# All About Minicomputers

For the past decade, minicomputers have been attracting more attention than any other subject in the fast-moving world of electronic data processing. These compact yet surprisingly powerful computers are being delivered at an ever-increasing rate for use in a steadily broadening spectrum of applications. Here are just a few of the reasons:

● Innovations in technology and manufacturing are resulting in the availability of minicomputers with steadily lower price tags and/or increased capabilities.

● Economic pressures are forcing computer users to strive to achieve maximum performance at minimum cost, and in many cases minicomputers represent the best answer.

● Increasing software consciousness on the part of both minicomputer makers and users is spurring software development along avenues undreamed of only a few years ago.

● Increasing emphasis upon distributed processing, in which large, centralized computers are augmented or replaced by multiple smaller computers located wherever there is data to be processed, is causing even the largest computer users to take a hard new look at the minicomputers.

The low prices and impressive capabilities of the current minicomputers are naturally attracting the attention of the businessmen, scientists, educators, and government officials who have the responsibility for deciding what
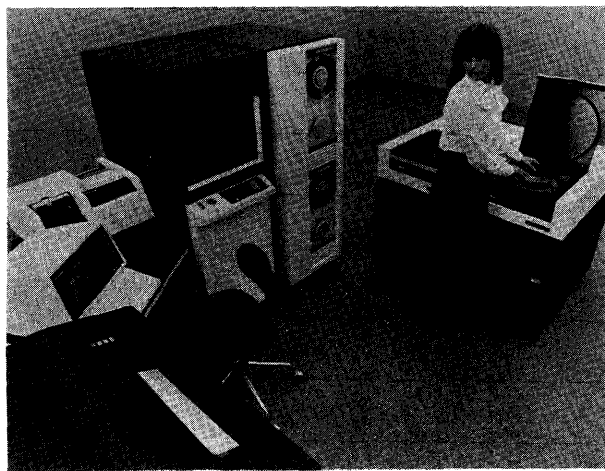
Honeywell's powerful new Level 6 Model 47 minicomputer can provide up to 2 million bytes of main memory and can process COBOL programs seven times faster than the earlier Model 33. The configuration shown includes (left to right) a 900-lpm printer, VIP 7200 console display/keyboard, 500-cpm card reader, CPU with 320K bytes of memory, two diskette units above the processor, two magnetic tape units, and two 256-megabyte disk units. Prices for the Model 47 begin at $28,050.

This report is designed to aid you in understanding what's available in the fast-moving minicomputer field and selecting the system that can best satisfy your requirements. You'll find detailed comparison charts covering the characteristics of 251 current minicomputers from 74 vendors.

types of information processing equipment will be used in their operations.

But what, exactly, is a minicomputer? Where are they being used? What are the significant features and drawbacks of these machines? How can you tell whether a minicomputer will fit into your own information processing plans? And, if so, which of the many available models represents the best overall choice for you?

This report is designed to answer these questions and bring you up to date on the rapidly advancing state of the art in minicomputers. The current offerings of 74 vendors are summarized in 51 pages of detailed comparison charts. parison charts.

TODAY'S TYPICAL MINICOMPUTER

There is some disagreement within the industry as to just what constitutes a minicomputer. Some insiders reserve the minicomputer designation for machines whose mainframes sell for less than $20,000 (or some other arbitrary figure), and—in keeping with fashion terminology—use "midicomputer" for the machines that range from $20,000 on up to about $100,000 in purchase price.

Throughout this report, we'll simplify the picture by using the single term "minicomputers" for the whole class of stored-program digital computers which are suitable for general-purpose applications and are priced below $100,000. Excluded from this survey are the larger general-purpose data processing systems which are described in detailed reports in the Computer section of DATAPRO 70, as well as many of the purely business-oriented systems which are described in our companion report, *All About Small Business Computers* (70C-010-30).

Although the currently available minicomputers exhibit a wide variety of characteristics and capabilities, there are enough similarities and common traits to make it possible to define a "typical minicomputer" whose characteristics are reasonably representative of most of the machines on the market today.

The typical minicomputer is a parallel, binary processor with a 16-bit word length (though 8-bit, 12-bit, 18-bit, 24-bit, and 32-bit word lengths are also fairly common). It uses integrated circuits and is housed in a compact cabinet ▷

All About Minicomputers

suitable for either tabletop use or mounting in a standard 19-inch rack. It weighs less than 50 pounds, consumes less than 500 watts of standard 115-volt electric power, and requires no special air conditioning. It offers from 4,096 to 65,536 words of magnetic core or semiconductor storage with a cycle time of 0.6 to 1.2 microseconds. Parity checking and storage protection are available as extra-cost options.

Today's typical minicomputer uses a one-address instruction format and has two accumulators, a single index register, and a multi-level indirect addressing facility. The add time for 16-bit operands is 1 to 3 microseconds. Hardware multiply/divide instructions are optional, as are power-failure protection and a real-time clock or timer. Floating-point arithmetic requires the use of software subroutines.

Input/output operations in the typical minicomputer are facilitated by an optional direct memory access (DMA) channel, which accommodates I/O data rates of up to about 1,000,000 words per second. The typical complement of standard peripheral equipment consists of a teletypewriter, CRT display terminal, disk storage unit, magnetic tape drive, card reader, paper tape reader and punch, line printer, and an assortment of interfaces for communication and control applications.

Software support for today's typical minicomputer is limited to a symbolic assembler, a BASIC or FORTRAN compiler, a simple batch-mode operating system or real-time monitor, and a modest assortment of utility routines. And the list purchase price of the basic system, including 4,096 words of main storage but no input/output devices, is likely to be well under the $5,000 mark, with liberal discounts available to quantity purchasers. By all previous standards of value in the computer field, it's a truly impressive little package of computing power for the price.

THE MINICOMPUTER INDUSTRY

Digital Equipment Corporation, the company that started the minicomputer boom in the mid-sixties with its highly successful PDP-8 line, is still the undisputed king of the "classical" minicomputer field (as distinguished from the small business computer market, where IBM and Burroughs are the leaders). DEC has delivered more than 100,000 computers to date and currently commands roughly a 40 percent share of the minicomputer market with its continually expanding product line.

Ranking next in minicomputer revenues, but well behind DEC, are Hewlett-Packard, Data General, and IBM. HP was another pioneer in the minicomputer field and currently offers a broad range of mini-based systems oriented toward specific applications, as well as general-purpose minicomputers. Data General, established in 1969, quickly earned a reputation as a supplier of reliable, low-cost minicomputers and has already delivered more than 50,000 of them. IBM, the undisputed leader in most

other segments of the computer field, plays a much smaller role in the minicomputer market, although it is beginning to make up for lost time. The IBM Series/1, the company's first really competitive "pure" minicomputer, was introduced in November 1976 and is now competing aggressively with the products of DEC, Data General, Hewlett-Packard, and other minicomputer makers. (The very popular IBM System/3, System/32, and System/34 fall into the small business computer category.)

In the second echelon of minicomputer makers are aggressive, innovative young companies such as Computer Automation, General Automation, Interdata, Microdata, Modular Computer Systems, and Prime Computer. Minicomputers are also being built by divisions of large, well-established companies such as Control Data, Harris, Honeywell, Lockheed, Raytheon, Sperry Rand, and Texas Instruments. And then there are dozens of comparatively small, unproven companies whose survival will depend upon their ability to back up their imaginative hardware ideas with effective marketing, production, software, and customer support.

Two well-established minicomputer suppliers were acquired by larger computer companies during the past two years. Varian Data Machines, the former minicomputer subsidiary of Varian Associates, was purchased by Sperry Rand Corporation and became a part of the Sperry Univac Division. Digital Computer Controls, whose claim to fame was a line of direct replacements for the Data General Nova minicomputers, became a wholly owned subsidiary of Data General itself.

The current offerings of 71 minicomputer suppliers are summarized in the accompanying comparison charts.

Minicomputer builders are gradually realizing that the buyers for their wares generally fall into three basic categories:

● Original equipment manufacturers, who incorporate the minicomputers into their own products or systems and are primarily interested in adequate performance at minimum cost.

● Knowledgeable end users, who demand the availability of peripheral equipment, software, and manufacturer support that will enable them to implement their own applications.

● Comparatively unsophisticated end users, who want complete systems programmed and installed on a "turnkey" basis.

Just a few years ago, nearly all minicomputer sales were to buyers in the first, or OEM, category. Now most of the minicomputer builders are placing increasing emphasis upon the end-user market, which is potentially far more lucrative—but also far more costly to enter and support.

MINICOMPUTER TRENDS

During the past year, new models were introduced by nearly all of the major minicomputer makers. As any veteran industry observer would expect, the great

All About Minicomputers

▷ majority of these new models maintain program and hardware compatibility with earlier models from the same manufacturers, while featuring significantly increased performance and/or reduced price tags. What's more, most of the recent arrivals continue the clear-cut industry trend toward the use of semiconductor memory and LSI (large-scale integrated) circuitry.

Many of the recently announced minicomputer systems are, in fact, special "packaged" configurations that consist of previously available minicomputer processors together with specialized peripheral equipment and software designed for specific types of applications. Examples include the various DEC Datasystems, which use the company's popular PDP-8 or PDP-11 minicomputers in systems designed for business data processing; the General Automation DM-100 systems, which adapt GA's SPC 16 mini to data management applications; and the Harris Series 100 systems, which use the company's 24-bit Slash/4 computer in configurations oriented toward communications and control functions. These "packaged" configurations are described in the companion DATAPRO 70 report, *All About Small Business Computers* (70C-010-30), while the minicomputers on which they are based are covered in this report.

Having solidified their position as a cheaper alternative to the larger general-purpose computers for many applications, the minicomputers are in turn being threatened by a newer and still cheaper class of computers called "microprocessors." A microprocessor can be defined as a single LSI chip or set of chips that performs the basic arithmetic and logical functions of a computer central processing unit. When equipped with memory and input/output control circuitry, the microprocessor becomes a "microcomputer," which can offer capabilities quite similar to those of the smaller minicomputers.

Intel Corporation pioneered the microprocessor concept in 1971 and remains the leader in the field. But microprocessors received such rapid acceptance that numerous other companies quickly announced competitive products, including such leading electronics firms as Fairchild, Motorola, National Semiconductor, RCA, Rockwell, Signetics, and Texas Instruments. Detailed specifications of the current microprocessors and microcomputers can be found in *DATAPRO REPORTS ON MINICOMPUTERS*, a companion looseleaf information service.

For the next few years, at least, it appears that the microcomputers will be slower than the commercially available minicomputers. Moreover, the present microcomputers are aimed almost exclusively at the large-quantity OEM market rather than at one-of-a-kind user applications. Therefore, instead of displacing large numbers of minicomputers, the microcomputers can be expected to open up vast new application areas where even the cheapest minicomputers have been economically unjustifiable. Thanks to the advent of the microcomputers, the day when there will be a computer in every car and every household may not be too far away.

Another evident design trend is toward increasing use of microprogrammed logic, which can make it comparatively easy for the manufacturer, OEM, and/or end user to tailor a minicomputer's capabilities to fit his particular needs. Current systems that feature user-accessible microprogramming include the Data General Eclipse S systems, Hewlett-Packard 1000 Series, Interdata 8/32C, and Microdata 1600.

Semiconductor main memories are being used, as either standard or optional equipment, in most of the recently introduced minicomputers. Both the MOS and bipolar LSI memory technologies are in evidence, but the trend is clearly toward the cheaper MOS approach. Some minicomputer builders are still exhibiting an understandable reluctance to turn away from the traditional (and highly reliable) core memories. But it is now quite clear that the continuing demand for higher performance at lower cost will force most minicomputer makers to switch from core to semiconductor memories within the next few years. And the industry-wide trend toward the use of LSI technology for logic circuits is certain to continue for the same reason.

Running counter to the trend toward ever smaller and cheaper minicomputers is a concurrent trend toward a class of "super minicomputers" whose power and flexibility rival those of far more costly medium-scale computers. Most of these systems feature large main storage capacities, fast semiconductor memory, advanced memory management facilities, multiprogramming operating systems, and other "big computer" software facilities, at mainframe prices ranging from about $15,000 upward. Among the high-performance minicomputers that adhere to the "traditional" 16-bit word length are the DEC PDP-11/45 and PDP-11/70, the Data General Eclipse Series, and the Prime 500. Meanwhile, the increased computational power and flexibility made possible by the use of a 32-bit word length are being stressed in such systems as the Interdata 8/32C Megamini, the SEL 32/55, and DEC's new VAX-11/780.

Peripheral equipment designed specifically for use with minicomputers continues to proliferate. Nearly all of the major minicomputer builders are striving to expand their own product lines and reduce their dependence upon outside suppliers of disk storage and input/output devices. Moreover, literally hundreds of independent firms are now offering an incredible variety of disk drives, floppy disk units, cassette tape units, printers, card readers, CRT displays, and many other products whose capabilities and prices are oriented toward the minicomputer buyer's needs and budget. Here again, the careful buyer can get more for his money than ever before.

Software, which had long received only cursory attention from the predominantly hardware-oriented minicomputer makers, is rapidly becoming the principal distinguishing factor between competitive product lines. Efficient compilers for programming languages such as FORTRAN, BASIC, and COBOL are becoming available for most of the popular minicomputers from the manufacturers and/ ▷

All About Minicomputers

▷ or proprietary software houses. The quality and power of the minicomputer operating systems are steadily increasing, with full-fledged multiprogramming systems now available from numerous vendors. Meanwhile, the minicomputer makers are beginning to focus their attention on more specialized software that opens up new markets for their equipment, such as data management systems and emulators for the IBM 2780 and other popular remote job entry terminals.

The developers of proprietary software and systems are increasingly designing their wares around minicomputers. As a result, minicomputer-based systems are now available, from both the minicomputer manufacturers and independent "systems houses," to handle a wide range of specialized applications in both the scientific and business fields.

Among the most popular minicomputer-based systems are the in-house time-sharing systems. Hewlett-Packard has long been the leader in this area, but now DEC, Data General, General Automation, and other suppliers are also offering economical systems designed to distribute the problem-solving capabilities of a minicomputer among a number of simultaneous users seated at individual teletypewriter or CRT terminals. Many companies are discovering that these in-house time-sharing systems can satisfy their computational needs at a substantially lower cost than the commercial time-sharing services.

MINICOMPUTER APPLICATIONS

Most of the currently installed minicomputers are being used in industrial control and laboratory instrumentation. These are the areas where it all began. The minicomputer boom started when it became apparent that the impressive recent advances in semiconductor and magnetic technologies had made it possible to construct general-purpose computers at a lower cost than the single-purpose, hard-wired controllers which were formerly used in these specialized applications. The added flexibility of stored-program computer control was a welcome bonus that helped to ensure the rapid acceptance of the minicomputers.

During the past decade, the capabilities of the minicomputers have been steadily increasing while their costs have been decreasing in equally rapid fashion. The proliferation of these small, economical, and surprisingly fast computers has led to an ever-widening range of applications for them.

Among the largest current markets for minicomputers are industrial control, research, engineering and scientific computation, business data processing, data communications, and education. Specific applications in which minicomputers are already being widely and successfully used include:

- Process control

- Numerical control of machine tools

- Direct control of machines and production lines

- Automated testing and inspection

- Telemetry

- Data acquisition and logging

- Control and analysis of laboratory experiments

- Analysis and interpretation of medical tests

- Traffic control

- Shipboard navigation control

- Message switching

- Communications controllers for larger computers

- Communications line concentrators

- Programmable communications terminals

- Peripheral controllers for larger computers

- Control of multistation key-to-tape/disk systems

- Display control

- Computer-aided design

- Typesetting and photocomposition

- Computer-assisted instruction

- Engineering and scientific computations

- Time-sharing computational services

- Business data processing of all types.

MINICOMPUTERS FOR BUSINESSMEN

Conventional business data processing applications, which represent by far the largest potential market for the minicomputers, turned out to be a rather elusive target. Theoretically, the minicomputer's capabilities and economy should make it an ideal solution to the information processing needs of nearly every small business. In retail stores of all kinds, a minicomputer could handle the bookkeeping, inventory control, labeling, billing, payroll, and a variety of other useful functions—and it could do all this at roughly the cost of a single clerk.

Yet true minicomputers—as distinguished from the less powerful electronic accounting machines—were relatively slow to make a significant impact in the business world.

The problem, of course, is software. Despite claims to the contrary, programming for the minicomputers is no ▷

All About Minicomputers

This representative Data General Eclipse M/600 host network system includes the CPU and 512K bytes of main storage, magnetic tape drives, fixed- and moving-head disk drives, a 600-lpm printer, card reader, Dasher master display and printer consoles, and a communications subsystem with 48 local and remote time-sharing terminals. Its price tag is about $325,000. The M/600 is designed specifically to perform in a multiprogramming operating system environment. It features a three-level Input/Output Management System (IOMS) and a demand-paged one-megabyte main memory facility supported by DG's Advanced Operating System, which extends the system's capabilities to up to 64 users.

▷ easier than programming for the larger, general-purpose data processing systems. In fact, the minicomputers' short word lengths, limited storage capacities, and lack of sophisticated software aids tend to make the programmer's job even more difficult. As a result, it is common in minicomputer applications for programming costs to far exceed the cost of the hardware itself.

Even if small businessmen were willing to pay the price of the software required to solve their problems, they would find it hard to get from most of the current builders of "classical" minicomputers. In general, the manufacturers have oriented their marketing efforts toward the comparatively sophisticated engineering and scientific markets, which are equipped to design the systems and write the programs required to accomplish their goals with a minimum of assistance from the manufacturer. In fact, a high proportion of all minicomputers are still being sold in quantity, on an OEM (original equipment manufacturer) basis, to other companies that incorporate them into a wide variety of devices and systems for various end-user markets. It's no secret that mass production is the key to success for the minicomputer builders, and OEM sales represent the quickest route to maximum volume with a minimal investment in marketing, software development, and customer support. As a result, the businessman who is interested in buying a single minicomputer won't receive much encouragement or aid from many of the manufacturers.

But help for the businessman is definitely available, in the form of three significant trends.

First, numerous manufacturers have introduced minicomputer-based systems designed primarily for business data processing applications. Many of them are included in this report, and you can find the details on dozens of other business-oriented systems in a companion DATA-PRO 70 report called *All About Small Business Computers* (Report 70C-010-30).

Second, the larger minicomputer builders are directing an increasing proportion of their marketing efforts toward the end-user market. It has become clear that their potential for growth and profitability will be severely limited until they can supply the peripheral equipment, software, and service required to support individual user installations in the same manner as IBM and the other major computer makers. Therefore, DEC, Hewlett-Packard, Data General, and other manufacturers are strengthening their support staffs and developing peripheral devices and software facilities that equip their computers to serve in a variety of specific applications, including business-oriented ones.

Third, the availability of the minicomputers has led to the emergence of a new group of computer entrepreneurs: "systems houses" that use the minicomputers as the central components of integrated hardware/software systems designed to handle specific applications. Dozens of companies have entered this business within the past few years. They offer packaged systems to handle a wide range of applications, such as general accounting, billing, order processing, inventory control, payroll, text editing, hospital data processing, credit authorization, stock brokerage accounting, and many more. These systems, too, are described in Report 70C-010-30, *All About Small Business Computers*. The systems houses are accelerating the minicomputer boom by penetrating new markets and making it easier for unsophisticated users to get started in EDP.

