepared by Xerox Corporation to the user's specifications.

Hopper and stacker paper capacities are 2400 pages each. Two stackers (bins) are provided; each provides half the total stacker capacity of 2400 pages. The two-bin stacker is a modular unit that physically mates with the printer. Printed pages move across the top of the stacker, are inverted, and are then stacked face down so that the first page of a job or run appears on the bottom of the stack, with the last page on top. To distinguish between copy sets, each copy set is offset from the previous one by 1/2 inch. Bin selection is performed manually; pages are stacked in the first bin when a bin has not been selected. The alternate bin is loaded following overflow from the active bin. Bins can be switched at any time provided the alternate bin is available.

A sample print tray provides access to printed copy during processing on operator request to allow the copy ▶

Xerox 1200 Computer Printing System

and copy collation. As many as 99 copies of a file can be printed, either collated or uncollated. Printed files and copy sets are physically separated within the stacks to increase ease of operation. Printed forms can be used or, as an alternative, a form overlay (produced by Xerox according to user specifications) can be projected onto the print drum as each copy is produced. A sample-print feature permits the operator to produce a printed copy of the page being printed to sample its contents as well as the print quality.

The advantages of the Xerox 1200 System, as well as its basic limitations, should be carefully evaluated when considering the system as an alternative to impact printing for your own installation. The advantages of the Xerox 1200 over conventional impact printers include:

- Its comparatively high printing speed.
- The ease of handling standard 8½-by-11-inch sheets of paper as contrasted with the usual wide fanfold forms.
- The use of ordinary paper stock, which is readily available and significantly less expensive than fanfold printer forms.
- The elimination of costly preprinted forms and/or multiple-part form sets.
- The elimination of forms bursting and decollating equipment.
- The inherently high print quality of the xerographic printing technique.
- The consistency of print quality for multiple printed copies.

The basic limitations of the Xerox 1200, as compared with conventional impact printers, are as follows:

- Only one copy is produced at a time.
- The need for multiple copies and/or partially filled pages can substantially reduce the effective print speed (although the page rate remains constant).
- Narrow paper widths cannot be accommodated (but paper slicing equipment is available).
- The sequence of pages within a report can be inadvertently altered as a result of the sheets not being attached to one another.
- Sizeable floor space is required; 157.5 square feet, including a 3-foot clearance on all sides, is required for the off-line unit.
- Power consumption is comparatively high: 14.5 KW for the printer/stacker and 2.4 KW for the tape drive.

The off-line version of the Xerox 1200 is scheduled for initial production deliveries during July and August 1973.

Service is provided by Xerox through its nationwide service locations. □

quality to be checked. Misprinted pages are automatically rejected and are directed to the sample print tray, face up. During file processing, each page directed to the sample print tray is reprinted for delivery to the active stacker bin.

The printer is a specially engineered Xerox 3600-I copier that has been modified to operate in variable print mode in addition to the normal fixed-data, page-scanning mode. The printer combines the xerographic printing technique with the symbol-formation technique of conventional drum-type line printers. Instead of being mechanically struck to form images on the paper, as in drum printers, the characters on the Xerox 1200 print drum are optically imaged on a xerographic drum and then transferred xerographically to the paper.

The optically opaque print drum contains transparent character images; each character of the print set is arranged in a row of 132 characters, one row for each print position, just as the characters are arranged on a conventional print drum. The characters on the optical drum are imaged onto the xerographic drum by means of a row of high-intensity flash lamps inside the optical drum. The flash lamps are analogous to the print hammers of a conventional drum printer in that they flash at the instant when the particular character to be imaged is passing the lamp. Xerox refers to the imaging system as the optical character generator (OCG).

DEVICE CONTROL: The nucleus of the Xerox 1200 is a programmable controller that controls and supervises job processing under the direction of the Printer Control Program, a standard operating program (furnished by Xerox) that controls tape motion, tape reading, label processing, format interpretation, and output printing.

File-related parameters that define the code and format of the input tape for the Printer Control Program are defined as discrete entries within the Job Descriptor Library, a user-prepared file consisting of up to 33 sets of file-related parameters. Each job descriptor entry is an 80-byte record that contains the input/output parameters for a particular file or class of files to be processed by the Xerox 1200 system.

Xerox provides three standard job descriptor entries as part of the Printer Control Program. If all job tapes to be processed conform to the prepared entries, it is not necessary to load a Job Descriptor Library tape. The prepared job descriptor entries accommodate IBM OS/360, ANSI, or unlabeled job tapes having a block length of 10 133-byte records; the printed line length is defined as 132 characters, with the initial character printed in column one.

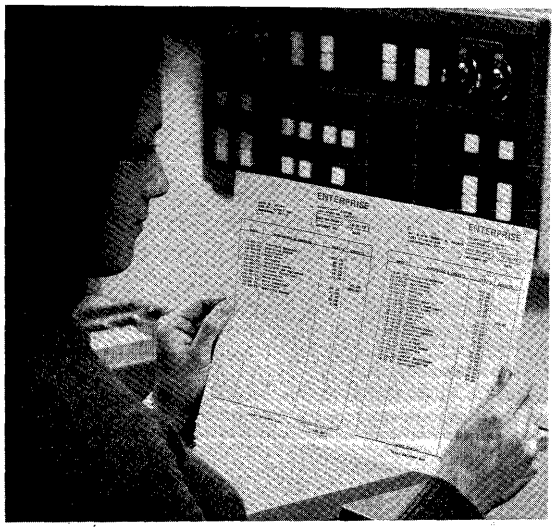
The Printer Control Program and Job Descriptor Library are loaded from tape prior to operation.

