NOVEMBER 14, 1986

Mini-Micro Systems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

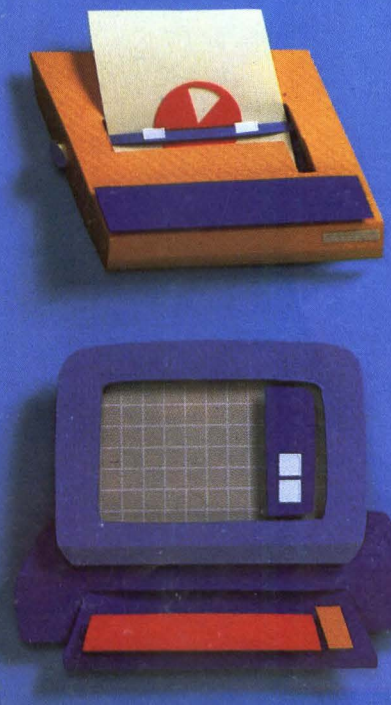
FALL PERIPHERALS HANDBOOK

Problem-Solving Guide

SCSI aids PC/AT tape drive integration

How to solve high-capacity backup problems with quarter-inch and half-inch tape drives . . . . . .

Product Reference File



5 ¼-inch and smaller rigid disk drives

3 ½-inch flexible disk drives

Matrix character printers

Alphanumeric display terminals

NOVEMBER ISSUE SUPPLEMENT

Until now, you expected to get what you paid for. Bruning's new ZETADRAF 900 E-size, single sheet plotter gives you *more.*

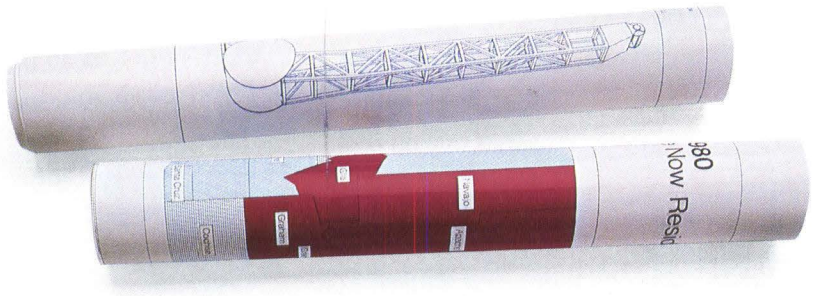
How? We've designed and engineered a totally new E-size plotter to the point where it outperforms every other plotter of its type.

And at the same time, we reduced the price!

The drawing quality is superb. And, when you consider 6 g's acceleration, 45 ips chart speed and 8-pen color capability, it's unmatched.

Of course our faster plot speed means your output is higher than ever. ZETADRAF 900 could cut the plot time for your most dense design in half.

ZETADRAF 900 supports all major CAD software packages and is compatible with most computers. Interfaces include RS232, IEEE-488, GML and HPGL.



No prior plotter experience is required, even for liquid ink. ZETADRAF 900 has two levels of operation–novice and advanced. But *everyone* appreciates features such as the angled, LCD control panel and the ability of the plotter to store even complex user-designed configurations.

Sorry CalComp and HP. We just didn't realize when we started out that we could produce so much plotter for so little money. But we did. Get all the facts about ZETADRAF 900 or our other ZETA drafting plotters by calling (415) 372-PLOT or write:

Bruning Computer Graphics
777 Arnold Drive
Martinez, CA 94533
TWX 910-481-5951

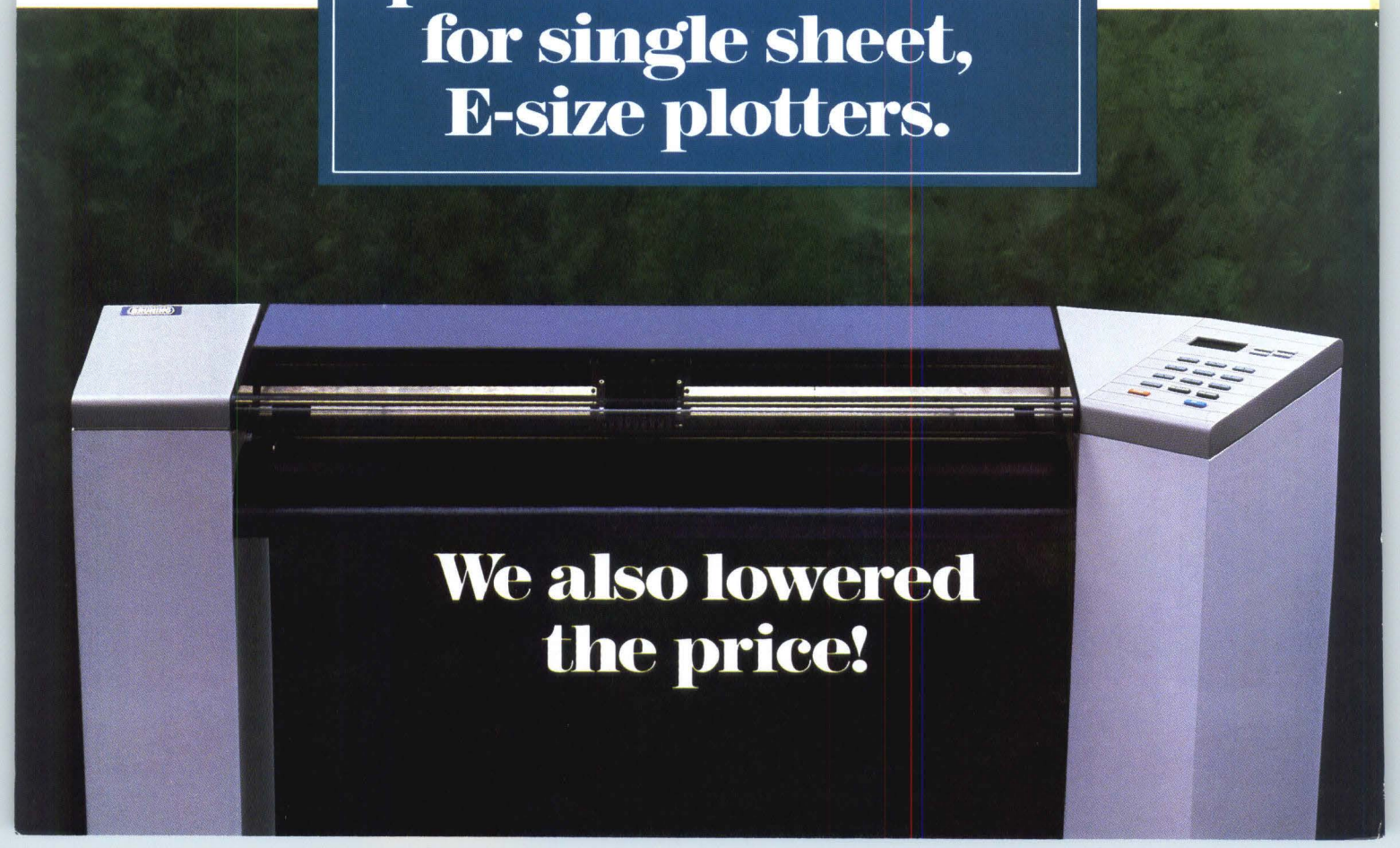
A division of AM International

CIRCLE NO. 1 ON INQUIRY CARD

BRUNING

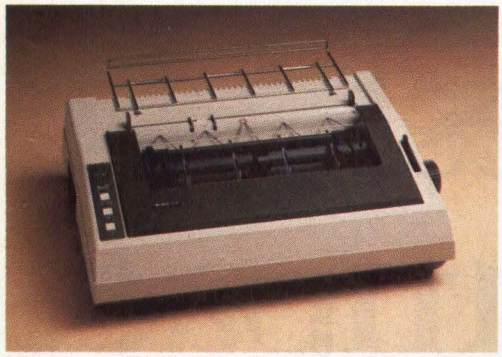
Introducing the ZETADRAF 900 for $7,950.

We just raised the performance level for single sheet, E-size plotters.



We also lowered the price!

YOUR OFFICE PRINTER FAMILY



Tailored for your IBM PC or compatibles, the Facit 4509 provides graphics and multi-font printing at a budget price.

The 132-column Facit 4514 printer features NLQ as well as Epson FX and IBM PC character and command sets.

The fast Facit D2000 daisywheel printer is IBM/Epson compatible and can be equipped with a cut-sheet feeder.

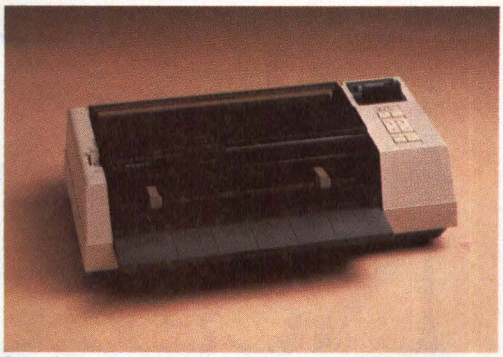
The C-line printers, Facit C5500 and Facit C7500, provide 250/400 cps, color graphics, multi-interfacing and flexible paper handling.

Meet eight representatives of the extensive Facit Office Printer family. Encompassing almost every aspect of quality printing, they make your printer choice easy. From dedicated PC-printers to extremely heavy-duty system printers for round-the-clock operation.

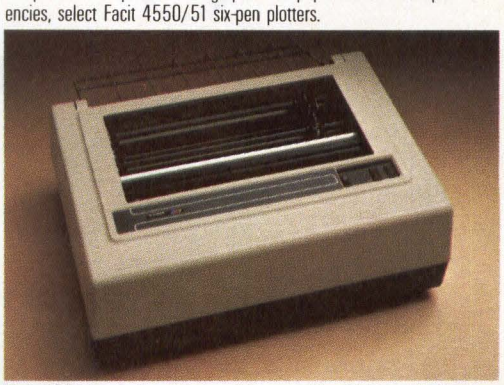
In addition to the Facit multi-purpose printer concept, the Office Printer family also includes printers for more specialized applications like bar-code/labels, word-processing and high-speed color graphics.

The full selection of standard interfaces, character sets and command protocols ensure that every Facit Printer will make friends with your system.

And, no doubt, with your budget, too.

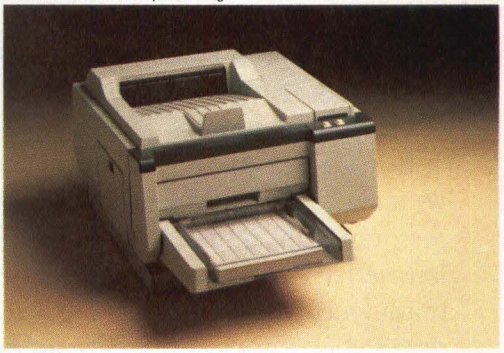


For professional presentation graphics on paper and OH-transparencies, select Facit 4550/51 six-pen plotters.



Facit 4544 heavy-duty Paintbox Printer provides high speed printing as well as multi-color graphics/labels.

Facit 4571 is equally at home in round-the-clock data report applications as in NLQ wordprocessing.



Facit Opus 1 Laser Printer provides high-quality printing at workloads of 20,000 pages/month.

CIRCLE NO. 251 ON INQUIRY CARD

FACIT

Head Office: *Facit AB, S-172 91 Sundbyberg. Sweden. Phone: (8) 764 30 00.* USA: *Facit Inc. P.O. Box 334, Merrimack. NH 03054. Phone: (603) 424-8000*
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Disk Crashes Negatively Impact

So Hitachi Disk Drives are Built to Last.

"That *$(#&!! system you sold us died. The disk drive crashed." To the customer on the phone it doesn't matter that you purchased the drive from someone else. Your logo is on the product.

Hitachi understands the feeling. After all, we're one of the largest OEM computer system manufacturers in the world, and we use disk drives in our own equipment, too. If a drive should fail in a piece of our equipment, we'd get those charming phone calls, same as you.

So we use the most reliable disk drives available anywhere: Hitachi disk drives.

The art of making disk drives better.

Hitachi has 1,500 design engineers who work on nothing but disk drives. We design and build our own motors, heads, microprocessors, and custom LSI to ultra-high specifications. Then we subject them to the most stringent Quality Assurance program in the industry. We've learned over the past 15 years of disk drive manufacturing that this is the only way to make drives good enough to use in our own systems.

A serious commitment to disk drive solutions.

We have one of the broadest lines of state-of-the-art disk drives you can find, including 3.5", 5.25", 8", and 8.8" Winchesters. We've also made the enormous R & D expenditures necessary to be one of the pioneers in optical storage technology.

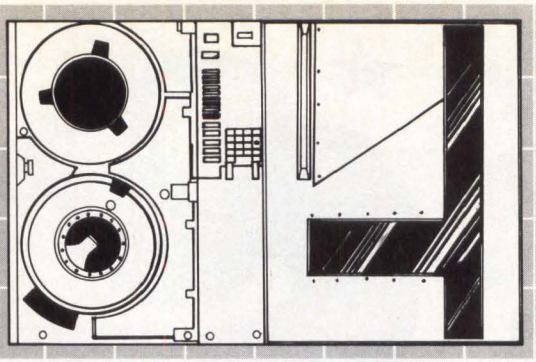
Hitachi is serious about staying with the product line for the long haul. Very serious. We believe in forging long-lasting relationships through a combination of superior quality products and superior support.

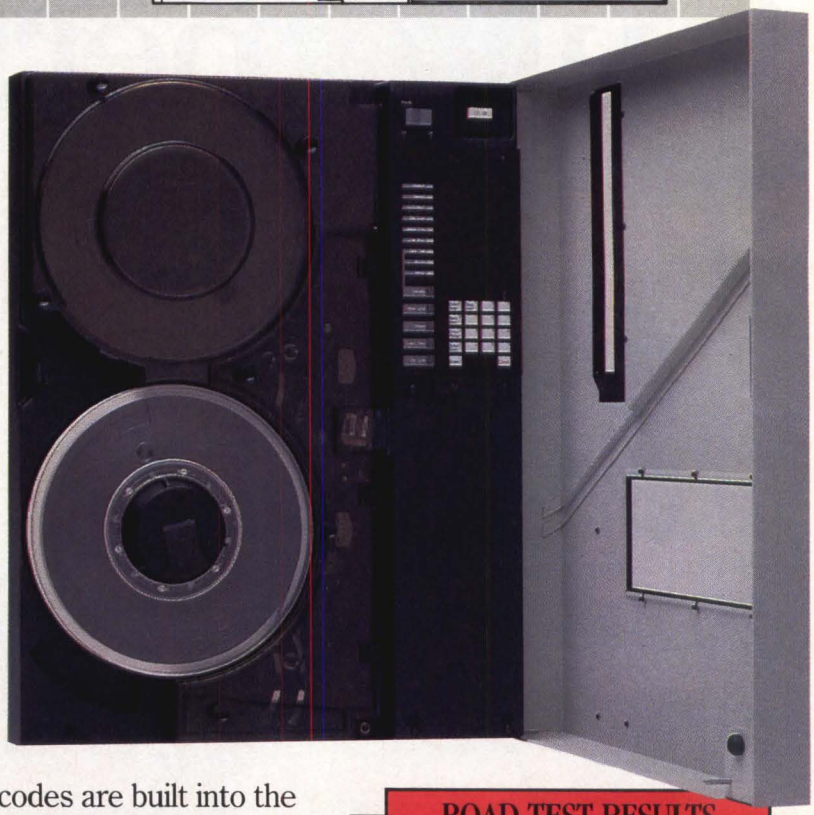
With Hitachi, you choose a business partner who will be here to work with you, today and tomorrow . . . helping you to keep your phone ringing with new orders, not complaints.

Fast Action:
To obtain product literature immediately, CALL TOLL FREE 1-800/842-9000, Ext. 6901. Ask for literature number PB-001.

Storage Technology's
New 2925
Tape Accelerator.

It goes with unsurpassed speed.
It comes with unsurpassed features.





TAKE THE PERFORMANCE DRIVE.

StorageTek's Model 2925 gives you the speed you need, and the features your customers demand. The 2925's Accelerator (Cache) feature dynamically adapts to system requirements and the host's capability ...at transfer rates ranging from 100 kilobytes per second up to 1.25 megabytes per second. The 2925 goes with speed indeed; but what it *comes with* is even more remarkable.

AT A GLANCE

Series Standard Features

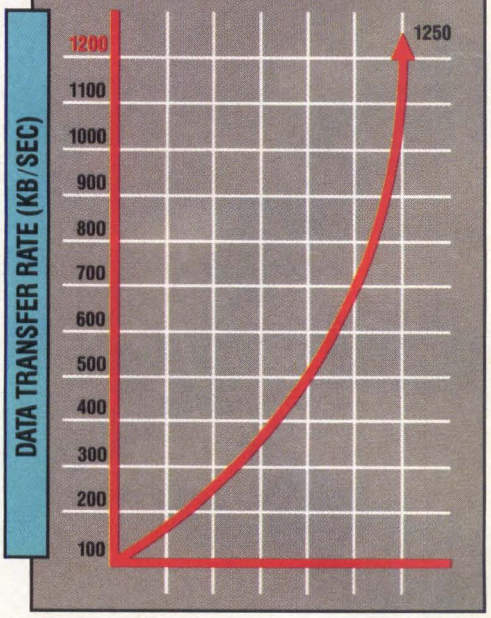
- *Dual-speed 50 ips Start/Stop and 100 ips Streaming with Buffered or Synchronous mode*
- *ANSI Standard 1600 bpi/6250 bpi formats*
- *Convenient Auto-Threading*
- *Integrated Formatter/Controller*
- *Service Panel with Alpha/Numeric Display*
- *Resident Diagnostics*
- *Host-optimized Data Transfer Rates*

Error correction codes are built into the cache's 256k of multi-record memory; so your data is checked both as it enters cache and as it is written onto tape. Data can be retrieved directly from cache–should defective media be encountered. The 2925 allows OEM systems integrators to attach ANSI-compatible 1600/6250 bpi capability to systems ranging from micros to minis...without software modification. For ease of integration, the 2925 is available with either StorageTek- or Pertec-compatible interfaces.

That's still only the beginning–be sure to read the accompanying list of features. You'll understand at a glance that 2925 performance is not only *speed...but reliability, flexibility and ease of operation.* StorageTek's experience with GCR 6250 bpi technology includes a full 11 years of pioneering, proving and perfecting. Our 2920 Series includes the 2921 (50 ips start/stop), the 2922 (50 ips start/stop with 100 ips streaming) in addition to the 2925 subsystem.

Take a drive in our 2920 Series...
and experience performance you'll be proud to call your own.

ROAD TEST RESULTS



StorageTek

Storage Technology. It's More Than Our Name...It's Our Commitment.

CIRCLE NO. 3 ON INQUIRY CARD

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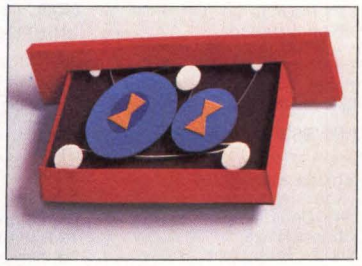
Mini-Micro Systems

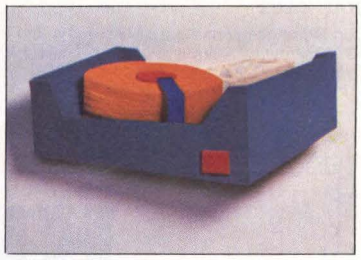
Fall Peripherals Handbook

A CAHNERS PUBLICATION VOL. XIX NO. 14 NOVEMBER 14, 1986

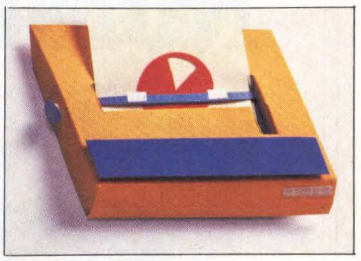
FEATURES

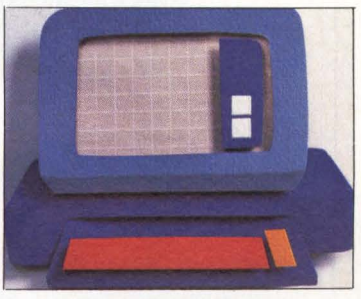


PRODUCT GUIDES



DEPARTMENTS





Cahners Publishing Company • A Division of Reed Publishing USA • Specialized Business Magazines for Building and Construction • Electronics and Computers • Foodservice • Manufacturing • Book Publishing & Libraries • Medical/Health Care.
MINI-MICRO SYSTEMS (ISSN 0364-9342) is published monthly with additional issues in February, April, June and November by Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington St., Newton, MA 02158. William M. Platt, President; Terrence M. McDermott, Executive Vice President; Jerry D. Neth, Vice President of Publishing Operations; J.J. Walsh, Financial Vice President/Magazine Division; Thomas J. Dellamaria, Vice President Production and Manufacturing; Terrence M. McDermott, Group Vice President.

Circulation records are maintained at Cahners Publishing Co., 270 St. Paul St., Denver, CO 80206. Second class postage paid at Denver, CO 80202 and additional mailing offices. Postmaster: Send address changes to MINI-MICRO SYSTEMS, 270 St. Paul St., Denver, CO 80206. MINI-MICRO SYSTEMS is circulated without charge by name and title to U.S.- and Western European-based corporate and technical management, systems engineers and other personnel who meet qualification procedures. Available to others at the rate of $65 per year in the United States; $70 in Canada and Mexico; $95 surface mail in all other countries; air mail surcharge, $35 (16 issues). Special HANDBOOK issues, $15. Single issues, $5 in the United States; $6 in Canada and Mexico; $7 in all other countries.

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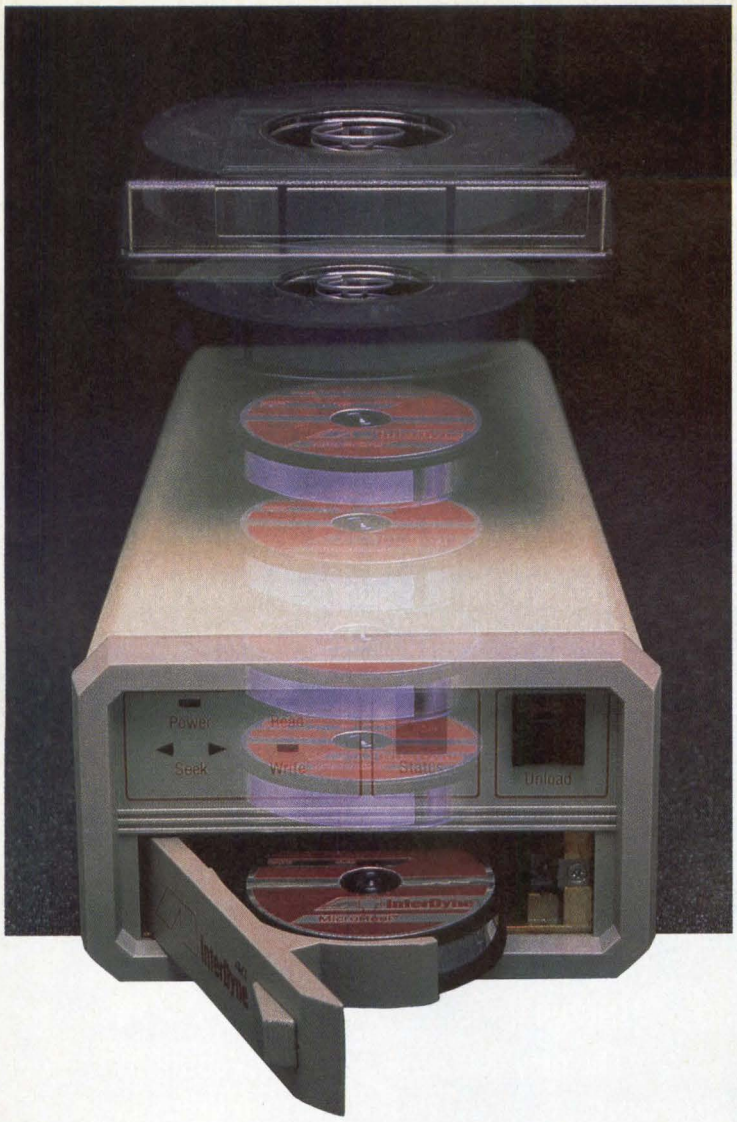

Why did IBM and InterDyne Choose Single Reel Technology?

The most experienced and respected leader in computer technology today had the foresight to choose single reel technology for its 3480 tape back-up products. Considering its reputation for high quality, it is obvious to us that IBM chose this technology after conducting exhaustive tests. Our test results reinforce the fact that single reel technology is more reliable, cost-effective, and has potential for greater capacity than cartridge technology.

InterDyne has followed in IBM's footsteps to create single reel technology for the PC, XT, and AT. Our 3½" form factor tape back-up subsystems offer 10, 20, 40 and 60 megabytes of capacity — storing an entire hard drive on a single MicroReel.™

InterDyne's technology makes IBM's insight work for you. We are a leading manufacturer of quality products and a technology developer for the computer peripheral marketplace. Call us for more information.