These trends, together with the increasing emphasis on distributed processing and the steadily decreasing price tags of the minicomputers themselves, make it clear that minicomputers will have an ever-increasing impact in the business data processing world. At the same time, enough problems remain to be solved to make it safe to predict that the widely-discussed day when there will be a computer in every store and office is still a few years away. ▷

All About Minicomputers

USER EXPERIENCE

If you're shopping for a minicomputer, it's important to know how well the systems on the market are performing in actual user installations. In order to determine the current level of user satisfaction with specific minicomputer systems and with minicomputers in general, Datapro conducts an extensive user survey each year. Detailed results of the most recent survey, including the users' ratings of more than 60 popular minicomputer models, are presented in a companion DATAPRO 70 report, *User Ratings of Minicomputers and Small Business Computers* (70C-010-40).

THE COMPARISON CHARTS

The key functional characteristics of 251 commercially available minicomputers from 74 vendors are presented in the accompanying comparison charts. Nearly all of the information in the charts was supplied and/or verified by the vendors during the months of August and September 1978; their close cooperation with the Datapro Research staff in the preparation of these charts is greatly appreciated.

The comparison charts can be used effectively to complete a comprehensive, first-level search of the minicomputer universe in just a few minutes. For example, if you want a minicomputer but know you can't pay more than $5,000 for the basic CPU and memory, then you can quickly scan across the charts noting the entry "Price of CPU, power supply, front panel, and minimum memory in chassis" and jotting down the manufacturer and model number of each minicomputer that applies. Or, your requirements may be for a minicomputer that has a BASIC programming language in addition to removable disk pack storage. A similar quick scan across the entries called "Disk pack/cartridge drives" and "Compilers" will produce a complete list of those minicomputers that satisfy both requirements.

PLEASE NOTE that a similar presentation of the characteristics of minicomputers with a strong orientation toward business data processing applications is contained in a companion DATAPRO 70 report called "All About Small Business Computers" (Report 70C-010-30). Thus, to assure that your search will be complete, we suggest that you also scan that report because, as you know, categorical descriptions and definitions in the area of minicomputers can be difficult. What you may consider to be a small business computer, someone else may call a minicomputer, or the converse. To be sure, therefore, we suggest you quickly scan both sets of charts. For your convenience, many of today's popular small computer systems are listed in both sets of charts.

The chart entries and their significance to potential minicomputer users are explained in the following paragraphs, together with some useful guidelines for selecting the most suitable minicomputer for your application.

Data Formats

Probably the single most important distinguishing characteristic of a minicomputer is its *word length, bits*;

i.e., the number of bits (binary digits) that can be stored in or retrieved from main storage during a single cycle. In general, the longer the word length, the greater the efficiency and accuracy of a computer's internal operations—and the higher its price tag. Most of the minicomputers currently on the market have a 16-bit word length; this size neatly accommodates two 8-bit bytes (characters) and has been shown to yield an attractive balance between economy and performance for many applications. Other widely used models have word lengths of 8, 12, 18, 24, or 32 bits. The 8-bit minicomputers are suitable for many functions where low cost is more important than high precision or sophisticated instruction repertoires—and they can be particularly effective when extensive manipulation of 8-bit bytes must be performed. Entries also indicate parity and error correction bits when applicable.

For most minicomputers, the *fixed-point operand length, bits* is the same as the word length. Some machines, however, have "extended precision" facilities which enable them to handle arithmetic operands two or more words in length. For many applications, extended precision arithmetic is a valuable feature that helps to overcome the limitations upon number range and accuracy which are otherwise imposed by the short word lengths used in most minicomputers. Some of the 8-bit minicomputers are really byte-oriented machines, designed for efficient processing of variable-length operands composed of one or more 8-bit bytes.

Instruction length, bits is one word in most computers, but some are capable of using instructions which are two or more words in length. In most two-word instruction formats, the first word defines the operation to be performed and the second word contains the address of the required operand. The use of two-word instructions greatly increases the number of storage locations that can be directly addressed. This in turn simplifies programming—but the simplification is usually gained at the expense of two words of storage space to hold each instruction and two memory cycles for each instruction retrieved for processing.

Main Storage

The *storage type* generally falls into one of two basic categories, magnetic core or semiconductor memory. Magnetic core storage has been widely used for more than a decade, and has proved to be fast, flexible, and reliable. Semiconductor memories began to appear in commerically available minicomputers late in 1970, and most minicomputer makers are now using semiconductor memory in their new products. It is clear that the demand for higher performance at lower cost, together with forthcoming improvements in semiconductor technology, has acclerated the trend toward the use of semiconductor memories.

Two types of semiconductor memories appear in the charts, MOS (metal oxide semiconductor) and bipolar (bipolar transistor). MOS is decidedly more popular ▷

All About Minicomputers

▷ because of its compactness and price. However, bipolar technology, a type of transistor-transistor logic, offers a classic trade-off—higher speed at the expense of more space and greater power consumed, as well as greater cost.

The *cycle time, microseconds/word* for a storage device is the minimum time interval that must elapse between the starts of two successive accesses to any one storage location. Though cycle time ranks with word length as one of the most significant individual indicators of a computer's performance potential, it is definitely *not* safe to assume that the computer with the fastest cycle time will be the best overall performer in a particular application. Other parameters that have an important effect on a minicomputer's performance include the flexibility and power of its instruction repertoire, the number of storage cycles it requires to execute each instruction, its input/output capabilities, etc.

Access time, microseconds/word is the actual elapsed time between the CPU's request for data and the time when that data is received (read). In core memory, the access time is usually one-half the cycle time; semiconductor memories do not display a similar relationship.

Our comparison charts show the amount of main storage available for each computer in terms of the *minimum capacity* and *maximum capacity*, expressed in words. In the great majority of cases, storage is available in all the usual binary increments of capacity. Thus, if a computer has minimum and maximum storage capabilities of 4,096 and 32,768 words, respectively, it's safe to assume that capacities of 8,192 and 16,384 words are also available.

It is important to choose the right storage capacity; for nonmultiprogramming systems, that usually means enough storage to hold your largest program and all associated subroutines and data, but not too much more than that. It's also wise to make sure that your computer's main storage capacity can be expanded if necessary, preferably by simply plugging in an additional storage module.

Parity checking is a standard feature of some minicomputers and an extra-cost option for others. In still other cases, the manufacturers maintain—with some justification—that the reliability of modern magnetic core and semiconductor memories is so high that parity checking is an unnecessary luxury unless absolute accuracy is a must. Parity checking requires the addition of one more bit to each main storage location. This added bit is set to the appropriate value (0 or 1) whenever a word is written into main storage and checked each time the word is read out; the technique permits detection of most, though not all, read and write errors.

Error correction is a rather new feature which is beginning to appear in some of the recent minicomputer offerings. This feature typically involves appending five or six check bits to each word of memory. The check bits,

called a Hamming code, and special algorithms allow a system to detect and correct single-bit errors, and also to detect a fair proportion of the multiple-bit errors that occur.

Storage protection is a feature that prevents unauthorized writing in certain areas of main storage. The protection can be accomplished by hardware means, software means, or a combination of both. Though unnecessary in simple dedicated systems, an effective storage protection scheme is an essential element in multiprogramming and time-sharing environments.

Central Processor

Although there are many variations in their internal architecture, the great majority of currently available minicomputers are parallel, binary processors with single-address instructions and fixed word lengths of 8, 12, 16, 18, 24, or 32 bits.

In single-address computers, the *number of accumulators* can have a significant effect upon internal flexibility and processing power. An accumulator is a register that holds one operand and permits various arithmetic and logical operations to be performed upon it (e.g., a second operand might be added to the operand contained in the accumulator, with the sum replacing the first operand in the accumulator). In computers with multiple accumulators, instructions involving operands in two of the accumulators can often be executed more rapidly than instructions which require the retrieval of an operand from main storage.

Indexing is an important form of address modification in which the contents of a special register called an index register are added to the machine address contained in an instruction prior to its execution. An effective indexing scheme is particularly desirable in minicomputers, since it can help to compensate for their limited direct addressing capabilities. The *number of index registers* serves as an indication of a computer's programming flexibility and efficiency. Prospective buyers should note, however, that there are wide variations in the indexing schemes used in current minicomputers. It is important to determine whether the index registers are separate hardware registers or simply reserved locations in main storage, whether special instructions are provided for loading, incrementing, and testing the index registers, and how much additional time (if any) indexing adds to the instruction execution times. It should also be noted that many of the current computers use "general registers" which can serve as either accumulators or index registers.

The *number of directly addressable words* of main storage is an important characteristic that may require some explanation if you're investigating minicomputers for the first time. The problem is that the short word lengths impose serious limitations upon the number of bits that can be assigned to hold the address part of each instruction. A typical 16-bit minicomputer instruction ▷

All About Minicomputers

▷ might consist of three parts: operation code, address mode field, and the address itself. If 6 bits are assigned to hold the operation code (permitting up to 64 distinct operations) and 2 bits are used to designate the addressing mode (permitting specification of indexing and/or indirect addressing), then only 8 bits are left to hold the address field. Since these 8 bits permit direct addressing of only 256 distinct memory locations, it is clear that other means will need to be employed to access most regions of the computer's main storage. The most common solutions to the problem are the use of multi-word instructions, indexing, and/or indirect addressing.

Number of addressing modes refers to the number of different types of additional addressing modes (other than direct) available to the user. There are many addressing modes being offered today: program-relative, base-relative, indexed, base plus displacement, auto increment/decrement, and many others. Many of these modes can also be combined with indirect addressing, the most popular of all non-direct addressing modes, to create an almost unlimited list of addressing schemes.

Since indirect addressing is so prominent, it deserves a short explanation. Indirect addressing is an address modification technique in which the address part of an instruction specifies a storage location that contains another address rather than the desired operand itself. This second address may in turn be either the address of the desired operand or another indirect address; the latter case is called multi-level indirect addressing. Indirect addressing permits the use of an entire word to hold an operand address. It can also simplify programming and speed up execution times in some applications by making it possible to change the effective address of numerous instructions by altering the indirect address in a single storage location. Each level of indirect addressing, however, usually requires one additional storage cycle of execution time.

Control storage is an indication of the microprogrammability of the minicomputer. Microprogrammability is a trait that enables the vendor and/or the user to tailor a minicomputer's internal processing capabilities to suit his particular needs. In place of conventional hard-wired logic, a microprogrammed computer uses sequences of microinstructions, usually stored in a special read-only memory (ROM), programmable read-only memory (PROM), or bipolar read-only memory (BROM) unit, to define the effects of each instruction in its repertoire. In some cases the microprograms can be altered by the user himself, while in others they are accessible only to the vendor. Microprogrammability can greatly increase the flexibility of a minicomputer, but its presence may involve a trade-off in terms of reduced performance or increased price. Entries here indicate both the type and the size of central storage.

Although it is undeniably dangerous to make inferences about a computer's overall performance capability on the basis of instruction execution times, our charts show the

basic *add time, microseconds* to give a first-level indication of fixed-point arithmetic speeds. In general, the indicated add times are the times required to retrieve a one-word operand from main storage and add it to another operand already contained in an accumulator, with no indexing or indirect addressing. Comparisons based on add times can easily be misleading, however, because of differences in word lengths and instruction repertoires.

Hardware multiply/divide facilities are standard in some minicomputers and optional in others. When no hardware facilities are present, multiplication and division must be performed by means of programmed subroutines at a significant reduction in execution speeds. Many minicomputer applications, however, impose little or no need for multiplication or division operations, and in these cases the hardware facilities would be superfluous.

Hardware floating-point facilities are not included in the standard instruction repertoires of most of the currently available minicomputers, despite the fact that floating-point arithmetic is highly desirable, if not essential, in many scientific applications. Where available, these facilities can dramatically reduce the execution times for certain programs by eliminating the need for time-consuming floating-point subroutines.

Hardware byte manipulation is the ability to conveniently process information expressed in the 8-bit character codes which are rapidly becoming an industry standard. Obviously, most of the 8-bit minicomputers are effective byte manipulators, and many of the 16-bit machines offer special instructions that permit either half of a word to be addressed and processed as an 8-bit byte.

Battery backup is a feature unique to minicomputers with semiconductor memory, which is volatile and requires refreshing at regular intervals to retain the data that has been written into it. In the event of a power failure, the contents of memory would be lost if the regulator power supply were not backed up by the battery pack.

A *real-time clock or timer* is another essential element in most "time-conscious" systems. A real-time clock enables the program to determine the time of day, while an interval timer usually indicates the amount of time that has elapsed since the occurrence of some significant event. In many cases the timer can trigger an interrupt signal when a predetermined interval of time has elapsed.

Input/Output Control

A *direct memory access channel* (DMA) permits direct transfer of I/O data between main storage and a peripheral controller. When a DMA channel is used, the I/O data bypasses the computer's main hardware registers, and the I/O operation proceeds independently of program control once it has been initiated by the program. In minicomputers that lack a DMA channel, I/O data transfers are generally carried out under direct program control, with each word being transferred by way of the processor's ▷

All About Minicomputers

registers. Generally speaking, the DMA channel has two significant advantages over program-controlled I/O: it can accommodate higher I/O data rates, and it causes far less interference with internal processing operations. Regardless of the type of I/O control they employ, most minicomputers can accommodate multiple I/O devices and include appropriate facilities for addressing the desired device.

Maximum I/O rate, words/sec is a measure of each computer's potential ability to transfer data to and from peripheral devices or other external sources. In machines equipped with a DMA channel, the maximum I/O rate frequently equals the cycling rate of the main storage unit. These maximum I/O rates, however, can be quite deceptive in the case of minicomputers. In general, their storage capacities are limited, their capabilities for simultaneous input/output operations are restricted, and fairly complex programming is associated with I/O operations. For all these reasons, I/O data rates approaching the indicated maximum rates can usually be handled only in short bursts, if at all.

An effective *program interrupt* facility is a requirement for virtually all applications of a real-time nature. An interrupt is a signal that causes a temporary suspension of normal program execution so that the particular condition that caused the interrupt can be dealt with. Interrupts fall into two basic categories: internal and external. Internal interrupts are usually triggered by conditions such as a memory parity error, an illegal instruction, or a power failure. External interrupts usually indicate that a particular peripheral device requires attention or has completed an I/O operation. An interrupt usually results in automatic storage of the current contents of the instruction counter, followed by a transfer of control to a software routine that determines the cause of the interrupt and initiates the appropriate action.

The *number of external interrupt levels* provides a reasonable indication of the power of a minicomputer's interrupt system. It shows the number of different external devices whose interrupt signals can be identified by the processor—though it should be noted that this identification process may require a fairly complex and time-consuming sequence of instructions. Many of the minicomputers offer additional external interrupt levels as extra-cost options, and in these cases our charts show the available range, from minimum to maximum.

Peripheral Equipment

The comparison charts summarize the standard peripheral devices that are available for each minicomputer.

Users who are accustomed to larger general-purpose computer systems will find that the term "standard peripheral device" often has a somewhat different meaning when used by a minicomputer manufacturer. Since comparatively few of the minicomputer makers produce their own peripheral equipment, the indicated availability of a given type of device may simply mean that an appropriate interface is available to couple the computer with a peripheral unit supplied by some other manufacturer. In many instances the minicomputer manufacturer buys the peripheral device from the peripheral manufacturer and supplies an appropriate interface for his minicomputer. Datapro has made every effort to include *only* the peripheral devices that are physically supplied by the minicomputer vendors; therefore, prospective buyers should ask these questions about each item of peripheral equipment they will need:

● Has it actually been installed and used with the computer of interest?

● If so, what has the users' experience been?

● What software support is available?

● Who will provide service for the device, and under what conditions?

The inclusion of mass storage devices (magnetic disk units) can greatly increase the data storage and processing capabilities of a minicomputer system. Disk units enable millions of characters of information to be constantly accessible to the computer. Moreover, any desired record can be retrieved, updated, and re-recorded on the disk, usually within a fraction of a second.

By replacing or augmenting slower, less flexible file storage media such as punched cards, paper tape, or magnetic ledger cards, disk units can enable small computers to handle applications and processing volumes that would otherwise be impossible. The principal disadvantages of disk units are their comparatively high costs and the software complexities that are encountered by users who attempt to harness their full potential. One or both of these considerations will make disk units impractical for many small computer buyers, despite the obvious appeal of disk-oriented data processing.

The diskette, or "floppy disk," is an innovation that can significantly reduce the cost of disk-oriented data processing. The diskette itself consists of a flexible Mylar disk, about 8 inches in diameter, that is permanently housed in a plastic envelope. It can serve as an input/output and/or random-access storage medium that is considerably smaller in capability and slower in performance than conventional disk units—but also far lower in cost. Introduced by IBM in 1972, diskettes and diskette drive units are now being produced by dozens of vendors and are finding their way into numerous small computer systems, such as the IBM System/32 and Burroughs B 80. Recent enhancements to the floppy disk concept include more concentrated data storage and "flippies" (floppy disks that utilize both sides of the diskette), allowing more data to be stored on-line.

The other, more conventional types of mass storage devices, cartridge and disk pack drives, provide access to far more data and at significantly faster rates. Unfor-

All About Minicomputers

The Meta 4/5020 is one model of the Meta 4 family of micro-programmed computers from Digital Scientific Corporation. This family offers a broad range of capabilities to accommodate a variety of high-throughput time-sharing applications. The 5020 is a midrange member of this family, which extends from a small OEM package to a large-scale system. The purchase price of a basic Meta 4/5020 is $24,500.

▷ tunately, they also carry price tags several times higher than their floppy counterparts. Most of these units employ cartridges or disk packs that can easily be removed from the drive units and interchanged in much the same manner as magnetic tape reels.

Some cartridge-type units either use nonremovable media or use two cartridges, one fixed and the other removable. Nonremovable disks impose two important limitations. First, the system's file storage capacity is effectively limited to the amount of information that can be stored on-line. Second, disk dumps to create backup files for efficient restart procedures in case of catastrophe are not available to the user.

Interchangeable disks, conversely, provide great flexibility and make it practical to use small computers effectively for both sequential and random data processing applications. In sequential applications, files of virtually unlimited size can be handled through the use of multiple disk packs or cartridges.

Fixed-head (head-per-track) disk and drum units can provide much faster access to on-line data than any other type of mass storage device. The reason is that there is no loss of time due to head positioning because a head is provided for each track. The only delay is rotational delay (latency), or the time required for the desired data to move under the read/write head. But the price of this type of equipment is higher than that of the preceding varieties, and less data can be stored on-line. Fixed-head devices are used when data bases are relatively small and very rapid access to the information is required.

Floppy disk (diskette) drives indicates whether floppies are available for a particular minicomputer and the minimum and maximum on-line capacities that are offered.

Disk pack/cartridge drives signifies whether one or the other, or both, types of devices can be interfaced to the system and the minimum and maximum on-line capacities available.

Drum/fixed-head disk storage informs the reader as to the availability of a drum or head-per-track (fixed-head) disk drive and the minimum and maximum on-line capacities offered.

The indicated maximum storage capacities are shown in thousands (K) or millions (M) of bytes and may be the capacity of a single disk or the total capacity of two or more (typically, four to eight) drives that can be connected to one controller. It is difficult to imagine minicomputer users wanting more disk storage, but if an I/O slot is open, theoretically, another controller and its associated drives can be added to most systems.