Job descriptor entries define blocked or unblocked EBCDIC or ASCII tape formats having fixed, variable, or undefined record lengths and standard labels or no labels. Block lengths can vary from 12 to 4096 bytes. Label conventions must conform to IBM OS/360, DOS/360, or ANSI standards. Print formats can be defined according to several parameters, including the initial print position (1 to 132), line length (1 to 132), and vertical format control (1 to 12 channels). The carriage control character can be defined as ANSI, IBM 1403, or Xerox. Also, the location of the carriage control code, initial print character, and length (in bytes) of the block prefix for ANSI labels on the job tape can be defined.

The Job Descriptor Library is created on an unblocked, unlabeled tape where each block is one of the 80-byte job descriptor entry records.

Job-related functions are established by operator selection at set-up time, using controls located on the system control panel. The job descriptor parameters that define the

Xerox 1200 Computer Printing System



These statements were printed in "two-up" fashion on ordinary 8½-by-11-inch paper, using the novel forms overlay capability of the Xerox 1200 system.

job to be processed are selected from one of the 33 sets of entries contained in the Job Descriptor Library; the selection is sampled by the Printer Control Program each time processing of a new file begins. Single- or multi-file reels are specified. Single-file selection causes the system to halt after the processing of each file to allow the operator to select the appropriate job set-up parameters for the next file. With multi-file selection, all of the files contained on a reel are processed prior to system halt. Files that are contained on a single reel or that overflow onto two or more reels are specified through single- or multi-reel selection.

The number of copies to be printed of each file is specified by means of a two-digit entry that is sampled by the Printer Control Program each time processing of a new file begins. Collation can be specified when multiple copies are requested. If collation is not specified for multiple-copy printing, all copies of a given page are printed before the next page is printed. If collation is specified and the file is confined to a single reel, each page is printed in succession and the tape is automatically rewound and reread for each copy set. When the file overflows to a second reel, operation is the same as for a single reel except that all requested copies of the page that spans reel boundaries are printed uncollated after operation is started for the continuation reel. Collated copies for the remainder of the tape or file are then produced. Therefore, collated multiple copies of multiple-reel files require a manual merging of the collated partial copy sets and the uncollated reel-spanning pages.

Controls are also provided for bin (stacker) selection, bin positioning (up or down), and overlay illumination for the use of forms overlays.

Manual tape controls move the tape forward or backward by one block or continuously in the selected direction until the process is manually halted, a tape mark is encountered, or (when moving backward) the beginning of tape (load point) is encountered. Except for the load point, the tape always stops in an interblock gap.

Other manual tape controls move the tape forward or backward at the normal reading rate to the next tape mark that indicates the boundary of the current file. When moving backward through the first or only file on the reel, the tape stops at the load point. A special control enables the bootstrap loader to load the Printer Control Program.

A three-digit status indicator displays the coded status of the system whenever processing stops. The status code defines the stopping conditions.

ERROR CONTROL: Error recovery procedures are implemented to provide automatic recovery from specific input/output errors. Operator intervention is required only when errors cannot be automatically recovered.

Input or tape-related errors that are recoverable include tape read errors and tape timeouts. Tape read errors cause the tape to be backspaced and the erroneous block to be reread. The number of times that a block will be reread as a result of subsequent errors is determined by user parameters under program control. Noise records are defined as blocks of less than 12 bytes that produce tape read errors; no attempt is made to process or print noise records. A tape timeout occurs when tape data is not detected within 800 milliseconds after a read command has been issued. The system is halted after all pages have been delivered to the output bin; continuation can be manually initiated.

Output or printer-related errors are classed as single or multiple page errors. Recoverable errors include feedchecks, data transfer and imaging errors, single-page and multiple-page errors. A feedcheck error is defined as either a no-sheet feed or a multi-sheet page. Single-page errors are classified as feedchecks or data transfer and imaging errors; correction is attempted by reprinting the page. The number of repeated attempts to print a page is determined by user parameters under program control. Recovery for multi-page errors, resulting from paper jams, is implemented by automatically backspacing the tape to the beginning of the last block and reprinting all pages beginning with the first page that did not reach the stacker. Operator intervention is required to correct the paper jam and remove all pages that did not reach the stacker.

PRICING: The Xerox 1200 is currently available on a rental basis only. Monthly rental includes usage and meter charges; meter charges are based on the number of copies printed during the 30-day period. A minimum meter charge applies against the initial 100,000 copies; graduated descending charges apply to all printed copies in excess of the initial 100,000 copies, as tabulated below. Minimum installation period is 6 months. A 30-day notification is required prior to cancellation.

Xerox 1200 System	Usage Charge	Meter Minimum*	Total Minimum
On-Line	$1,000	$1,100	$2,100
Off-Line	$1,500	$1,100	$2,600

Meter Rates	$ Per Copy
Number of copies:	
0 to 100,000	0.011
100,001 to 300,000	0.007
Over 300,000	0.004

Supplies	Purchase Price
New overlay	$55
Replacement overlay	$30 ■