Reliability •
High Capacity •
Compactness •
Multi-channel Head Design •
Low Cost Media •
Upward Compatability •
Future Growth •

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CIRCLE NO. 5 ON INQUIRY CARD

A New Micro Sub

The Smallest Tape Subsystem Available Today.

The new IRWIN 400 Series micro subsystem is so small you probably won't even notice it sitting next to your computer. IRWIN's *little* (3″ by 5″ by 8″) technological breakthrough, stores up to 40 Mb of data on a shirt pocket-sized cartridge. That's *BIG* protection for your IBM PC/XT, PC/AT or compatibles.

The new 400 Series provides backup capacities of 10 Mb, 20 Mb or 40 Mb. So you only pay for exactly what you need. And with IRWIN, compatibility is assured when your backup requirements grow. Our larger capacity tape drives can read your important files written on any other IRWIN drive.

You'll find that the cost of an IRWIN 400 is small too. The first time you need to restore data with any of the 400 Series, it will more than pay for itself.

One function, even easier than installing an IRWIN 400, is operating the menu-driven software. The IRWIN software permits unattended backup of your entire disk or only those files you choose. And it's fast. You can backup 40 Mb in the time it takes to say ABRA-CA-DABRA. Well-l-l . . . Maybe several ABRA-CA-DABRA's.

The only way to take up less space than with an IRWIN 400 is to install an Irwin BACKUP™ right inside your PC . . . we do that too! IRWIN has 10 Mb, 20 Mb and 40 Mb internal systems that slide right into a PC's floppy disk slot, providing you with a "zero" footprint for your backup needs.

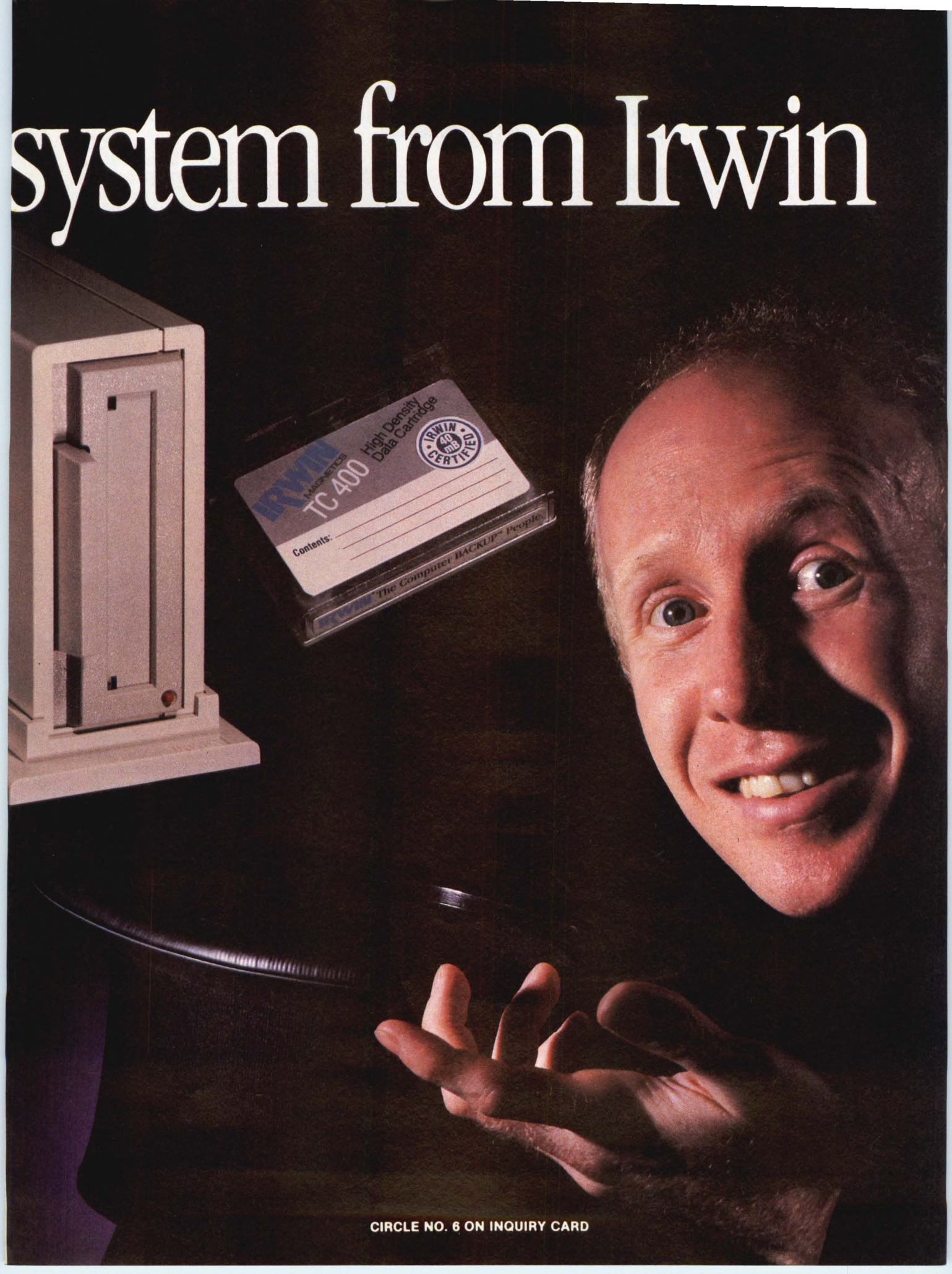
The new 400 Series, extremely small in size yet large in capacity . . . a little more magic from Irwin.

Unlike magicians, Irwin wants you to know how it's done. To find out, call 1-800-BACKUP 1 or visit a leading computer store for a "hands on" demonstration.

IRWIN® MAGNETICS

Irwin Magnetics Box 7639
Mt. Prospect, IL 60068
1•800•BACKUP 1

data cartridge technology™



INTERPHASE PULLS A FAST ONE

30 MBytes/s on VMEbus

INTERPHASE® shatters the old speed limits of the VMEbus with its second generation of VME disk controllers boasting 30 megabytes per second bus speeds and above. Using a new INTERPHASE technology breakthrough called the BUSpacket Interface℠ ... the new V/SMD 4200 Cheetah and V/ESDI 4201 Panther triple existing VMEbus speeds and approach the VMEbus theoretical bandwidth of 40 megabytes per second!

SIMPLY THE FASTEST

The combination of the BUSpacket Interface and a large (128 KBytes) cache memory provide the V/SMD 4200 and V/ESDI 4201 with unequalled speed, and make them the fastest SMD and ESDI controllers by a factor of three. No one even comes close!

In simple terms, the new INTERPHASE technology preformats packets of data to go across the bus before acquiring it. The INTERPHASE BUSpacket approach unharnesses the VMEbus from slow devices through deep, high-speed bus FIFOs and an asynchronous delay line-based state machine, which controls bus transfers. Data is emptied onto the bus in packets at speeds 30 megabytes per second and above.

STICK WITH THE WINNERS

The V/SMD 4200 and V/ESDI 4201 also incorporate the proven INTERPHASE features of the multitasking Virtual Buffer Architecture℠, Intelligent Caching, and zero latency operation found on other popular INTERPHASE products. The four drive V/ESDI 4201 Panther even adds an integral SCSI port for easy addition of back up devices.

Both products complement INTERPHASE's high-performance V/Tape 3209 1/2" tape controller, and are **PLUG & PLAY** software compatible with the industry's most successful SMD and ESDI controllers, our V/SMD 3200 and V/ESDI 3201.

THEY'RE GOING FAST

To learn more about the fastest SMD, ESDI and 1/2" tape controllers around, call or write today ... but you better move fast ... INTERPHASE certainly is.

(214) 350-9000

INTERPHASE corporation

2925 Merrell Road • Dallas, Texas 75229 • Telex: 9109976245 NASDAQ-NMS:INPH

Interphase International
93a New Street, Aylesbury, Bucks. HP20 2NY, England (0296)35661 Telex: 826715 AERO G

CIRCLE NO. 7 ON INQUIRY CARD

By efficiently linking quarter-inch and half-inch tape drives to desktop systems, integrators can solve high-capacity backup and data-interchange problems

SCSI AIDS PC/AT TAPE DRIVE INTEGRATION

D.L. Millican
Millican Consulting Associates Inc.

Desktop systems based on the IBM Corp. PC/AT backplane provide system integrators with augmented processing power and Winchester data storage well beyond the 20M bytes typically associated with PCs. Consequently, the need to back up and protect this larger amount of data and to transfer it from one desktop system to another becomes increasingly important.

Tape systems provide storage at low cost relative to RAM and rigid disk methods. They thus make the best choice for off-line storage, such as in backup and archival applications where data is not frequently accessed.

Most tape systems available for personal computers are streaming-drive types, designed to provide backup storage of the main rigid disk drive. These tape drives achieve high storage capacity and transfer rates by means of high tape speeds and data-transfer synchronization so that the tape runs in continuous motion. This setup usually results in a "disk image" backup, in which an exact copy is made of the system disk (including those areas that never change or contain no useful data).

An alternative method of performing data backup is the file-oriented approach. In this method, only selected data files are backed up at the discretion of the user (typically when data have been significantly altered). The main problem with this method is that it requires user discipline.

This article describes the implementation of a sophisticated backup/archive system that uses powerful small computer systems interface (SCSI) tape-storage systems. System-level considerations met in interfacing high-performance quarter- and half-inch tape drives are examined as are two different hardware and software approaches using the SCSI bus. This backup scheme represents a compromise between the disk-image and file-oriented approaches.

SCSI provides system integrators with a powerful integration tool.

SCSI: A quick interface solution

SCSI provides system integrators with a powerful integration tool. The interface permits relatively easy connection of a variety of data-storage devices and other peripherals to virtually any system. With new SCSI-based peripherals, personal computers can easily handle many jobs that were previously possible only with large minicomputers or mainframes.

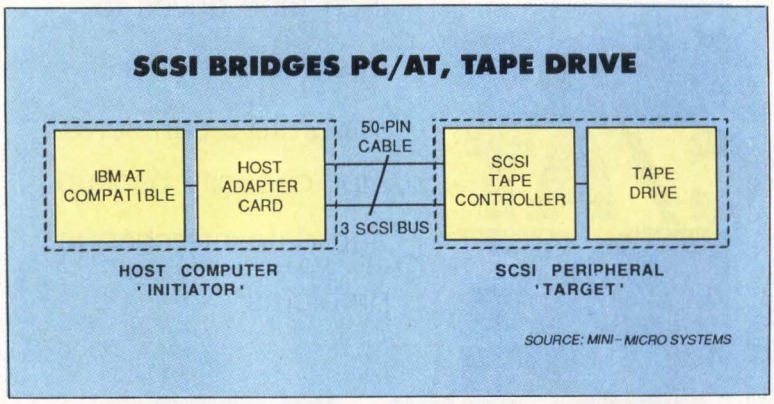


Fig. 1. All SCSI communications *take place over a 50-pin cable. The configuration shown represents the simplest implementation possible under the SCSI standard: one "initiator" device (the computer) and one "target" device (the tape drive).*

All SCSI communications take place over a 50-pin cable (Fig. 1). This cable transfers 9 data bits, including one for parity, and 9 control (handshaking) bits.

Although the SCSI bus may be driven differentially (e.g., dual lines driven out of phase with each other), the application described in this article entails the simpler single-line configuration. Cable lengths are well within the specified 3-meter distance limit.

The system architecture shown in Fig. 1 depicts the hardware used in this project. This approach represents the simplest implementation possible under the SCSI standard: one "initiator" device (the computer) and one "target" device (the tape drive).

The Faraday Electronics ATease, an IBM PC/AT-compatible system, serves as the host computer and integration backplane. The described integration methods incorporate components provided by Cipher Data Products Inc., Emulex Corp. and the Adaptive Data Systems Inc. (ADSI) division of Western Digital Corp. And 3M supplied the tape media for all drives.

Note that the integration methods aren't limited to these specific products. The same integration techniques apply to various combinations of drives, host adapters and controllers (Table 1).

A host-adapter card converts software commands from the host computer into device signals on the SCSI bus. Two host-adapter cards from two different manufacturers were used in this project to examine alternative approaches to interfacing with the SCSI bus. The first card, manufactured by ADSI, provides simplicity (minimum component count); the second, manufactured by Emulex, provides a high-level software interface via an onboard ROM basic input/output system.

The ADSI PC Master Link represents a "mimimum-hardware" approach to interfacing the tape drive to the SCSI I/O bus (Fig. 2). You configure this adapter card via onboard dip switches. Communications with the SCSI bus using this card generally occur at the bit level (Tables 2 and 3). For example, the select phase is initiated by first writing the controller ID bit to the data port, followed immediately by writing the SEL bit to the control port. During data phase, however, the handshaking and direct-memory access (DMA) functions are managed by the hardware. The ports and their functions are shown in Table 4.

The device controller, contained within the external subsystem, resides between the SCSI bus and the peripheral device. Many manufacturers now provide SCSI controller cards that "piggy-back" onto non-SCSI devices, such as ST506-based 5¼-inch rigid disk drives. ADSI, for example, offers the SABRE 55-M, which provides connection of one or two ST506-type rigid disk drives to the SCSI bus.

The Cipher Data tape subsystems used as target devices in this project represent current tape drive technology. Four Cipher Data drives were used: the model 540 quarter-inch tape cartridge system (Table 5), which is optimized for streaming applications, and three half-inch tape drives—the M990 CacheTape, the M880 STREAMER and the M890 CacheTape.

The Model M990 CacheTape (Table 6) is a full-sized half-inch reel-to-reel unit for use in mainframe or minicomputer systems and is larger than an IBM PC. Adding the M990 to the PC system provides the bonus of making the database interchangeable with larger systems. Cipher Data's optional SCSI controller allows the unit to be connected to the SCSI bus.

The M880 and M890 drives are similiar to the M990 unit except that they do not support the high-density GCR (group-code recording) mode of operation. For practical purposes the integration task is the same for these drives as it is for the M990.

Install the host adapter

In order to install the ADSI card in the PC system, three hardware selections must be made: the port address, the interrupt-request level (IRQ) and the DMA channel.

An eight-position dip switch allows addressing the card from zero to 3FC hex (four-port groupings). Due to the proliferation of plug-in cards for the IBM PC, ADSI recommends that the card be addressed in the range of 320 to 32C. It is a good idea, however, to use the PC-DOS debug program to determine whether the address you select is already being used.

Table 7 shows the "standard" allocation of the eight possible IRQs. However, any inter-

rupt that is not being used in your system is a possible choice for selection of the IRQ. Level 3 is used in this system.

The IBM PC/AT has eight DMA channels; three of these are available for selection on the ADSI card. Channel 1 is used by the SDLC (synchronous data link control) card (if installed); channel 2 is used by the disk. Therefore, channel 3 is the best choice for most systems.

Try a sophisticated adapter

Interfacing to the SCSI bus is somewhat simplified by the use of a sophisticated host adapter, such as Emulex's IB02 because of an onboard BIOS-programmable ROM. Commands to the SCSI bus may be handled by BIOS calls (using the software interrupt technique). The IB02 installs itself in the PC system environment at bootstrap time and thereafter behaves as an integral part of the system BIOS.

To use the IB02 BIOS it is necessary to load the code of the desired function into the AH register and the SCSI device address (plus 80H) of the target device into the DL register (note: the latter is required for any function even though the function may not communicate with a controller). This is the proper calling sequence:

```
...
...
MOV AH,AFUNC          ; Load function code to AH
MOV DL,DRV+80H        ; Drive code in DL
INT 13H               ; Call the BIOS
...
...
```

Most functions provided by the IB02 BIOS are intended for direct-access devices and are not useful for this project. However, for a system that includes SCSI disk drives, these functions prove helpful. For this project, the most useful was the "EXECUTE SCSI COMMAND" function (code 18 hex). To use this function, set up a SCSI command packet, point to it with a BIOS address block and call the BIOS to execute it. Thus you are spared the programming associated with the many SCSI bus phases described below.

Prior to invoking this function it is necessary to create a data buffer area in RAM of the appropriate size, to set up the SCSI command block (as specified in the ANSI standard), and to construct the BIOS address block. The ES and BX registers are then used to point to the BIOS address block. Finally, the AH and DL

With SCSI-based peripherals, personal computers can easily handle jobs that were previously possible only with minicomputers or mainframes.

Representative manufacturers of SCSI controllers, host adapters and tape drives

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Products Div.
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St. Paul, Minn. 55144
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Circle 701

Adaptec Inc.
580 Cottonwood Drive
Milpitas, Calif. 95035
(408) 946-8600
Circle 702

ADSI, a Western Digital Corp. company
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Irvine, Calif. 92714
(914) 863-0102
Circle 703

Alloy Computer Products Inc.
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Framingham, Mass. 01701
(617) 875-6100
Circle 704

Archive Corp.
1650 Sunflower
Costa Mesa, Calif. 92626
(714) 641-0279
Circle 705

Cipher Data Products Inc.
10101 Old Grove Road
P.O. Box 85170
San Diego, Calif. 92138
(800)4-CIPHER
Circle 706

Digi-Data Corp.
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Jessup, Md. 20794
(301) 498-0200
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Circle 708

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Costa Mesa, Calif. 92626
(714) 662-5600
Circle 709

Future Domain Corp.
1582 Parkway Loop
Tustin, Calif. 92680
(714) 259-0400
Circle 710

Irwin Magnetics Systems Inc.
2311 Green Road
Ann Arbor, Mich. 48105
(313) 996-3300
Circle 711

Meca Engineering
56677 Sunset Ave.
Yucca Valley, Calif. 92284
(619) 365-7689
Circle 712

Mountain Computer Inc.
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Scotts Valley, Calif. 95066
(408) 438-6650
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NCR Corp.
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Wichita, Kans. 67226
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North Atlantic Industries
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60 Plant Ave.
Hauppauge, N.Y. 11788
(800) 645-5292
Circle 715

Qualstar Corp.
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Canoga Park, Calif. 91304
(818) 882-5822
Circle 716

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Mountain View, Calif. 94039
(415) 964-5720
Circle 717

Tallgrass Technologies Corp.
11100 W. 82nd St.
Overland Park, Kan. 66214
(913) 492-6002
Circle 718

Wangtek Inc.
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Simi Valley, Calif. 93065
(805) 583-5255
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Table 1

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CIRCLE NO. 8 ON INQUIRY CARD

The command set supports virtually any peripheral device, including optical disks and printers.

registers are loaded with the values specified above and an INT 13H is executed. The following assembler listing illustrates a SCSI sequential read command for the 540 tape drive, which has a 512-byte fixed block size:

```
;
;  The SCSI command and data buffer are set
;  up in the Data segment
;
DSEG    SEGMENT PARA PUBLIC 'DATA'
SCMND   DB  8                   ; The Read command code
        DB  1                   ; Specifies fixed blocks
        DB  0                   ; Number of blocks (MSB)
        DB  0                   ; Number of blocks (ASB)
        DB  10H                 ; Number of blocks (LSB)
        DB  0                   ; Flag & link bits (not used)
;
; Data buffer follows. This allows 8k bytes
;
DBUFR   8192 DUP (0)
;
; Main 'CSEG' program code
;
; The Address block is defined in CSEG in this
; example
;
ADBL    DW OFFSET SCMND         ; Offset address of SCSI command
        DW DSEG                 ; Segment address of command
        DW OFFSET DBUFR         ; Offset address of Data buffer
        DW DSEG                 ; Segment address of Data buffer
        DW 0                    ; Link address (not used)
        DW 0                    ; Link address (not used)
        DW 7                    ; Command time out (seconds)
        DW 7                    ; Flags
        DB 0                    ; SCSI Status byte returned here
        DB 0                    ; SCSI Message byte will be here
        3 DUP (0)               ; Not used
;
; The actual execution follows
;
    ...
    ...
    LD AX,CSEG                  ; Get segment of Address block
    LD ES,AX                    ; To ES
    LD BX,OFFSET ADBL           ; Address block offset to BX
    LD AH,18H                   ; BIOS function
    LD DL,80H                   ; Drive 0+ 80H
    INT 13H
    ;
; BIOS will return to here with the requested 8k
bytes at 'DBUFR'
;
```

Although numerous other functions are available via the IB02 BIOS, they are not listed here.

Install the IB02

The IB02 is a full-sized IBM PC plug-in board. There are major system decisions you'll have to make to use it:

1. Selection of the DMA transfer mode: One of three modes is selected by two dip-switch positions (1-byte, 4-byte demand or 8-byte demand). The 8-byte demand mode was selected for this project, as recommended by Emulex.
2. Selection of the DMA channel: There are only two options (dip-switch selected) for DMA with the IB02: channel 1 or channel 3. For this project, channel 3 was selected, as with the ADSI board above and for the same reasons.
3. Interrupt-level selection: Three dip-switch positions are used to select one of the eight interrupt levels on which the IB02 will interrupt. Level 3 was selected.
4. SCSI device address selection: In order to provide for multiple originating devices on the same SCSI bus, Emulex allocates three dip-switch positions for selecting the SCSI address of the IB02. Address 7 was selected.
5. IB02 memory address: Because the IB02 BIOS PROM occupies space in the PC system memory, the address at which it resides must be selected. Only five dip switches are necessary to allow addressing the card in the range C8000-EE000 hex (the only potentially free memory space in the PC system). After using the debug program to verify that the memory space was unused, IB02 was addressed at CA000 hex (the recommended address).
6. Parity-check option: With IB02, the user has the option of having hardware disable the parity-checking function via a dip switch position. This does not affect the parity-generation function, however.
7. Enable SCSI bus disconnect: This option is dip-switch selectable and allows connecting the IB02 to support the SCSI disconnect function. Although this function is of no use in this application, set it at the recommended setting of ON.

Understand the SCSI phases

The SCSI bus has a relatively complicated protocol, due in part to the flexibility it provides. The command set supports virtually any peripheral device, including optical disks and printers.

SCSI transactions are divided into phases. As a given transaction progresses, the participating devices pass from one phase into another in a

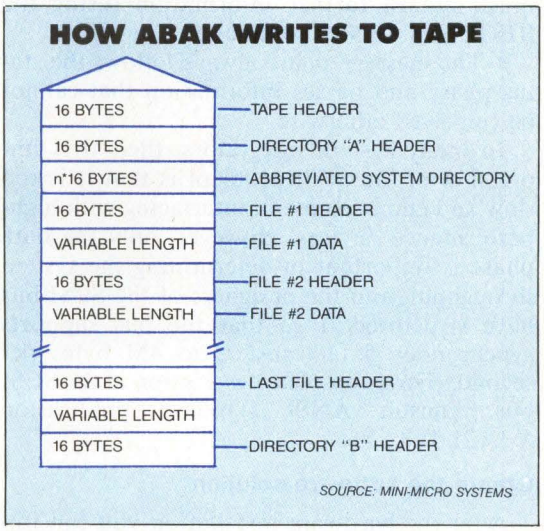


Fig. 3. The ABAK backup program *writes to tape in the physical organization shown. Each backup dump sequence starts with the 32-byte tape header.*

well-defined fashion. The phases of a typical data transfer are as follows:

- The bus-free phase: The host computer must establish that the bus is free before initiating bus activity.
- The arbitration phase: Once a host detects the bus-free phase, it may try to gain control of the bus. It does this by the process of arbitration. When there is only one originator in the system, no arbitration phase is necessary (as is the case in this system).
- The selection phase: The originator of the transaction addresses the particular controller with which it wishes to communicate. This phase is complete when the controller responds.
- The command phase: The host computer informs the peripheral controller the function it wishes performed. There are numerous standard commands defined for SCSI-compatible devices as well as provisions for any number of vendor-specific commands. The standard commands for a sequentially organized SCSI device are given in Table 8.
- The data phase: Any data to be stored (or which has been read) is transferred across the interface. The data phase is absent in many transactions. If the tape unit has been commanded to rewind, for example, no data phase will be present.
- The status phase: The controller sends information to the host about how a requested function has terminated. This transaction normally takes the form of an "all okay" or "error" message. This message byte does not fully specify an error condition, however, and the host must request further information (using the REQUEST SENSE command).
- The message phase always follows the status phase and passes information that cannot be conveyed otherwise.

To many system integrators, their first impression of the SCSI protocol is that it is too slow and cumbersome in interfacing with high-performance devices. However, only the data phase is important in determining the system throughput, and the designers of the SCSI bus have structured it so that the bus supports synchronous data transfers to 4M bytes per second. (For a complete description of the SCSI bus, consult ANSI standard publication X3.131-198.)

Create the software solution

After the hardware installation you can implement the automatic file-backup program, ABAK. This program is automatically installed at system intialization time by means of the PC-DOS AUTOEXEC feature. When invoked, the program "hides" itself in system RAM and waits for the system's idle state.