Magnetic tape cassettes and cartridges offer increased convenience in that they can be transported and stored with little fear of damaging the data that has been recorded. What's more, price tags for cassette and cartridge drives are significantly lower than those of the more conventional reel-to-reel variety, but once again the trade-off of slower transfer rates and reduced on-line storage must be accepted. The charts indicate the availability of *magnetic tape cassettes/cartridges* and *magnetic tape, 1/2-inch* drives and their associated transfer rates in characters per second (cps) or thousands of bytes per second (KBS).

Punched card input informs the reader if a punched card reader is offered and its speed in cards per minute (cpm).

Serial (character-at-a-time) printers, are enjoying increased popularity with the prolific growth of the minicomputer marketplace. The main reason is price; serial printers can provide excellent-quality hard-copy reports for far less money than the line-at-a-time printers used with larger computers. However, for users who require faster printing capabilities, *line printers* are also available for many systems. Serial printers generally range in speed from about 30 to 600 or more characters per second (cps), while line printers operate at speeds of 100 to 2000 or more lines per minute (lpm). The user who needs faster printed output can obviously get it, but he must be willing to pay the higher price tag associated with the line printers.

Data communications interface describes the minicomputer's capabilities, if any, to send and receive data over a common-carrier communications link. Depending on the configuration, a minicomputer can be programmed to function as an intelligent terminal communicating with a larger host computer, or the mini can act as the host computer communicating with other terminals in a network. The chart entry indicates whether an interface is available and gives the range of data rates or the maximum data rate in bits per second (bps).

CRT indicates the availability of a CRT display unit and describes its standard screen size in characters per line and number of lines per screen (e.g., 80 char. x 24 lines). ▷

All About Minicomputers

▷ *Other standard peripheral units* lists the additional peripheral devices that are available for each system. Typical entries include analog/digital (A/D) converters, paper tape readers, paper tape punches, plotters, etc.

Software

A critically important area to be evaluated is *software*—the programming packages and languages used to program the computer and thereby direct its operations. It is important that you carefully investigate the available software. This investigation should include the operating systems, programming languages, preprogrammed utility packages such as sorts and file maintenance, and application packages such as payroll, inventory control, general ledger, etc. Prospective buyers should carefully note whether the software they will require is included in the cost of the system or offered at extra cost.

Vendors' claims and promises concerning the availability and capability of software should be carefully checked. This is particularly true of software that has been announced but not yet released. Vendors have frequently failed to live up to their marketing publicity.

An *assembler* is a special-purpose program that uses the computer's power to facilitate the preparation of other programs. It enables the programmer to write his own program in a simplified format that uses mnemonic operation codes and symbolic operand addresses. The assembler program then converts these symbolic instructions into their machine-language equivalents, producing computer programs ready for loading and execution. Entries here indicate the availability of an assembler or, in some cases, a macro assembler.

A macro assembler is another software tool to aid the programmer and make his job a little easier. Macro routines can be called by the programmer and copied right into his program. This saves the programmer from having to recode the routine each time it is used and also eliminates the possibility of keying errors when that part of the program is entered. As usual, there is a price to pay: the use of macros usually wastes memory space.

Entries in this section of the charts indicate whether an assembler, a macro assembler, or both are available.

A *compiler* is a software tool designed to shift part of the program preparation task from the user to the computer itself by converting programs written in a simplified, procedure-oriented language into machine-language object programs. Compilers are now used in virtually all large and medium-scale computer installations because of their demonstrated ability to slash programming costs—and they are becoming increasingly available for minicomputers. This trend is possible because of the more powerful central processors now being used, since compilation is an intricate process that requires more storage space and processing power than the earlier minicomputers provided. Where compilers are offered, however, they frequently limit the programmer to restricted subsets of the standard programming languages and/or require the use of a larger computer to perform the compilation process.

Entries in this section of the charts may include *COBOL* (COmmon Business Oriented Language), *RPG* (Report Program Generator), *FORTRAN* (FORmula TRANslator), *BASIC* (Beginners All-purpose Symbolic Instruction Code), *ALGOL* (ALGOrithmic Language), or proprietary languages that are available from a vendor for use on a particular system, and indicate the availability of those compilers for each minicomputer. The key word of warning here is that if you use a language that is unique to a vendor, you will be faced with a big problem if someday you decide to change vendors. Your investment in software will be lost, since the programs will not operate on any other system.

An *operating system* facilitates the operation of a computer by handling functions such as: (1) scheduling, loading, and supervising the execution of programs; (2) allocating storage and I/O devices; (3) initiating and controlling I/O operations; (4) analyzing interrupt signals and dealing with errors; (5) handling communications between the system and its human operator; and (6) controlling multiprogramming or time-sharing operations.

Typical entries describing the available operating systems include "batch," which means that the system processes one or more jobs sequentially and requires all data to be supplied before initiation (communication between operator and system is not permitted once the job has begun); "interactive," which means that the system allows data, parameters, etc., to be entered as the job is executing; "real-time," which means that the system responds to external demands on a priority basis; or "time-sharing," which means that the system allows multiple users to access the system and share all its resources at the same time.

Language implemented in firmware and *operating system implemented in firmware* tell the reader whether or not the language processor and/or the operating system are contained in microcode. The entries stipulate "Fully," "partially," or "no" to indicate the extent of firmware implementation. An advantage to the user is that a language and/or operating system implemented in firmware frees up more memory space for the user's programs and data. Also, the microcode is usually inaccessible to the user (generally contained in read-only memory), eliminating any possible tampering with the language processor or operating system and reducing chances for error. A third advantage derived from firmware implementation is the ability to create more sophisticated and complex system functions at the hardware level. Microcode routines can be substituted for often-used subroutines, thereby increasing system performance. ▷

All About Minicomputers

Pricing and Availability

The comparison charts show the *price of CPU, power supply, front panel, and minimum memory in chassis* along with the memory size in parentheses. *Price of memory increment* stipulates the costs of various sizes (when available) of memory increments, with the actual sizes in parentheses.

If you'll need two or more minicomputers, it's also worth noting that most of the manufacturers offer sizeable discounts from their list prices on orders for multiple computers. Discounts of up to 40 percent are not unusual on large orders.

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

Number installed to date shows how many systems of each type had been delivered to customers as of approximately August 31, 1978. All figures were supplied by the manufacturers themselves.

Comments

This final entry on the comparison charts is used to explain or amplify the preceding entries and to provide other pertinent information about each system's hardware, software, pricing, or applications.

MINICOMPUTER MANUFACTURERS

Listed below, for your convenience in obtaining additional information, are the full names, addresses, and telephone numbers of the 74 suppliers whose products are listed in the comparison charts that follow.

Advanced Information Design, Inc., 1240 Elko Drive, Sunnyvale, California 94086. Telephone (408) 744-0900.

Anderson-Jacobson, Inc., 521 Charcot Avenue, San Jose, California 95131. Telephone (408) 263-8520.

Applied Systems Corporation, 26401 Harper Avenue, St. Clair Shores, Michigan 48081. Telephone (313) 779-8700.

Bainbridge Research & Development, Inc., 12715 Miller Road, N.E., Bainbridge Island, Washington 98110. Telephone (800) 426-0070.

Basic/Four Corporation, 14101 Myford Road, Tustin, California 92680. Telephone (714) 731-5100.

BTI Computer Systems, Inc., 870 West Maude Avenue, Sunnyvale, California 94086. Telephone (408) 733-1122.

Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7525.

Cado Systems Corporation, 2730 Monterey Street, Torrance, California 90503. Telephone (213) 320-9660.

Cascade Data, Inc., 6300 28th Street, S.E., Grand Rapids, Michigan 49506. Telephone (616) 942-1420.

Century Computer Corporation, 4410 Spring Valley Road, Dallas, Texas 75240. Telephone (214) 233-3238.

Cincinnati Milacron, Inc., Mason Road and S.R. 48, Lebanon, Ohio 45036. Telephone (513) 494-1200.

Computer Automation, Inc., 18651 Von Karman Avenue, Irvine, California 92664. Telephone (714) 835-8830.

Computer Hardware, Inc., 411 North Freeway Boulevard, P.O. Box 255000, Sacramento, California 95834. Telephone (916) 929-2020.

Computer Talk, Inc., P.O. Box 100, Idledale, Colorado 80453. Telephone (303) 697-4315.

Computervision Corporation, 201 Burlington Road, Route 62, Bedford, Massachusetts 01730. Telephone (617) 275-1800.

Control Data Corporation, P.O. Box 0, Minneapolis, Minnesota 55440. Telephone (612) 853-4656.

Data General Corporation, 15 Turnpike Road, Westboro, Massachusetts 01581. Telephone (617) 366-8911.

Datapoint Corporation, 9725 Datapoint Drive, San Antonio, Texas 78284. Telephone (512) 690-7000.

Dataram Corporation, Princeton-Hightstown Road, Cranbury, New Jersey 08512. Telephone (609) 799-0071.

Datasaab Systems Inc., 437 Madison Avenue, New York, New York 10022. Telephone (212) 754-0680.

Decision Data Computer Corporation, 100 Witmer Road, Horsham, Pennsylvania 19044. Telephone (215) 674-3300.

Diablo Systems, Inc., 1270 East Arques Avenue, Sunnyvale, California 94086. Telephone (408) 733-2300.

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

The Digital Group, P.O. Box 6528, Denver, Colorado 80206. Telephone (303) 777-7133.

Digital Scientific Corporation, 11455 Sorrento Valley Road, San Diego, California 92121. Telephone (714) 453-6050.

Digital Systems Corporation, P.O. Box 396, Walkersville, Maryland 21793. Telephone (301) 845-4141.

Display Data Corporation, Executive Plaza IV, Hunt Valley, Maryland 21031. Telephone (301) 667-9211.

Durango Systems, Inc., 10101 Bubb Road, Cupertino, California 95014. Telephone (408) 996-1001.

Financial Computer Corporation, 412 West Redwood Street, Baltimore, Maryland 21201. Telephone (301) 837-9510.

Four-Phase Systems, Inc., 10700 North DeAnza Boulevard, Cupertino, California 95014. Telephone (408) 255-0900.

Functional Automation, Inc., 118 Northeastern Boulevard, Nashua, New Hampshire 03060. Telephone (603) 882-1580.

General Automation, Inc., 1055 South East Street, Anaheim, California 92805. Telephone (714) 778-4800.

General Robotics Corporation, 55-57 North Main Street, Hartford, Wisconsin 53027. Telephone (414) 673-6800.

GRI Computer Corporation, 320 Needham Street, Newton, Massachusetts 02164. Telephone (617) 969-0800. ▷

All About Minicomputers

▷ *Harris Corporation*, Computer Systems Division, 1200 Gateway Drive, Fort Lauderdale, Florida 33309. Telephone (305) 974-1700.

Hewlett-Packard, Data Systems Division, 11000 Wolfe Road, Cupertino, California 95014. Telephone (408) 257-7000.

Hewlett-Packard, Fort Collins Division, 3400 East Harmony Road, Fort Collins, Colorado 80521. Telephone (303) 226-3800.

Hewlett-Packard, Desktop Computer Division, 3725 Canal Drive, Fort Collins, Colorado 80521. Telephone (303) 221-5000.

Hewlett-Packard, GSD Division, 5303 Stevens Creek Road, Santa Clara, California 95050. Telephone (408) 249-7020.

Honeywell Information Systems, Inc., 200 Smith Street, Waltham, Massachusetts 02154. Telephone (617) 890-8400.

IBM Corporation, General Systems Division, 875 Johnson Ferry Road, N.E., Atlanta, Georgia 30342. Telephone (404) 231-3000.

ICL, Inc., Turnpike Plaza, 197 Highway 18, East Brunswick, New Jersey 08816. Telephone (201) 246-3400.

Intelligent Systems Corporation, 5965 Peachtree Corners East, Norcross, Georgia 30071. Telephone (404) 449-5961.

Interdata, Inc., 2 Crescent Place, Oceanport, New Jersey 07757. Telephone (201) 229-4040.

Jacquard Systems, 1639 11th Street, Santa Monica, California 90404. Telephone (213) 393-9784.

Katcard Systems Ltd., 250 Don Park Road, Unit 14, Markham (Toronto), Ontario, Canada L3R 2V1. Telephone (416) 495-9590.

Keronix Data Systems, Inc., 250 East Emerson Avenue, Orange, California 92665. Telephone (714) 974-0800.

Lockheed Electronics Company, Data Products Division, U.S. Highway 22, Plainfield, New Jersey 07061. Telephone (201) 575-8100.

MCM Computers Ltd., P.O. Box 310, 133 Dalton Street, Kingston, Ontario, Canada K7L 4W2. Telephone (613) 544-9860.

Melcom Business Systems, Inc., 2200 West Artesia Boulevard, Suite 101, Compton, California 90220. Telephone (213) 979-6055.

Microdata Corporation, 17481 Red Hill Avenue, Irvine, California 92705. Telephone (714) 540-8341.

Modular Computer Systems, Inc., 1650 West McNab Road, Fort Lauderdale, Florida 33309. Telephone (305) 974-1380.

Mylee Digital Sciences, Inc., 155 Weldon Parkway, Maryland Heights, Missouri 63043. Telephone (314) 567-3420.

Nanodata Corporation, 2457 Wehrle Drive, Williamsville, New York 14221. Telephone (716) 631-5880.

NCR Corporation, Main and K Streets, Dayton, Ohio 45409. Telephone (513) 449-2000.

New England Digital Corporation, P.O. Box 305, Norwich, Vermont 05055. Telephone (802) 649-5183.

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

Philips Business Systems, Inc., 175 Froehlich Farm Boulevard, Woodbury, New York 11797. Telephone (516) 921-9310.

Plessey Peripheral Systems, Inc., 17466 Daimler Street, Irvine, California 92714. Telephone (714) 540-9945.

Prime Computer, Inc., 40 Walnut Street, Wellesley, Massachusetts 02181. Telephone (617) 879-2960.

Qantel Corporation, 3525 Breakwater Avenue, Hayward, California 94545. Telephone (415) 783-3410.

Randal Data Systems, Inc., 365 Maple Avenue, Torrance, California 90503. Telephone (213) 320-8550.

Raytheon Data Systems Company, 1415 Boston-Providence Turnpike, Norwood, Massachusetts 02062. Telephone (617) 762-6700.

Rolm Corporation, 4900 Old Ironsides Drive, Santa Clara, California 95050. Telephone (408) 988-2900.

Systems Approach Ltd., 1257 Algoma Road, Ottawa, Ontario, Canada K1B 3W7. Telephone (613) 741-9500.

Systems Engineering Laboratories, Inc., 6901 West Sunrise Boulevard, Fort Lauderdale, Florida 33313. Telephone (305) 587-2900.

Tandem Computers, Inc., 19333 Vallco Parkway, Cupertino, California 95014. Telephone (408) 996-6000.

Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97077. Telephone (503) 644-0161.

Texas Instruments, Inc., P.O. Box 2909, Austin, Texas 78769. Telephone (512) 258-7111.

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

Univac Minicomputer Operations, 2722 Michelson Drive, Irvine, California 94662. Telephone (714) 833-2400.

Wang Laboratories, Inc., One Industrial Avenue, Lowell, Massachusetts 01851. Telephone (617) 851-4111.

Warrex Computer Corporation, 2505 North Central Expressway, Dallas, Texas 75243. Telephone (214) 233-8400.

Westinghouse Electric Corporation, Digital Products Department, 1200 West Colonial Drive, Orlando, Florida 32804. Telephone (305) 843-7030.□

All About Minicomputers

MANUFACTURER & MODEL	Advanced Information Design System 2000	Anderson Jacobsen 1500	Applied Systems Corporation ASC/80	Basic Four 200	Basic Four 400
DATA FORMATS					
Word length, bits	16	8-bit byte	8, 16	8-bit byte	8-bit byte
Fixed-point operand length, bits	16	8, 16	8, 32	16, 32	16, 32
Instruction length, bits	16, 32	8, 24	8, 32	8, 16, 24, 32	8, 16, 24, 32
MAIN STORAGE					
Storage type	MOS or core	Core, MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.6	1.0; 0.8	1.0	0.60	0.60
Access time, microseconds/word	0.3	0.8; 0.5	0.5	0.40	0.40
Minimum capacity, words	4K	32K bytes	4K	32K bytes	32K bytes
Maximum capacity, words	32K	64K bytes	128K	40K bytes	64K bytes
Parity checking	Optional	No	Optional	Standard	Standard
Error correction	No	No	Optional	No	No
Storage protection	Optional	No	Optional	No	No
CENTRAL PROCESSOR					
No. of accumulators	16	128	2	2	2
No. of index registers	15	3	7	1	1
No. of directly addressable words	32K	64K	64K	64K	64K
No. of addressing modes	4	2	3	8	8
Control storage	ROM; 4K bytes	ROM; 4K bytes	PROM; 64K max.	ROM; 1K x 16 bits	ROM; 1K x 16 bits
Add time, microseconds	1.2	4	1.0	7.4	7.4
Hardware multiply/divide	Standard	No	Optional	No	No
Hardware floating point	Optional	No	Optional	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	No	Optional	Standard	Standard
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Optional	Standard	Standard
Maximum I/O rate, words/sec.	1 million	606K	50K	1M	1M
No. of external interrupt levels	4-256	15	8 optional	8	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	640-2,400KB	640K-2.56M bytes	250KB to 2MB	No	No
Disk pack/cartridge drives	Pack & Cartridge; 10-1200M bytes	Cartridge; 10-40M bytes	Optional	Cartridge; 10-20M bytes	Cartridge; 10-40M bytes
Drum/Fixed-head disk storage	No	No	10 to 100MB (optional)	No	No
Magnetic tape cassettes/cartridges	Cassette; 500 bps	No	./R optional	Std.; 2.3M bytes	No
Magnetic tape, ½-inch	4 units; 45-120 KBS	No	Optional	10 KBS	10 KBS
Punched card input	300-1000 cpm	No	300 cpm	No	No
Serial printer	30-165 cps	45, 120 cps	30/180 cps	120 cps	160 cps
Line printer	300-1200 lpm	125 lpm, 300 lpm	A/R optional	No	300, 600 lpm
Data Communications interface	50-9600 bps	1200 bps; asynch.	To 19.2KB	1200 bps	1200 bps
CRT	24 char. x 80 lines	80 char. x 24 lines	64 x 16 std.; 80 x 24	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape, A/D converters	—	Plotters, graphic CRT, A/D-D/A I/O	—	—
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler	Yes; macro assembler optional	No	No
Compilers	FORTRAN, BUSINESS, BASIC, COBOL, RPG II	BASIC ESP	BASIC, FORTRAN, PASCAL, PL/M	Business BASIC	Business BASIC
Operating system	Multi-user, time-sharing, real-time	Multi-user	Optional	Single-user interactive	Multi-user
Language implemented in firmware	No	Partially	Optional	No	No
Operating system implemented in firmware	No	Partially	Optional	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$2,800 (8K bytes)	$18,150 (32K bytes)	$900 (basic system)	$29,000 (32K bytes)	$36,900 (32K bytes)
Price of memory increment	$800 (8K words)	$3,000 (32K bytes)	$250 (8K bytes)	$2,000 (8K bytes)	$2,000 (8K bytes) $2,500 (16K bytes)
Date of first delivery	June 1975	July 1977	1977	1978	1971
Number installed to date	50+	200+	NA	5000 (all models)	5000 (all models)
COMMENTS	System operates either under a commercially oriented time-sharing system with Business BASIC or a real-time OS with background batch for FORTRAN, COBOL, etc.; also has interactive control system; instruction set is similar to that of IBM 370	Multiprogramming operating system, up to four partitions; client accounting software—Payroll, A/R, G/L, A/P, sales acctg., word proc., time cost billing, inventory control	Modular computer system designed for general applications and special business, communications, and real-time/control operations	Available as packaged systems only; system price also includes fixed disk subsystem, serial printer, and CRT terminal	