When the predetermined conditions for backup are met (elapsed time in the idle state and time of day), the program activates itself and searches the directories of the system's rigid disks for files that have been changed (as indicated by the directory archive bit). Such files are considered as candidates for automatic backup. The program also supports an internal file name table that allows inhibiting (or forcing) the backup of certain files. Before beginning the backup, however, the system signals its intentions with the console message:

AUTO-BACKUP ACTIVATED
any key aborts

Striking any key within 7 seconds inhibits the

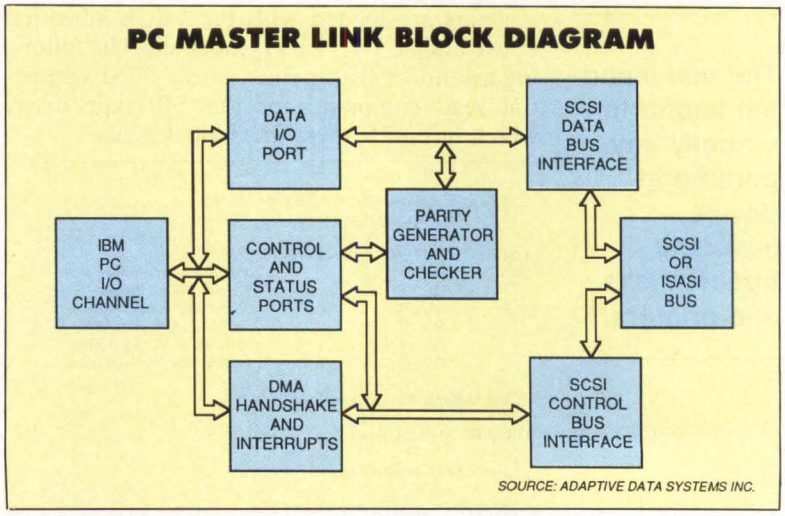


Fig. 2. The PC Master Link *is an adapter card that provides an interface between a tape drive and a PC via the SCSI bus. The adapter is programmed via dip switches.*

PC MASTER LINK STATUS-REGISTER BIT DESCRIPTIONS

Name	Bit	Significance
PTYERR	7	This bit is a "one" when a parity error is detected.
SELECT	6	Provides direct sensing of the SCSI SEL line.
IRQ	5	This bit is a "one" when the IRQ signal is active on the IBM PC I/O channel.
BSY	4	Provides direct sensing of the SCSI BSY line.
MSG	3	Provides direct sensing of the SCSI MSG line.
C/D	2	Provides direct sensing of the SCSI C/D line.
I/O	1	Provides direct sensing of the SCSI I/O line.
REQ	0	Provides direct sensing of the SCSI REQ line.

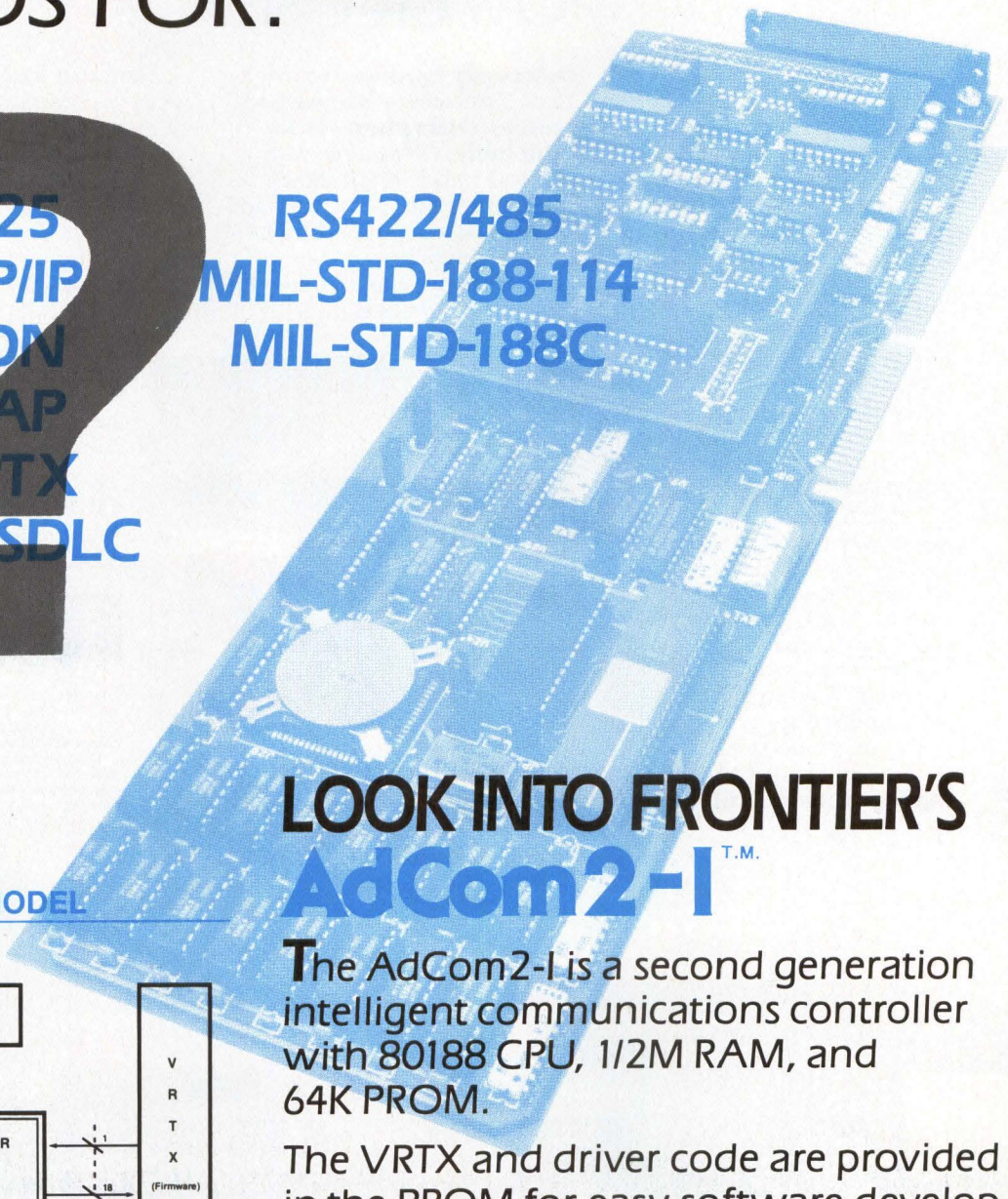
NOTES:
The auxiliary status port has only one bit of significance. Bit 0 provides a polled interlock for the REQ/ACK sequence. When this bit is zero, it indicates a completed handshake sequence.

Table 2

PC COMMUNICATION NEEDS FOR:

X-25
TCP/IP
DDN
MAP
VRTX
SNA/SDLC

RS422/485
MIL-STD-188-114
MIL-STD-188C



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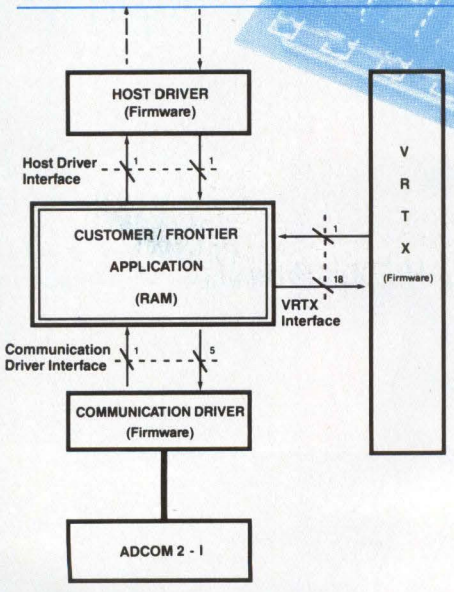

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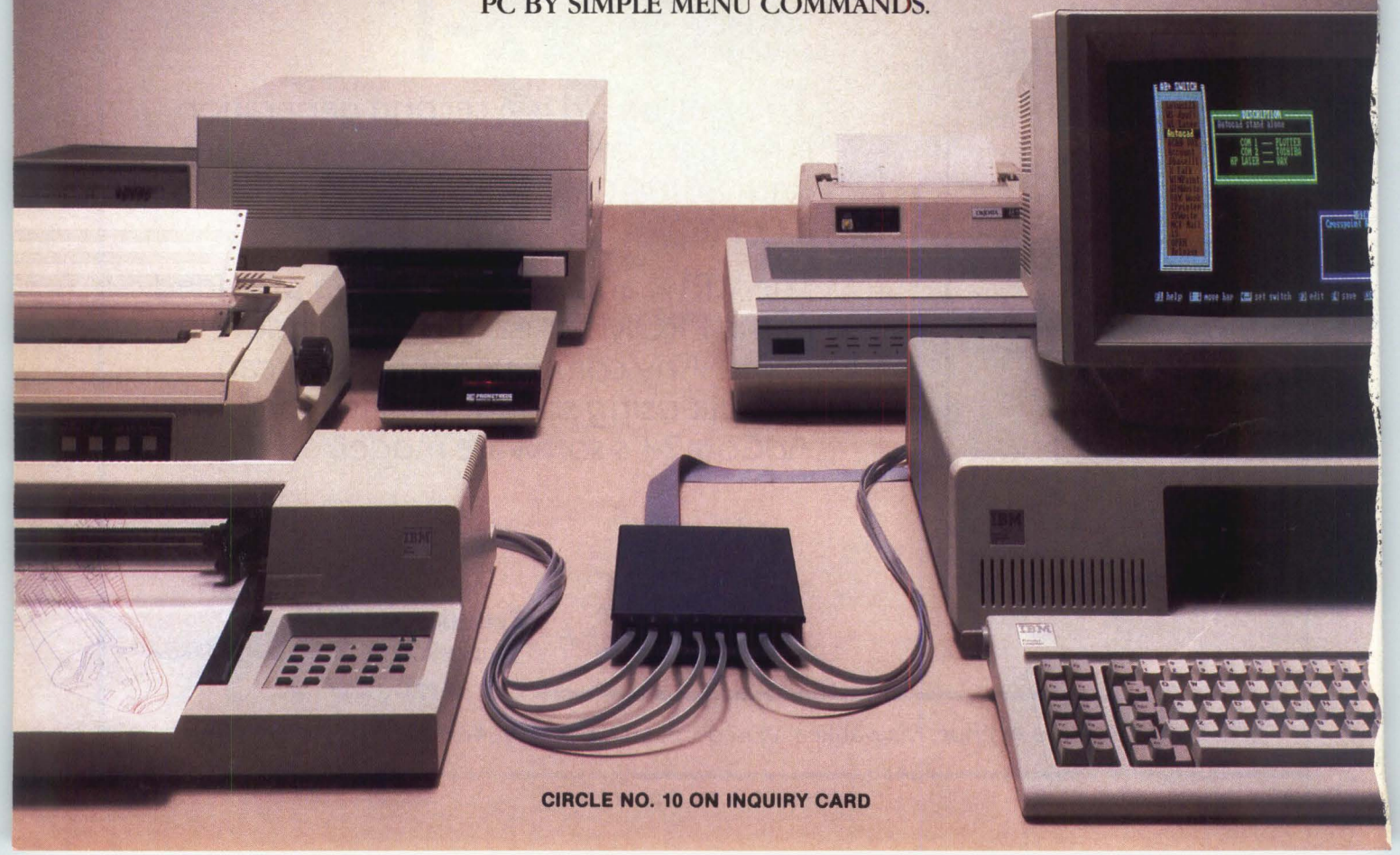

CIRCLE NO. 10 ON INQUIRY CARD

PC MASTER LINK CONTROL-PORT BIT FUNCTIONS

Name	Bit	Function
PTYEN	7	When set to "one," this bit enables the HAC parity generation and checking circuitry.
SELECT	6	Directly controls the SEL line.
RST	5	Directly controls the RST line.
BSY	4	Directly controls the BSY line.
XFRINH	3	Inhibits the automatic REQ/ACK sequence during a data port read or write.
ATN	2	Directly controls the ATN line.
SYSEN	1	This bit is used to enable DMA data transfers. Setting it to zero clears the interrupt logic and turns off the DMA request.
BUSEN	0	This bit enables the SCSI bus drivers. When this bit is zero the drivers are disconnected.

Table 3

Cipher Data 540 tape drive specifications

- **Length of tape (feet)** . . . . . 450 (555, optional)
- **Bytes per inch** 1,000
- **Bytes per track** . . . . . 5 million
- **Number of tracks** . . . . . 9 (serpentine)
- **Tape speed** . . . . . 90 inches per second
- **Block size** . . . . . 512 bytes
- **Time/Block (streaming)** . . . . . 5.8 msec
- **Reposition time** . . . . . 2 seconds approximately

Table 5

Cipher Data M990 tape drive specifications

- **Number of tracks** . . . . . 9 parallel
- **Density (bpi)** . . . . . 1600 & 3200 PE, 6250 GCR
- **Block size (maximum)** . . . . . 64K bytes
- **Capacity (2,400 feet)** . . . . . 150M bytes
- **Tape speed (ips)** . . . . . 100 & 50 PE, 70 GCR

Table 6

IBM PC/AT INTERRUPT-LEVEL ASSIGNMENTS

Level	Usage
0	Time of day
1	Keyboard
2	Secondary interrupt controller
3	Secondary serial port
4	Primary serial port
5	Secondary printer port
6	Disk
7	Primary printer port

Table 7

auto-backup; the program then will revert to its timing mode. Otherwise, the program transfers the changed file(s) to the tape system and the archive bits are cleared.

You can implement an optional tape directory on the system's rigid disk to help the system locate backup files quickly.

In streaming mode, the Cipher Data 540 can back up 45M bytes of rigid disk storage in about 9 minutes. To achieve this high data rate, however, the computer must have the data

ADSI I/O PORT ASSIGNMENTS

Port (base relative) in/out	Function
0	Data port (bidirectional)
1	Status register (input)
2	Auxiliary status port (input)
3	Parity-error reset control (input)
3	Control port (output)

NOTES:
The data port is a bidirectional, 8-bit port by means of which communication with the SCSI peripheral takes place.
The status register is an 8-bit, read-only port that allows the host program to directly determine the state of the SCSI bus.

Table 4

ready when the streamer needs it. Inattention to a streaming tape drive's data demands can exact severe penalties. If the Cipher Data drive is forced to stop to wait for data, the ensuing mechanical repositioning takes almost 2 seconds. This delay could cause the system throughput to plunge from a respectable 88K bytes per second to a mere 256 bytes per second (one block every two seconds).

One method of maintaining a reasonable data throughput is to buffer as much data as possible into RAM memory before activating the tape drive. In this project, for example, 64K bytes was allocated as a tape buffer, providing an average data rate of 20K bytes per second. Under these conditions, the 540 drive can back up a rigid disk file of 64K bytes in approximately 4 seconds.

The Cipher Data M990, on the other hand, has an internal 64K-byte cache memory, which relieves you of providing system memory as a buffer. With the M990, the time to back up a 64K-byte file is less than 1 second and is virtually transparent to the user.

The physical organization of a tape written by the ABAK program is shown in Fig. 3. Each backup "dump" sequence begins with a 32-byte header. This header consists of a 16-byte tape-identification field and a 16-byte system-directory header, which contains the directory name, length, and drive information for the first directory. The actual directory information follows in an abbreviated form (16 bytes per file name instead of the normal 32 bytes). The files that follow are indicated by the state of the archive bit.

Immediately following the directory is the first file whose archive bit is reset (there may only be one). Each file is preceded by a 16-byte header that matches the directory entry. The file information follows the header. Other files that need to be dumped are appended in the same format.

The last file of the first directory is followed by the header of other system directories that

STANDARD SERIAL SCSI COMMANDS

Function code (hex)	Description of function
00	Test unit ready
01	Rewind tape
03	Request sense information
05	Read block limits
08	Read blocks
0A	Write blocks
0B	Select track
0F	Read reverse
10	Write file marks
11	Space (skip) blocks
12	Inquiry
13	Verify tape
14	Recover buffered data
15	Mode select
18	Copy
19	Erase tape
1A	Mode sense
1B	Load/unload tape
1C	Receive diagnostic
1D	Send diagnostic
1E	Prevent-allow medium

Table 8

contain files to be dumped. The program supports file continuation across physical tape boundaries (the user is prompted when a tape change is required).

The Automatic Recovery Program (AREC) allows recovery of data either file by file manually or automatically (in the case of catastrophic data loss). User options for the program are conversational in nature. The program sign-on screen is shown below. The "browse" feature allows inspection of the file information in either ASCII or hex format.

MECA AUTOMATIC DATA RECOVERY PROGRAM (c) 1986

Select the option desired:

1. Browse (examine tape contents)
2. Search for a file name
3. Restore files
4. Restore a directory
5. Restore all

Selection? __

The complete integration of hardware and software thus provides rapid backup that doesn't require much operator attention. Whether you use the simpler or more sophisticated hardware approach, the solution works. The only question the system integrator must answer is that of how many extra features, such as information interchange, the system needs. □

D.L. Millican is vice president of engineering at Millican Consulting Associates Inc., Yucca Valley, Calif.

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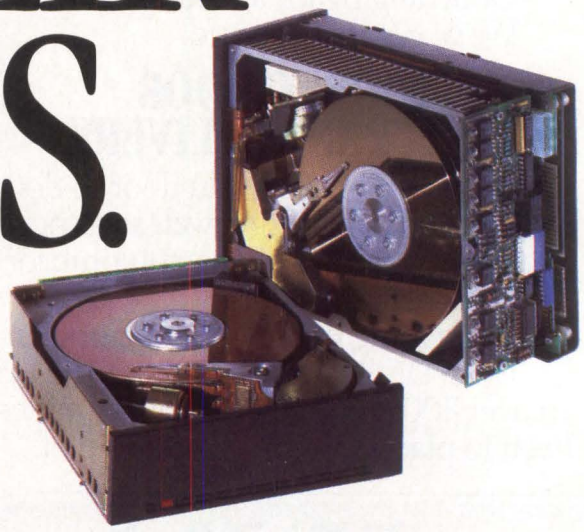

Announcing the Wren™ II Half-Height and Wren III 5¼″ drives.

Two high performance, high capacity drives that represent not only the fastest of their species, but the best engineered, best designed drives in the world.

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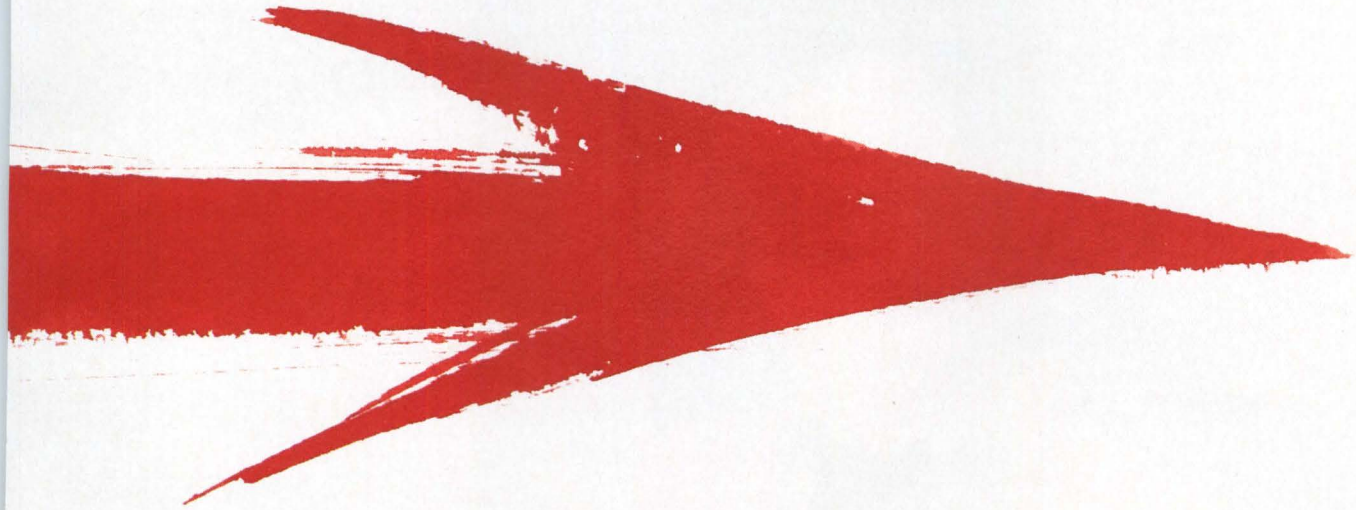
The Wren III is the fastest high capacity unit available anywhere. It stores up to 182 MB with a typical seek time of 16.4 ms.



Both have 20,000-hour MTBF and require no preventative maintenance. And both are covered by the best support services in the industry.

The Wren family offers a variety of industry standard interfaces, including ST506 on the Wren II Half-Height. The Wren III offers ESDI and SCSI.

No one in the world has sold more 5¼" high performance, high capacity drives than Control Data. A sure sign of satisfied customers.

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It's the perfect companion for both 3½" and 5¼" Winchester disc drives. Specifically designed for the DC2000 data cartridge, the QicBac is a new, rather than downsized product. New technology and an innovative mechanical design insure speed stability and track location.

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With a price tag commensurate with its size, and special OEM pricing available, the QicBac provides the perfect price/performance fit.

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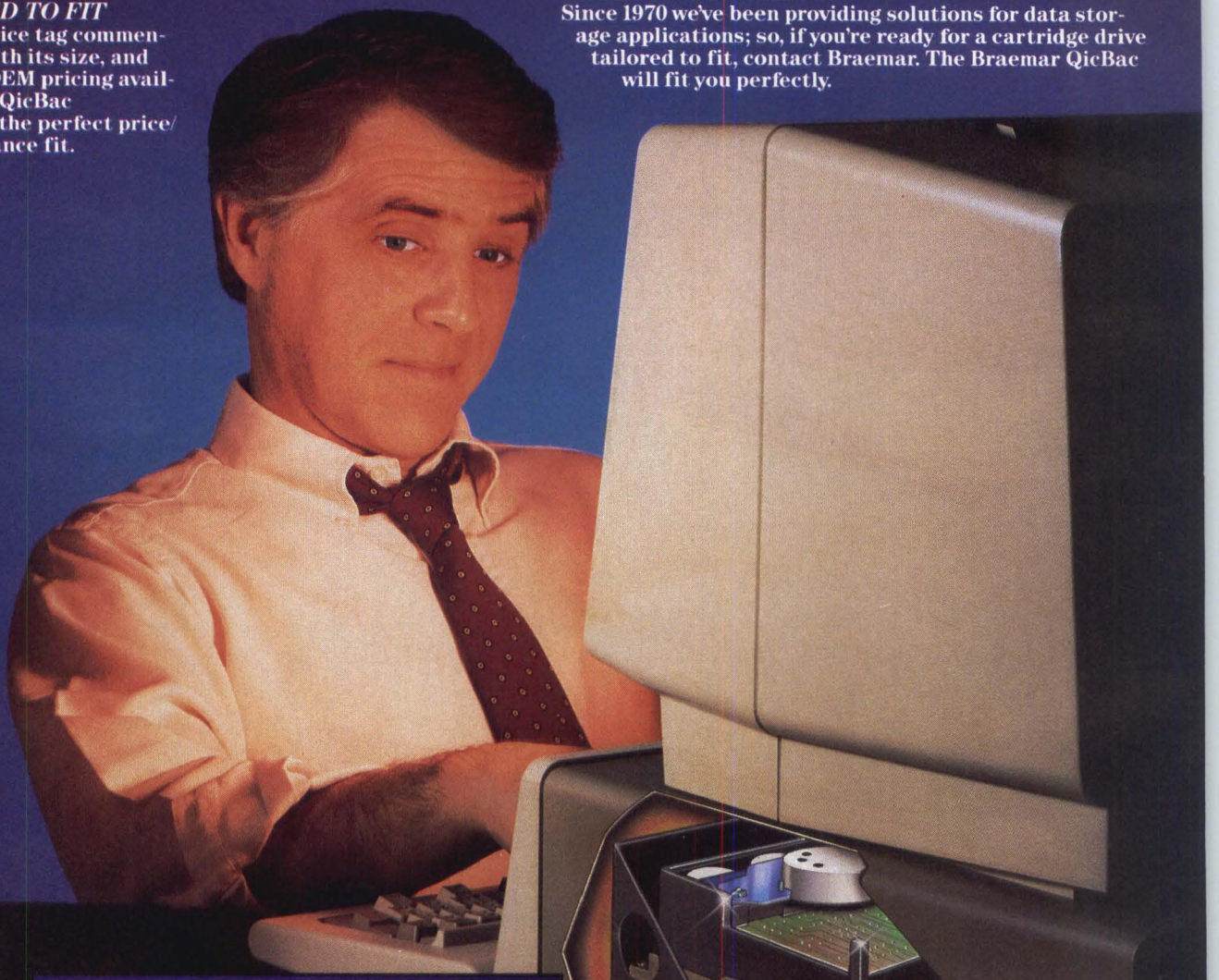

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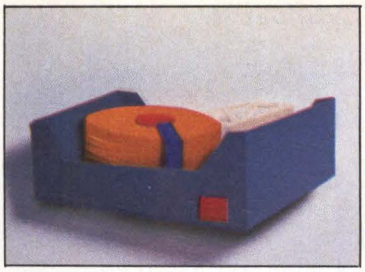