All About Minicomputers

MANUFACTURER & MODEL	Basic Four 610	Basic Four 730	BRD Dolphin	BRD Porpoise	BTI 5000
DATA FORMATS					
Word length, bits	8-bit byte	8-bit byte	8-bit byte	8-bit byte	16
Fixed-point operand length, bits	16, 32	16, 32	8	8	16
Instruction length, bits	8, 16, 24, 32	8, 16, 24, 32	16	16	16
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS and core
Cycle time, microseconds/word	0.60	0.60	0.60	0.60	0.60
Access time, microseconds/word	0.40	0.40	1.00	1.00	0.3
Minimum capacity, words	40K bytes	96K bytes	4K bytes	4K bytes	32K bytes
Maximum capacity, words	128K bytes	256K bytes	32K bytes	32K bytes	32K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	Yes, with MOS
Storage protection	No	No	No	No	Standard
CENTRAL PROCESSOR					
No. of accumulators	2	2	480	480	2; not user-accessible
No. of index registers	1	1	480	480	NA
No. of directly addressable words	64K	64K	4K to 8K	4K to 8K	NA
No. of addressing modes	8	8	2	2	NA
Control storage	ROM; 1K x 16 bits	ROM; 1K x 16 bits	EPROM; 14K	EPROM; 12K	PROM; 98K bits
Add time, microseconds	7.4	7.4	5.0	5.0	20
Hardware multiply/divide	No	No	Standard	Standard	Standard
Hardware floating point	No	No	No	No	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Standard	Standard	No	No	Standard
Real-time clock or timer	Standard	Standard	No	No	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1M	1M	1M	1M	616K
No. of external interrupt levels	8	8	None	None	NA
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	1.2MB; dual dr. std.	622KB; dual dr. std.	No
Disk pack/cartridge drives	Cartridge; 35M-105M	Cartridge; 75M-300M bytes	No	No	Non-remov. pack, 29MB to 392MB
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Opt., 9.2 bytes	No	No	No	No
Magnetic tape, ½-inch	10 KBS	10 KBS	No	No	Cart; 24KB/sec.
Punched card input	No	No	No	No	No
Serial printer	160 cps	160 cps	45-200 cps	30-55 cps	No
Line printer	300, 600 lpm	300, 600 lpm	No	No	300, 600, 900 lpm
Data Communications interface	1200 bps	1200 bps	300-1200 bps	300 bps	2400 bps, asynch.
CRT	80 char. x 24 lines	80 char. x 24 lines	24 x 80	24 x 80	No
Other standard peripheral units	—	—	No	No	None
SOFTWARE					
Assembler	No	No	No	No	No
Compilers	Business BASIC	Business BASIC	BASIC	BASIC	BASIC
Operating system	Multi-user	Multi-user	Real-time	Real-time	Time-sharing
Language implemented in firmware	No	No	B.A.L. fully	B.A.L./fully	Partially
Operating system implemented in firmware	Partially	Partially	Fully	Fully	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$51,400 (40K bytes)	$110,000 (96K bytes)	$18,000 to $25,000	$10,000 to $15,000	$38,950
Price of memory increment	$2,000 (8K bytes) $2,500 (16K bytes)	$3,900 (32K bytes)	$400 (4K bytes)	$400 (4K bytes)	None
Date of first delivery	1978	1978	July 1977	January 1978	August 1978
Number installed to date	5000 (all models)	5000 (all models)	125	25	650 (all models)
COMMENTS			Entry-level small business system; price also includes dual floppy disk drives, workstation, cabinet, and desk as standard; software packages available for most business applications	Entry-level small business system; price also includes dual floppy disk drives, workstation, cabinet, and desk as standard; software packages available for most business applications	Packaged system includes non-removable and/or pack disk drives, cartridge magnetic tape drives; reel-to-reel tape drives and line printers are standard options; up to 32 users supported; price is for minimum system configuration

All About Minicomputers

MANUFACTURER & MODEL	BTI 8000	Burroughs L 9000 Series	Burroughs B 80	Burroughs B 730/B 720	Burroughs B 770 Series
DATA FORMATS					
Word length, bits	32	64	8-bit byte	64	16
Fixed-point operand length, bits	32 and 64	—	—	—	—
Instruction length, bits	32	Variable	Variable	Variable	Variable
MAIN STORAGE					
Storage type	Core	MOS	MOS	MOS	Core, MOS
Cycle time, microseconds/word	0.67	1.5	1.0	1.0	1
Access time, microseconds/word	0.4	1.2	0.5	0.5	0.4; 0.63
Minimum capacity, words	64K bytes	4K bytes	32K bytes	32K bytes	16K bytes
Maximum capacity, words	32M bytes	48K bytes	128K bytes	80K bytes	48K; 96K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	—	None to user	None to user	None to user	None to user
No. of index registers	8 gen.-purpose reg.	4	None to user	None to user	None to user
No. of directly addressable words	—	—	—	—	—
No. of addressing modes	—	—	—	—	—
Control storage	PROM	RAM; 8K bytes	ROM; 4K bytes	ROM; 3584 bytes	RAM; 32K bytes
Add time, microseconds	3.5	—	—	0.43	—
Hardware multiply/divide	Standard	—	—	No	—
Hardware floating point	Standard	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	—
Battery backup	Standard	—	—	—	—
Real-time clock or timer	Standard	—	—	—	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	6 std., 32 opt.	—	—	—	Standard
Maximum I/O rate, words/sec.	10M	—	—	—	—
No. of external interrupt levels	NA	—	—	—	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	243K-6M bytes	243K-1.5 bytes	243K bytes
Disk pack/cartridge drives	Pack; 33 MB to 46,368 MB	No	Cartridge; 4.6-27.6M bytes	Cartridge; 4.6-36.8M bytes	Cartridge; 4.6-36.8M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS
Magnetic tape, ½-inch	Cart.; 24 KBS	10 KBS	No	10 KBS	10 KBS
Punched card input	No	480 cpm	No	600 cpm	300-800 cpm
Serial printer	No	60, 90, 120, 150 cps	60, 180 cps	60 cps	No
Line printer	300, 600, 900 lpm	90-250 lpm	160, 250 lpm	85-400 lpm	85-750 lpm
Data Communications interface	19.2 bps; asynch.	9600 bps	9600 bps	9600 bps	9600 bps
CRT	No	32 char. x 8 lines	80 char. x 24 lines	80 char. x 24 lines	No
Other standard peripheral units	None	Mag. ledger card reader	—	Card punch, card reader/punch	Up to 2 data communications processors; reader/punch/data record
SOFTWARE					
Assembler	No	Assembler	No	No	Assembler
Compilers	BASIC, FORTRAN, COBOL, PASCAL, RPG II	COBOL	COBOL, RPG, NDL, MPL	COBOL, RPG, AEL	COBOL, RPG, NDL, MPL
Operating system	Time-sharing and batch	—	Interactive	Real-time	Batch, real-time
Language implemented in firmware	No	Fully	Fully	Fully	Fully
Operating system implemented in firmware	No	—	Fully	Fully	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$86,850	$16,490 (4K bytes)	$19,510 (32K bytes)	$20,900 (32K bytes)	$16,200 (32K bytes)
Price of memory increment	$9,000 (128K bytes)	$800 (2K bytes); $1,400 (4K bytes)	$900 (4K bytes); $1,500 (16K bytes)	$2,280 (8K bytes)	$990 (8K bytes)
Date of first delivery	March 1979	June 1975	April 1976	March 1973	1974
Number installed to date	None	Thousands	NA	NA	NA
COMMENTS	Packaged system for interactive and multistream batch workload; variable resource bus architecture accommodates up to 8 processors, together with multiple memory modules and peripheral processor	Six models: L 9300, L 9400, and L 9500 with 60-cps printer; L 9700, L 9800, and L 9900 with 90-cps printer; L 9500 and L 9900 have mag. ledger capability	Offers the technology of Burroughs' larger computers	System price includes console printer; AEL and COBOL or RPG programs can run concurrently	Systems and communications processors; not all models allow all features presented

All About Minicomputers

MANUFACTURER & MODEL	Burroughs B 800 Series	Burroughs B 1700 Series	Burroughs B 1720 Series	Burroughs B 1800 Series	Cado Systems Corporation System 20
DATA FORMATS					
Word length, bits	64, 16	8-bit byte	64	8-bit byte	8-bit byte
Fixed-point operand length, bits	—	—	—	—	48
Instruction length, bits	Variable	Variable	Variable	Variable	8
MAIN STORAGE					
Storage type	MOS; bipolar	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	1	1.5	1.0	1.7-2.0	2.5
Access time, microseconds/word	0.5	1.0	0.67	—	0.75
Minimum capacity, words	32K bytes	24K bytes	48K bytes	96K bytes	6K
Maximum capacity, words	144K bytes	128K bytes	378K bytes	1M bytes	10K
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	No	No	No	No	No
Storage protection	Standard	Standard	Standard	Standard	No
CENTRAL PROCESSOR					
No. of accumulators	None to user	None to user	None to user	None to user	1
No. of index registers	None to user	None to user	None to user	None to user	0
No. of directly addressable words	—	—	—	—	10K
No. of addressing modes	—	—	—	—	NA
Control storage	RAM; to 48K	No	ROM; to 8K bytes	ROM; 4K bytes	PROM; 1-2K, 1-1K
Add time, microseconds	—	—	—	—	6.0 (5 digits)
Hardware multiply/divide	—	—	—	—	No
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	—	—	—	—	Standard
Battery backup	—	—	—	—	No
Real-time clock or timer	Standard	—	—	Standard	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	—	—	—	Standard
Maximum I/O rate, words/sec.	2M bytes	—	—	—	1 MB/sec
No. of external interrupt levels	—	—	—	—	None
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	2M bytes	No	No	486K bytes	1.2 to 3.6M bytes
Disk pack/cartridge drives	Pack/cartridge; 4.6-130.4M bytes	Pack & cartridge; 2.3-697.6M bytes	Pack & cartridge; 2.3-697.6M bytes	Pack & cartridge; 4.6-697M bytes	Cart.; 9.5 to 19M bytes
Drum/Fixed-head disk storage	Fixed-head; 9.4-65.6M bytes	Fixed-head disk; 1.9M bytes	Fixed-head disk; 1.9-70M bytes	No	Fixed media ; 15M bytes
Magnetic tape cassettes/cartridges	Cassette; 3 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	No
Magnetic tape, ½-inch	10 KBS	10-120 KBS	10-120 KBS	10-120 KBS	NA
Punched card input	300-600 cpm	300-1400 cpm	300-1400 cpm	300-1400 cps	No
Serial printer	120 cps	No	No	No	150 cps
Line printer	160-750 lpm	85-1040 lpm	85-1040 lpm	400-1500 lpm	No
Data Communications interface	9600 bps	9600 bps	9600 bps	9600 bps	9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Card punch; card reader punch; DDES	Card punch, card reader punch	Card punch, card reader/punch	Card punch; card reader/punch	None
SOFTWARE					
Assembler	No	No	No	No	No
Compilers	COBOL, RPG, NDL, MPL	COBOL, FORTRAN, RPG, BASIC, UPL, NDL	COBOL, FORTRAN, RPG, BASIC, UPL NDL	COBOL, RPG, MPL, NDL	Basic (CADOL)
Operating system	Batch, real-time	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time	Real-time
Language implemented in firmware	Fully	Fully	Fully	Fully	Partially
Operating system implemented in firmware	Fully	Fully	Fully	Fully	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$32,400 (32K bytes)	$25,780 (24K bytes)	$64,800 (48K bytes)	$48,500-$140,090	$5,000
Price of memory increment	$990 (8K MOS)	$2,500 (16K bytes)	$2,500 (16K bytes)	$3,000 (16K bytes)	
Date of first delivery	—	3rd qtr. 1972	2nd qtr. 1973	2nd qtr. 1977	January 1978
Number installed to date	NA	Over 1300 total	Over 1300 total	NA	200+
COMMENTS		See Report 70C-112-04 for more details	See Report 70C-112-04 for more details	See Report 70C-112-05 for more details	

All About Minicomputers

MANUFACTURER & MODEL	Cado Systems Corporation System 20/IV	Cado Systems Corporation System 40	Cado Systems Corporation System 40/IV	Cascade Data Concept II	Cascade Data Concept III
DATA FORMATS					
Word length, bits	8-bit byte	8-bit byte	8-bit byte	16	16
Fixed-point operand length, bits	48	48	48	16-32	16-32
Instruction length, bits	8	8	8	16-40	16-40
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core	Core
Cycle time, microseconds/word	1.3	2.5	1.3	1.2	1.0
Access time, microseconds/word	0.4	0.75	0.4	0.35	0.35
Minimum capacity, words	20K	5K	20K	16K	16K
Maximum capacity, words	52K	9K	48K	64K	64K
Parity checking	Standard	No	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	1	1	1	16	16
No. of index registers	0	0	0	3	3
No. of directly addressable words	52K	9K	52K	32K	32K
No. of addressing modes	NA	NA	NA	2	2
Control storage	PROM; 2—2K	ROM; 2K	PROM; 2—2K	No	No
Add time, microseconds	3.9 (5 digits)	6.0 (5 digits)	3.9 (5 digits)	8.8	7.5 (word)
Hardware multiply/divide	No	No	No	Standard	Standard
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	Optional	Optional
Real-time clock or timer	Standard	No	Standard	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1MB/sec	1MB/sec	1MB/sec	413K	413K
No. of external interrupt levels	3	None	3	0	0
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	1.2 to 3.6M bytes	1.2 to 3.6M bytes	1.2 to 3.6M bytes	No	1.2M bytes
Disk pack/cartridge drives	Cart.; 9.5 to 19M bytes	Cart.; 9.5 to 19M bytes	Cart.; 9.5 to 19M bytes	Cartridge; 40M bytes	Cartridge; 40M bytes
Drum/Fixed-head disk storage	Fixed media; 15M bytes	Fixed media; 15M bytes	Fixed media; 15M bytes	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	NA	NA	NA	30, 60 KBS	30-60 KBS
Punched card input	No	No	No	300 cpm	300 cpm
Serial printer	150 cps	45 cps	45 cps	55 cps	55 cps
Line printer	300 lpm	300 lpm	300 lpm	125-600 lpm	125-600 lpm
Data Communications interface	9600 bps	9600 bps	9600 bps	9600 bps	9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	None	None	None	Paper tape reader, paper tape punch	Paper tape reader, paper tape punch, card reader
SOFTWARE					
Assembler	No	No	No	Macro assembler	Macro assembler
Compilers	Basic (CADOL)	Basic (CADOL)	Basic (CADOL)	RPG	RPG
Operating system	Real-time, multi-task	Real-time	Real-time, multi-task	Batch, real-time, time-sharing	Batch, real-time, time-sharing
Language implemented in firmware	Partially	Partially	Partially	No	No
Operating system implemented in firmware	Partially	Partially	Partially	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$7,000	$5,000	$7,000	$22,200 (16K bytes)	$26,900 (16K bytes)
Price of memory increment	--	—	—	$1,200 (16K bytes); $2,700 (32K bytes)	$1,200 (16K bytes); $2,700 (32K bytes)
Date of first delivery	June 1978	April 1976	June 1978	January 1970	November 1977
Number installed to date	60+	600+	60+	260	15
COMMENTS				Operating system provides 2 partitions; system price includes CRT and cartridge disk	Operating system provides 4 partitions; system price includes CRT and cartridge disk

All About Minicomputers

MANUFACTURER & MODEL	Cascade Data Concept IV	Century Computer 300	Century Computer 400	Century Computer 700	Century Computer 900
DATA FORMATS					
Word length, bits	8	8-bit byte	16 + 5	8	8
Fixed-point operand length, bits	16-32	8	16	16	16
Instruction length, bits	8-24	8, 16, 24	8, 16, 24	8, 16, 24, 32	8, 16, 24, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.5	0.6	0.6	0.6	0.6
Access time, microseconds/word	0.5	0.2	0.2	0.2	0.2
Minimum capacity, words	32K	16K, 32K bytes	32K bytes	32K bytes	96K bytes
Maximum capacity, words	64K	60K	512K bytes	256K bytes	512K bytes
Parity checking	No	No	Optional	Optional	Optional
Error correction	No	No	Optional	Optional	Optional
Storage protection	No	No	Optional	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	12	16	16	16	16
No. of index registers	6	16	16	16	16
No. of directly addressable words	64	64K bytes	64K bytes	64K bytes	64K bytes
No. of addressing modes	7	17	17	17	17
Control storage	No	PROM; to 2K bytes	PROM; to 2K bytes	PROM; to 2K bytes	PROM; to 2K bytes
Add time, microseconds	2.0 (byte)	2.6	2.6	2.6	2.6
Hardware multiply/divide	No	Optional	Optional	Optional	Optional
Hardware floating point	No	Standard	Standard	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	No	Optional	Optional	Optional
Real-time clock or timer	Standard	No	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Optional	Standard	Standard	Standard
Maximum I/O rate, words/sec.	750K	1M	1M	1M	1M
No. of external interrupt levels	0	15; 120	120	120	120
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	4.8M bytes	376K bytes	384K bytes	No	No
Disk pack/cartridge drives	No	Pack & cartridge; 20-100M bytes	Pack & cartridge; 10-1200M bytes	Pack & cartridge; 10-120M bytes	Pack & cartridge; 10-120M bytes
Drum/Fixed-head disk storage	No	No	No	Fixed-head; 74-296M bytes	Fixed-head; 74-296M bytes
Magnetic tape cassettes/cartridges	No	Cassette; 300 cps	Cassette; 300 cps	No	No
Magnetic tape, ½-inch	No	120 KBS	120 KBS	36 KBS	36 KBS
Punched card input	No	300, 600 lpm	300, 600 cpm	300 cpm	300 cpm
Serial printer	60 cps	165 cps	165 cps	165 cps	165 cps
Line printer	125-600 lpm	300, 600 lpm	300, 600 lpm	600 lpm	600 lpm
Data Communications interface	19.2K bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape reader, paper tape punch	Paper tape reader	Paper tape reader	Paper tape reader	Paper tape reader
SOFTWARE					
Assembler	Macro assembler, BASIC	Yes	Yes	Yes	Yes
Compilers	No	BASIC, CPL	BASIC, CPL	BASIC, CPL	BASIC, CPL
Operating system	Batch, real-time	Batch, real-time	Batch, real-time	Batch, real-time	Batch, real-time
Language implemented in firmware	Partially	No	No	No	No
Operating system implemented in firmware	Partially	No	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$14,000 (32K bytes)	$17,000 (32K bytes)	$21,000 (32K bytes)	$21,000 (32K bytes)	$27,000 (32K bytes)
Price of memory increment	$1,500 (16K bytes)	$3,200 (32K bytes)	$3,200 (32K bytes)	$3,200 (32K bytes)	$3,200 (32K bytes)
Date of first delivery	September 1978	February 1971	March 1975	April 1976	June 1976
Number installed to date	—	Over 600	117	154	12
COMMENTS	Applications compatible with concept II and III; system price includes two application software packages	System price also includes RS-232C interface; system is intended primarily for system/turnkey houses and dealers; volume discounts available	System price also includes RS-232C interface; system is intended primarily for system/turnkey houses and dealers; volume discounts available	System price also includes RS-232C interface; system is intended primarily for system/turnkey houses and dealers; volume discounts available	

All About Minicomputers

MANUFACTURER & MODEL	Century Computer 1000	Cincinnati Milacron CIP/2200B	Cincinnati Milacron CIP/4400	Computer Automation Naked Milli LSI-3/05	Computer Automation Naked Mini LSI-2 Series
DATA FORMATS					
Word length, bits	8, 16, 24	16	16	16	16 + 2
Fixed-point operand length, bits	16	8-32	8-32	8, 16, 32	8, 16, 32
Instruction length, bits	8	8-64	8-64	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core MOS	Core MOS
Cycle time, microseconds/word	1.2	1.1	0.9	0.98-1.6	0.85-1.2
Access time, microseconds/word	0.5	0.66	0.6	0.5-0.8	0.4-0.6
Minimum capacity, words	128K bytes	32K bytes	64K bytes	512	8K
Maximum capacity, words	512K bytes	64K bytes	256K bytes	8K	512K
Parity checking	Optional	Optional	Standard	No	Optional
Error correction	Optional	No	No	No	No
Storage protection	Optional	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	16	3	3	2	2
No. of index registers	16	1	1	1	1
No. of directly addressable words	64K bytes	32K	32K	128	32K
No. of addressing modes	17	9	9	8	8
Control storage	PROM; to 2K bytes	ROM; 16 x 2K bytes	ROM; 24 x 2K bits	ROM; 512 x 24 bits	ROM; 512 x 56 bits
Add time, microseconds	2.6	10.3	2.1	6.25 (2 digits)	4.12, 2.06
Hardware multiply/divide	Optional	Standard	Standard	No	Standard
Hardware floating point	Standard	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	No	Optional	Optional	Optional
Real-time clock or timer	Optional	Standard	Standard	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1M	909K	1.2M	250K	1M
No. of external interrupt levels	120	32-64	32-64	1	3
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	630K bytes	630K-2.52M bytes	630K-1.26M bytes	243-972K bytes	243-972K bytes
Disk pack/cartridge drives	Cartridge; 46.4M bytes	Cartridge; 5-4M bytes	Both; 10-320M bytes	Cartridge; 4.92-19.68M bytes	Cartridge; 4.92-19.68M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	120 KBS	20 KBS	15 & 20 KBS	20 KBS	20 KBS
Punched card input	300 cpm	600 cpm	600 cpm	285 cpm	285 cpm
Serial printer	300 cps	60 cps	60 cps	100, 165 cps	100, 165 cps
Line printer	1200 lpm	60-600 lpm	60-600 lpm	No	No
Data Communications interface	Up to 9600 bps	9600 bps	9600 bps	To 9600 bps	110-50K bps
CRT	80 char. x 24 lines	80 char. x 12 lines	80 char. x 12 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape reader	Remote printer, keyboard printer, data entry station	Remote printer, keyboard printer, data entry station	Paper tape reader, paper tape reader/punch	Paper tape reader, paper tape reader/punch
SOFTWARE					
Assembler	Yes	Assembler & macro assembler	Assembler & macro assembler	Macro assembler	Macro assembler
Compilers	BASIC, CPL, ALGOL	RPG II	RPG II	FORTRAN	FORTRAN, BASIC
Operating system	Batch, real-time	Batch, interactive	Multi-user inter-active, batch	Real-time	Batch, real-time, multi-tasking
Language implemented in firmware	Partially	Fully	Fully	No	No
Operating system implemented in firmware	Partially	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$40,000 (32K bytes)	$16,100 (32K bytes)	$45,900 (64K bytes)	$725 (4K MOS)	$1,750 (2/10)
Price of memory increment	$3,200 (32K bytes)	$3,200 (32K bytes)	$3,200 (32K bytes)	$550 (4K MOS)	$985 (4K core)
Date of first delivery	June 1977	June 1973	July 1976	January 1975	July 1973
Number installed to date	6	590 (all models)	590 (all models)	NA	NA
COMMENTS		Packaged system including CPU with 32K bytes, 960-character VDT 60-cps printer dual floppy disk drives; accounting software available	Packaged system including CPU with 64K bytes printer, 60-lpm dual floppy disk drives, 960-character VDT; accounting software available	ROM/EPROM & RAM/ROM/PROM are available in combination; ROM, PROM, EROM avail-able in max. capa-cities of 8K, 2K, & 4K words, respec-tively	ROM/EPROM & RAM/ROM/PROM are available in combination; ROM, PROM, EROM avail-able in max. capa-cities of 8K, 2K, & 4K words respec-tively

All About Minicomputers

MANUFACTURER & MODEL	Computer Automation Naked Mini 4 Family	Computer Hardware Inc. 2130	Computer Hardware Inc. 3230	Computer Hardware Inc. 4210	Computer Hardware Inc. 4250
DATA FORMATS					
Word length, bits	16	16	16	16	16
Fixed-point operand length, bits	16	16	16	—	—
Instruction length, bits	16, 32	16-64	16-64	16	16
MAIN STORAGE					
Storage type	Core or MOS	MOS, core	MOS	MOS	MOS
Cycle time, microseconds/word	0.55-0.85	0.8	1.6	0.47	0.47
Access time, microseconds/word	0.3-0.4	0.25	0.25	0.3	0.3
Minimum capacity, words	4K	8K	8K	4K	4K
Maximum capacity, words	64K	2,000K	64K	26K	1024K
Parity checking	Optional	Standard	Standard	Standard	Standard
Error correction	No	Optional	No	No	Optional
Storage protection	No	Standard	Standard	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	2	8	8	0	0
No. of index registers	8	6	6	16	16
No. of directly addressable words	64K	64K	64K	32K	64K
No. of addressing modes	12	—	—	8	8
Control storage	None	—	—	No	PROM; 256 x 45 bits
Add time, microseconds	1.5-3.0	1.6	2.7	4.662	3.5
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	No	No
Hardware byte manipulation	Standard	No	No	Standard	Standard
Battery backup	Optional	No	No	No	No
Real-time clock or timer	Standard	Optional	Optional	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	115K	1.25M	1.25M	—	—
No. of external interrupt levels	4	8	8	8	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	4: 243K-972K bytes	No	No	Yes	Yes
Disk pack/cartridge drives	Cartridge & pack; 5-1200M bytes	Pack; 1600M bytes	Pack; 1600M bytes	No	Cartridge; 3M or 10M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges					
Magnetic tape, ½-inch	20 KBS	Yes	Yes	No	No
Punched card input	285 cps	300-1000 cpm	300-1000 cpm	No	No
Serial printer	No	No	No	30-180 cps	30-180 cps
Line printer	60-165 lpm	300, 600 lpm	300, 600 lpm	300 lpm	300 lpm
Data Communications interface	50K bps	To 4800 bps; synch.	To 4800 bps; synch.	9600 bps	9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape units, A/D-D/A converters	Card reader/punch, paper tape reader, paper tape punch, plotter	Card reader/punch, paper tape reader, paper tape punch, plotter	None	None
SOFTWARE					
Assembler	Assembler, macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler	Macro assembler
Compilers	BASIC, FORTRAN	RPG, COBOL, FORTRAN	RPG, COBOL, FORTRAN	FORTRAN	FORTRAN, BASIC, COBOL
Operating system	Batch, real-time	Batch, time-sharing	Batch, time-sharing	Real-time	Real-time
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$995 (4K words)	$32,000	$15,000	$13,000 (32K bytes)	$24,950 (96K bytes)
Price of memory increment	$995 (16K words)	$1,500	$1,500	$1,550	$1,625
Date of first delivery	June 1977	June 1974	April 1976	October 1977	January 1978
Number installed to date	800	NA	NA	NA	NA
COMMENTS	All processors include power-fail, auto restart, auto load, and real-time clock capabilities as standard features	Asynchronous communications to 9600 bps	Asynchronous communications to 9600 bps	Software and hardware supports CHI 4111 Time Clock—standard feature for T/A and Labor Distribution Control	Software and hardware supports CHI 4111 Time Clock—standard feature for T/A and Labor Distribution Control

All About Minicomputers

MANUFACTURER & MODEL	Computer Talk Model 400	Computer Talk Model 407	Computer Talk Model 408	Computervision Corporation CGP-100	Control Data Cyber 18-17
DATA FORMATS					
Word length, bits	16	16	16	16	16 + 1
Fixed-point operand length, bits	8, 16, 32-128	8, 16, 32-128	8, 16, 32-128	16	16
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48	16, 32
MAIN STORAGE					
Storage type	MOS	MOST	MOS	MOS	
Cycle time, microseconds/word	0.5; 0.3	0.5; 0.3	0.5; 0.3	0.7	0.6, 0.9
Access time, microseconds/word	0.3; 0.15	0.3; 0.15	0.3; 0.15	0.4	—
Minimum capacity, words	4K	4K	4K	32K	4K
Maximum capacity, words	512K	512K	512K	512K	64K
Parity checking	Optional	Optional	Optional	Standard	Standard
Error correction	Optional	Optional	Optional	None	No
Storage protection	See comments	See comments	See comments	Optional	Standard
CENTRAL PROCESSOR					
No. of accumulators	12 (4 more opt.)	12 (4 more opt.)	12 (4 more opt.)	4	2
No. of index registers	2	2	2	2	2 (1 in memory)
No. of directly addressable words	32K; 512K	32K; 512K	32K; 512K	32K	256
No. of addressing modes	10	10	10	6	7
Control storage	PROM; 768 words	PROM; 768 words	PROM; 768 words	PROM, 60 x 512 words	No
Add time, microseconds	1	1	1	0.9	1.8
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	Standard	Standard	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	No	Optional
Battery backup	Standard	Standard	Standard	No	Optional
Real-time clock or timer	Standard with date	Standard with date	Standard with date	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1M	1M	1M	0.7M words/sec	1.6M
No. of external interrupt levels	1-256	1-256	1-256	16	2-16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	110K-10M bytes	110K bytes	110K-10M bytes	256K-4M bytes	None
Disk pack/cartridge drives	Both; 1.2M-1 billion bytes	Both; 1.2M-1 billion bytes	Both; 1.2M-1 billion bytes	Pack; 1.2 billion bytes	Cartridge; 4-36M bytes
Drum/Fixed-head disk storage	Moving-head; 2.5M bytes	Moving-head; 2.5M bytes	Moving-head; 2.5M bytes	No	No
Magnetic tape cassettes/cartridges	30-800 cps; 4 KBS	30-800 cps; 4 KBS	100 cps; 50 KBS	No	No
Magnetic tape, ½-inch	5-120 KBS	5-120 KBS	5-120 KBS	30-75 KBS	40 KBS
Punched card input	10-100 cpm	10-1000 cpm	10-1000 cpm	150-1000 cpm	300 cpm
Serial printer	10-200 cps	10-200 cps	10-200 cps	165 cps	No
Line printer	220-600 lpm	300 lpm	300 lpm	340 lpm	300, 600 lpm
Data Communications interface	50-9600; 56K	50-9600; 56K	50-9600; 56K	9600 bps	Up to 9600 bps
CRT	96 char. x 32 lines	96 char. x 32 lines	96 char. x 32 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Digitizers, plotters, factory automation equipment	Digitizers, plotters, factory automation equipment	Digitizers, plotters, factory automation equipment	Graphic displays, plotters, digitizers,	A/D & D/A converters
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler	Assembler & macro assembler
Compilers	BASIC, FORTRAN, APL	BASIC, FORTRAN, APL	BASIC, FORTRAN, APL	FORTRAN, TPL, PEP	FORTRAN, BASIC, AUTRAN
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Multi-sharing, multi-tasking	Batch, real-time
Language implemented in firmware	Partially	Partially	Partially	No	No
Operating system implemented in firmware	Partially	Partially	Partially	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$24,950 (4K MOS)	$31,500 (4K MOS)	$30,500 (4K MOS)	Contact manufacturer	$11,160
Price of memory increment	$1,100 (4K)	$1,100 (4K)	$1,100 (4K)	Contact manufacturer	$2,360 (8KB)
Date of first delivery	May 1975	January 1978	January 1978	November 1977	July 1973
Number installed to date	NA	NA	NA	100+	NA
COMMENTS	Storage protection std. by memory partition and opt. by page; mapping to 512K opt.; 4K PROM opt.; on low power, memory is stored on disk; price includes CRT, light pen, modem, 1.2M-byte disk, arith. & I/O processors, & battery pack operation	Expanded Model 400 with additional features: disk expanded to 2.5M bytes, 300-lpm x 132 printer and mini-floppy disk for I/O	Expanded Model 400 with additional features: disk expanded to 2.5M bytes, 300-lpm x 132 printer and mini-cassette for I/O	Extensive 3-D interactive CAD/CAM design application software; 24-slot high-resolution chassis; micro-diagnostic and bootstrap diagnostic facilities; 100-amp power supply; desk console	

All About Minicomputers

MANUFACTURER & MODEL	Control Data Cyber 18 Series	Data General Eclipse C/330	Data General Eclipse C/350	Data General Eclipse M/600	Data General Eclipse S/130
DATA FORMATS					
Word length, bits	16 + 5 or + 1	16 + 5	16 + 5	16 + 5	16 + 5
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16, 32	16, 32	16, 32	16, 32	16, 32
MAIN STORAGE					
Storage type	MOS	Core, MOS	Core, MOS	Core, MOS	Core, MOS
Cycle time, microseconds/word	0.75	0.8, 0.7	0.8, 0.7	0.8	0.8, 0.5-0.7
Access time, microseconds/word	0.3	0.4, 0.5	0.5	0.5	0.4
Minimum capacity, words	16K	16K	32K	32K	16K
Maximum capacity, words	128K	256K	512K	512K	128K
Parity checking	Standard	No	No	No	No
Error correction	Optional	Optional	Standard	Standard	Standard
Storage protection	Standard	Optional	Standard	Standard	Optional
CENTRAL PROCESSOR					
No. of accumulators	6	4	4	4	4 + 4
No. of index registers	6	2	2	2	2 + 1,6
No. of directly addressable words	64K	32K	32K	32K	64K
No. of addressing modes	8	7	7	7	7
Control storage	ROM/RAM; 8K instructions	ROM: 2K x 56 bits	ROM; 2K x 56 bits	ROM; 2K x 56 bits	PROM/RAM; 4 x 56 bits
Add time, microseconds	1.76	0.6	0.6	0.6	0.6
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	Standard	Standard	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Optional
Battery backup	Optional	No	No	No	Optional
Real-time clock or timer	Standard	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1.2M	1.25M	1.25M/5.0M	1.25M/5.0M	1.25M
No. of external interrupt levels	2-16	16	16	16	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	560K bytes	315K-2.5M bytes	315K-2.5M bytes	315K-2.5M bytes	315K-2.5M bytes
Disk pack/cartridge drives	Pack/cartridge; 4-400M bytes	Pack & cartridge; 10-1520M bytes	Pack & cartridge; 10-1520M bytes	Pack & cartridge; 10-6080M bytes	Pack & cartridge; 10-1520M bytes
Drum/Fixed-head disk storage	No	Fixed-head; 1-16M bytes	Fixed-head; 1-16M bytes	Fixed-head; 1-16M bytes	Fixed-head; 1-16M bytes
Magnetic tape cassettes/cartridges	No	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 1.6 KBS
Magnetic tape, ½-inch	80 KBS	10-72 KBS	10-72 KBS	10-72 KBS	10-72 KBS
Punched card input	300, 600 cpm	150-1000 cpm	150-1000 cpm	150-1000 cpm	150-1000 cpm
Serial printer	70 lpm	10-165 cps	10-165 cps	10-165 cps	10-165 cps
Line printer	300, 600 lpm	240-600 lpm	240-900 lpm	240-900 lpm	240-600 lpm
Data Communications interface	Up to 9600 bps	56,000 bps	56,000 bps max.	56,000 bps max.	56,000 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	None	Modular digital & analog data control & acquisition sub-system optional	Modular digital & analog data control & acquisition sub-system optional	Modular digital & analog data control & acquisition sub-system optional	Modular digital & analog data control & acquisition sub-system optional
SOFTWARE					
Assembler	Macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	FORTRAN, BASIC, RPG, COBOL	FORTRAN, BASIC, BASIC, ALGOL	COBOL, IDEA, FORTRAN, PL/1, DG/L, ALGOL	COBOL, IDEA, FORTRAN, PL/1, DG/L	FORTRAN, BASIC, ALGOL
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$15,300	$30,000 (32K core)	$53,500 (32K MOS)	$80,000 (128K)	$9,200 (8K core)
Price of memory increment	$3,000 (16KW)	$4,500 (16K core); $8,500 (32K MOS)	$6,000 (32K MOS); $8,500 (32K MOS)	$6,000 (32K MOS); $4,500 (16K core)	$4,500 (16K core); $8,500 (32K MOS)
Date of first delivery	May 1976	October 1976	NA	April 1978	February 1975
Number installed to date	NA	1000+ (all models)	NA	14	1000+ (all models)
COMMENTS		Extended arithmetic processor standard; extended memory allocation and protection unit optional; error correction std. on MOS, opt. on core; IDEA software	Includes COBOL ANSI '74, highest Level 2 implementation; 128KB ERCC-MOS, $10,000; 256KB ERCC MOS, $18,000; std. features include extended floating-point functions, plus a commercial instruction set	Includes COBOL ANSI '74, highest Level 2 implementation; I/O processor with 64 KB for handling low-speed character-oriented data movement	256 56-bit words of writable control store optionally available