5¼-inch and smaller rigid disk drives & subsystems

Company / Model	Unformatted capacity (M bytes)	Disk size (inches)	Average access time (msec)	Dimensions (H×W×D/inches)	Interfaces	Price $ (quantity)	Notes, features
ADAC CORP.							**Circle 541**
70 Tower Office Park, Woburn, MA 01801, (617) 935-6668							
1240 (subsystem)	10, 40, 160	5¼	85-91	7×19×26	Q-bus, SBC 11/21	4,500-12,000(Q1)	dual 5¼-inch flexible drive, streaming tape drive backup
ALLOY COMPUTER PRODUCTS INC.							**Circle 542**
100 Pennsylvania Ave., Framingham, MA 01701, (617) 875-6100							
PC-QICSTOR (subsystem)	30-300 (formatted)	5¼	28-45	19.6×18×5.4	IBM PC/AT	4,595-15,995(Q1)	tape drive backup, includes power supply
SD 85/190 (subsystem)	67-150 (formatted)	5¼	28-30	5.25×8.75×5.25	IBM PC/AT	4,595-6,995(Q1)	includes power supply
SL-60 (subsystem)	25-51	5¼	35-80	5.25×8.75×5.25	IBM PC/AT, Convertible	4,595-6,995(Q1)	tape drive backup, includes power supply
ATASI CORP.							**Circle 543**
2075 Zanker Rd., San Jose, CA 95131, (408) 436-0335							
2085	85.3	5¼	25	3.25×5.75×8	SCSI	890(Q500)	
2128	128	5¼	25	3.25×5.75×8	SCSI	1,125(Q500)	
2170	170.6	5¼	25	3.25×5.75×8	SCSI	1,450(Q500)	
BERING INDUSTRIES INC.							**Circle 544**
1400 Fulton Place, Fremont, CA 94539, (415) 651-3300							
8010RM	10 (removable)	5¼	85	4.2×15×17.5			removable cartridge
8170	70 10 (removable)	5¼	30	4.2×15×17.5			fixed/removable cartridge
80190-EP	190	5¼	30	4.2×15×17.5			
C. ITOH ELECTRONICS INC.							**Circle 545**
5301 Beethoven St., Los Angeles, CA 90066, (213) 306-6700							
3540	40 (formatted)	3½	40	1.6×4×5.75	ST506/412	1,000(Q1)	
CHRISLIN INDUSTRIES INC.							**Circle 546**
31352 Via Colinas, Westlake Village, CA 91362, (818) 991-2254							
CI-550-20WF (subsystem)	26 1 (removable)	5¼	40	5.25×9×12	MSCP	3,095(Q1)	fixed/removable cartridge; includes controller, dual flexible drives
CI-820-70 (subsystem)	80 3.2 (removable)	5¼	35	5.25×19×23	MSCP	5,695(Q1)	fixed/removable cartridge; includes controller, dual flexible drives
CI-820-120 (subsystem)	140 3.2 (removable)	5¼	35	5.25×19×23	MSCP	6,595(Q1)	fixed/removable cartridge; includes controller, dual flexible drives
CMS							**Circle 547**
3080 Airway, Costa Mesa, CA 92626, (714) 549-9111							
Perfect Series	20-80	5¼	65	1.63×5.75×8, 3.23×5.75×8	ST506/412	795-2,195(Q1); 369-1,375(Q500)	half- or full-height
COMPUTER DYNAMICS INC.							**Circle 548**
105 S. Main St., Greer, SC 29651, (803) 877-8700							
WIN-3-HDD-10 (subsystem)	10	3½	85	1.625×4×5.75	ST506, STDbus	1,110(Q1)	
WIN-3-HDD-20 (subsystem)	20	3½	85	1.625×4×5.75	ST506, STDbus	1,400(Q1)	
WIN-3-HDD-40 (subsystem)	40	5¼	28	1.69×5.88×8	ST506, STDbus		
CONTROL DATA CORP.							**Circle 549**
8100 34th Ave. South, P.O. Box 0, Minneapolis, MN 55440, (800) 828-8001							
Wren II 9415X	48	5¼	28	3.25×5.7×8	ST506/412, ESDI, SCSI	1,770(Q1); 1,065(Q500)	automatic actuator lock
Wren II HH 9420X	51	5¼	28	1.625×5.75×8	ST506/412	2,420(Q1); 1,530(Q500)	automatic actuator lock
Wren III 9416X	101	5¼	16.5	3.25×5.75×8	ST506/412, ESDI, SCSI	1,860(Q1); 1,120(Q500)	
DIGITAL EQUIPMENT CORP.							**Circle 550**
146 Main St., Maynard, MA 01754, (617) 897-5111							
RD51 (subsystem)	10 (formatted)	5¼	85	3.25×5.75×8	Q-bus	2,295(Q1)	includes power supply, cables

5 ¼-inch and smaller rigid disk drives & subsystems

Company Model	Unformatted capacity (M bytes)	Disk size (inches)	Average access time (msec)	Dimensions (H×W×D/inches)	Interfaces	Price $ (quantity)	Notes, features
RD52 (subsystem)	31 (formatted)	5¼	57.5	3.25×5.75×8	Q-bus	3,600(Q1)	includes power supply, cables
RD53 (subsystem)	71 (formatted)	5¼	38.3	3.25×5.75×8	Q-bus	4,050(Q1)	includes power supply, cables
EMULEX CORP.							**Circle 551**
3545 Harbor Blvd., Costa Mesa, CA 92626, (714) 662-5600							
EQ2 (subsystem)	67-110 (formatted)	5¼	30	5.25×19×22	ST506/412	7,275-10,500(Q1)	tape drive backup
EQ3 (subsystem)	110-319 (formatted)	5¼	30	5.25×19×23.4 (rackmount) 6×24.5×30.5 (standalone)	ST506/412, ESDI	6,050-21,010(Q1)	tape drive backup
ER2	36 (formatted) 10.5 (removable)	5¼	35	5.25×19×22	ST506/412, SCSI	7,775(Q1)	fixed/removable cartridge
EXTENDED SYSTEMS							**Circle 552**
P.O. Box 4937, Boise, ID 83711, (208) 322-7163							
ShareData ESI-3504	80 (formatted)	5¼	30	8×6×14	RS232C, RS422	5,595-5,995(Q1)	up to 4 users concurrently access same disk, tape cartridge drive backup
ShareData ESI-3772	20 (formatted)	5¼	65	2.5×6×14	RS232C, RS422	1,995/2,395(Q1)	up to 4 users concurrently access same disk
ShareData ESI-3774	80 (formatted)	5¼	30	2.5×6×14	RS232C, RS422	3,995/4,395(Q1)	up to 4 users concurrently access same disk
FUJITSU AMERICA INC.							**Circle 553**
3055 Orchard Dr., San Jose, CA 95134, (408) 946-8777							
M2227D	51	3½	45	1.63×4×5.7	ST506/412	750(Q500)	
M2243	86	5¼	33	3.3×5.7×8	ST506/412		
M2246E	172	5¼	25	3.3×5.7×8	ESDI	2,000(Q500)	
GENISCO MEMORY PRODUCTS CORP.							**Circle 554**
10874 Hope St., Cypress, CA 90630, (714) 220-0720							
EDR-105	72 (removable)	5¼	30	7.6×7.5×19.6	ST506, SCSI	30,000(Q1)	removable cartridge, ruggedized
EDR-105 Dual	144 (removable)	5¼	30	7.6×12×19.6	ST506, SCSI	48,500(Q1)	removable cartridge, ruggedized
EDR-105 E.T.	36 (removable)	5¼	30	7.6×7.5×19.6	ST506, SCSI	28,500(Q1)	removable cartridge, ruggedized
HEWLETT-PACKARD CO. (GREELEY DIV.)							**Circle 555**
700 71st Ave., Greeley, CO 80634, (303) 350-4000							
9133H (subsystem)	20 (formatted)	5¼	85	5.2×12.8×11.2	HP-IB	2,740(Q1)	3½-inch flexible drive
9133L (subsystem)		5¼	40	5.2×12.8×11.2	HP-IB	4,450(Q1)	3½-inch flexible drive
9750IB	28.1	3½	75	2×4×5.1	SCSI, IBM PC/AT/XT	1,250(Q1)	includes controller board, ruggedized
HITACHI AMERICA LTD.							**Circle 556**
950 Elm Ave., San Bruno, CA 94066, (415) 872-1902							
DK511-5	51	5¼	30	3.25×5.75×8	ST506/412		
DK511-8	85.7	5¼	23	3.25×5.75×8	ST506/412		
DK512-17	172.3	5¼	23	3.25×5.75×8	ESDI, SMD		
IDEASSOCIATES INC.							**Circle 557**
29 Dunham Rd., Billerica, MA 01821, (617) 663-6878							
Diskit (subsystem)	10-122 5.5-10.7 (removable)	5¼	28-90		IBM PC/AT/XT		fixed/removable cartridge; tape drive backup available
Diskit 2 (subsystem)	21.4 (removable)	5¼	90	2.2×13×15.2	IBM PC/AT/XT	2,595(Q1)	removable cartridge
IDEAdisk (subsystem)	10-122 5.5-10.7 (removable)	5¼	28-90	5.5×12.5×14.5	IBM PC/AT/XT		fixed/removable cartridge; tape drive backup available
INTERNATIONAL MEMORIES INC. (DIV. OF CORVUS SYSTEMS INC.)							**Circle 558**
7600 4th St., White City, OR 97503, (503) 826-3733							
5012H	12.75	5¼	68	3.25×5.75×8	ST506	450(Q1)	plated media
5018H	19.1	5¼	68	3.25×5.75×8	ST506	500(Q1)	plated media
MSI 740	40	5¼	40	3.25×5.75×8	ST506	600(Q1)	plated media
LAPINE TECHNOLOGY							**Circle 559**
182 Topaz St., Milpitas, CA 95035, (408) 262-7077							
Titan LT200	25.6	3½	65	1.63×4×5.75	ST506/412	395(Q1); 335(Q500)	
Titan LT300	38.4	3½	65	1.63×4×5.75	ST412, RLL	425(Q1); 355(Q500)	
Titan LT400	42.8 (formatted)	3½	35	1.63×4×5.75	SCSI		includes controller, thin-film media
LOBO SYSTEMS INC.							**Circle 560**
P.O. Box 1808, Goleta, CA 93116, (805) 968-6929							
WIN 5 (subsystem)	6.3	5¼	99	4.5×6×16	ANSI, SASI, SCSI	945(Q1); 729(Q500)	flexible drive backup
WIN 10 (subsystem)	11.2	5¼	92	4.5×6×16	ANSI, SASI, SCSI	1,395(Q1); 1,044(Q500)	flexible drive backup

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9″ Drives: 800 MB, or 520 MB sized for today's smaller superminis.

NEC goes all the way to 800 MB.

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Capacity is not the only edge our large drives offer. They're also fast. Our 800 MB drive has a 2.4 MB/sec data transfer rate and a 15 ms. seek time.

And our 9″ Winchesters use a special design that supports the spindle at both ends resulting in greater read/write accuracy.

NEC drives are still going, after others fail.

Take our 8″ Winchester. It has the longest MTBF in the industry. 24,000 POH. Which makes it two to three times as reliable as anybody else's.

Our 9″ drives are also outstanding. With 20,000 POH. And the MTTR of our large drives is less than one hour.

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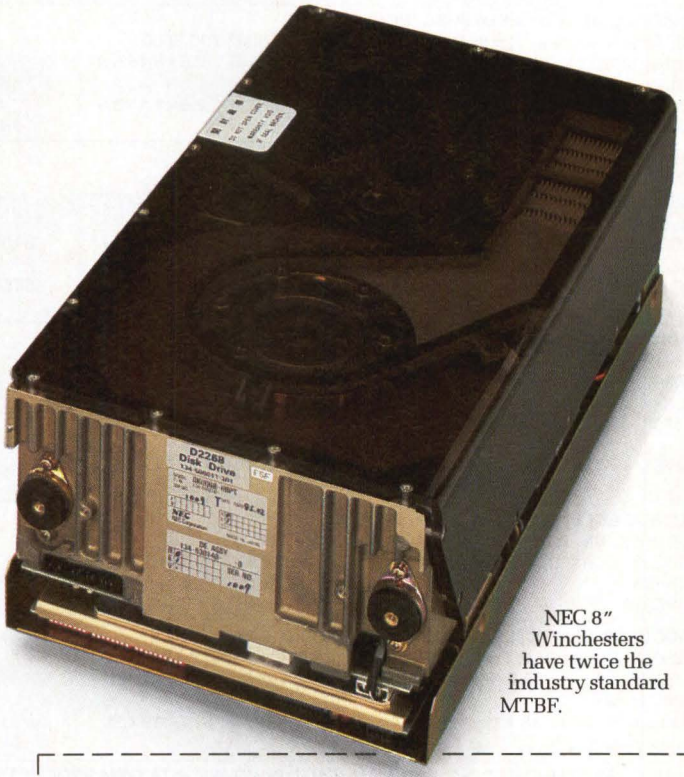

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5 ¼-inch and smaller rigid disk drives & subsystems

Company Model	Unformatted capacity (M bytes)	Disk size (inches)	Average access time (msec)	Dimensions (H×W×D/inches)	Interfaces	Price $ (quantity)	Notes, features
WIN 20 (subsystem)	22.4	5¼	92	4.5×6×16	ANSI, SASI, SCSI	1,995(Q1)	dual 10M-byte drive, flexible drive backup
MAXTOR CORP.							**Circle 561**
150 River Oaks Pkwy., San Jose, CA 95134, (408) 942-1700							
EXT-4380	382.03	5¼	27	3.25×5.75×8.2	ESDI		thin-film media
XT-2190	191.24	5¼	30	3.25×5.75×8.2	ST506/412		thin-film media
XT-3380	382.03	5¼	27	3.25×5.75×8.2	SCSI		thin-film media
MAYNARD ELECTRONICS INC.							**Circle 562**
460 E. Semoran Blvd., Casselberry, FL 32707, (305) 331-6402							
DX 110	143.55	5¼	30	3.25×5.75×8	ST506/412	6,770(Q1)	includes software
ONBOARD 30	34.5	3½	60	4×1.5×5.75	ST506/412	1,395(Q1)	drive is on a card, includes software
Transport Plus (subsystem)	23	5¼	60	3.25×5.75×8	ST506/412	2,400(Q1)	portable, tape drive backup
MICRO STORAGE CORP.							**Circle 563**
2986 Oakmead Village Court, Santa Clara, CA 95051, (408) 986-0770							
MS212	12.9 (removable)	5¼	95	1.63×5.75×8	ST506	1,085(Q1); 645(Q500)	removable cartridge, thin-film media
MICROCOMPUTER MEMORIES INC.							**Circle 564**
6855 Vineland Ave., North Hollywood, CA 91605, (818) 700-8000							
Transpac-10 (subsystem)	12.75 10 (removable)	3½	75	2.6×4.1×5.9	ST506/412, IBM PC/AT/XT	595(Q1)	portable, includes controller
Transpac-20 (subsystem)	25.50 20 (removable)	3½	65	2.6×4.1×5.9	ST506/412, IBM PC/AT/XT	895(Q1)	portable, includes controller
MILTOPE CORP.							**Circle 565**
1770 Walt Whitman Rd., Melville, NY 11747, (516) 420-0200							
RDS-1720 (subsystem)	172 (removable)	5¼	40	9.38×9×17.75	ESDI, SCSI	25,500(Q1)	removable cartridge, meets military specifications
RDS-3400 (subsystem)	34 (removable)	3½	40	9.38×7×11.75	ST506/412, SCSI	15,000(Q1)	removable cartridge, meets military specifications
RDS-5001	53.3 (removable)	5¼	40	9.38×7×11.75	ST506/412, SCSI	22,000(Q1)	removable cartridge, meets military specifications
MINISCRIBE CORP.							**Circle 566**
1861 Lefthand Circle, Longmont, CO 80501-6798, (303) 651-6000							
6085	85.3	5¼	28	3.25×5.75×8	ST506/412	1,370(Q1); 1,250(Q500)	actuator lock
6170E	170.6	5¼	28	3.25×5.75×8	ESDI	1,795(Q1); 1,595(Q500)	actuator lock
8425S	25.5	3½	68	1.625×4×5.75	SCSI	450(Q1); 420(Q500)	
MITSUBISHI ELECTRONICS AMERICA INC.							**Circle 567**
991 Knox St., Torrance, CA 90502, (213) 515-3993							
MR533	30	5¼	38	1.63×5.75×8	ST506	1,100(Q1)	
MR535	50	5¼	38	1.63×5.75×8	ST506, SCSI	1,280(Q1)	
MR5310	100	5¼	38	1.63×5.75×8	ESDI, SCSI	1,600(Q1)	
MODULAR COMPUTER SYSTEMS INC. (MODCOMP)							**Circle 568**
1650 W. McNab Rd., Fort Lauderdale, FL 33310, (305) 977-1823							
4185-2 (subsystem)	20.2 (formatted)	5¼	158	7×19×21	proprietary	4,500(Q1)	includes controller, flexible drive backup
4185-3 (subsystem)	40.4 (formatted)	5¼	158	7×19×21	proprietary	7,000(Q1)	includes controller, two 20.2M-byte drives
NCR CORP. (ENGINEERING AND MANUFACTURING-WICHITA OEM PRODUCTS)							**Circle 569**
3718 N. Rock Rd., Wichita, KS 67226, (316) 688-8510							
NCR 6097-5342 (subsystem)	30 (formatted)	5¼	53	6×14×16	SCSI		
NCR 6097-7542 (subsystem)	70 (formatted)	5¼	42	6×14×16	SCSI		includes power supply
NEC INFORMATION SYSTEMS INC.							**Circle 695**
1414 Massachusetts Ave., Boxborough, MA 01719, (617) 264-8000							
D3126	25.62	3½	85	1.6×4×5.9	ST412	500(Q1); 387(Q1000)	plated media, automatic carriage lock
D5100 Series	12.91-51.24	5¼	37.85	1.63×5.75×8, 1.6×5.75×8.2	ST412	450-1,000(Q1); 350-717(Q1000)	half-height, automatic carriage lock
D5652	172.76	5¼	23	3.2×5.75×8.2	ESDI	4,500(Q1); 2,100(Q500)	automatic carriage lock
NEWBURY DATA INC.							**Circle 570**
2200 Pacific Coast Hwy., Suite 208, Hermosa Beach, CA 90254, (213) 372-3775							
NDR 1000	65, 85, 105, 140	5¼	25, 26	3.25×5.75×8.2	ST506/412		thin-film media
NDR 2000	190	5¼	28	3.25×5.75×8.2	ST506/412		thin-film media
Penny	51	3½	40	1.62×4×6.46	ST506/412		thin-film media

5 ¼-inch and smaller rigid disk drives & subsystems

Company Model	Unformatted capacity (M bytes)	Disk size (inches)	Average access time (msec)	Dimensions (H×W×D/inches)	Interfaces	Price $ (quantity)	Notes, features
PRIAM CORP.							**Circle 571**
20 West Montague Expwy., San Jose, CA 95134, (408) 946-4600							
519	191.2	5¼	20	3.25×5.75×8	ST412	3,150(Q1); 2,065(Q500)	automatic actuator, spindle locks, thin-film media
638	382.4	5¼	20	3.25×5.75×8	ESDI	3,425(Q1); 2,250(Q500)	automatic actuator, spindle locks, thin-film media
738	382.4	5¼	20	3.25×5.75×8	SCSI	3,600(Q1); 2,365(Q500)	automatic actuator, spindle locks, thin-film media
PRIME COMPUTER INC.							**Circle 572**
Prime Park, Natick, MA 01760, (617) 655-8000							
4711 (subsystem)	85	5¼	28	3.25×5.75×8	ST506/412	3,400(Q1)	
4715 (subsystem)	170	5¼	28	3.25×5.75×8	ESDI	4,900(Q1)	
4735 (subsystem)	515	5¼	20	10.2×8.5×30	ESMD	24,500(Q1)	
QUADRAM CORP.							**Circle 573**
One Quad Way, Norcross, GA 30093-2919, (404) 923-6666							
QuadDrive 20MB AT	25.5	5¼	85	1.63×5.75×8		1,095(Q1)	half-height
QuadDrive 72MB AT	86.5	5¼	25	3.25×5.75×8		3,595(Q1)	
QuadDrive 72MB XT	86.5	5¼	25	3.25×5.75×8		3,795(Q1)	
QUANTUM CORP.							**Circle 574**
1804 McCarthy Blvd., Milpitas, CA 95035, (408) 262-1100							
Q250	53 (formatted)	5¼	30	1.63×5.75×8.05	SCSI	895(Q1000)	
Q280	80 (formatted)	5¼	30	1.63×5.75×8.05	SCSI	995(Q1000)	
Q500	42.66	5¼	45	3.25×5.75×8.05	ST506/412	1,000(Q1000)	
RICOH SYSTEMS INC.							**Circle 575**
2071 Concourse Dr., San Jose, CA 95131, (408) 946-6200							
RH5130	12.75 (removable)	5¼	85	1.625×5.75×8	ST506/412	1,045(Q1); 625(Q500)	removable cartridge, half-height
RODIME INC.							**Circle 576**
901 Broken Sound Blvd. N.W., Boca Raton, FL 33431, (305) 994-6200							
RO400	40-170	5¼	30	1.625×5.75×8	ST412, SCSI		
RO600	20	3½	85	1.625×4×5.75	ST506/412, IBM PC/XT		
RO800	20-100	3½	30	1.625×4×5.75	ST506/412, SCSI		
SCIENTIFIC MICRO SYSTEMS INC.							**Circle 577**
339 N. Bernardo Ave., Mountain View, CA 94043, (415) 964-5700							
5000/60	280 10 (removable)	5¼	30	5×19×20	ST506/412		fixed/removable cartridge; includes controller, power supply
8000/60	280 10 (removable)	5¼	30	5×19×20	ST506/412		fixed/removable cartridge; includes controller, power supply
SEAGATE TECHNOLOGY							**Circle 578**
920 Disc Dr., Scotts Valley, CA 95066-4544, (408) 438-6550							
ST225N	22.57	5¼	65	1.63×5.75×8	SCSI		half-height
ST251	51.25	5¼	40	1.63×5.75×8	ST412		thin-film media
ST4096	95.99	5¼	28	3.25×5.75×8	ST412		half-height
SIEMENS INFORMATION SYSTEMS INC. (MEMORY PRODUCTS DIV.)							**Circle 579**
5655 Lindero Canyon Rd., Suite 325, Westlake Village, CA 91362, (818) 706-8872							
MegaFile 1200	207	5¼	25	3.25×5.75×8	ESDI, SCSI	4,120(Q1); 2,940(Q500)	thin-film heads and media
MegaFile 1300	310	5¼	25	3.25×5.75×8	ESDI, SCSI	4,860(Q1); 3,500(Q500)	thin-film heads and media
SUNOL SYSTEMS INC.							**Circle 580**
1177 Quarry Lane, Pleasanton, CA 94566, (415) 484-3322							
Sun*Disk (subsystem)	21, 45, 70, 110, 160	5¼	3	11×8.5×20	Sun*Net, IBM PC Net	2,195+(Q1)	
Sun*Mufs (subsystem)	21, 45, 70, 110	5¼	3	11×8.5×20	Appletalk, Sun*Net, IBM PC Net	2,595+(Q1)	
Sun*Streak (subsystem)	21, 45, 70, 110, 160	5¼	3	8×3×10	SCSI	2,195+(Q1)	
SYQUEST TECHNOLOGY							**Circle 581**
47923 Warm Springs Blvd., Fremont, CA 94539, (415) 490-7511							
SQ15X15 (subsystem)	38 (removable)	5¼	135	2.5×19×17	IBM PC/AT/XT	2,695(Q1)	dual removable 19M-byte cartridge
SQ312RD (subsystem)	12.75 (removable)	5¼	135	1.625×4.8×8	ST506	690(Q1); 600(Q500)	removable cartridge
SQ319KIT (subsystem)	19 (removable)	5¼	135	1.625×4.8×8	IBM PC/AT/XT	1,195(Q1)	internal drive kit, removable cartridge