All About Minicomputers

MANUFACTURER & MODEL	Data General Eclipse S/230	Data General Eclipse S/250	Data General Nova 3/4	Data General Nova 3/12, 3-D	Datapoint 1100
DATA FORMATS					
Word length, bits	16 + 5	16 + 5	16 + 1	16 + 1	8-bit byte
Fixed-point operand length, bits	16	16	16	16	8
Instruction length, bits	16, 32	16, 32	16	16	8-24
MAIN STORAGE					
Storage type	Core, MOS	Core, MOS	Core, MOS	Core, MOS	MOS
Cycle time, microseconds/word	0.8, 0.7	0.8, 0.7	0.7	0.7	1.6
Access time, microseconds/word	0.4, 0.5	0.5	0.35	0.35	0.6
Minimum capacity, words	16K	32K	4K	4K	4K bytes
Maximum capacity, words	256K	512K	32K	32K	16K bytes
Parity checking	No	No	Optional	Optional	No
Error correction	Optional	Standard	No	No	No
Storage protection	Optional	Standard	No	No; see comments	No
CENTRAL PROCESSOR					
No. of accumulators	4	4	4	4	2
No. of index registers	2	2	2	2	12
No. of directly addressable words	32K	32K	256	256	16K bytes
No. of addressing modes	7	7	6	6	2
Control storage	ROM; 256 x 56 bits	ROM, 1.5K; RAM, 1K; PROM, 2K	No	No	No
Add time, microseconds	0.6	0.6	0.7	0.7	4.8
Hardware multiply/divide	Standard	Standard	Optional	Optional	No
Hardware floating point	Optional	Optional	No	Optional	No
Hardware byte manipulation	Standard	Standard	No	No	Standard
Battery backup	No	No	Optional	Optional	No
Real-time clock or timer	Optional	Standard	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	No
Maximum I/O rate, words/sec.	1.25M	1.25M/5.0M	1.10M	1.10M	195K
No. of external interrupt levels	16	16	16	16	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	315K-2.5M bytes	315K-2.5M bytes	315K-1.25M bytes	315K-2.5M bytes	256K-1M bytes
Disk pack/cartridge drives	Pack & cartridge, 10-1520M bytes	Pack & cartridge; 10-1520M bytes	Cartridge; 2.5-10M bytes	Pack & cartridge; 2.5-736M bytes	No
Drum/Fixed-head disk storage	Fixed-head; 1-16M bytes	Fixed-head; 1-16M bytes	Fixed-head; 256K-1M bytes	Fixed-head; 256K-2M bytes	No
Magnetic tape cassettes/cartridges	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 352 cps
Magnetic tape, ½-inch	10-72 KBS	10-72 KBS	10-72 KBS	10-72 KBS	9.6-20 KBS
Punched card input	150-1000 cpm	150-1000 cpm	150-1000 cpm	150-1000 cpm	300 cpm
Serial printer	10-165 cps	10-165 cps	10-165 cps	10-165 cps	120 cps
Line printer	240-600 lpm	240-900 lpm	240-600 lpm	240-600 lpm	300, 600 lpm
Data Communications interface	56,000 bps	56,000 bps max.	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 12 lines
Other standard peripheral units	Modular digital & analog data control & acquisition sub-system optional	Modular digital & analog data control & acquisition sub-system optional	Modular digital & analog data control & acquisition sub-system optional	Modular digital & analog data control & acquisition sub-system optional	—
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Yes
Compilers	FORTRAN BASIC, ALGOL	FORTRAN, ALGOL, PL/1, DG/L	FORTRAN, BASIC, ALGOL	FORTRAN, BASIC, ALOGL	BASIC, RPG II, SCRIBE, DATA-BUS, DATAFORM BATCH
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Real-time	Batch, real-time, time-sharing	
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$15,000 (16K core)	$34,500 (64K core)	$2,600 (4K MOS)	$3,600 (4K MOS)	$6,400 (4K bytes)
Price of memory increment	$4,500 (16K core); $8,500 (32K MOS)	$6,000 (32K MOS); $4,500 (16K core)	—	—	$434 (4K bytes)
Date of first delivery	November 1976	NA	April 1976	April 1976	January 1974
Number installed to date	1000+ (all models)	NA	NA	NA	6000
COMMENTS	256 56-bit words of writable control store, extended memory allocation and protection unit optionally available; error correction std. on MOS, opt. on core	Optional extended floating-point functions; optional Integral Array Processor; optional character instruction set; optional written and fixed control store	4-slot chassis; auto program load and power monitor/auto restart opt.	12-slot chassis; memory management unit standard; memory allocation and protection unit standard on 3-D	System price also includes integral CRT/keyboard and dual cassette tape drives; diskette-based system also available with 16K bytes of memory for $12,880; the 1150 is an augmented 1100 with a 5500 instruction set for $14,480

All About Minicomputers

MANUFACTURER & MODEL	Datapoint 1150	Datapoint 1170	Datapoint 1500	Datapoint 1800	Datapoint 2200
DATA FORMATS					
Word length, bits	8-bit byte	8-bit byte	8-bit byte	8-bit byte	8-bit byte
Fixed-point operand length, bits	8	8	8	8	8
Instruction length, bits	8-24	8-24	8-24	8-24	8-24
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.8	0.8	0.65	0.63	1.6
Access time, microseconds/word	0.3	0.3	0.3	NA	0.6
Minimum capacity, words	24K bytes	48K bytes	32K bytes	60K bytes	4K bytes
Maximum capacity, words	24K bytes	48K bytes	32K bytes	60K bytes	16K bytes
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	Standard	Standard	Standard	Standard	No
Storage protection	Standard	Standard	No	Standard	No
CENTRAL PROCESSOR					
No. of accumulators	2	2	2	Instruction-dependent	2
No. of index registers	16	16	16	16	12
No. of directly addressable words	24K bytes	48K bytes	32K bytes	60K	16K bytes
No. of addressing modes	2	2	2	2	2
Control storage	ROM; 4K bytes	ROM; 4K bytes	ROM; 4K bytes	ROM, 4K bytes (sys.); RAM,60K bytes (user)	No
Add time, microseconds	1.4	1.4	1.8	3.8	4.8
Hardware multiply/divide	No	No	No	No	No
Hardware floating point	No	No	No	NA	No
Hardware byte manipulation	No	Standard	—	Standard	Standard
Battery backup	No	No	No	No; auto restart	No
Real-time clock or timer	No	No	No	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	No	No	No	Standard	No
Maximum I/O rate, words/sec.	114K	114K	250K	Instruction-dependent	195K
No. of external interrupt levels	—	—	—	4	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	512K-1M bytes	512K-1M bytes	512K	1MB (dual-density)	256K-1M bytes
Disk pack/cartridge drives	No	No	No	No	Pack & cartridge; 2.4-50M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	Cassette; 352 cps
Magnetic tape, ½-inch	9.6-20 KBS	9.6-20 KBS	No	560-1600 bpi; 7&9 trk	9.6-20 KBS
Punched card input	300 cpm	300 cpm	No	Yes	300 cpm
Serial printer	80-160 cps	80-160 cps	80-160 cps	80, 160 cps	120 cps
Line printer	300, 600 lpm	300, 600 lpm	No	300, 600, 900 lpm	300, 600 lpm
Data Communications interface	Up to 9600 bps	Up to 9600 bps	Up to 4800 bps	Up to 9600 bps	Up to 9600 bps
CRT	80 char. x 12 lines	80 char. x 12 lines	80 char. x 24 lines	1920 char.; 50 or 60	80 char. x 12 lines
Other standard peripheral units	—	—	—	Single-density disk storage, serial printers, belt printers	—
SOFTWARE					
Assembler	Yes	Yes	No	Macro assembler	Yes
Compilers	DATABUS, MULTI-FORM, BASIC, RPG II	BASIC, DATA-SHARE, DATABUS, MULTIFORM, RPG II	DATABUS, DATAFORM	COBOL, BASIC, RPG II, DATABUS, DATA-SHARE	BASIC, RPG II, SCRIBE, DATA-BUS, DATAFORM
Operating system	BATCH	Batch, time-sharing	Batch, stand-alone	Batch, interactive, real-time	Batch, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	Partially	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$14,480 (24K bytes)	$15,980 (48K bytes)	$5,950 (32K bytes)	$12,500	$8,571 (4K bytes)
Price of memory increment	—	—	—	$4,100 (1M-char. diskette modules)	$1,432 (4K bytes); $1,647 (8K bytes)
Date of first delivery	August 1976	July 1977	October 1977	August 1978	April 1972
Number installed to date	NA	NA	NA	NA	9000
COMMENTS	1152 system with 24K memory and two diskette drives	1172 system with 48K memory and two diskette drives	All user instructions are in high-level language	One, two, and three-year leases also available, at $433, $391, and $377 per month, respectively; $125 monthly maintenance charge	System price also includes integral CRT/keyboard and dual cassette tape drives

All About Minicomputers

MANUFACTURER & MODEL	Datapoint 5500	Datapoint 6600	Dataram BCM-1	Datasaab Systems 5020	Datasaab Systems 5051 & 5052
DATA FORMATS					
Word length, bits	8-bit byte	8-bit byte	16	16 + 2	16
Fixed-point operand length, bits	8	8	16	8, 16	1-255 digits
Instruction length, bits	8-24	8-24	16, 32, 48	16	16-128
MAIN STORAGE					
Storage type	MOS	MOS	Core, MOS	Core	Core
Cycle time, microseconds/word	0.8	0.6	1.2	1.2	0.98; 1.2
Access time, microseconds/word	0.3	0.2	1.2	—	—
Minimum capacity, words	48K bytes	120K bytes	8K	4K	4K; 8K
Maximum capacity, words	48K bytes	120K bytes	32K	32K	32K
Parity checking	Standard	Standard	No	Standard	No
Error correction	No	Standard	No	No	No
Storage protection	Standard	Standard	No	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	2	2	6	8	7
No. of index registers	16	16	6	3	7
No. of directly addressable words	48K bytes	120K bytes	32K	256	32K
No. of addressing modes	2	2	8	3	8
Control storage	ROM; 4K bytes	ROM; 4K bytes	ROM, 1K; PROM, 1K	—	—
Add time, microseconds	1.4	1.15	3.5	7.2	3.2
Hardware multiply/divide	No	Standard	Optional	No	Standard
Hardware floating point	No	No	Optional	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Optional	No	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	No	No	Standard	Optional	Standard
Maximum I/O rate, words/sec.	114K	125K	833K	—	1M
No. of external interrupt levels	—	—	Variable	—	5
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256-1M bytes	No	No	256K-1M bytes	No
Disk pack/cartridge drives	Pack & cartridge; 2.4-200M bytes	Pack & cartridge; 2.5-200M bytes	No	No	Cartridge; 5-40M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette, 352 cps	Cassette, 352 cps	No	Cassette; 756 cps	Cassette; 756 cps
Magnetic tape, ½-inch	9.6-20 KBS	9.6-20KBS	No	No	10 KBS
Punched card input	300 cpm	300 cpm	No	No	No
Serial printer	120 cps	80-160 cps	No	15-330 cps	15-330 cps
Line printer	300, 600 lpm	300, 600 lpm	No	200 lpm	200 lpm
Data Communications interface	Up to 9600 bps	Up to 9600 bps	No	To 9600 bps	To 9600 bps
CRT	80 char. x 12 lines	80 char. x 12 lines	No	40 char. x 12 lines	64 char. x 16 lines
Other standard peripheral units	—	—	1-megabyte bulk core storage is standard	Paper tape reader, paper tape punch	Paper tape reader, paper tape punch, RS-232C interface
SOFTWARE					
Assembler	Yes	Yes	Assembler, macro-assembler	Yes	No
Compilers	BASIC, RPG II, SCRIBE, DATA-BUS, DATAFORM	BASIC, RPG II, COB., DATASH, DATABUS, DATAFORM, SCRIBE	NA	DIL-5	Logic-3/MALL
Operating system	Batch, time-sharing	Batch, time-sharing	Batch, real-time	Time-sharing	Time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$26,271 (48K bytes)	Only	$9,800 (64 KB memory + 256KB bulk core	—	$45,000 (8K words)
Price of memory increment	CPU cannot be expanded	$31,685	$840 (32KB)	—	$2,000 (8K words)
Date of first delivery	December 1974	July 1977	November 1978	1971	NA
Number installed to date	500	NA	NA	4000	NA
COMMENTS	System price also includes integral CRT/keyboard and dual cassette tape drives	System price also includes integral CRT/keyboard, dual cassette tape drives, multipoint communications adapter, and software; a batch processing system with no comm. adapter costs $32,500	BCM-1 is a packaged system containing DEC LSI-11 and Dataram Bulk Core as high-speed peripheral storage; has provisions for up to 10 slots for DEC-compatible quad-size peripheral controllers	Basis for Datasaab D5/20 business minicomputer system; terminal oriented system for data collection and on-line data entry; intelligent terminals can process data locally	Basis for Datasaab D15 business mini-computer system; interpreter-based system for up to 16 simultaneous users; system price also includes 10-megabyte disk drive, CRT workstation, and serial printer

All About Minicomputers

MANUFACTURER & MODEL	Decision Data System/4	Diablo 3200	Digital Equipment PDP-8/A	Digital Equipment PDP-11/03	Digital Equipment PDP-11/04
DATA FORMATS					
Word length, bits	8-bit bytes	8 + parity	12	16	16 + 2
Fixed-point operand length, bits	8	8, 16	12	16	16
Instruction length, bits	16-32	8 to 24	12	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	MOS	MOS	Core; MOS	Core; MOS	Core; MOS
Cycle time, microseconds/word	1	0.488	1.2; 1.5; 2.4	1.2; 1.2	0.98; 0.725
Access time, microseconds/word	0.5	0.3	0.6; 0.75; 2.4	—	0.51; 0.635
Minimum capacity, words	48K bytes	20K	1K	4K	16K
Maximum capacity, words	64K bytes	64K	128K	32K	32K
Parity checking	Standard	Standard	No	No	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	6	7	1	6	6
No. of index registers	6	None	8 per 4K (in mem.)	6	6
No. of directly addressable words	64K	64K	256	32K	32K
No. of addressing modes	3	4	4	8	8
Control storage	ROM; 2K	No	—	ROM; PROM; 1K	—
Add time, microseconds	—	23.9 (6 digits)	3.0-3.8	3.5	3.17
Hardware multiply/divide	Standard	No	Optional	Optional	Optional
Hardware floating point	No	No	Optional	Optional	Optional
Hardware byte manipulation	Standard	Standard	No	Standard	Standard
Battery backup	No	No	Optional	No	Optional
Real-time clock or timer	Standard	No	Optional	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	400K	1M	526-667K	833K	2M
No. of external interrupt levels	8	8	1-64	Variable	Variable
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	1-3M bytes	1-2M bytes	128-2M (6-bit)	256-512K bytes	256-512K bytes
Disk pack/cartridge drives	Cartridge; 10-40M bytes	Cartridge over fixed; 10-20M bytes	Cartridge; 3.2-12.8M (6-bit)	No	Cartridge & pack; 2.5-1408M bytes
Drum/Fixed-head disk storage	No	None	No	No	Fixed-head. 512K-8M bytes
Magnetic tape cassettes/cartridges	No	None	Cassette; 562 cps	No	Cassette; 562 cps
Magnetic tape, ½-inch	No	None	10-36 KBS	No	10-72 KBS
Punched card input	300-1200 cpm	None	300 cpm	No	285-1200 cpm
Serial printer	120 cps	45 cps/200 cps	180 cps	180 cps	30-180 cps
Line printer	600 lpm	None	230 lpm	No	230-1200 lpm
Data Communications interface	Up to 9600 bps	Programmable	110-71K bps	50-56,000 bps	50-56,000 bps
CRT	80 char. x 24 lines	Multiple, 1920 char.	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	None	None	DECtape, 8325 words/sec; A/D converter, paper tape reader, paper tape punch	Serial line and parallel line controllers	DECtape, 8325 words/sec.; paper tape reader; paper tape punch
SOFTWARE					
Assembler	No	Global assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	RPG	DACL (English-like compiler)	BASIC, DIBOL ALGOL, FOCAL	BASIC, FORTRAN	BASIC, FORTRAN, FOCAL
Operating system	Batch, interactive	Batch, interactive, time-sharing	Batch, real-time, time-sharing	Batch, real-time	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	Partially	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$22,615	$19,500 (20K bytes)	$1,835-$8,295	$1,995	$3,995 (16K MOS);
Price of memory increment	$935 (16K bytes)	Various	$2,850 (8K core); $1,230 (4K MOS)	$990 (8K core); $625 (8K MOS)	$2,280 (16K core); $1,700 (16K MOS)
Date of first delivery	July 1975	December 1976	December 1974	NA	NA
Number installed to date	15	500	Over 30,000	NA	NA
COMMENTS		Sold exclusively in U.S. through Shasta General Systems with word processing software and application systems; contact Shasta at 895 Stanton Rd., Burlingame, CA, 94010; (415) 692-0722	Also available in packaged version called Datasystem 310	Packaged version of LSI-11 microcomputer; instruction set equivalent to PDP-11/40	Successor to PDP-11/05 and 11/10; upgradable to PDP-11/34 status

All About Minicomputers

MANUFACTURER & MODEL	Digital Equipment PDP-11/34A	Digital Equipment PDP-11/35 & 11/40	Digital Equipment PDP-11/45	Digital Equipment PDP-11/55	Digital Equipment PDP-11/60
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16 + 2	16 + 2	16 + 2
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	Core; MOS	Core	Core; MOS; bipolar	Core; bipolar	Core; MOS
Cycle time, microseconds/word	0.98; 0.725	0.98	0.98; 0.50; 0.30	0.98; 0.30	0.98
Access time, microseconds/word	0.51; 0.635	0.36	—	—	—
Minimum capacity, words	16K	8K	32K	16K	32K
Maximum capacity, words	124K	124K	124K	124K	256K
Parity checking	Standard	Optional	Standard	Standard	Standard
Error correction	No	No	No	No	Standard (MOS)
Storage protection	Standard	Optional	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	6	6	12	12	8
No. of index registers	6	6	12	12	8
No. of directly addressable words	32K	32K	32K	32K	32K
No. of addressing modes	8	8	8	8	8
Control storage	—	No	—	—	RAM; 1K words
Add time, microseconds	2.03	1.07	0.30-0.97	0.30-0.97	2.2
Hardware multiply/divide	Optional	Optional	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Optional	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	No	No	No	No
Real-time clock or timer	Standard	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	—	2M	2M (core); 4M (bi.)	2M (core); 4M (bi.)	—
No. of external interrupt levels	Variable	Variable	Variable	Variable	Variable
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256-512K bytes	256-512K bytes	256-512K bytes	256-512K bytes	256-512K bytes
Disk pack/cartridge drives	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes
Drum/Fixed-head disk storage	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes
Magnetic tape cassettes/cartridges	Cassette; 562 cps	Cassette; 562 cps	Cassette; 562 cps	Cassette; 562 cps	Cassette; 562 cps
Magnetic tape, ½-inch	10-72 KBS	10-72 KBS	10-72 KBS	10-72 KBS	10-72 KBS
Punched card input	285-1200 cpm	285-1200 cpm	285-1200 cpm	285-1200 cpm	285-1200 cps
Serial printer	30-180 cps	30-180 cps	30-180 cps	30-180 cps	30-180 cps
Line printer	230-1200 lpm	230-1200 lpm	280-1200 lpm	230-1200 lpm	230-1200 lpm
Data Communications interface	50-56,000 bps	50-56,000 bps	50-56,000 bps	50-56,000 bps	50-56,000 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	DECtape, 8325 words/sec.; paper tape reader, paper tape punch	DECtape, 8325 words/sec.; paper tape reader, paper tape punch	DECtape, 8325 words/sec.; paper tape reader, paper tape punch	DECtape, 8325 words/sec.; paper tape reader, paper tape punch	DECtape, 8325 words/sec.; paper tape reader, paper tape punch
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	BASIC, FORTRAN, COBOL, FOCAL	BASIC, FORTRAN, COBOL, FOCAL	BASIC, FORTRAN; COBOL, FOCAL	BASIC, FORTRAN, COBOL, FOCAL	BASIC, FORTRAN, COBOL
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Real-time, interactive, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$9,050 (32K MOS); $10,030 (32K core)	$19,800	$41,800 (64K core)	$44,100 (64K core)	$35,700 (32K core)
Price of memory increment	$1,700 (16K MOS); $2,280 (16K core)	$2,200 (32K core)	$2,200 (32K core)	$2,200 (32K core)	$6,650 (64K core); $4,500 (64K MOS)
Date of first delivery	NA	NA	NA	NA	June 1977
Number installed to date	NA	NA	NA	NA	—
COMMENTS	Uses similar technology to PDP-11/04; includes memory management for greater addressing capability; packaged version called Datasystem 530 is also available	PDP-11/35 is an OEM version of the PDP-11/40; packaged version is called Datasystem 350, based on PDP-11/40	PDP-11/45 features two internal Unibuses, one normal-speed and one high-speed	PDP-11/55 is based on a PDP-11/45 with core and bipolar memory; designed for applications requiring high-speed calculations	Includes user-accessible microprogramming; error-correcting memory