5¼-inch and smaller rigid disk drives & subsystems

Company Model	Unformatted capacity (M bytes)	Disk size (inches)	Average access time (msec)	Dimensions (H×W×D/inches)	Interfaces	Price $ (quantity)	Notes, features
SYSGEN INC.							**Circle 582**
47853 Warm Springs Blvd., Fremont, CA 94539, (415) 490-6770							
DuraPak (subsystem)	15 (removable)	3.9	85	1.75×5.75×8	ST506/412, RLL	1,295(Q1)	interchangeable removable cartridge
Matched Pair (subsystem)	51/86	5¼	28/30	1.75×5.75×8.25, 3.5×5.75×8	ST506/412, MFM	1,795/2,995(Q1)	half- or full-height, includes SC6000 controller
SYSTEMS PERIPHERALS CONSULTANTS							**Circle 583**
9747 Business Park Ave., San Diego, CA 92131, (619) 693-8611							
Diskit (subsystem)	13-50 13 (removable)	5¼	65-80	2×6.5×14	ST506, IBM PC/AT/XT	595-2,995(Q1)	fixed/removable cartridge
Diskit jr. (subsystem)	10-50 10 (removable)	3½, 5¼	65-80	4×6.5×14	ST506, IBM PC/AT/XT	595-2,995(Q1)	fixed/removable cartridge
Ultrastore (subsystem)	60-280	5¼	30	4×6.5×14	ST506, IBM PC/AT/XT	3,995-5,995(Q1)	
SYSTEMS AND SOFTWARE INC.							**Circle 584**
7825 E. Redfield Rd., Scottsdale, AZ 85260, (602) 948-7313							
PS12RINT-PLUS (subsystem)	12 (removable)	5¼	95	1.63×5.75×8	ST506/412, IBM PC/AT/XT	1,296(Q1); 1,143(Q500)	removable cartridge
PS12R12REXT (subsystem)	24 (removable)	5¼	95	1.63×5.75×8	ST506/412, IBM PC/AT/XT	2,933(Q1); 2,589(Q500)	removable cartridge
PS12R26EXT (subsystem)	26 12 (removable)	5¼	95	1.63×5.75×8	ST506/412, IBM PC/AT/XT	2,127(Q1); 1,876(Q500)	fixed/removable cartridge
TALLGRASS TECHNOLOGIES CORP.							**Circle 585**
11100 West 82nd St., Overland Park, KS 66214, (913) 492-6002							
TG-2025e (subsystem)	26	5¼	85	7.1×4×14.95	ST506	2,295(Q1)	includes 20M-byte tape drive backup
TG-6180 (subsystem)	86	5¼	30	5.3×10×16.4	ST506	7,495(Q1)	includes 60M-byte tape drive backup
TANDON CORP.							**Circle 586**
20320 Prairie St., Chatsworth, CA 91311, (818) 993-6644							
TM262	25	5¼	80	1.62×5.75×7.34	ST506/412		plated media, Whitney technology, half-height
TM362	25	3½	80	1.62×4×5.78	ST506/412		plated media, Whitney technology
TM755	51	5¼	35	1.62×5.75×8.06	ST506/412		plated media, Whitney technology, half-height
TECMAR INC.							**Circle 587**
6225 Cochran Rd., Solon, OH 44139, (216) 349-0600							
QIC60 W20	23.5	5¼	85	7×3.8×15.6		3,495(Q1)	includes 60M-byte tape drive backup
TOSHIBA AMERICA INC. (DISK PRODUCTS DIV.)							**Circle 588**
3910 Freedom Circle, Suite 103, Santa Clara, CA 95054, (408) 727-3939							
MK-50 Series	43.2-86.5	5¼	25	3.25×5.75×8	ST506/412	1,025-1,195(Q500)	up to 130M bytes with RLL controller
MK-150 Series	86.5-172.9	5¼	25	3.25×5.75×8	ESDI, SCSI	1,305-1,780(Q500)	
U.S. DESIGN CORP.							**Circle 589**
5100 Philadelphia Way, Lanham, MD 20706, (301) 577-2880							
VIP (subsystem)	140-1500	5¼	12	5.25×17.5×25.5	ESDI, SCSI, Q-bus, UNIbus, IBM PC/AT/XT		includes 100M-byte tape cartridge drive backup
MicroVIP (subsystem)	140-380	5¼	12	5.25×17.5×25.5	ESDI, SCSI, Q-bus, UNIbus, IBM PC/AT/XT		includes 100M-byte tape cartridge drive backup
WINCHESTER SYSTEMS INC.							**Circle 590**
400 W. Cummings Park, Woburn, MA 01801, (617) 933-8500							
4xRL02-2R (subsystem)	27 27 (removable)	5¼	45.7	5.25×19×23	Q-bus, UNIbus	10,500(Q1)	fixed/removable cartridge
DataSafe 120+11R (subsystem)	150 13 (removable)	5¼	45.7	5.25×17.5×23	MSCP, Q-bus, UNIbus	13,750(Q1)	fixed/removable cartridge
DataSafe Dual 11R+11R (subsystem)	27 13 (removable)	5¼	45.7	5.25×17.5×23	MSCP, Q-bus, UNIbus	10,500(Q1)	fixed/removable cartridge
XIDEX CORP.							**Circle 591**
5100 Patrick Henry Dr., Santa Clara, CA 95050, (408) 988-3472							
FileCard (subsystem)	20	3½	80	4×1.75×13.5	SCSI	895(Q1)	includes controller board, XTREE software
PortaFile (subsystem)	20	3½	74	5.5×6.25×10.25	SCSI	1,495(Q1)	includes controller board, power supply, XTREE software

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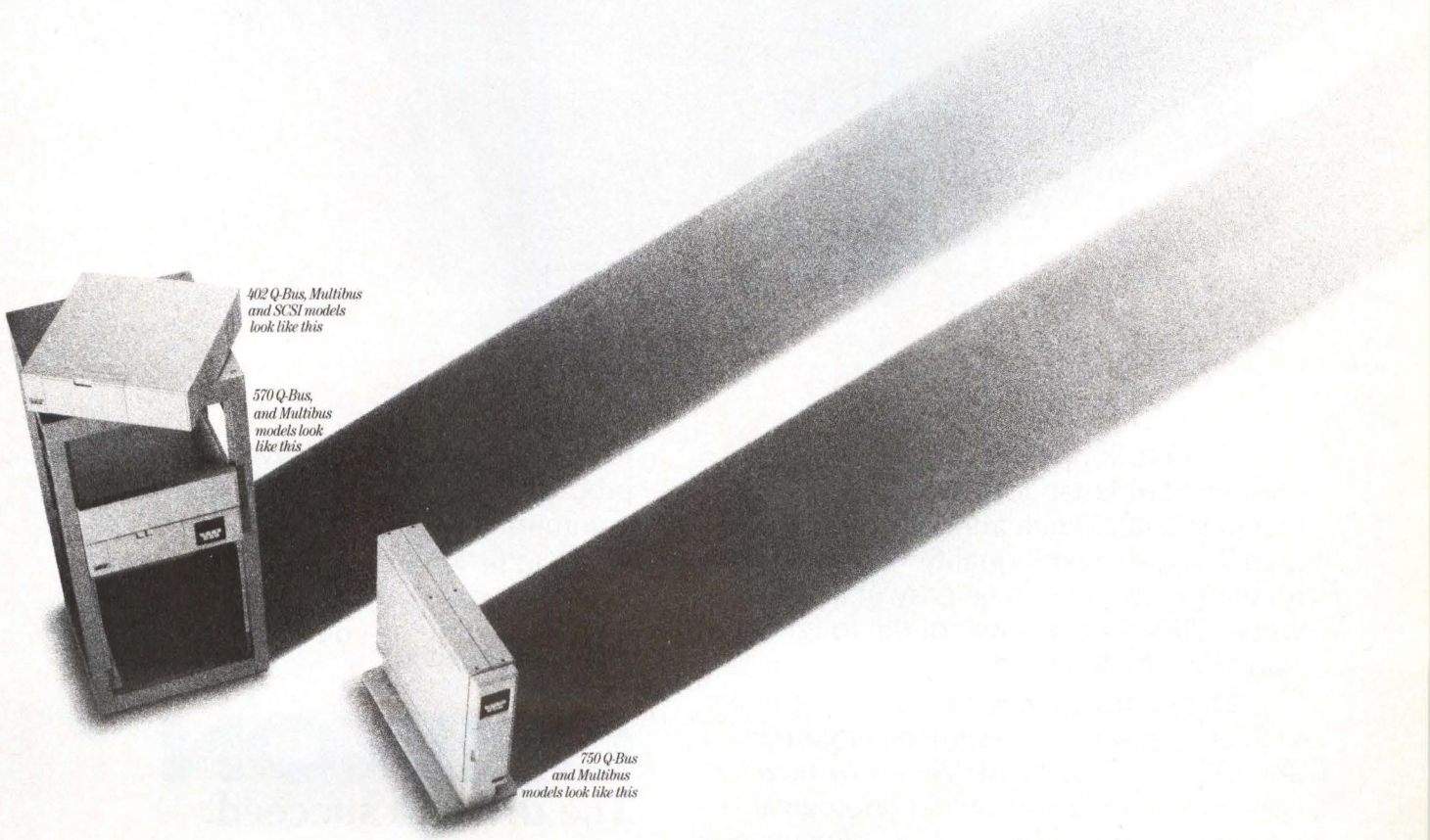

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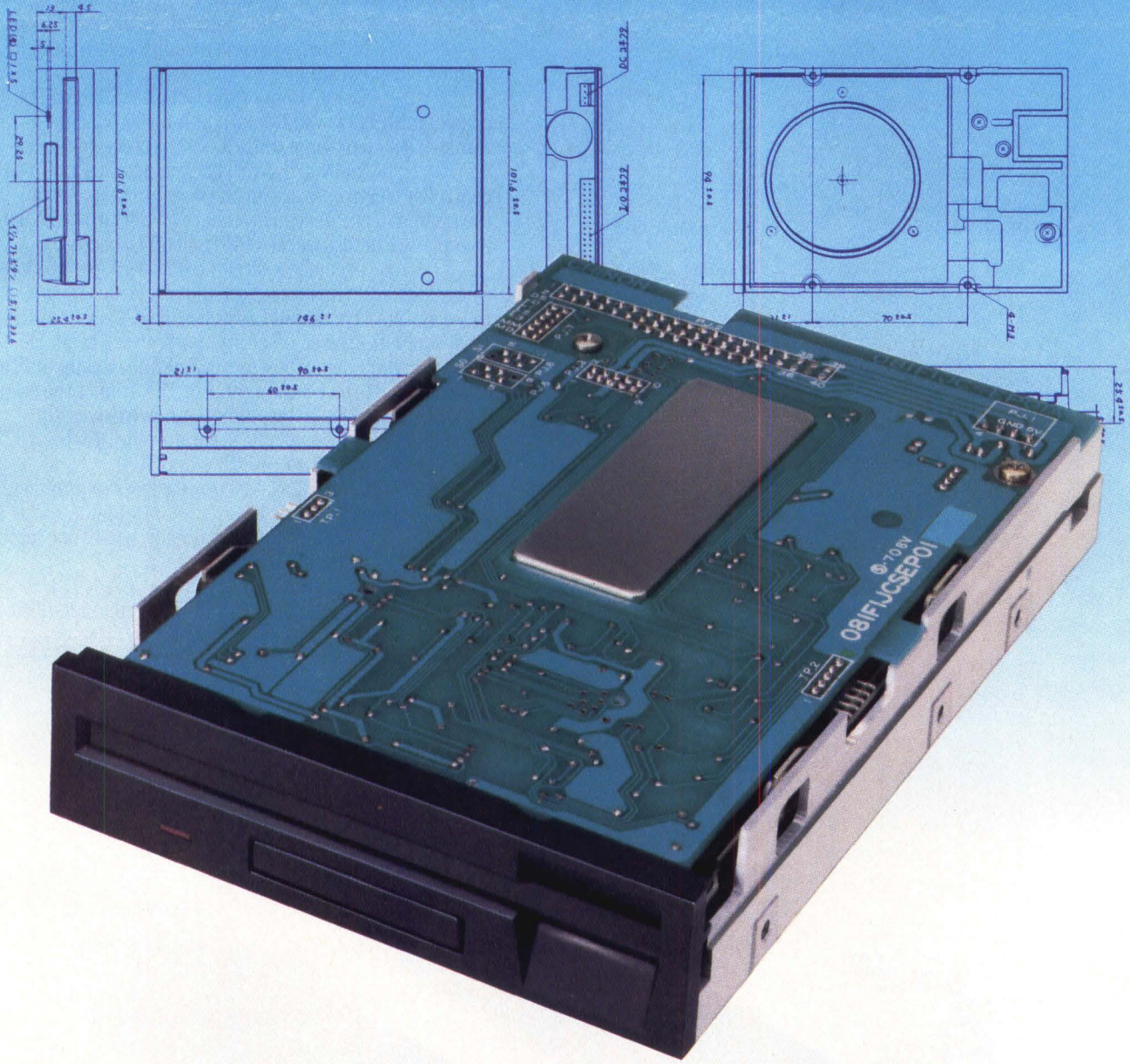

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PICTURED IS CHINON F-354L: 5V, ONE-INCH, 1MB SLIM-LINE MODEL.

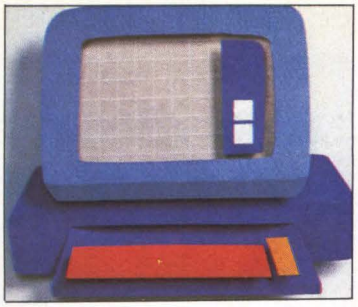
CIRCLE NO. 16 ON INQUIRY CARD

3½-inch flexible disk drives & subsystems

Company Model	Capacity (bytes)	Single- or double-sided	Average access time (msec)	Transfer rate (K bits/sec.)	Tracks/surface	Dimensions (H×W×D/inches)	Price $ (quantity)	Notes, features
ANALOG & DIGITAL PERIPHERALS INC. (ADPI)								**Circle 501**
815 Diana Dr., Troy, OH 45373, (513) 339-2241								
Easi Disk	375K, 750K	double-sided	158	19.2	80, 160	6.5×5.15×9.5	995(Q1); 795(Q500)	RS232C interface
APPLE COMPUTER INC.								**Circle 502**
20525 Mariani Ave., Cupertino, CA 95014, (408) 996-1010								
Macintosh 800K External (subsystem)	800K	double-sided	30	489.6	80	1.85×4.72×7.87	399(Q1)	
UniDisk (subsystem)	800K	double-sided	30	489.6	80	2.07×4.72×7.87	399(Q1)	
C. ITOH ELECTRONICS INC.								**Circle 503**
5301 Beethoven St., P.O. Box 66903, Los Angeles, CA 90066, (213) 306-6700								
YDF-620B/625B	500K	double-sided	95	250	80	1.58×4×5.34	175(Q1)	
YD-640B/645B	1M	double-sided	175	250	160	1.58×4×5.34	178(Q1)	
YD-665B	1.6M	double-sided	91	500	154	1.58×4×5.98	185(Q1)	
CITIZEN AMERICA CORP.								**Circle 504**
2425 Colorado Ave., Suite 300, Santa Monica, CA 90404, (213) 453-0614								
OPDA-00A	1M	double-sided	94	250	80	1×4×5.9	115(Q1); 110(Q500)	single power supply, battery operation
OPDB-OOA	1M	double-sided	173	250	80	1×4×5.9	115(Q1); 110(Q500)	single power supply, battery operation
ORDA-OOA	1.6M	double-sided	94	500	77	1×4×5.9	130(Q1); 125(Q500)	single power supply, battery operation
DATA TRACK USA								**Circle 696**
9451 Sohap Lane, Columbia, MD 21045, (301) 992-9143								
Tracker 1300	360K-1.2M	double-sided		19.2K	40-80	5.5×7.25×14	1,495(Q1); 1,150(Q500)	RS232C interface; IBM PC/AT/XT, Hewlett-Packard 150 compatible
EPSON AMERICA INC.								**Circle 505**
23600 Telo St., Torrance, CA 90505, (213) 534-4500								
SMD-240H	2M	double-sided	3	500	80	1.1×4×5.88		
SMD-280H	1M	double-sided	3	250	80	1.1×4×5.88		
SMD-280L	1M	double-sided	3	250	80	1×4×5.88		
FUJITSU AMERICA INC. (STORAGE PRODUCTS DIV.)								**Circle 506**
3055 Orchard Dr., San Jose, CA 95134, (408) 946-8777								
M2531A	500K	single-sided	94	250	80	1.26×4.06×6.16	96(Q500)	
M2532A	1M	double-sided	94	250	160	1.26×4.06×6.16	112(Q500)	
HEWLETT-PACKARD CO. (GREELEY DIV.)								**Circle 507**
700 71st Ave., Greeley, CO 80634, (303) 352-2741								
9114B (subsystem)	788K	double-sided	175	500	80	3.1×11.5×8	795(Q1)	HP-IL interface, portable
9122D (subsystem)	788K	double-sided	175	500	80	3.2×12.8×11.2	1,390(Q1)	dual drives, HP-IB interface
MITSUBISHI ELECTRONICS AMERICA INC.								**Circle 508**
991 Knox St., Torrance, CA 90502, (213) 515-3993								
MF353A	1M	double-sided	173	250	80	1.26×4×5.9	140(Q1)	
MF353AF	1M	double-sided	94	250	80	1.26×4×5.9	140(Q1)	
NEC INFORMATION SYSTEMS INC.								**Circle 509**
1414 Massachusetts Ave., Boxborough, MA 01719, (617) 264-8000								
FD1035	1M	double-sided	95	250	80	1.6×4×5.1	232(Q1); 105(Q1000)	
FD1036A	1M	double-sided	95	250	80	1.8×4×5.75	200(Q1); 100(Q1000)	

3 ½-inch flexible disk drives & subsystems

Company Model	Capacity (bytes)	Single- or double-sided	Average access time (msec)	Transfer rate (K bits/sec.)	Tracks/surface	Dimensions (H×W×D/inches)	Price $ (quantity)	Notes, features
PANASONIC INDUSTRIAL CO.								**Circle 510**
1731 Technology Dr., Suite 650, San Jose, CA 95110, (408) 294-5888								
JU-363/JU-364	1M	double-sided	94	250	80	1.25×4×6	125(Q1); 98(Q500)	
JU-386	1.6M	double-sided	94	250, 500	80	1.25×4×6	187(Q1); 147(Q500)	
JU-394	2M	double-sided	94	500	80	1.25×4×6	196(Q1); 154(Q500)	
SANKYO SEIKI (AMERICA) INC.								**Circle 511**
20911 Western Ave., Torrance, CA 90501, (213) 321-0320								
FDU355-DB	1M	double-sided	3	250	80	1.575×4×6.048	195(Q1); 100(Q500)	rugged construction
FDU365-DB	1M	double-sided	6	250	80	1.18×4×5.12	185(Q1); 95(Q500)	rugged construction
TOSHIBA AMERICA INC. (DISK PRODUCTS DIV.)								**Circle 512**
3910 Freedom Circle, Suite 103, Santa Clara, CA 95054, (408) 727-3939								
ND-352	1M	double-sided	158	250	160	1×4×6	89(OEM)	CMOS, TTL interface
ND-354	1M	double-sided	79	250	160	1.6×4×5.6	85(OEM)	CMOS, TTL interface



Alphanumeric display terminals

Company Model	Terminal type	Display size, color (diagonal inches)	Screen format (col.×lines)	Interfaces (protocols)	Emulations	Price $ (quantity)	Notes, features
3M (TELETERMINAL PRODUCTS)							**Circle 645**
311 Turquoise St., Milpitas, CA 95035, (408) 943-1970							
Whisper Screen 1923	intelligent	9-inch, green	80×25	RS232C (X-on/X-off, TTY)	DEC VT52, VT100		12 programmable function keys, built-in modem
Whisper Screen 1924	intelligent	9-inch, green	80×25	RS232C (X-on/X-off, TTY)	DEC VT52, VT100		12 programmable function keys, built-in modem
ADAC CORP.							**Circle 646**
70 Tower Office Park, Woburn, MA 01801, (617) 935-6668							
3200CR	intelligent/graphics	7-inch, green		RS232C, RS423		1,200-2,300(Q1)	bar graphs, circle, rectangle, vector graphics
ALTOS COMPUTER SYSTEMS							**Circle 647**
2641 Orchard Parkway, San Jose, CA 95014, (408) 946-6700							
Altos III	intelligent	14-inch, green	132×26	RS232C (X-on/X-off, DTR)	DEC, TeleVideo, Wyse	795(Q1)	16 or 32 programmable function keys
Altos IV	intelligent	14-inch, green	80×26	RS232C (X-on/X-off, DTR)	DEC, TeleVideo, Wyse	495(Q1)	16 or 32 programmable function keys
AMPEX CORP. (COMPUTER PRODUCTS DIV.)							**Circle 648**
200 N. Nash St., El Segundo, CA 90245, (213) 640-0150							
210 plus	intelligent	14-inch; amber, green	80×25, 132×25	RS232C (X-on/X-off, DTR)	ADDS Viewpoint, Regent; Hazeltine; Lear Siegler; Qume; TeleVideo	469(Q1)	14 programmable function keys, line graphics
230 plus	intelligent	14-inch; amber, green	80×25, 132×25	RS232C (X-on/X-off, DTR)	ADDS, Hazeltine, TeleVideo, Wyse	569(Q1)	16 programmable function keys, split screen, business graphics
232	editing	14-inch; amber, green	80×25, 132×25	RS232C (X-on/X-off, DTR)	IBM PC/AT/XT, TeleVideo 925	649(Q1)	10 function keys
ANN ARBOR TERMINALS INC.							**Circle 649**
6175 Jackson Rd., Ann Arbor, MI 48103, (313) 663-8000							
Ambassador XL	intelligent	15-inch, green	80×60	RS232C, RS422, current loop (X-on/X-off)	DEC VT52, VT100	1,595(Q1); 1,275(Q100)	programmable keyboard, line drawing graphics, scroll, zoom
GXL	intelligent/graphics	15-inch, green	80×60	RS232C, RS422, current loop (X-on/X-off)	DEC VT52, VT100; Tektronix 4010, 4014	3,090(Q1); 2,475(Q100)	bit-mapped graphics, PLOT 10 software, polygon draw and fill
VXL	intelligent	15-inch, amber	160×60	RS232C, RS422, current loop (X-on/X-off)	DEC VT52, VT100	2,795(Q1); 2,235(Q100)	programmable keyboard, line drawing graphics, scroll, zoom
AT&T							**Circle 650**
5555 Touhy Ave., Skokie, IL 60077, (312) 982-2000							
510 Personal Terminal	editing	9-inch, green	132×27	RS232C, RJ-11 (ANSI X3.64)	AT&T 513, DEC VT100	1,645(Q1)	voice/data terminal
610 BCT	editing/graphics	12-inch; amber, green, white	132×27	RS232C (ANSI X3.64)	AT&T 4410	875(Q1)	16 programmable function keys, business graphics
4425	editing/graphics	12-inch; amber, green	132×27	RS232C (ANSI X3.64)	DEC VT52, VT100	1,295(Q1)	16 function keys, business graphics
BEEHIVE INTERNATIONAL							**Circle 651**
4910 Amelia Earhart Dr., Salt Lake City, UT 84116-2837, (801) 355-6000							
ATL-179	editing	14-inch, 8-color	80×24	coaxial	IBM 3179		24 programmable function keys
ATL-180	editing	14-inch; amber, green	132×43	coaxial	IBM 3180		24 programmable function keys
ATL-191	editing	14-inch; amber, green	80×24	coaxial	IBM 3191		24 programmable function keys
BURROUGHS CORP.							**Circle 652**
One Burroughs Place, Detroit, MI 48232, (313) 972-7000							
ET1100	editing	14-inch, green	80×25	RS232C, TDI (synch)		1,660(Q1); 1,375(Q100)	10 physical, 20 logical function keys; up to 10 display pages

Alphanumeric display terminals

Company Model	Terminal type	Display size, color (diagonal inches)	Screen format (col.×lines)	Interfaces (protocols)	Emulations	Price $ (quantity)	Notes, features
CIE SYSTEMS							**Circle 653**
2515 McCabe Way, Irvine, CA 92714, (714) 660-1800							
CIE 7101	editing	14-inch; amber, green	132×25	RS232C, RS422 (X-on/X-off, DTR)	ADDS Viewpoint; DEC VT100, VT102; IBM 3101	595(Q1)	24 function keys, split screen
CIE 7102	editing	14-inch; amber, green	132×25	RS232C, RS422 (X-on/X-off, DTR)	IBM PC/AT/XT	649(Q1)	24 function keys, split screen
CIE 7900	editing	13-inch, 7-color	80×24, 80×32	RS232C (X-on/X-off, DTR)	IBM 3179, 3279; DEC VT100	1,695(Q1); 1,525(Q100)	12-24 programmable function keys
CIE TERMINALS INC.							**Circle 654**
2505 McCabe Way, Irvine, CA 92714 (714) 660-1421							
ANT	editing	14-inch, amber	80×25	RS232C (X-on/X-off, DTR)	ADDS Viewpoint; Lear Siegler ADM 3A, ADM 5; TeleVideo 910	299(Q1)	20 function keys, line drawing character set
CIT 50+	editing	14-inch; amber, green	132×25	RS232C (X-on/X-off, DTR)	ADDS Viewpoint; DEC VT100, VT102; Wyse WY-50	649(Q1)	32 function keys, split screen, line drawing character set
CIT 224	editing	14-inch; amber, green, white	132×25	RS232C (X-on/X-off, DTR)	DEC VT100, VT102, VT220	749(Q1)	60 function keys, split screen, line drawing character set
CLEVELAND CODONICS INC.							**Circle 655**
18001 Englewood Dr., Middleburg Heights, OH 44130, (216) 243-1198							
1550	intelligent/graphics	14-inch; amber, green	132×24	RS232C (X-on/X-off)	ADDS, Hazeltine, Lear Siegler, TeleVideo, Tektronix, Wyse	1,895(Q1)	32 function keys; 16 programmable function keys; vector, point plot graphics
1575	intelligent/graphics	14-inch; amber, green	132×24	RS232C (X-on/X-off)	DEC VT100; Tektronix 4010, 4014; Wyse WY-75	1,895(Q1)	32 function keys; 16 programmable function keys; vector, point plot graphics
COLORGRAPHIC COMMUNICATIONS CORP.							**Circle 656**
P.O. Box 80448, Atlanta, GA 30366, (404) 455-3921							
480	intelligent/graphics	13-inch, 8-color	80×48	RS232C (X-on/X-off, ANSI X3.64)	DEC VT52, VT100	2,600(Q1); 2,000(Q100)	24 function keys, PLOT 10 compatible
480XL	intelligent/graphics	13-inch, 8-color	80×48	RS232C (X-on/X-off, ANSI X3.64)	DEC VT52, VT100	2,600(Q1); 2,000(Q100)	24 function keys, PLOT 10 compatible
489	intelligent/graphics	19-inch, 8-color	80×48	RS232C (X-on/X-off, ANSI X3.64)	DEC VT52, VT100	3,000(Q1); 2,400(Q100)	24 function keys, PLOT 10 compatible
DATA GENERAL CORP.							**Circle 657**
4400 Computer Dr., Westboro, MA 01580, (617) 366-8911							
D214	intelligent	12-inch; amber, green	80×24	RS232C (X-on/X-off)	Data General D210	795(Q1)	19 function keys
D411	intelligent	12-inch; amber, green	81×24, 135×24	RS232C, RS422, current loop (X-on/X-off)	ANSI	1,195(Q1)	19 function keys, line drawing graphics
D461	intelligent	12-inch; amber, green	81×24, 135×24	RS232C, RS422, current loop (X-on/X-off)	Data General D450	1,495(Q1)	19 function keys, character graphics
DIGITAL EQUIPMENT CORP.							**Circle 694**
129 Parker St., Maynard, MA 01754, (617) 897-5111							
VT220	intelligent	12-inch; amber, b&w, green	132×25	RS232C (X-on/X-off)	DEC VT100	1,095(Q1)	36 function keys, 15 programmable function keys
VT240	intelligent/graphics	12-inch; amber, b&w, green	132×25	RS232C (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	2,195(Q1)	36 function keys, 15 programmable function keys, bit-mapped graphics
VT241	intelligent/graphics	13-inch, RGB	132×25	RS232C (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	3,195(Q1)	36 function keys, 15 programmable function keys, bit-mapped graphics
ELECTRO MECHANICAL SYSTEMS INC. (EMS)							**Circle 658**
801 W. Bradley Ave., Champaign, IL 61820, (217) 359-7125							
Touch Information Display	dumb	12-inch; amber, green	80×25	RS232C, RS422	Lear Siegler ADM 3A	1,400-1,500(Q1)	desktop or rackmount
FALCO DATA PRODUCTS							**Circle 659**
1294 Hammerwood Ave., Sunnyvale, CA 94089, (408) 745-7123							
Falco 500	intelligent	14-inch; amber, green, white	132×40	RS232C, RS422 (X-on/X-off, asynch, DTR)	ADDS, DEC, Hazeltine, TeleVideo, Wyse	795(Q1)	64 function keys, 2 pages of memory
Falco 550	intelligent	14-inch; amber, green, white	132×40	RS232C, RS422 (X-on/X-off, asynch, DTR)	ADDS Viewpoint, Data General, IBM 3101, TeleVideo, Wyse	595(Q1)	16 programmable function keys, split screen, 2 pages of memory

Alphanumeric display terminals

Company Model	Terminal type	Display size, color (diagonal inches)	Screen format (col.×lines)	Interfaces (protocols)	Emulations	Price $ (quantity)	Notes, features
Falco 5220	intelligent	14-inch; amber, green, white	132×40	RS232C, RS422 (X-on/X-off, asynch, DTR)	DEC VT52, VT100, VT220	595(Q1)	64 function keys, 2 pages of memory
GENERAL BUSINESS TECHNOLOGY INC. 1891 McGaw Ave., Irvine, CA 92714, (714) 261-1891							**Circle 660**
7700DS	dumb	14-inch; amber, green	80×24	IBM System 34, 36, 38	IBM 5251-11	1,450(Q1)	
7710DS	dumb	14-inch; amber, green	80×24	IBM System 34, 36, 38	IBM 5251-11	1,450(Q1)	
GENERAL DIGITAL CORP. 160 Chapel Rd., P.O. Box 1657, Manchester, CT 06040, (203) 647-9700							**Circle 661**
VuePoint II	intelligent	10½-inch; green, orange	40×12	RS232C, RS422, RS423, RS485, current loop, TTL (X-on/X-off)		2,930(Q1); 2,403(Q100)	touch sensitive display, 3 pages of memory, 240 programmable touch areas
Smart VuePoint	intelligent	10½-inch; green, orange	40×12	RS232C, RS422, RS423, RS485, current loop, TTL (X-on/X-off)		4,500(Q1); 3,375(Q100)	additional on-board CPU off-loads processing from controller
HEWLETT-PACKARD CO. (ROSEVILLE TERMINALS DIV.) 8020 Foothills Blvd., Roseville, CA 95678, (916) 786-8000							**Circle 662**
2392A	intelligent	12-inch, green	80×96	RS232C, RS422, Centronics, HP-IB (X-on/X-off)	DEC VT52, VT100	1,375(Q1)	8 programmable function keys
2394A	intelligent	12-inch, green	80×192	RS232C, RS422, Centronics, HP-IB (X-on/X-off)	DEC VT52, VT100	1,875(Q1)	8 programmable function keys
HMW DATA SYSTEM GMBH Bahnhofstr. 1, 8011 Höhenkirchen, Siegertsbrunn, West Germany, (08102) 4077							**Circle 663**
MCD 4003	intelligent/graphics	20-inch, 64-color	80×48	RS232C (DTR)	DEC VT100		32 function keys, split screen, bit-mapped graphics, polygon fill
UMDC	intelligent/graphics	20-inch, 256-color	256×256	RS232C, RS485 (X-on/X-off, DTR)			bit-mapped graphics, polygon fill
HONEYWELL INFORMATION SYSTEMS INC. 200 Smith St., Waltham, MA 02254, (617) 895-6000							**Circle 664**
HDS2	editing/graphics	12-inch; amber, green	80×25	RS232C, RS422A (TTY)	Honeywell 7305	1,295(Q1); 1,036(Q100)	12 programmable function keys, split screen, line graphics
VIP7826	editing/graphics	12-inch, green	80×25	RS232C, RS422A (Honeywell VIP Poll/Select)	Honeywell 7705R VIP, VIP 7814	2,800(Q1); 2,240(Q100)	12 function keys; line, mosaic graphics
HUMAN DESIGNED SYSTEMS INC. 3440 Market St., Philadelphia, PA 19104, (215) 382-5000							**Circle 665**
HDS2200	intelligent	15-inch; amber, green, white	132×25	RS232C, current loop (X-on/X-off, CTS/RTS, DTR)	DEC VT100, VT220	795(Q1)	42 function keys, split screen
HDS2200G	intelligent/graphics	15-inch; amber, green, white	132×25	RS232C, current loop (X-on/X-off, CTS/RTS, DTR)	DEC, Retrographics, Tektronix, Visual	1,295(Q1)	42 function keys, split screen, bit-mapped graphics, PLOT 10 compatible
HDS2200GX	intelligent/graphics	15-inch; amber, green, white	132×25	RS232C, current loop (X-on/X-off, CTS/RTS, DTR)	DEC, Retrographics, Tektronix, Visual	1,595(Q1)	42 function keys, split screen, bit-mapped graphics, PLOT 10 compatible
ITT COURIER TERMINAL SYSTEMS P.O. Box 29039, Phoenix, AZ 85038-9039, (602) 894-7000							**Circle 666**
921X	editing	14-inch; amber, green, 7-color	80×24	coaxial (BSC, SNA/SDLC)	IBM 3270	1,550(Q1)	24 programmable function keys, non-volatile setup mode
923X	editing/graphics	15-inch; amber, green, 7-color	132×43	coaxial (BSC, SNA/SDLC)	IBM 3270	1,995(Q1)	24 programmable function keys, split screen
1778	editing	12-inch; amber, green	80×24	coaxial (BSC, SNA/SDLC)	IBM 3178, 3191	1,550(Q1)	24 programmable function keys
IXO INC. 865 Manhattan Beach Blvd., Suite 207, Manhattan Beach, CA 90266, (213) 417-8080							**Circle 667**
TC200	intelligent	4-inch; black, green	16×1	RS232C, phone line (X-on/X-off)		395(Q1); 350(Q100)	hand-held unit, built-in modem, split screen
KIMTRON CORP. 1709 Junction Court, Bldg. 380, San Jose, CA 95112, (408) 436-6550							**Circle 668**
KT-5	intelligent/graphics	14-inch; amber, green	80×24, 132×24	RS232C (X-on/X-off, DTR)	ADDS, DEC, Hazeltine, Lear Siegler, TeleVideo	495(Q1)	84 programmable function keys; line, block graphics; 2 pages of memory

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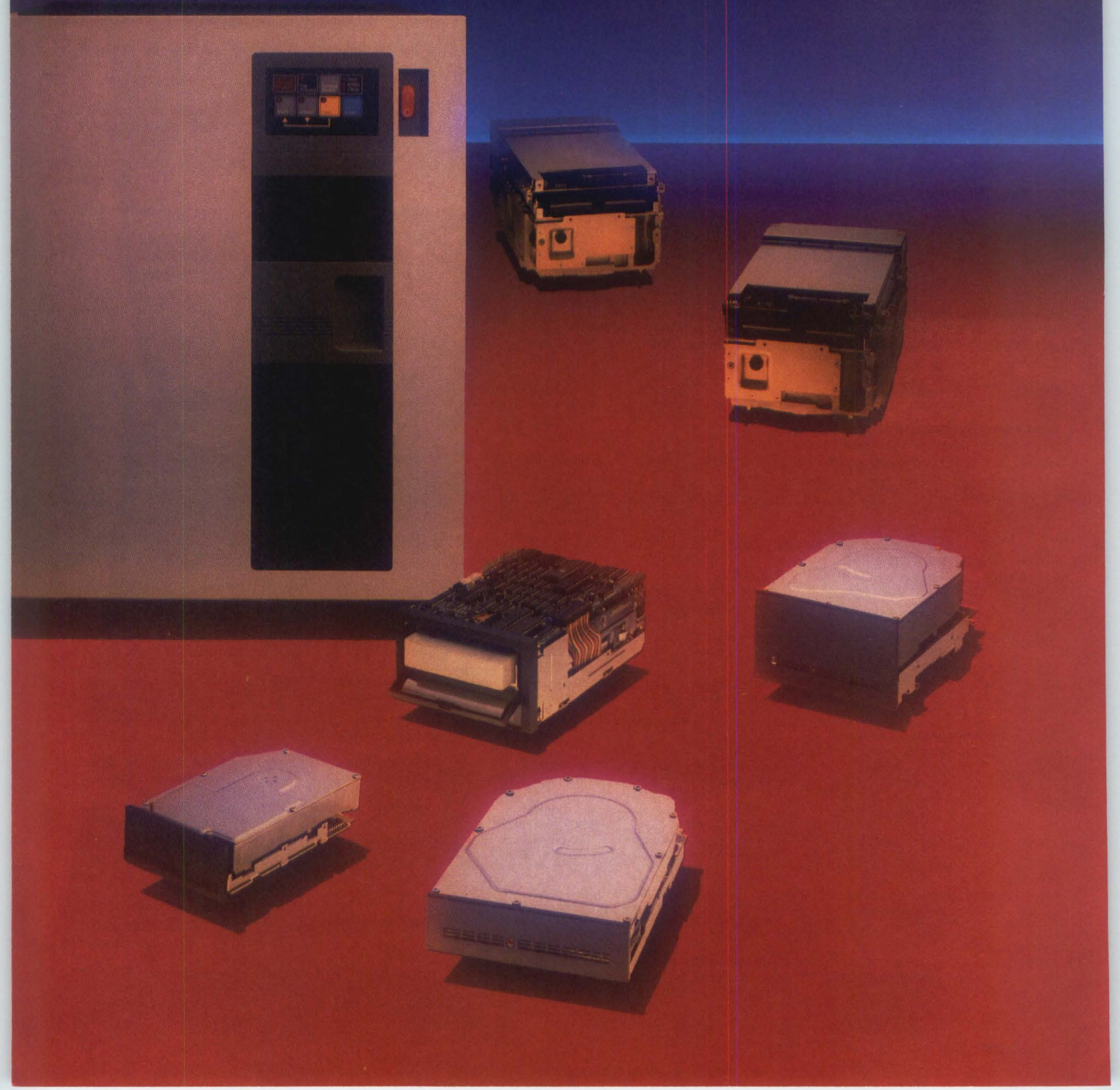

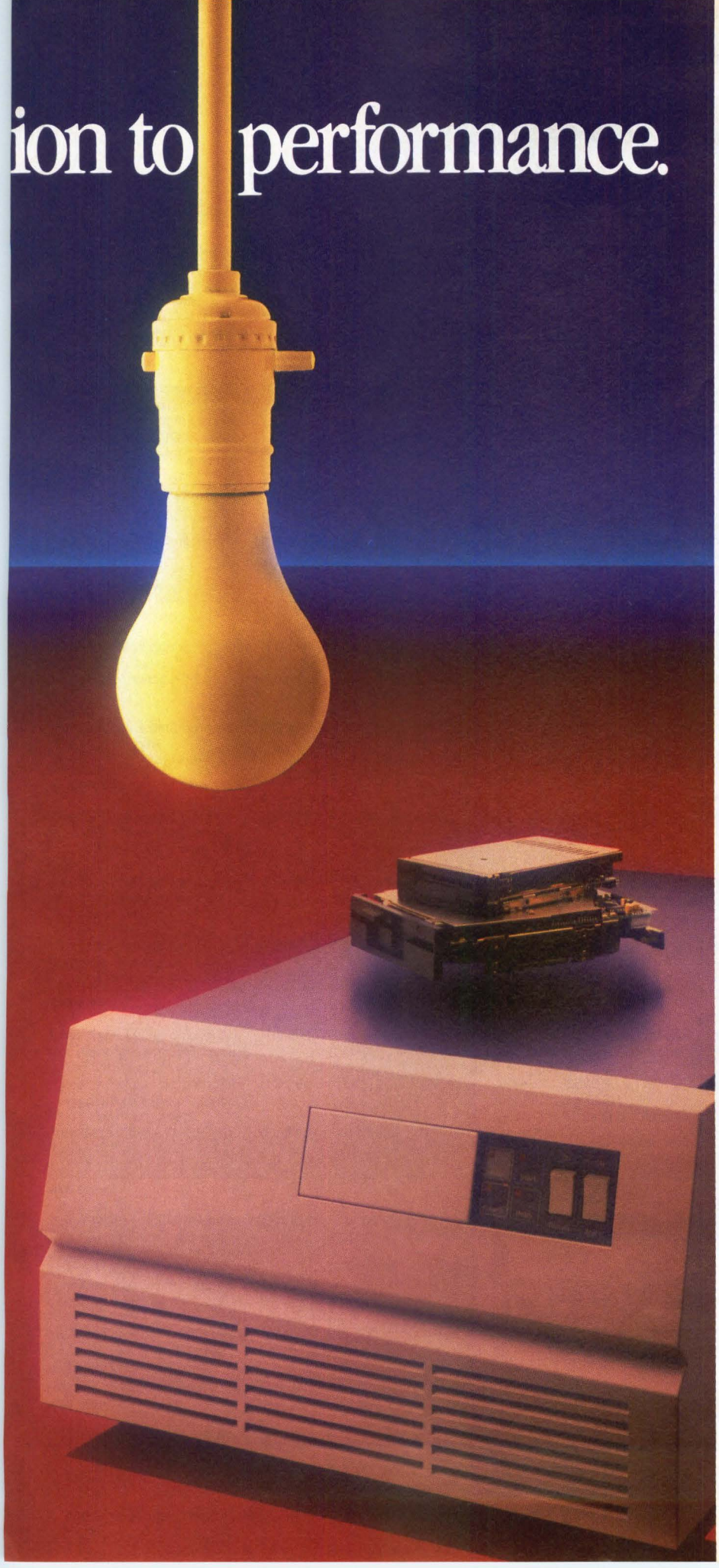

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CIRCLE NO. 18 ON INQUIRY CARD

Alphanumeric display terminals

Company Model	Terminal type	Display size, color (diagonal inches)	Screen format (col.×lines)	Interfaces (protocols)	Emulations	Price $ (quantity)	Notes, features
KT-7/PC	intelligent/graphics	14-inch; amber, green	80×25	RS232C (X-on/X-off, DTR)	IBM PC/AT/XT, TeleVideo 925	695(Q1)	20 programmable function keys; line, block drawing graphics
KT-22	intelligent/graphics	14-inch; amber, green	80×24, 132×24	RS232C (X-on/X-off, DTR)	DEC VT52, VT100, VT220	599(Q1)	30 programmable function keys; line, block drawing graphics; 3 pages of memory
LANPAR TECHNOLOGIES INC.							**Circle 669**
747 Main St., #207, Concord, MA 01742, (617) 371-0915							
Vision II-3220	intelligent/graphics	14-inch; amber, b&w, green	132×25	RS232C	DEC VT52, VT100, VT220		96 programmable function keys
Vision II-3222	intelligent	14-inch; amber, b&w, green	132×25	RS232C	DEC VT52, VT100, VT220		96 programmable function keys, PLOT 10 compatible
LEE DATA CORP. (DATASTREAM NETWORKING DIV.)							**Circle 670**
2520 Mission College Blvd., Santa Clara, CA 95050, (408) 986-8022							
8178	editing/graphics	14-inch; amber, green	80×25	RS232C, current loop (X-on/X-off, BSC, SNA)	DEC VT220, IBM 3178	995(Q1)	24 programmable function keys
8180	editing/graphics	14-inch; amber, green	80×24, 80×32, 80×43, 132×27	RS232C, current loop (X-on/X-off, BSC, SNA)	DEC VT220, IBM 3180	1,595(Q1)	24 programmable function keys
LEE DATA CORP. (PHAZE TERMINAL DIV.)							**Circle 671**
7650 E. Redfield Rd., Scottsdale, AZ 85260, (602) 991-6855							
1178	editing	14-inch; amber, green	80×24	(IBM 3270 type A coaxial)	IBM 3178, 3278	995(Q1)	24 programmable function keys
1179	editing	14-inch, 7-color	80×24	Centronics (IBM 3270 type A coaxial)	IBM 3178, 3179, 3278, 3279	1,865(Q1)	24 function keys
P3278	editing	12-inch, green	80×24	Centronics (IBM 3270 type A coaxial)	IBM 3178, 3278	995(Q1)	24 programmable function keys
LIBERTY ELECTRONICS USA							**Circle 672**
332 Harbor Way, South San Francisco, CA 94080, (415) 742-9960							
Freedom ONE	intelligent	14-inch, green	132×24	RS232C (X-on/X-off, DTR)	ADDS Viewpoint, Lear Siegler ADM 31, TeleVideo 950, Wyse WY-50	449(Q1)	44 programmable function keys, non-volatile setup mode, split screen
Freedom 110	editing	14-inch; amber, green	80×24	RS232C (X-on/X-off, DTR)	ADDS Regent 25, Hazeltine 1420, Lear Siegler ADM 3A, TeleVideo 910	545(Q1)	10 programmable function keys, non-volatile setup mode
Freedom 220	editing	14-inch; amber, green	132×24	RS232C (X-on/X-off, DTR)	DEC VT52, VT100, VT220	745(Q1)	15 programmable function keys, non-volatile setup mode, split screen
LINK TECHNOLOGIES INC.							**Circle 673**
47339 Warm Springs Blvd., Fremont, CA 94539, (415) 651-8000							
Link 125	editing/graphics	14-inch; amber, green, white	132×26	RS232C, current loop (X-on/X-off, DTR, asynch)	ADDS, Lear Siegler, TeleVideo, Wyse	649(Q1)	32 programmable function keys, line drawing graphics
Link 220	editing/graphics	14-inch; amber, green, white	132×26	RS232C, RS422, RS423, current loop (X-on/X-off, DTR)	DEC VT52, VT100, VT220	595(Q1)	38 programmable function keys, 2 pages of memory, block graphics
PCTerm	editing	14-inch; amber, green, white	132×26	RS232C, current loop (X-on/X-off, DTR, asynch)	PCTerm; TeleVideo 925; Wyse WY-50, WY-50+	649(Q1)	IBM PC/AT keyboard layout
MILTOPE CORP.							**Circle 674**
1770 Walt Whitman Rd., Melville, NY 11747, (516) 420-0220							
TER-100	editing/graphics	4.1 inches high×8.3 inches wide, amber	80×25	RS232C, RS422, Centronics, current loop (X-on/X-off)	DEC VT100	27,000(Q1)	militarized, non-volatile setup mode, split screen, dot-addressable graphics, diagnostics
TER-200	editing/graphics	8.2 inches high×8.3 inches wide, amber	80×50	RS232C, RS422, Centronics, current loop (X-on/X-off)	DEC VT100	36,000(Q1)	function keys, split screen, dot-addressable graphics
MILTERM-280	editing/graphics	4.1 inches high×8.3 inches wide, amber	80×25	RS232C, RS422, Centronics, current loop (X-on/X-off)	DEC VT100	17,700(Q1)	militarized, non-volatile setup mode, split screen, dot-addressable graphics, diagnostics
MODULAR COMPUTER SYSTEMS INC. (MODCOMP)							**Circle 675**
1650 W. McNab Rd., Fort Lauderdale, FL 33310, (305) 977-1823							
4614-A	editing/graphics	14-inch, green	132×26	RS232C (X-on/X-off, DTR)		550(Q1)	64 programmable function keys, split screen, line graphics characters

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CIRCLE NO. 20 ON INQUIRY CARD