All About Minicomputers

MANUFACTURER & MODEL	Digital Equipment PDP-11/70	Digital Group, Inc. "Systems"	Digital Group, Inc. "Bytemaster"	Digital Scientific 4030/40	Digital Scientific 5010
DATA FORMATS					
Word length, bits	16 + 2	8-bit byte	8-bit byte	16 + 2	16 + 2
Fixed-point operand length, bits	16	8, 16	8, 16	16-32	16-32
Instruction length, bits	16, 32, 48	8, 16, 24, 32	8, 16, 24, 32	16-32	16-32
MAIN STORAGE					
Storage type	Core	MOS	MOS	Core	MOS
Cycle time, microseconds/word	0.98	2.5	2.5	4	0.5
Access time, microseconds/word	0.36	1.0	1.0	0.5	0.3
Minimum capacity, words	64K	10K bytes	18K bytes	8K	4K
Maximum capacity, words	1024K	64K bytes	64K bytes	128K	32K
Parity checking	Standard	No	No	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	Standard	No	No	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	12	16	16	Up to 28	1 + 1
No. of index registers	12	3	3	3	3
No. of directly addressable words	32K	64K	64K	64K	16K
No. of addressing modes	8	11	11	4	4
Control storage	—	Boot only	Boot only	ROM; 4K words	PROM
Add time, microseconds	0.30-1.20	NA	NA	2.9	1.44
Hardware multiply/divide	Standard	No	No	Standard	Standard
Hardware floating point	Optional	No	No	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	No	No
Battery backup	No	No	No	No	No
Real-time clock or timer	Standard	Optional	Optional	Standard	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	2.9M	NA	NA	1M	2M
No. of external interrupt levels	Variable	0-8	0-8	16	6
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256-512K bytes	256K-1M bytes	90K-1M bytes	No	No
Disk pack/cartridge drives	Cartridge & pack; 2.5-1408M bytes	No	No	Pack, cartridge; 1-160M bytes	Cartridge; 1-5M bytes
Drum/Fixed-head disk storage	Fixed-head; 512K-8M bytes	No	No	Fixed-head; 1-2M bytes	No
Magnetic tape cassettes/cartridges	Cassette; 562 cps	Cassette	Cassette	No	No
Magnetic tape, ½-inch	10-72 KBS	No	No	30, 60 KBS	Optional
Punched card input	285-1200 cpm	No	No	60,100 cpm	600, 1000 cpm
Serial printer	30-180 cps	60-200 cps	60-200 cps	180 cps	180 cps
Line printer	230-1200 lpm	300 lpm	300 lpm	300 to 1000 lpm	300, 600 lpm
Data Communications interface	50-56,000 bps	100-9600 bps	100-9600 bps	Up to 19,200 bps	Up to 19,200 bps
CRT	80 char. x 24 lines	64 x 16 or 96 x 24	64 x 16 or 96 x 24	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	DECtape, 8325 words/sec.; paper tape reader, paper tape punch	Speech synthesizers, ham radio interfaces, real-world controllers	Speech, synthesizers, ham radio interfaces, graphics (video)	Paper tape reader/punch, XY plotter, digital/analog I/O	—
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	BASIC, FORTRAN, COBOL, FOCAL	BASIC, APL	BASIC, APL	COBOL, RPG II, FORTRAN, BASIC, APL	RPG II, FORTRAN, BASIC
Operating system	Real-time, interactive, time-sharing	Batch	Batch	Real-time, time-sharing	Batch
Language implemented in firmware	No	No	No	Partially	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$63,000 (128K core)	$1,995	$2,495	$33,850 (4030); $42,285 (4040)	$18,000
Price of memory increment	$18,590 (128K core)	$695 (32K bytes)	$695 (32K bytes)	$4,000 (8K bytes) core	$1,000 (4K by.) MOS
Date of first delivery	NA	November 1976	June 1978	1970	NA
Number installed to date	NA	3,500	100	240+ (both models)	NA
COMMENTS	Uses same technology as PDP-11-45 and includes 2048 bytes of cache memory for increased performance; disk storage & mag tape periphs. avail. in packaged system called Datasystem 570		Fully integrated desk-top system	Real-time, process-control monitoring and time-sharing/multi-programming operating systems; IBM 1130 and 1800 compatible; user microprogrammable	Intelligent RJE or local batch for applications requiring high-speed calculations; expandable to Model 5020

All About Minicomputers

MANUFACTURER & MODEL	Digital Scientific 5020	Digital Scientific 5030	Digital Systems Galaxy/5 Model 130	Digital Systems Galaxy/5 Model 140	Digital Systems Galaxy/5 Model 150
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	8 to 20	8 to 20	8 to 20
Fixed-point operand length, bits	16-32	16-32	8 to 2048	8 to 2048	8 to 2048
Instruction length, bits	16-32	16-32	16, 32, 48	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	Core, MOS	Core, MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.9, 0.5	0.9, 0.5	0.50	0.50	0.50
Access time, microseconds/word	0.5, 0.3	0.5, 0.3	0.50	0.50	0.50
Minimum capacity, words	8K	64K	64K bytes	128K bytes	128K bytes
Maximum capacity, words	64K	1M	128K bytes	256K bytes	256K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	Standard	Standard	Standard
Storage protection	Standard	Standard	Optional	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	1 + 1	1 + 1	7 to 14	14-21	21-28
No. of index registers	3	3	7 to 14	14-21	21-28
No. of directly addressable words	32K	64K	128K	256K	512K
No. of addressing modes	4	4	1	1	1
Control storage	PROM	PROM	PROM; 512 x 40 bits	PROM; 1024 x 40 bits	PROM; 1024 x 40 bits
Add time, microseconds	1.44	1.44	0.30	0.30	0.30
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	Optional	No	No	No
Hardware byte manipulation	No	No	Standard	Standard	Standard
Battery backup	No	Optional	Optional	Optional	Optional
Real-time clock or timer	Optional	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1M-2M	1M-2M	280K	200K	200K
No. of external interrupt levels	6	6	15	30	30
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	Optional	Optional	Optional
Disk pack/cartridge drives	Pack, cartridge; 1.24M bytes	Pack, cartridge; 1M-600M bytes	Pack, cartridge	Pack, cartridge	Pack, cartridge
Drum/Fixed-head disk storage	1M-2M bytes; fixed-head/track	Fixed-head/track; 1-2M bytes	No	No	No
Magnetic tape cassettes/cartridges	No	No	Optional	Optional	Optional
Magnetic tape, ½-inch	Optional	30, 60 KBS	1600 bpi	1600 bpi	1600 bpi
Punched card input	600, 1000 cpm	600, 1000 cpm	Optional	Optional	Optional
Serial printer	180 cps	180 cps	120 cps	120 cps	120 cps
Line printer	300, 600 lpm	300, 600 lpm	200 to 900 lpm	200-900 lpm	200-900 lpm
Data Communications interface	Up to 19,300 bps	Up to 19,200 bps	110-9600 bps	110-9600 bps	110-9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape reader/punch; XY plotter	Paper tape reader/punch; XY plotter	15-port asynchronous multiplexer, 360/370 interface	15-port asynchronous multiplexer, 360/370 interface	15-port asynchronous multiplexer, 360/370 interface
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Yes	Yes	Yes
Compilers	COBOL, RPG II, FORTRAN, BASIC	COBOL, RPG II, FORTRAN, BASIC, APL	RPG II, BASIC/5, PL/G	RPG II, BASIC/5, PL/G	RPG II, BASIC/5, PL/G
Operating system	Batch, time-sharing	Batch, time-sharing	Time-sharing	Time-sharing	Time-sharing
Language implemented in firmware	No	Partially	Partially	Partially	Partially
Operating system implemented in firmware	No	No	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$24,500	$39,600	$34,700	$55,400	$82,900
Price of memory increment	$1,800 (8KB MOS); $2,100 (8KB core)	$1,800 (8KB MOS); $2,100 (8KB core)	$4,500 (32K bytes)	$4,500 (32K bytes)	$4,500 (32K bytes)
Date of first delivery	NA	NA	August 1976	NA	NA
Number installed to date	NA	NA	30 (all models)	NA	NA
COMMENTS	Up to 8 concurrent users in a mixed conversational and batch mode; IBM 1130-compatible, in a time-sharing environment; expandable to Model 5030	Up to 32 concurrent users in a mixed conversational and batch mode; IBM 1130-compatible plus the ability to perform multiprogramming in a time-sharing environment	In-cabinet, on-site upgrades available on all configurations; Galaxy/5 is a multiple microprocessor system; DMA channel and communications interface are both microprocessor-based	Has two CPU's and two DMA channels; each DMA supports 15 high-speed devices	Has three CPU's and three DMA channels; all CPU's execute independent instruction streams

All About Minicomputers

MANUFACTURER & MODEL	Digital Systems Galaxy/5 Model 170	Durango Systems, Inc. F-85	Financial Computer System III/6	Financial Computer System III/10	Four Phase IV/40
DATA FORMATS					
Word length, bits	8 to 20	8-bit byte	8-bit byte	8-bit byte	24
Fixed-point operand length, bits	8 to 2048	8	8	8	15
Instruction length, bits	16, 32, 48	8, 16, 24	8	8	24
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.50	0.50	0.6	0.6	2
Access time, microseconds/word	0.50	0.25	0.2	0.2	—
Minimum capacity, words	128K bytes	32K bytes	4K bytes	4K bytes	24K bytes
Maximum capacity, words	256K bytes	64K bytes	256K bytes	256K bytes	96K bytes
Parity checking	Standard	Standard	Optional	Optional	Standard
Error correction	Standard	No	Optional	Optional	No
Storage protection	Optional	No	Optional	Optional	No
CENTRAL PROCESSOR					
No. of accumulators	28	1	Software-assigned	Software-assigned	2
No. of index registers	28	0	128	128	3
No. of directly addressable words	1M	64K bytes	64K bytes	64K bytes	98,304 bytes
No. of addressing modes	1	3	3	3	3
Control storage	PROM; 1024 x 40 bits	EROM; 2-8K	PROM, 1-16K bytes	PROM, 1-16K bytes	ROM; 1K x 48 bits
Add time, microseconds	0.30	1.33	3.2	3.2	16
Hardware multiply/divide	Standard	No	Optional	Optional	Standard
Hardware floating point	No	No	Optional	Optional	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	Optional	Optional	—
Real-time clock or timer	Standard	Standard	Optional	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	No
Maximum I/O rate, words/sec.	200K	750K	960K	960K	125K
No. of external interrupt levels	30	8	16	16	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Optional	473K-1890K bytes	266K-2M bytes	266K-5M bytes	354K bytes
Disk pack/cartridge drives	Pack, cartridge	Cartridge; 10-20M bytes	Cartridge; 10-400M bytes	Cartridge; 10-400M bytes	Cartridge; 2.5-10M bytes
Drum/Fixed-head disk storage	No	No	No	No	10-20M bytes
Magnetic tape cassettes/cartridges	Optional	No	Cassette; 1.2 KBS	Cassette; 1.2 KBS	No
Magnetic tape, ½-inch	1600 bpi	No	72 KBS	72 KBS	No
Punched card input	Optional	No	300, 600 lpm	300, 600 cpm	300, 600 cpm
Serial printer	120 cps	165 cps	30 cps	165 cps	30 cps
Line printer	200-900 lpm	No	300-1250 lpm	300-1250 lpm	245-1800 lpm
Data Communications interface	110-9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	15 port asynchronous multiplexer 360/370 interface	—	Paper tape reader, paper tape punch	Paper tape reader, paper tape punch	None
SOFTWARE					
Assembler	Yes	No	Yes	Yes	Yes
Compilers	RPG II, BASIC/5, PL/G	BASIC	BASIC, CPL, PL/X	BASIC, CPL, PL/X	None
Operating system	Time-sharing	Batch, real-time, multiprogramming	Batch, real-time	Batch, real-time	Batch, interactive
Language implemented in firmware	Partially	No	No	No	Partially
Operating system implemented in firmware	Partially	No	Partially	Partially	—
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$186,800	$12,983 (48K bytes)	$17,950 (32K bytes)	$29,950 (32K bytes)	$37,440 (24K bytes)
Price of memory increment	$4,500 (32K bytes)	$1,030 (16K bytes)	$1,600 (16K bytes); $3,000 (32K bytes)	$1,600 (16K bytes); $3,000 (32K bytes)	—
Date of first delivery	NA	January 1979	January 1975	January 1975	June 1973
Number installed to date	NA	—	250+	250+	6000 (all models)
COMMENTS	Has four CPU's and four DMA channels	Totally integrated desktop small business system; emphasis on packaged applications software; system price includes two 473K-byte diskette drives, CRT, keyboard, & printer; does not include system software ($550)	Also available as a turnkey system with applications software for manufacturers, wholesalers, accountants, hospitals, construction, insurance agencies, and trucking firms	Also available as a turnkey system with applications software for manufacturers, wholesalers, accountants, hospitals, construction, insurance agencies, and trucking firms	System price also includes 4 CRT's, 2.5-megabyte disk drive, and bisynch. communications controller

All About Minicomputers

MANUFACTURER & MODEL	Four Phase IV/70	Four Phase IV/90	Functional Automation F6400	General Automation 16/110	General Automation 16/220
DATA FORMATS					
Word length, bits	24	24	64	16 + 1	16 + 2
Fixed-point operand length, bits	15	15	8, 16, 32, 64, 128	16, 32	16
Instruction length, bits	24	24	32, 64	16, 32	16, 32, 48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	2	0.8	0.5	0.5	0.5
Access time, microseconds/word	—	—	1.0	0.6	0.225
Minimum capacity, words	24K bytes	96K bytes	256K bytes	2K	2K
Maximum capacity, words	96K bytes	384K bytes	30M bytes	64K	32K
Parity checking	Standard	Standard	Optional	Optional	Optional
Error correction	No	No	Optional	No	No
Storage protection	No	No	Standard	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	5	5	256	16	16
No. of index registers	3	3	256	8	8
No. of directly addressable words	98,304 bytes	98,304 bytes	250 million	64K	64K
No. of addressing modes	—	—	16	11	11
Control storage	ROM; 1K x 48 bits	ROM; 1K x 48 bits	4K x 128 RAM	—	ROM; 320 x 34 bits
Add time, microseconds	16	12	6.0	2.4	1.9
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	Standard	Standard	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	No	Standard
Battery backup	—	—	Standard	No	No
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	No	No	Standard	Standard	Standard
Maximum I/O rate, words/sec.	125K	125K	5 million	120K; 2000K (DMT)	1.25M
No. of external interrupt levels	8	8	4-128	Unlimited, vectored	Unlimited, vectored
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	354K bytes	354K bytes	No	No	500K-2M bytes
Disk pack/cartridge drives	Pack & cartridge; 2.5-270M bytes	Pack & cartridge; 2.5-270M bytes	Cartridge; up to 2.4 billion bytes	Pack & cartridge; 1.02-80M bytes	Pack & cartridge; 5-2400M bytes
Drum/Fixed-head disk storage	10-20M bytes	10-20M bytes	No	No	Fixed-head; 256K-2M bytes
Magnetic tape cassettes/cartridges	No	No	3M tape	No	No
Magnetic tape, ½-inch	10, 60 KBS	10, 60 KBS	No	20-60 KBS	20-60 KBS
Punched card input	300, 600 cpm	300, 600 cpm	No	400, 1000 cpm	400, 1000 cpm
Serial printer	30 cps	30 cps	No	No	10, 165 cps
Line printer	245-1800 lpm	120-1800 lpm	300 lpm	300, 600 lpm	200-600 lpm
Data Communications interface	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	To 9600 bps	75-9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	96 char. x 42 lines, 3M data cartridge	See Comments	80 char. x 24 lines
Other standard peripheral units	None	None		TTY, paper tape units, card punches, plotters	TTY, paper tape units, card punches, A/D converters, digital I/O plotters
SOFTWARE					
Assembler	Yes	Yes	No	Yes	Macro assembler
Compilers	COBOL, RPG	COBOL, RPG	MPL, FORTRAN	APL, BASIC, COBOL, FORTRAN IV, RPG II	FORTRAN IV, BASIC, COBOL
Operating system	Batch, interactive	Batch, interactive	Real-time	Batch, real-time, time-sharing	Batch, real-time
Language implemented in firmware	Partially	Partially	Partially	No	No
Operating system implemented in firmware	—	—	Partially	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$72,315 (48K bytes)	$1,876/month (48-month lease)	$68,700	$585	$770
Price of memory increment	—	—	$20,100 (256 KB and I/O controller)	$1,625 (8K words)	$1,810 (8K words)
Date of first delivery	February 1971	July 1977	1st. qtr. 1979	September 1975	December 1975
Number installed to date	6000 (all models)	6000 (all models)	NA	800	800
COMMENTS	System price also includes 12 CRT's, 2.5-megabyte disk drive, and 9-track magnetic tape drive	System price also includes 12 CRT's, 2.5-megabyte disk drive, and 9-track magnetic tape drive			