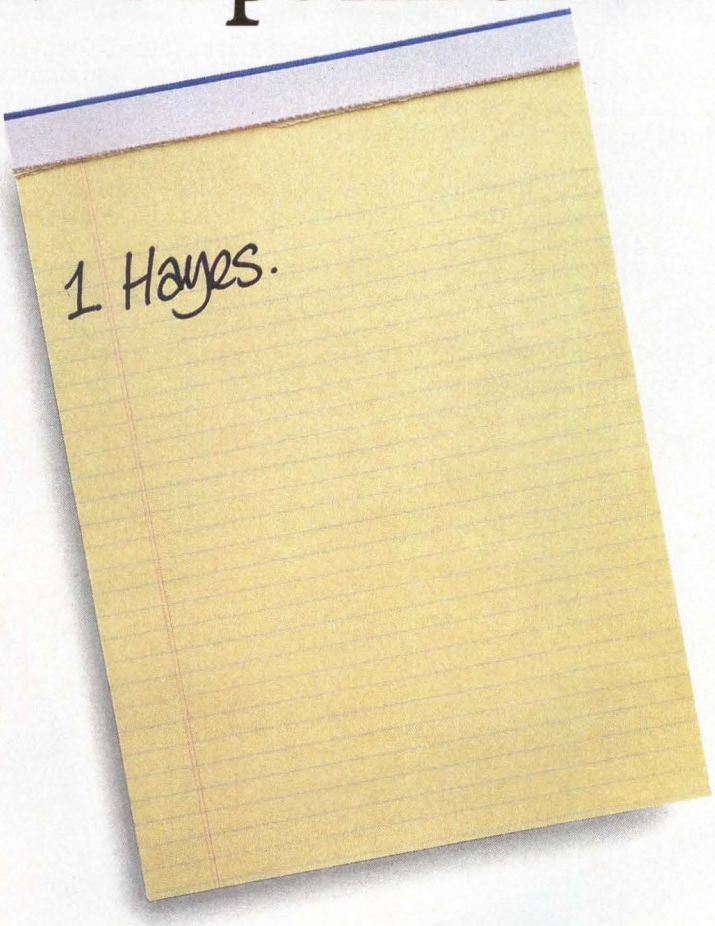
Alphanumeric display terminals

Company Model	Terminal type	Display size, color (diagonal inches)	Screen format (col.×lines)	Interfaces (protocols)	Emulations	Price $ (quantity)	Notes, features
NCR CORP.							**Circle 676**
1700 S. Patterson Blvd., Dayton, OH 45479, (513) 445-5000							
7902	dumb	13-inch, 8-color	80×25	RS232C (X-on/X-off, DTR)	ADDS Viewpoint		16 pre-programmed function keys
7930	dumb	12-inch, green	80×25	RS232C (X-on/X-off, DTR)	NCR 7900M-1, 7901, 796-101		24 programmable function keys
NEWBURY DATA RECORDING LTD.							**Circle 677**
Hawthorne Rd., Staines, Middlesex, TW18 3BJ, England, (0784) 61500							
3001	intelligent	14-inch; amber, green	80×25	RS232C (X-on/X-off, DTR, TWX)	ADDS, Lear Siegler, TeleVideo, Wyse	395(Q1)	split screen
3009	intelligent	14-inch; amber, green	132×26	RS232C, RS422A (X-on/X-off, DTR, TWX)	IBM 3101, ANSI X3.64	495(Q1)	split screen
3022	editing	14-inch; amber, green	132×24	RS232C, RS422A (X-on/X-off, DTR, TWX)	DEC VT100, VT220	595(Q1)	split screen
PARADYNE CORP.							**Circle 678**
8550 Ulmerton Rd., P.O. Box 2826, Largo, FL 34294-2826, (305) 530-2000							
7812	intelligent/graphics	12-inch; amber, green	80×24	proprietary (PIX)	IBM 3178	1,500(Q1); 1,300(Q100)	12 function keys, PC graphics
7814	intelligent/graphics	14-inch; amber, green	80×24, 80×32, 80×43, 132×27	proprietary (PIX)	IBM 3278 Model 2, 3, 4, 5	2,400(Q1); 2,100(Q100)	12 function keys, split screen, PC graphics
7913	intelligent/graphics	13-inch; amber, green	80×24, 80×32	proprietary (PIX)	IBM 3279 Model 2B, 3B	3,100(Q1); 2,700(Q100)	12 function keys, split screen, PC graphics
PDS TECHNOLOGIES INC.							**Circle 679**
2000 Black Rock Turnpike, Fairfield, CT 06430, (203) 333-5183							
Ruggedized	editing	14-inch; amber, green, white	80×25	RS232C	ADDS, DEC, Hazeltine, Lear Siegler, TeleVideo	1,995(Q1)	25 function keys, use in harsh environments
PINZONE INTERNATIONAL INC.							**Circle 680**
1103 S. Cedar Ridge Dr., Duncanville, TX 75137, (214) 780-1600							
E-411	intelligent	14-inch; amber, b&w, green	132×43	RS232C, RS422 (X-on/X-off, DTR)	IBM 1301; TeleVideo 910+; Wyse WY-50+, WY-60		15 function keys, split screen
PRIME COMPUTER INC.							**Circle 681**
Prime Park, Natick, MA 01760, (617) 655-8000							
PT200	intelligent/graphics	14-inch; amber, green, white	80×48, 132×48	ICSI, ICS2, RS232C (X-on/X-off)	IBM 3270	995(Q1)	26 programmable function keys, bit-mapped graphics
TAB PRODUCTS CO.							**Circle 682**
1400 Page Mill Rd., Palo Alto, CA 94304, (415) 852-2400							
E-22	intelligent	15-inch; amber, green	132×27	RS232C (X-on/X-off, DTR)	DEC VT52, VT100, VT220	799(Q1)	55 function keys, split screen, 2 pages of memory
E-32	intelligent	15-inch; amber, green	132×27	RS232C (X-on/X-off, DTR)	DEC VT52, VT100, VT132; Prime	950(Q1)	29 function keys, split screen, 2-4 pages of memory
TANDBERG EDUCATIONAL INC.							**Circle 683**
One Labriola Court, Armonk, NY 10504, (914) 273-6517							
TVD 2200S Family	intelligent	15-inch, green	132×25	RS232C, RS422, current loop (X-on/X-off, DTR, bisynch)	Data General, Datapoint, DEC, IBM	1,395(Q1); 950(Q100)	34 function keys, 16 programmable function keys, 8 pages of memory, non-volatile setup mode
TANDY CORP. (RADIO SHACK)							**Circle 684**
1700 One Tandy Center, Fort Worth, TX 76102, (817) 390-2728							
DT-100	editing	14-inch, green	132×26	RS232C (X-on/X-off)	DEC VT100, VT102, VT220	795(Q1); 715(Q100)	16 programmable function keys
TEC INC.							**Circle 685**
2727 N. Fairview Ave., Tucson, AZ 85703, (602) 792-2230							
Data-Pad	editing	16 lines, LCD	132×24	RS232C	DEC VT52, VT100; Hazeltine 1400, 1410; TeleVideo 910	995(Q1); 795(Q100)	business graphics, portable, rackmount
TEC ET Series	editing	15-inch, b&w	80×24	RS232C	DEC VT52, VT100; IBM 3278	1,995(Q1); 1,795(Q100)	4 pages of memory; split screen; business, line drawing graphics; rackmount

Alphanumeric display terminals

Company Model	Terminal type	Display size, color (diagonal inches)	Screen format (col.×lines)	Interfaces (protocols)	Emulations	Price $ (quantity)	Notes, features
TELEVIDEO INC. 1170 Morse Ave., Sunnyvale, CA 94088, (408) 745-7760							**Circle 686**
955	intelligent/graphics	14-inch; amber, green	132×24	RS232C, RS422, current loop (X-on/X-off, asynch ASCII, DTR)		629(Q1)	64 function keys; split screen; PLOT 10 software; arc, circle generation; polygon fill
9220	intelligent/graphics	14-inch; amber, green	132×24	RS232C, current loop (X-on/X-off, asynch ASCII, DTR)	DEC VT52, VT100, VT220; ANSI	619(Q1)	30 function keys; split screen; PLOT 10 software; arc, circle generation; polygon fill
pT100	intelligent	9-inch, green	80×24	RS232C (X-on/X-off, asynch ASCII, DTR)	DEC VT52, VT100	199(Q1)	14 function keys, split screen
VISUAL TECHNOLOGY INC. 1703 Middlesex St., Lowell, MA 01851, (617) 459-4903							**Circle 687**
V220	editing	14-inch; amber, green	132×25	RS232C, RS422, current loop (X-on/X-off)	DEC VT52, VT100, VT102, VT220; ANSI X3.64	795(Q1)	30 programmable function keys, split screen
WICAT SYSTEMS INC. 1875 S. State St., Orem, UT 84058, (801) 224-6400							**Circle 688**
T7100	editing	14-inch; amber, green	132×25	RS232C, current loop (X-on/X-off)	DEC VT52, VT131; Wyse WY-75		
WYSE TECHNOLOGY 3571 N. First St., San Jose, CA 95134, (408) 433-1000							**Circle 689**
WY-50	intelligent	14-inch, green	132×26	RS232C (X-on/X-off, DTR)	ADDS, Hazeltine, Lear Siegler, TeleVideo,	599(Q1)	16 programmable function keys, split screen, line drawing graphics
WY-60	intelligent	14-inch; amber, green, white	132×44	RS232C (X-on/X-off, DTR)	ADDS, Hazeltine, IBM, Lear Siegler, TeleVideo, Wyse	699(Q1)	16 function keys, line drawing graphics
WY-85	intelligent	14-inch; amber, green	132×25	RS232C (X-on/X-off, DTR)	DEC VT52, VT100, VT220	599(Q1)	20 function keys, line drawing graphics
ZENITH DATA SYSTEMS 1000 Milwaukee Ave., Glenview, IL 60025, (312) 391-8860							**Circle 690**
Z-22	intelligent/graphics	12-inch, green	80×24	RS232C (X-on/X-off, DTR)	Lear Siegler ADM 3A, ADM 5, ADM 11; TeleVideo 914; Zenith Z-19	499(Q1)	10 programmable function keys, split screen
Z-39	intelligent/graphics	14-inch, green	80×24	RS232C (X-on/X-off, DTR)	DEC VT52, VT100; Hazeltine 1500; Lear Siegler ADM 3A; Zenith Z-19, Z-29	599(Q1)	9 function keys, split screen
Z-49	intelligent/graphics	14-inch; amber, green	80×25	RS232C (X-on/X-off, DTR)	DEC VT52, VT100; Zenith Z-19, Z-29	799(Q1)	9 programmable function keys, split screen

A complete list of things to know about 2400 bps modems.



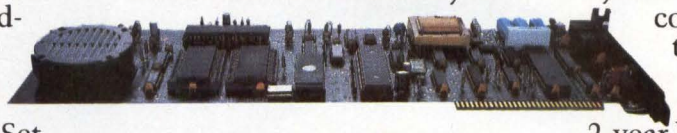
Now that you've memorized that, here's a partial list of why a Hayes® Smartmodem 2400™ is best for you.

1. The Hayes Smartmodem 2400 allows you to communicate with the vast installed-base of 300,1200 and 2400 bps "Hayes-compatible" modems. The Hayes Standard "AT" Command Set allows you to use Smartcom II® and other software that communicates.

2. Through synchronous/asynchronous technologies, the Smartmodem 2400 permits your PC to access mainframes, minis, and on-line services previously inaccessible through asynchronous-only modems.

3. The Hayes Smartmodem 2400 is efficient...it pays for itself in just 4 hours of annual use over long distance.

4. The technology of the Smartmodem 2400 allows you to transfer volumes of files with confidence across the city or across the ocean using Bell and CCITT standards.



5. The new Smartmodem 2400B™—a plug-in board for the IBM PC and compatibles—allows synchronous and asynchronous communication through the same Com port.

6. You will also get the Hayes standard 2-year limited warranty and the opportunity to extend the warranty to 4 years.

Best of all...you get Hayes. And that's all you ever really have to know!

For more information or technical specs, contact your authorized Hayes dealer. Or Hayes directly at (404) 441-1617.

Hayes Microcomputer Products, Inc., P.O. Box 105203, Atlanta, Georgia 30348.

Hayes®

Say yes to the future with Hayes.

CIRCLE NO. 21 ON INQUIRY CARD

JOIN A QUIET REVOLUTION.

Have you heard about Honeywell's new Model 4/66 Dot Matrix Printer? It's revolutionary.

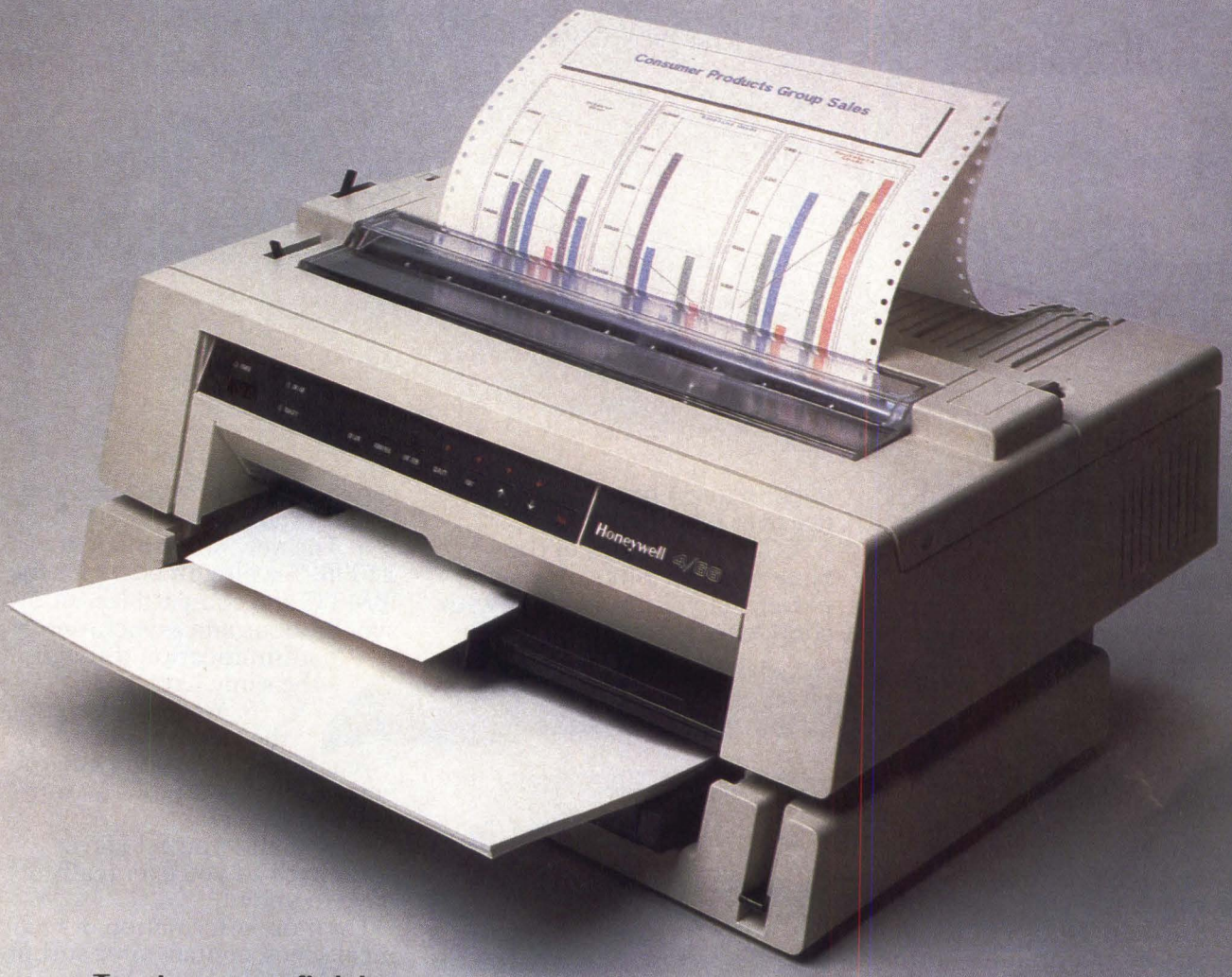
Quieter than any other 480 cps printer on the market. With paper handling versatility that is still on competitor drawing boards.

No wonder the 4/66 is silencing the competition. There are at least three good reasons why. The unique print head is one. Designed to generate very low heat, the 18-needle head is encapsulated in an anti-noise shield. So it will make little more noise in an office than it does in this photograph.

Look at the paper handling capabilities. It changes automatically from fanfold paper to single sheets. In addition, the 4/66 has automatic forms loading. Zero tear-off feature. And all are capable of handling paper sizes from 3″ to 17″ wide.

Print quality? Another reason the 4/66 stands out. With three modes (480 cps "draft", 180 cps "near letter quality", and 75 cps letter quality), up to 20 optional type fonts and one to seven colors for graphics output.

If you're looking for a truly multifunctional printer that will quietly revolutionize your operation, you're looking at it now. The Model 4/66 from Honeywell. For details call Honeywell today at 415-974-6116, or write Honeywell Information Systems Italia, 390 Fourth St., San Francisco, CA 94107.

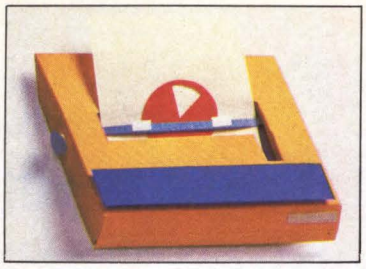


Together, we can find the answers.

Honeywell

Honeywell Information Systems Italia

CIRCLE NO. 22 ON INQUIRY CARD



Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
3M (TELETERMINAL PRODUCTS)						**Circle 592**
311 Turquoise St., Milpitas, CA 95035, (408) 943-1970						
1902/1912	thermal (5×7)	40	40, 80	RS232C (300-9.6K bps)	299(Q1)	bit-image graphics
1904/1914	thermal (5×7)	40	40, 80	Centronics	289(Q1)	bit-image graphics
ADVANCED COLOR TECHNOLOGY INC.						**Circle 593**
21 Alpha Rd., Chelmsford, MA 01824, (617) 256-1222						
Chromajet 4000	ink jet (18×36)	27	115	Centronics, RS232C (X-on/X-off, DTR, 19.2K bps)	2,000-3,000(Q100)	color printing, bit-mapped graphics
ADVANCED MATRIX TECHNOLOGY INC.						**Circle 594**
1157 Tourmaline Dr., Newbury Park, CA 91320, (805) 499-8741						
AMT 20XX	impact (8×30, 32×72)	45, 100, 250	10, 12, 13.3, 17, 20	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 110-19.2K bps)	1,845(Q1)	color printing, noise level less than 55 dB(a)
AMT 21XX	impact (8×30, 32×72)	45, 100, 250	10, 12, 13.3, 17, 20	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 110-19.2K bps)	1,645(Q1)	noise level less than 55 dB(a)
AMERICAN COMPUTER HARDWARE CORP.						**Circle 595**
2205 S. Wright St., Santa Ana, CA 92705, (714) 549-2688						
POS 132	impact (9×9)	165	132, 158, 217	RS232C, Centronics (X-on/X-off, DTR, up to 9.6K bps)	1,750(Q1)	
RADIX 10	impact (9×9)	200	40, 48, 68, 80, 96, 136	RS232C, Centronics (X-on/X-off, DTR)	750(Q1)	bit-image graphics
APPLE COMPUTER INC.						**Circle 596**
20525 Mariani Ave., Cupertino, CA 95014, (408) 996-1010						
Imagewriter II	impact (7×8)	45, 180, 250	up to 136	8-bit serial (X-on/X-off, up to 9.6K bps)	595(Q1)	color printing, bit-mapped graphics
Imagewriter 15"	impact (7×8)	120	up to 136	8-bit serial (X-on/X-off, up to 9.6K bps)	699(Q1)	bit-mapped graphics, wide carriage
AT&T						**Circle 597**
5555 Touhy Ave., Skokie, IL 60077, (312) 982-2000						
477	impact (36×24)	288	up to 272, programmable	RS232C, Centronics (up to 19.2K bps)	1,695(Q1)	7-color printing, built-in tractor feed
478	impact (9×7)	200	up to 220, programmable	Centronics	985(Q1)	bit-mapped graphics
5310	impact (9×7)	200	up to 220, programmable	RS232C (up to 9.6K bps)	1,285(Q1)	bit-mapped graphics
BROTHER INTERNATIONAL CORP.						**Circle 598**
8 Corporate Place, Piscataway, NJ 08854, (201) 981-0300						
M-1409	impact (9×9)	45, 180	55, 66, 94, 110, 132, 188	Centronics (110-9.6K bps)	479(Q1); 354(Q100)	bit-image graphics, noise level less than 58 dB(a)
M-1509	impact (9×9)	45, 180	68, 81, 116, 136, 162, 232	Centronics, RS232C (110-9.6K bps)	549(Q1); 406(Q100)	bit-image graphics, noise level less than 58 dB(a)
2024L	impact	80-96, 160	136, 163, 272	Centronics or RS232C (110-9.6K bps)	1,295(Q1); 958(Q100)	graphics
CAL-ABCO						**Circle 599**
6041 Variel Ave., Woodland Hills, CA 91367, (818) 704-9100						
LG1080	impact	140		Centronics	339(Q100)	bit-image graphics
CANON U.S.A. INC.						**Circle 600**
One Canon Plaza, Lake Success, NY 11042, (516) 488-6700						
A-55	impact (23×18)	34, 180	156	RS232C, Centronics (110-19.2K bps)	699(Q1)	bit-mapped graphics
A-60	impact (24×18)	100, 200	80	RS232C, Centronics (75-19.2K bps)	649(Q1)	bit-mapped graphics

Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
BJ-80	ink jet (18×24)	110, 220	80	Centronics	599(Q1)	bit-mapped graphics, noise level 45 dB(a)
CIE TERMINALS						**Circle 601**
2505 McCabe Way, Irvine, CA 92714, (714) 660-1421						
Tri Printer	impact (9×8, 17×16)	350	68-224, programmable	RS232C, Centronics (110-19.2K bps)	1,995(Q1)	removable interface, plug-in font cartridge
C. ITOH ELECTRONICS INC.						**Circle 602**
5301 Beethoven St., Los Angeles, CA 90066, (213) 306-6700						
9500/9515	impact (9×9, 10×9, 36×17)	28, 125, 250	136-231, proportional	RS232C, Centronics (110-19.2K bps)	649-9,500/ 819-9,515(Q1)	color printing, 2K-byte buffer
9700	impact (24×9, 24×33)	100, 250	136-272, proportional	RS232C, Centronics (110-19.2K bps)	1,395(Q1)	color printing, bit-mapped graphics
TPX-80	thermal (12×15, 24×15)	50, 80	80-136, proportional	Centronics	350(Q1)	color printing, noise level less than 50 dB(a)
COMPUTER TRANSCEIVER SYSTEMS INC.						**Circle 603**
East 66 Midland Ave., P.O. Box 15, Paramus, NJ 07652, (201) 261-6800						
1200	thermal (5×11, 9×11)	280	136, programmable	RS232C, Centronics, parallel (X-on/X-off, DTR, 110-9.6K bps)	995-1,895(Q1); 695-1,295(Q100)	dot-addressable, line drawing graphics
DATAPRODUCTS CORP.						**Circle 604**
6200 Canoga Ave., Woodland Hills, CA 91365, (818) 887-8000						
8070 Plus	impact (18×9, 24×9, 36×18)	100, 300, 400		RS232C, Centronics/Centronics (X-on/X-off, DTR, 300 to 9.6K bps)	1,999-2,099(Q1); 1,439-1,511(Q100)	color printing, bit-image or raster graphics
DATASOUTH COMPUTER CORP.						**Circle 605**
4216 Stuart Andrew Blvd., Charlotte, NC 28210, (704) 523-9500						
DS 180	impact (9×7)	180		RS232C, Centronics (X-on/X-off, DTR, 110-9.6K bps)	1,395(Q1)	dot-addressable graphics
DS 220	impact (9×7)	220		RS232C, Centronics ((X-on/X-off, DTR, 110-9.6K bps)	1,695(Q1)	dot-addressable graphics
DIGITAL EQUIPMENT CORP.						**Circle 691**
129 Parker St., Maynard, MA 01754, (617) 897-5111						
LA50	impact (13×9)	100		RS232C (X-on/X-off, 110-4.8K bps)	695(Q1)	bit-mapped graphics
LA75	impact (36×18)	250	programmable	RS232C, Centronics (X-on/X-off, 110-9.6K bps)	695(Q1)	bit-mapped graphics
LA210	impact (33×9)	240	programmable	RS232C, Centronics (X-on/X-off)	1,595(Q1)	bit-mapped graphics
DYNAX INC.						**Circle 606**
6070 Rickenbacker Rd., Commerce, CA 90040, (213) 727-1227						
Fortis DM2010	impact (9×9, 18×24)	200	80	Centronics	459(Q1)	graphics, built-in tractor feed
Fortis DM2015	impact (9×9, 18×24)	200	136	Centronics	559(Q1)	graphics, built-in tractor feed
EPSON AMERICA INC.						**Circle 607**
2780 Lomita Blvd., Torrance, CA 90505, (213) 539-9140						
EX-800	impact (9×9, 18×18)	54, 300	80, 96	8-bit parallel, serial (X-on/X-off, 300 to 9.6K bps)	749(Q1)	color printing, bit-mapped graphics
FX-286	impact (9×9, 18×18)	40, 200	136, 163	Centronics (X-on/X-off, 300 to 9.6K bps)	799(Q1)	bit-mapped graphics
LQ-1000	impact (12×2, 29×23)	60, 180	136, 163	8-bit parallel (X-on/X-off, 300 to 9.6K bps)	1,095(Q1)	bit-mapped graphics
ERGO SYSTEMS INC.						**Circle 608**
303-3 Convention Way, Redwood City, CA 94063, (415) 363-5966						
HUSH 80P/80PR	thermal (6×7)	80	40, 80, 160, programmable	Centronics	159/199(Q1)	dot-addressable graphics
HUSH 80 SR	thermal (6×7)	80	40, 80, 160, programmable	RS232C, serial (X-on/X-off, DTR, DSR, 300-1.2K bps)	224(Q1)	dot-addressable graphics
FACIT INC.						**Circle 609**
9 Executive Park Dr., Merrimack, NH 03054, (603) 424-8000						
4514	impact (9×9)	160	80, 132, programmable	RS232C, Centronics (X-on/X-off, ETX/ACK, READY, BUSY, up to 9.6K bps)	895(Q1)	bit-mapped graphics
4528V	impact (9×9)	160	80, 136	RS232C, Centronics (X-on/X-off, READY, BUSY, up to 9.6K bps)	1,545-1,595(Q1)	bit-mapped graphics

Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
C7500	impact (17×18)	400	80, 132, 136, programmable	RS232C, Centronics (X-on/X-off, READY, BUSY, up to 9.6K bps)	2,495(Q1)	15-color printing, bit-mapped graphics
FLORIDA DATA CORP.						**Circle 610**
600D John Rodes Blvd., Melbourne, FL 32935, (305) 259-4700						
130	impact (8×12)	100, 600	132, 237	RS232C, Centronics, Dataproducts (X-on/X-off, DTR, ENQ/ACT, ETX/ACK, READY, 100-19.2K bps)	3,995(Q1)	
3000	impact (8×12)	195, 675	132, 237	RS232C, Centronics, Dataproducts (X-on/X-off, DTR, ENQ/ACT, ETX/ACK, READY, 100-19.2K bps)	3,495(Q1)	
FUJITSU AMERICA INC.						**Circle 611**
3055 Orchard Dr., San Jose, CA 95134, (408) 946-8777						
DX2200	impact (18×16)	40, 220	136	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 200-9.6K bps)	645(Q1)	color printing
GENERAL BUSINESS TECHNOLOGY INC.						**Circle 612**
1891 McGaw Ave., Irvine, CA 92714, (714) 261-1891						
5220DP	impact	400	up to 198	IBM System 34/36/38	4,450(Q1)	
5222DP	impact	200	up to 198	IBM System 34/36/38	2,495(Q1)	
5227FA	impact	120	up to 132	IBM System 34/36/38	1,995(Q1)	
GENICOM CORP.						**Circle 613**
1 Genicom Dr., Waynesboro, VA 22980, (703) 949-1170, (800) 437-7468						
1020	impact (36×18)	100, 200	136-232, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	998(Q1)	7 international character sets
3210	impact (9×18)	60, 240	132-225, programmable	RS232C, Centronics (X-on/X-off, DTR, 9.6K bps)	1,495(Q1)	dot-addressable graphics
3320 Quiet	impact (21×18)	180, 300	136-232, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	2,395(Q1)	noise level less than 55 dB(a)
HEWLETT-PACKARD CO.						**Circle 614**
P.O. Box C-006, Vancouver, WA 98668-C006, (206) 254-8110						
HP2934A	impact (9×12, 36×24)	200	136	RS232C	2,995(Q1)	bar code generation
QuietJet Plus	ink jet (19×12, 19×24)	160	132, 158	RS232C, Centronics	799(Q1)	noise level less than 48.5 dB(a)
ThinkJet	ink jet (11×12)	150	80	RS232C, Centronics, HP-IB, HP-IL	495(Q1)	dot-addressable graphics
HONEYWELL INFORMATION SYSTEMS ITALIA						**Circle 692**
390 Fourth St., San Francisco, CA 94017, (415) 974-6116						
4/20, 4/21	impact (11×9, 36×18)	40, 200	80, 136	RS232C, Centronics, parallel, serial	599/849(Q1)	graphics, bidirectional printing, 20 downloadable fonts
INFOSCRIBE INC.						**Circle 615**
1808 Michael Faraday Court, Reston, VA 22090, (703) 689-2805						
800	impact (7×9, 24×18)	40, 200	136, 163, 224, programmable	RS232C, Centronics, current loop (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	1,895(Q1); 1,137(Q100)	dot-addressable graphics
1000	impact (7×9, 24×18)	40, 200	136, 163, 224, programmable	RS232C, Centronics, current loop (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	1,390(Q1); 834(Q100)	dot-addressable graphics
1400	impact (7×9, 24×18)	80, 400	136, 163, 224, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	1,845(Q1); 1,107(Q100)	dot-addressable graphics
JDL INC.						**Circle 616**
2801 Townsgate Rd., Suite 104, Westlake Village, CA 91361, (805) 495-3451						
750c	impact (18×24, 36×24)	100- 216	136, 163, 232	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 19.2K bps)	1,695(Q1); 1,101(Q100)	color printing, bit-mapped graphics
750e	impact (18×24, 36×24)	100- 216	136, 163, 232	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 19.2K bps)	1,850(Q1); 1,202(Q100)	color printing, bit-mapped graphics
MANNESMANN TALLY CORP.						**Circle 617**
8301 S. 180th St., Kent, WA 98032, (206) 251-5563						
MT85	impact (24×18)	180	37, 80, 96, programmable	RS232C, Centronics, Apple serial (X-on/X-off, DTR, ETX/ACK, 19.2K bps)	499(Q1)	noise level less than 55 dB(a)
MT290	impact	200	132, 154,	RS232C, current loop, IEEE	999(Q1)	

Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
	(40×18)		218, 264, programmable	(X-on/X-off, DTR, ETX/ACK, 9.6K bps)		
MT490	impact (48×18)	400	132, 158, 198, 225, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 19.2K bps)	2,199(Q1)	color printing, noise level less than 56 d(B)a
MODULAR COMPUTER SYSTEMS INC. (MODCOMP) 1650 W. McNab Rd., Fort Lauderdale, FL 33310, (305) 977-1823						**Circle 618**
4228	impact (9×7)	150	132	RS232C (110-9.6K bps)	4,140(Q1)	
NCR CORP. 1700 S. Patterson Blvd., Dayton, OH 45479, (513) 445-4000						**Circle 619**
6411	impact (5×9, 7×9, 14×18)	22, 120, 180	80, 136	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 100-9.6K bps)	795(Q1)	bit-mapped graphics
6442	impact (8×7, 8×9, 17×20)	80, 250, 325	132	RS232C, Centronics, proprietary (X-on/X-off, DTR, ETX/ACK, 100-9.6K bps)	3,290(Q1)	
6444	impact (5×9, 10×18)	100, 400	132	RS232C (X-on/X-off, DTR, ETX/ACK, 100-9.6K bps)	3,065(Q1)	bit-mapped graphics, noise level 55 dB(a)
NEC HOME ELECTRONICS (U.S.A.) INC. 1255 Michael Dr., Wood Dale, IL 60191-1094, (312) 860-9500						**Circle 620**
PR105A	impact (7×9)	46, 92, 110	80, 96, 137	Centronics, 8-bit parallel	399(Q1)	graphics
NEC INFORMATION SYSTEMS INC. 1414 Massachusetts Ave., Boxborough, MA 01719, (617) 264-8000						**Circle 693**
P5XL Series	impact (17×32, 15×26, 17×37)	100, 290	136, 233, 272	parallel or parallel, serial (X-on/X-off, DTR, 150-19.2K bps)	1,695-1,825(Q1)	7-color printing, bit-mapped graphics, 24-wire multistrike film ribbon
P6 Series	impact (17×32, 15×26, 17×37)	65, 216	80, 137, 160	parallel or RS232C with current loop (X-on/X-off, DTR, 150-19.2K bps)	699-775(Q1)	bit-mapped graphics, color version available, font indicator
P7 Series	impact (17×32, 15×26, 17×32)	65, 216	136, 233, 272	parallel or RS232C with current loop (X-on/X-off, DTR, 150-19.2K bps)	995-1,075(Q1)	bit-mapped graphics, color version available, font indicator
NEWBURY DATA INC. 2200 Pacific Coast Hwy., Suite 208, Hermosa Beach, CA 90254, (213) 372-3775						**Circle 621**
8850	impact (9×11, 9×7)	320, 480	132, 158, 176, 198, 226, programmable	RS232C, Centronics, current loop (X-on/X-off, DTR, ETX/ACK, 150-9.6K bps)		block graphics, noise level 53 dB(a)
8933	impact (8×12, 24×12)	120, 240	132, 158, 198, 220, programmable	RS232C, Centronics, current loop (X-on/X-off, DTR, ETX/ACK, 150-9.6K bps)		block graphics, noise level 51 dB(a)
OSP 1, 2, 3	impact (10×9, 20×16, 40×16)	50, 100, 200	113, 136, 169, 192, 226, programmable	RS232C, Centronics, current loop (X-on/X-off, DTR, ETX/ACK, 150-9.6K bps)		color printing, bit-mapped graphics
NISSHO INFORMATION SYSTEMS 10855 Business Center Dr., Suite 100, Cypress, CA 90630, (800) 952-1919 (outside CA), (800) 443-8889 (inside CA)						**Circle 622**
NP-910	impact (9×12, 17×24)	58, 350	132-237	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, up to 19.2K bps)	1,495(Q1)	bit-mapped graphics
NP-2410	impact (24×18, 24×36)	150-225, 300-540	132-237	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, up to 19.2K bps)	1,745(Q1)	bit-mapped graphics
NORTH ATLANTIC INDUSTRIES INC. 60 Plant Ave., Hauppauge, NY 11786, (516) 582-6060						**Circle 623**
7075	impact (9×5, 18×24)	45, 210		RS232C, Centronics (X-on/X-off, BUSY, STX/ETX, 19.2K bps)	1,795(Q1); 1,292(Q100)	
7085	impact (9×5, 14×24)	65, 300		RS232C, Centronics (X-on/X-off, BUSY, STX/ETX, 19.2K bps)	2,395(Q1); 1,724(Q100)	
OKIDATA 532 Fellowship Rd., Mt. Laurel, NJ 08054, (609) 235-2600						**Circle 624**
Microline 193 Plus	impact (7×9, 9×9, 17×17)	40, 160, 200	136, 163, 233, programmable	RS232C, Centronics (X-on/X-off, DTR, READY, BUSY, 19.2K bps)	749(Q1)	bit-mapped graphics
Microline 293	impact (9×9, 17×17)	100, 200	136, 163, 233, programmable	RS232C, RS422, Centronics (X-on/X-off, READY, BUSY,	949(Q1)	14-color printing, bit-image graphics

Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
Microline 294	impact (9×9, 17×17)	100, 400	136, 163, 233, programmable	19.2K bps) RS232C, RS422, Centronics (X-on/X-off, READY, BUSY, 19.2K bps)	1,399(Q1)	14-color printing, bit-image graphics
OLYMPIA USA INC. P.O. Box 22, Route 22, Somerville, NJ 08876, (201) 722-7000						**Circle 625**
NP 80	impact (9×9)	200	40, 48, 68, 80, 96, 137	Centronics (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	549(Q1)	
NP 136	impact (9×9)	200	68, 81, 116, 136, 163, 233	Centronics (X-on/X-off, DTR, ETX/ACK, 9.6K bps)	699(Q1)	
OUTPUT TECHNOLOGY CORP. E. 9922 Montgomery, Spokane, WA 99206, (509) 926-3855						**Circle 626**
OT-700e	impact (9×7)	700	68, 82, 116, 136, 163, 226	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, ACK/NACK, 300-9.6K bps)	1,995(Q1)	dot-addressable graphics
OT-700n	impact (9×7)	700	68, 82, 116, 136, 163, 226	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, ACK/NACK, 300-9.6K bps)	2,095(Q1)	dot-addressable graphics
OT-777	impact (9×7)	700	68, 82, 116, 136, 163, 226	RS232C, twin ax (X-on/X-off, DTR, ETX/ACK, ACK/NACK, 300-9.6K bps)	3,495(Q1)	dot-addressable graphics
PANASONIC INDUSTRIAL CO. (COMPUTER PRODUCTS DIV.) Two Panasonic Way, Secaucus, NJ 07094, (201) 392-4646						**Circle 627**
KX-P1092	impact (9×9, 12×18)	33, 180	40, 48, 68, 80, 96, 137, programmable	Centronics (X-on/X-off, DTR, ETX/ACK, 75 to 19.2K bps)	499(Q1)	bit-mapped graphics
KX-P1592	impact (9×9, 18×18)	38, 180	68, 81, 102, 116, 136, 163, 204, 233, programmable	Centronics (X-on/X-off, DTR, ETX/ACK, 75 to 19.2K bps)	699(Q1)	bit-mapped graphics
KX-P1595	impact (9×9, 18×18)	51, 240	68, 81, 102, 116, 136, 163, 204, 233, programmable	RS232C, Centronics (X-on/X-off, DTR, 75 to 9.6K bps)	949(Q1)	bit-mapped graphics
PERSONAL MICRO COMPUTERS INC. 275 Santa Ana Court, Sunnyvale, CA 94086, (408) 737-8444						**Circle 628**
DMP-85	impact (7×9)	120	80, 96, 137, programmable	Centronics	295(Q1)	proportional print, bit-mapped graphics
PRINTEK INC. 1517 Townline Rd., Benton Harbor, MI 49022, (616) 925-3200						**Circle 629**
FormsPro 2000	impact (9×9, 36×18)	200	227	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, BUSY, 300-9.6K bps)	2,195(Q1)	bit-mapped graphics, tilts for easy loading
910	impact (9×9, 24×18)	200	227	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, BUSY, 300-9.6K bps)	1,595(Q1)	bit-mapped graphics
920	impact (9×9, 24×18)	340	227	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, BUSY, 300-9.6K bps)	2,395(Q1)	bit-mapped graphics
PRINTRONIX INC. 17500 Cartwright Rd., Irvine, CA 92714, (714) 863-1900						**Circle 630**
S7024/S7024C	impact (17×18)	240	136, 163.2	RS232C, Centronics (X-on/X-off)	1,365-1,490(Q1)	color printing
QUADRAM CORP. One Quad Way, Norcross, GA 30093-2919, (404) 923-6666						**Circle 631**
Quadjet	ink jet (5×7)	37	80	Centronics	495(Q1)	7-color printing, bit-mapped graphics
SAMLECO LTD. 9 Fairacres Industrial Estate, Dedworth Rd., Windsor, Berkshire, SL4 4LE, England, (0753) 854717						**Circle 632**
DX-85	impact (9×9)	120	80-136, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 50-9.6K bps)		bit-image graphics, plug-in interface cartridge
DX-86	impact (9×9, 18×18)	120	80-136, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 50-9.6K bps)		bit-image graphics, plug-in interface cartridge
DX-136	impact (9×9, 18×18)	120	132-224, programmable	RS232C, Centronics (X-on/X-off, DTR, ETX/ACK, 50-9.6K bps)		bit-image graphics, plug-in interface cartridge

Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
SCI SYSTEMS INC.						**Circle 633**
1866 Independence Square, Atlanta, GA 30338, (404) 396-3428						
1080	non-impact electrosensitive (5×7)	1100	256, programmable	RS232C, Centronics (19.2K bps)	400(Q1); 310(Q100)	
1100	non-impact electrosensitive (5×7)	2200	256, programmable	RS232C, Centronics (19.2K bps)	400(Q1); 310(Q100)	
1800	non-impact electrosensitive (5×7)	6600	132	RS232C, Centronics (19.2K bps)	825(Q1); 720(Q100)	
SIEMENS INFORMATION SYSTEMS INC. (OFFICE PRINTER GROUP)						**Circle 634**
5500 Broken Sound Blvd., N.W., Boca Raton, FL 33431, (305) 994-7611						
PT88	ink jet (9×9)	150	80, programmable	RS232C, Centronics, TTY (X-on/X-off, 110 to 9.6K bps)	699(Q1); 454(Q100)	bit-mapped graphics, noise level 45 dB(a)
PT89	ink jet (9×9)	150	136, programmable	RS232C, Centronics, TTY (X-on/X-off, 110 to 9.6K bps)	849(Q1); 526(Q100)	bit-mapped graphics, noise level 45 dB(a)
SINGER DATA PRODUCTS						**Circle 635**
790 Maple Lane, Bensenville, IL 60106, (312) 860-6500						
400	impact (5×7, 5×9)	100, 400	132	RS232C, Centronics, Diablo (150-9.6K bps)	2,595(Q1)	color printing, bit-mapped graphics
5010	impact (5×7)	100	34	RS232C, Centronics, current loop (X-on/X-off, DTR, 50-9.6K bps)	1,075(Q1); 795(Q100)	
STAR MICRONICS AMERICA INC.						**Circle 636**
200 Park Ave., Suite 3510, New York, NY 10166, (212) 986-6770						
NB-15	impact	100, 300	136, 163, 222	Centronics	1,449(Q1)	bit-mapped graphics
NL-10	impact	30, 120	80, 96, 136		379(Q1)	bit-mapped graphics, plug-in interface cartridge
NX-10	impact	30, 120	80, 96, 136	Centronics	349(Q1)	bit-mapped graphics
SYNTEST CORP.						**Circle 637**
40 Locke Dr., Marlboro, MA 01752, (617) 481-7827						
SP-2010	impact (5×9)	130	80	RS232C, RS422, Centronics, current loop (X-on/X-off, 110-9.6K bps)	985(Q1); 850(Q100)	dot-addressable graphics
TANDY CORP. (RADIO SHACK)						**Circle 638**
1700 One Tandy Center, Fort Worth, TX 76102, (817) 390-2728						
DMP 220	impact (9×9, 18×18)	90, 380	136, 163, 233	parallel	599(Q1)	bit-image graphics, noise level less than 58 dB(a)
TELEX COMPUTER PRODUCTS INC.						**Circle 639**
6422 E. 41st St., Tulsa, OK 74135, (918) 627-1111						
281B	impact (7×9)	120	80, 132	parallel (X-on/X-off, ETX/ACK)	900(Q1)	
287-D2	impact (7×8)	150	132, 220	IBM 3287 A type coax		5,000(Q1)
387/387C	impact (7×8, 6×14)	140, 400	132, 233	IBM 3287 A type coax	7,200(Q1)	4-color printing
TEXAS INSTRUMENTS INC.						**Circle 640**
P.O. Box 809063, Dallas, TX 75380-9063, (214) 995-6611						
855	(9×9)	35, 150	40, 48, 66, 80, 96, 120, 134, 160	serial, parallel		bit-mapped graphics
857	(9×9)	35, 150	40, 48, 66, 80, 96, 120, 134, 160	serial, parallel		7-color printing
865	(9×9)	35, 150	68, 82, 113, 136, 163, 204, 227, 272	serial, parallel		bit-mapped graphics
TOSHIBA AMERICA INC. (INFORMATION SYSTEMS DIV.)						**Circle 641**
2441 Michelle Dr., Tustin, CA 92680, (714) 730-5000						
P321	impact	216	80, 96, 132	Centronics or Centronics with RS232C	699-749(Q1)	
P341	impact	216	136, 163, 226	Centronics or Centronics with RS232C	1,049-1,149(Q1)	dot-addressable graphics
P351C	impact	288	136, 163, 226	Centronics or Centronics with RS232C	1,749(Q1)	7-color printing, graphics
WALTERS INTERNATIONAL LTD.						**Circle 642**
Matrix House, Lincoln Rd., Cressex Industrial Estate, High Wycombe, Buckshire, HP12 3RD, England, (0494) 32751-9						
WM100	impact (8×8)	100		RS232C, Centronics (X-on/X-off, DTR, 50-19.2K bps)		

Matrix character printers

Company Model	Print method (matrix size)	Print speed (cps)	Characters/line	Interfaces (Protocols/ transmission rate)	Price $ (quantity)	Notes, features
WM280	impact (23×18)	280	136, 163, 195, 204, 231	RS232C, Centronics (X-on/X-off, DTR, 50-19.2K bps)		
WM350	impact (23×18)	280		RS232C, Centronics (X-on/X-off, DTR, 50-19.2K bps)		
WENGER DATENTECHNIK Im Kagen 23/25, CH-4153 Reinach, Switzerland, (061) 76 87 87						**Circle 643**
Wenger 1/1	impact (9×12, 18×36)	30, 160		RS232C, RS422A, Centronics (X-on/X-off, ENQ/ACK, ETX/ACK, READY, BUSY, 110-19.2K bps)		color printing, bit-image graphics
Wenger 3/1	impact (9×12, 9×36, 18×36)	70, 400		RS232C, RS422, Centronics (X-on/X-off, ENQ/ACK, ETX/ACK, 300-19.2K bps)		color printing, bit-image graphics
Wenger 4/1	impact (9×12, 18×36)	130, 400		RS232C, RS422, Centronics (X-on/X-off, ENQ/ACK, ETX/ACK, 50-19.2K bps)		color printing, bit-image graphics
XEROX CORP. (BUSINESS SYSTEMS GROUP) Xerox Square, Rochester, NY 14644, (716) 427-5400						**Circle 644**
Companion 34LQ	impact (9×11, 18×60)	60-270	132, 158, 176, 198, 220, 226	RS232C, RS422A, Centronics (X-on/X-off, ETX/ACK, 1.2K-9.6K bps)	1,399(Q1)	bit-mapped graphics, 8 national character sets

ADVERTISERS' INDEX

See P. 55-56 for Mini-Micro Marketplace

PRINTER-CONTROL PROGRAM FALLS SHORT

Edward Teja, Contributing Editor

In packaging a system that makes it easy to take full advantage of the widespread availability of laser printers, sophisticated graphics software and utilities—such as spelling checkers—system integrators need a tool that can pull all of these pieces together. This tool should come in the form of a printer-control program.

The perfect printer-control package would be memory resident, so that the user doesn't have to leave the application package in order to change fonts or do special formating. The program should also work with all of the popular graphics software packages so that an image created using Digital Research Inc.'s GEM, for example, would be easy to mix and match with text. Ideally, changing the size and orientation of an image within the text to produce the desired format should be possible without recourse to graduate seminars in the graphic arts.

In hopes of finding such a printer control, the PRINTILITY package from Metro was reviewed. Upon close examination, PRINTILITY was found to be, to a large extent, a "wantabe": It wants to be that perfect solution, and it does provide many of the features in our wish list. Still, it fails. For all the clever things that the program does, it doesn't address certain crucial problems, such as found in layout. In fact, here it can actually make using existing software more confusing. More surprisingly, many of the page layout commands (for shading, borders, etc.) don't even work on the Hewlett-Packard Co. Laserjet or Laserjet Plus. And this from a package that claims to be written for those printers. We can only assume the commands work with a dot-matrix printer.

The biggest problem with this package lies not in what it doesn't do, however. It's found in the traditional bugaboo: bad documentation. Not bad, exactly; selective. Things that are explained are easy to understand, for the commands follow a consistent format. The difficulty centers on those things left unaccountably unexplained—such as how to use the program to print a document.

The canned demo on the disk is impressive, but doesn't do much toward helping you understand how the software works. This utility prints a document that contains text with embedded commands that call and position graphic images. So far, so good. But how do you print your own files?

After a fair amount of trial and error we discovered that the secret is to print with good old WordStar (or some other word-processing package). PRINTILITY responds just to the embedded commands. The path to finding that out, however, wasn't a straight one, as you will see.

And what about images? Where do they come from?

Despite a detailed explanation of how to capture an image from the screen, it wasn't clear what the program looked for. We tried creating graphs with GEM, storing them under the appropriate file names (using the extension PT) and then employing embedded commands for the test file to call and position the graphs. This produced a page of gibberish. Although the documentation states that you can capture screen images using the RAM-resident utility, it doesn't tell you that is only way to get an image in an acceptable format.

To be fair to the developers, once images are stored in an acceptable format, placing it on the page with the centering, right-justify or other positioning commands is not in itself complex. Still, the layout process in its entirety can be a bit convoluted. You have some jiggering to do to find the exact size of the image. (The program will tell you how many lines and columns it takes to display the image, given any of the eight possible display sizes.)

Creating multiple-column formats relies on the word processor, just as the graphics package must create images. The printer controller is of no help in that task. You'll also find that images don't look good in every size. The chart that we created (see chart) looked good at sizes 2, 4, 6 and 8. The stock images looked good at every size. And that's why demos are demos, but reality is something else again.

Then there is the problem of installation. The PINSTALL program installs the utility itself nicely. You answer a few questions: Do you have a mouse? What kind of monitor? You then assume you are ready to go. Logical? Yes, but wrong. For example: If you print a file with WordStar, you can't use the software if the Laserjet is identified as the selected printer—the program will try to intercept graphics commands and execute them. The word processor program (whichever one you use) must be installed with a generic (ASCII) printer identified as the list device so that it will pass everything straight to the printer, interpreting nothing. As a result, you need to install two versions of the program: one with the Laserjet identified as the list device for normal word processing, and the other version installed with a generic printer for use with PRINTILITY.

Despite these problems, once you understand how to use it, the package delivers a more direct approach than do most programs we have encountered. And, because it offers flexibility in changing fonts and page layout in printing output from spreadsheet or graphics software, the package is a joy to use. But, expect to spend at least one busy day getting the hang of the intricacies of the program. Once you do, you'll find that it actually does more than the manual implies. $179.

Metro Software Inc., Suite 214, 2509 N. Campbell, Tucson, Ariz. 85719, (602) 299-7313.

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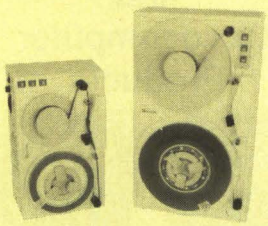

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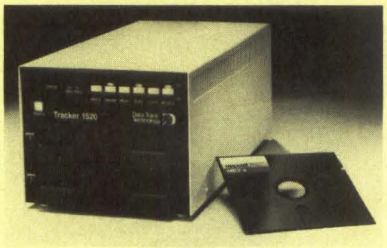

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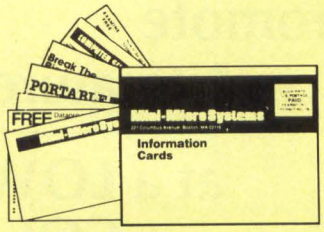

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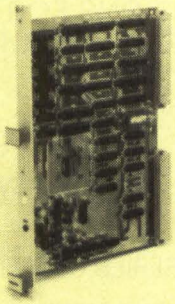

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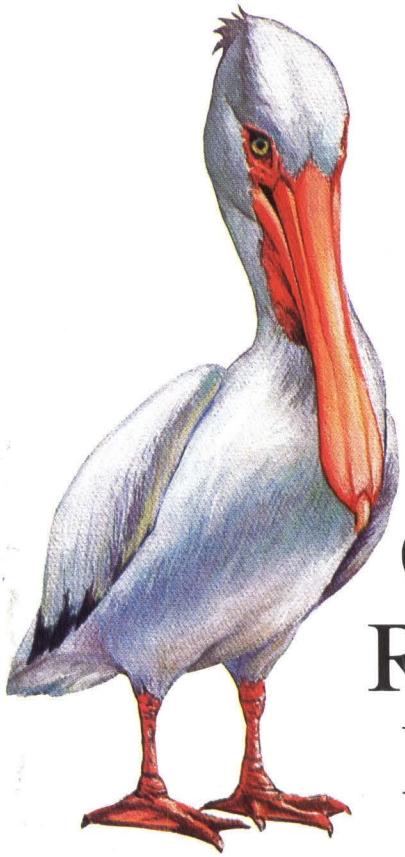

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