All About Minicomputers

MANUFACTURER & MODEL	General Automation 16/330	General Automation 16/440	General Automation 16/550	General Automation SPC-16	General Robotics CD/X3
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16 + 2	16	16
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16	16, 32, 48
MAIN STORAGE					
Storage type	Core	Core	Cache	Core	MOS
Cycle time, microseconds/word	0.72	0.72	0.24	0.8, 0.96, 1.44	0.45
Access time, microseconds/word	0.225	0.225	0.225	0.4, 0.48, 0.72	0.30
Minimum capacity, words	4K	16K	128K	4K	32K
Maximum capacity, words	32K	1024K	2048K	128K	32K
Parity checking	Optional	Optional	Standard	No	No
Error correction	No	No	Standard	No	No
Storage protection	Optional	Optional	Optional	Optional	No
CENTRAL PROCESSOR					
No. of accumulators	16	16	16	16	8
No. of index registers	8	8	8	6	8
No. of directly addressable words	64K	64K	64K	32K	32K
No. of addressing modes	11	11	11	11	8
Control storage	ROM; 320 x 34 bits	PROM; 512 x 64 bits	PROM; 512 x 64 bits	ROM; 4K words	PROM; 256 x 16
Add time, microseconds	1.9	0.78	0.78	0.8, 0.96, 1.44	3.5
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Optional	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	140K; 1200K (DMA)	1M	1M	1.04M	500K
No. of external interrupt levels	Unlimited; vectored	64-unlimited	64-unlimited	64-unlimited	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	500K-2M bytes	500K-2M bytes	500K-2M bytes	294-884K bytes	No
Disk pack/cartridge drives	Pack & cartridge; 5-2400M bytes	Pack & cartridge; 5-2400M bytes	Pack & cartridge; 5-2400M bytes	Pack & cartridge; 5-2400M bytes	No
Drum/Fixed-head disk storage	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	20-60 KBS	20-60 KBS	20-60 KBS	20-60 KBS	No
Punched card input	400, 1000 cpm	400, 1000 cpm	400, 1000 cpm	300-1000 cpm	No
Serial printer	10, 165 cps	10, 165 cps	10, 165 cps	10, 165 cps	No
Line printer	200-600 lpm	200-600 lpm	200-600 lpm	200-600 lpm	No
Data Communications interface	75-9600 bps	75-9600 bps	75-9600 bps	75-9600 bps	No
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	See Comments	No
Other standard peripheral units	TTY, paper tape units, card punches, A/D converters, digital I/O plotters	TTY, paper tape units, card punches, A/D converters, digital I/O, plotters	TTY, paper tape units, card punches, A/D converters, digital I/O plotters	TTY, A/D units, paper tape units	None
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Macro assembler	Assembler & macro assembler	Assembler and macro assembler
Compilers	FORTRAN IV, BASIC, COBOL	FORTRAN IV, BASIC, COBOL	FORTRAN IV, BASIC, COBOL	FORTRAN IV, BASIC, COBOL	FORTRAN, BASIC, APL
Operating system	Batch, real-time	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Real-time, batch	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$4,550 (4K words)	$8,950 (16K words)	$8,950 (16K words)	$5,550 (4K words)	$18,000
Price of memory increment	$3,250 (16K words)	$6,980 (16K words)	Not est. to date	$1,400 (4K words)	NA
Date of first delivery	December 1975	June 1975	NA	NA	November 1977
Number installed to date	250	250	NA	8,300	50
COMMENTS		Software and I/O compatible with SPC-16; oriented toward multi-user environment	Software and I/O compatible with SPC-16; oriented toward multi-user environment	The DM-100 Series is a line of packaged systems based on the SPC/16; CRT may be either 32 char. x 16 lines or 74 char. x 27 lines	Based on DEC LSI-11 with RK05-compatible hard disk

All About Minicomputers

MANUFACTURER & MODEL	General Robotics CD/X3S	General Robotics FD/X3	General Robotics FD/X3S	General Robotics MVT/X3	GRI System 99/50
DATA FORMATS					
Word length, bits	16	16	16	16	16
Fixed-point operand length, bits	16	16	16	16	—
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48	16-48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	Core; MOS
Cycle time, microseconds/word	0.45	0.45	0.45	0.45	1.76
Access time, microseconds/word	0.30	0.30	0.30	0.30	0.3
Minimum capacity, words	32K	32K	32K	32K	32K bytes
Maximum capacity, words	32K	32K	32K	32K	64K bytes
Parity checking	No	No	No	No	Optional
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	8	8	8	8	8
No. of index registers	8	8	8	8	1
No. of directly addressable words	32K	32K	32K	32K	32K
No. of addressing modes	8	8	8	8	5
Control storage	PROM; 256 x 16	No	No	PROM; 256 x 16	—
Add time, microseconds	3.5	3.5	3.5	3.5	1.76
Hardware multiply/divide	Standard	Standard	Standard	Standard	Optional
Hardware floating point	Standard	Standard	Standard	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	Optional	Optional	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	500K	500K	500K	500K	568K
No. of external interrupt levels	1	1	1	1	Unlimited
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	3.75M bytes	3.75M bytes	1.3M bytes	No
Disk pack/cartridge drives	No	No	No	No	Cartridge; 10.6-42.4M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	Cassette
Magnetic tape, ½-inch	No	No	No	No	60 KBS
Punched card input	No	No	No	120 cps	300 cpm
Serial printer	No	No	180 cps, bidirectional	No	88-330 cps
Line printer	No	No	No	No	200-600 lpm
Data Communications interface	No	No	No	No	Up to 9600 bps
CRT	No	No	2000 char.	480 char.	80 char. x 24 lines
Other standard peripheral units	None	None	None	None	Paper tape equip., A/D and D/A converters, industrial devices
SOFTWARE					
Assembler	Assembler and macro assembler	Assembler and macro assembler	Assembler and macro assembler	Assembler and macro assembler	Yes
Compilers	FORTRAN, BASIC, APL	FORTRAN, BASIC, APL	FORTRAN, BASIC, APL	FORTRAN, BASIC, APL	BASIC, RPG II
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Real-time, multi-user
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$24,000	$11,000	$17,000	$12,000	$6,410 (8K words)
Price of memory increment	NA	NA	NA	NA	$3,890 (16K words)
Date of first delivery	November 1977	June 1976	June 1976	June 1978	NA
Number installed to date	50	200	200	NA	NA
COMMENTS	Based on DEC LSI-11 with RK05-compatible hard disk	Triple drive double-sided double-density floppy disk with LSI-11 CPU	Triple drive double-sided double-density floppy disk with LSI-11 CPU	Complete desktop LSI-11 computer system with keyboard, screen, printer, CPU, and disks in self-contained unit	Basis for the GRI System 99 small business computer

All About Minicomputers

MANUFACTURER & MODEL	Harris Slash 4	Harris Slash 6	Harris Slash 7	Harris 550	Harris 570
DATA FORMATS					
Word length, bits	24 + 2	24 + 5	24 + 2	24	24
Fixed-point operand length, bits	24, 48	24, 48	24, 48	24, 48	24, 48
Instruction length, bits	24	24	24	24	24
MAIN STORAGE					
Storage type	Core; MOS	MOS	Core; MOS	MOS; core	Core; MOS
Cycle time, microseconds/word	0.75; 0.2	0.45	0.43; 0.2	0.3	0.3
Access time, microseconds/word	0.3	0.3	0.3	2.9	2.9
Minimum capacity, words	8K	16K	32K	960K bytes	960K bytes
Maximum capacity, words	256K	256K	256K	3072K bytes	3072K bytes
Parity checking	Standard	No	Standard	No	Standard
Error correction	No	Standard	No	Standard	Standard
Storage protection	Optional	Optional	Optional	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	5	5	5	5	5
No. of index registers	3	3	3	3	3
No. of directly addressable words	64K	64K	64K	1024K	1024K
No. of addressing modes	4	4	4	3	3
Control storage	No	No	No	No	No
Add time, microseconds	0.75	0.6	0.58	0.72	0.72
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	Optional	No	Standard	Standard
Real-time clock or timer	Optional	Optional	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Optional	Optional	Optional	Optional
Maximum I/O rate, words/sec.	1.3M	2.3M	1.9M	7.9M	7.9M
No. of external interrupt levels	4-48	8-24	4-48	16; 48 opt.	16; 48 opt.
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	310K-1.2M bytes	310K-3.7M bytes	310K-1.2M bytes	310K bytes	310K bytes
Disk pack/cartridge drives	Pack & cartridge; 2.7-300M bytes	Pack & cartridge; 2.7-300M bytes	Pack & cartridge; 2.7-300M bytes	Cartridge; 10.8M bytes	Cartridge; 10.8M bytes
Drum/Fixed-head disk storage	Fixed-head; 10.8M bytes	Fixed-head; 10.8M bytes	Fixed-head; 10.8M bytes	Moving-head; 40, 80, 150, & 300 MB	Moving-head; 40, 80, 150, & 300 MB
Magnetic tape cassettes/cartridges	—	—	—	—	—
Magnetic tape, ½-inch	25-320 KBS	25-320 KBS	25-320 KBS	800/1600 bpi	800/1600 bpi
Punched card input	300-1000 cpm	300-1000 cpm	300-1000 cpm	300, 600, 1K cpm	300, 600, 1K cpm
Serial printer	30 cps	30 cps	30 cps	—	—
Line printer	300-900 lpm	300-900 lpm	300-900 lpm	300, 600, 900 lpm	300, 600, 900 lpm
Data Communications interface	96K bps; synch.	98K bps; synch.	98K bps; synch.	Synch.; asynch.	Synch.; asynch.
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	Yes	Yes
Other standard peripheral units	Paper tape units, plotter/printer	Paper tape units, plotter/printer	Paper tape units, plotter/printer	Printer/plotters, paper tape devices, remote terminals	Printer/plotters, paper tape devices, remote terminals
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Macro assembler	Macro assembler	Macro assembler
Compilers	FORTRAN IV, BASIC, RPG II, SNOBOL, FORGO	FORTRAN IV, BASIC, RPG II, SNOBOL, FORGO	FORTRAN IV, BASIC, RPG II, FORGO, SNOBOL	BASIC V, APL, RPG II, SNOBOL, FORGO, FORTRAN	BASIC V, APL, RPG II, SNOBOL, FORGO, FORTRAN
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$24,000 (8K words)	$17,900 (16K words)	$55,000 (32K words)	$255,000	$376,000
Price of memory increment	$7,000 (8K words)	$5,500 (16K words)	$30,000 (32K words)	—	—
Date of first delivery	September 1973	December 1976	November 1975	1st qtr. 1979	1st qtr. 1979
Number installed to date	NA	NA	NA	NA	NA
COMMENTS					

All About Minicomputers

MANUFACTURER & MODEL	Hewlett-Packard Fort Collins Division HP 250	Hewlett-Packard Desktop Computer Division 9825	Hewlett-Packard Desktop Computer Division 9830	Hewlett-Packard Desktop Computer Division System 45	Hewlett-Packard Data Systems Division HP 1000 E-Series
DATA FORMATS					
Word length, bits	8-bit byte	16	8-bit byte	16	16 + 1
Fixed-point operand length, bits	64	64 bits	—	64	16, 32
Instruction length, bits	16	16	16	16	16, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	1.2	—	13	1	0.595, 0.35
Access time, microseconds/word	—	—	—	—	—
Minimum capacity, words	32K bytes	6844 bytes	3520 bytes	13,498 bytes	16K
Maximum capacity, words	64K bytes	31,420 bytes	30,144 bytes	62,650 bytes	1,024,000
Parity checking	No	No	No	No	Standard
Error correction	No	No	No	No	Optional
Storage protection	No	No	No	No	Optional
CENTRAL PROCESSOR					
No. of accumulators	4	2	Software-assigned	4	2
No. of index registers	Software-assigned	—	Software-assigned	—	2
No. of directly addressable words	2K	2K	—	2K	2K
No. of addressing modes	8	8	4	8	7
Control storage	—	See Comments	See Comments	—	ROM/RAM; 16K
Add time, microseconds	—	1.6	1000	1.6	0.910
Hardware multiply/divide	—	No	No	No	Standard
Hardware floating point	—	No	No	No	Firmware
Hardware byte manipulation	—	Standard	Standard	Standard	Standard
Battery backup	—	No	No	No	Optional
Real-time clock or timer	—	Optional	No	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Std.; 1	Standard	No	Standard	Optional
Maximum I/O rate, words/sec.	—	400K	1.2K	400K	1140K
No. of external interrupt levels	2	2	0	2	50
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	3 units; 1.2M bytes	468K-15M bytes	No	500K-24M bytes	0.5-2M bytes
Disk pack/cartridge drives	20 MB; 10 MB fixed, 10 MB cartridge	No	Cartridge; 4.8-9.6M bytes	Pack & cartridge; 15M-6400M bytes	Cartridge & pack; 4.9-400M bytes
Drum/Fixed-head disk storage	—	No	No	No	No
Magnetic tape cassettes/cartridges	—	Cartridge; 2.75 KBS	Cassette; 375 bps	Cartridge; 1.48 KBS	Yes
Magnetic tape, ½-inch	—	No	No	No	20-72 KBS
Punched card input	—	300 cpm	300 cpm	300 cpm	300, 600 cpm
Serial printer	180 cps	30-180 cps	30 cps	30-100 cps	180 cps
Line printer	30, 180 cps, 136 col.	240 lpm	165-300 lpm	240-480 lpm	1250 lpm
Data Communications interface	None currently offered	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	50K-25M bytes
CRT	1920 characters	See comments	80 char. x 24 lines	80 char. x 24 lines	80 char. x 25 lines
Other standard peripheral units	—	Paper tape reader, paper tape punch, plotter, digitizer,	Paper tape reader, paper tape punch, plotter	Paper tape reader, paper tape punch, plotter	Plotters, meas. or control processor plug-in ADC, IEEE std. 488-1975 intfce., TV intfce.
SOFTWARE					
Assembler	No	No	No	No	Assembler & micro assembler
Compilers	Business BASIC	HPL	BASIC	BASIC	FORTRAN, BASIC
Operating system	—	Interactive/interpretive	Interactive	Interactive/interpretive	Real-time, time-sharing, DBMS
Language implemented in firmware	—	Fully	Fully	Fully	Partially
Operating system implemented in firmware	—	Fully	Fully	Fully	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$24,500; 3 to 7 year leases available	$5,900 (6844 bytes)	$4,900 (3520 bytes)	$11,500 (13,498 bytes)	$9,250 (32K MOS)
Price of memory increment	—	$1,600 (8K bytes) $3,200 (16K bytes)	$1,000 (4K bytes) $3,000 (12K bytes)	$2,400 (16,384 bytes	$1,400 (32 KB); $4,000 (128 KB)
Date of first delivery	September 1978	January 1976	November 1972	November 1977	November 1976
Number installed to date	NA	NA	NA	NA	NA
COMMENTS		Approx. 31K bytes of ROM for oper. system and HPL language interp.; up to 16K bytes of addl. ROM can be added for language extension & periph. control; system price also includes mag. tape cartridge drive, 16-char. strip printer, and 32-char. display; CRT can be added as a peripheral	Approx. 15K bytes of ROM for oper. sys. and BASIC language interp.; BASIC language extensions can be added in 2K-byte ROM modules to a maximum of 16K; sys. price also incl. mag. tape cassette drive & 32-char. display	98K bytes of ROM for operating system and enhanced BASIC interpreter; up to 80K bytes of additional ROM can be added for language extensions and peripheral control; internal options can handle graphics capability, 2nd tape drive, and 80-char. thermal printer	Packaged systems include HP 1000, Models 20, 30, and 40; HP 1000 is also available as a board computer; peripheral units also include a graphics CRT and multipoint interface

All About Minicomputers

MANUFACTURER & MODEL	Hewlett-Packard Data Systems Division HP 1000 F-Series	Hewlett-Packard Data Systems Division HP 1000 M-Series	Hewlett-Packard General Sys. Div. HP 3000 Series I	Hewlett-Packard General Sys. Div. HP 3000 Series II	Hewlett-Packard General Sys. Div. HP 3000 Series III
DATA FORMATS					
Word length, bits	16 + 1	16 + 1	17	21	22
Fixed-point operand length, bits	16, 32	16, 32	—	—	—
Instruction length, bits	16, 32	16, 32	8, 16	8, 16, 32, 64	8, 16, 32, 64
MAIN STORAGE					
Storage type	MOS	MOS	Core	MOS	MOS
Cycle time, microseconds/word	0.35	0.65	1.05	0.7	0.7
Access time, microseconds/word	—	—	0.525	0.35	0.35
Minimum capacity, words	32K	8K	128K bytes	256K bytes	256K bytes
Maximum capacity, words	2048 KB	1,024,000	128K bytes	512K bytes	2048K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	Optional	Optional	No	Standard	Standard
Storage protection	Optional	Optional	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	2	2	16	20	20
No. of index registers	2	2	1	1	1
No. of directly addressable words	2K	2K	64K bytes	64K bytes	64K bytes
No. of addressing modes	7	7	6	6	6
Control storage	ROM/RAM; 16K	ROM/RAM; 4K	ROM; 4K x 32	ROM; 10K x 32 bits	ROM; 10K x 32 bits
Add time, microseconds	0.910	1.9	1.23	1.05	1.05
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Floating pt. or std.	Firmware	Standard	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	No	Standard	Standard
Real-time clock or timer	Optional	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Optional	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1140K	616K	1.92M	2.86M	2.86M
No. of external interrupt levels	50	50	To 125	To 125	To 124
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	0.5-2M bytes	0.5-2M bytes	No	No	No
Disk pack/cartridge drives	Cartridge & pack; 4.9-400M bytes	Cartridge & pack; 4.9-400M bytes	15M-400M bytes	50M-960M bytes	50M-960M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Yes	Yes	No	110K bytes	110K bytes
Magnetic tape, ½-inch	20-72 KBS	20-72 KBS	72 KBS	72 KBS	72 KBS
Punched card input	300, 600 cpm	300, 600 cpm	600 cpm	600 cpm	600 cpm
Serial printer	180 cps	180 cps	30, 180 cps	30, 180 cps	30, 180 cps
Line printer	1250 lpm	1250 lpm	200-1250 lpm	200-1250 lpm	200-1250 lpm
Data Communications interface	50K-2.5M bytes	50K-2.5M bytes	1200 bps	To 9600 bps	To 9600 bps
CRT	80 char. x 25 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Plotters, meas. or control processor plug-in ADC, IEEE std. 488-1975 intfce., TV intfce.	Plotters, meas. & control processor, plug-in ADC, IEEE Std. 88-1975 intfce; TV intfce.	Paper tape, punched card reader/punch, graphics terminal	Paper tape, punched card reader/punch, graphics terminal	Paper tape, punched card reader/punch, graphics terminal
SOFTWARE					
Assembler	Assembler & micro assembler	Assembler & micro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	FORTRAN, BASIC	FORTRAN, BASIC	SPL, COBOL, RPG II, FORTRAN IV, BASIC	COBOL, RPG II, FORTRAN IV, BASIC, SPL, APL	COBOL, RPG II, FORTRAN IV, BASIC, SPL, APL
Operating system	Real-time, time-sharing, DBMS	Real-time, time-sharing DBMS	Batch, real-time, time-sharing	Batch, time-sharing, transaction processing	Batch, time-sharing, transaction processing
Language implemented in firmware	Partially	No	Partially	Partially	Partially
Operating system implemented in firmware	Partially	No	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$12,250	17,425 (64K bytes)	$64,000 (128K bytes)	$99,000 (256K bytes)	$115,000 (256K bytes)
Price of memory increment	$1,700 (16K bytes), $5,000 (128K bytes)	$1,400 (32K bytes), $4,000 (128K bytes)	—	$4,000 (64K bytes)	$8,000 (256K bytes)
Date of first delivery	July 1978	May 1974	April 1977	June 1976	June 1978
Number installed to date	—	—	—	—	—
COMMENTS	Model 45 system includes F-Series processor with 128KB memory, 20 MB disk, graphics terminal, RTE-IV software, desk-style cabinet, 1000 software, installation, and 90-day support services	Unique scientific instruction set includes most trigonometric functions and logarithmic functions, including hyperbolic tangent, arctangent, and base 10 logarithm	The Series I is the entry-level product in HP's 3000 line; it is fully upgradable to a Series II	The Series II is the mid-range HP 3000, with a $99,000 entry price; it is fully upgradable to a Series III and offers the same communications, languages, data entry, data base mgmt., and peripherals	The Series III offers on-line transaction processing power with up to 2 MB of memory, and a variety of communications, languages, data entry, data base mgmt., and peripherals

All About Minicomputers

MANUFACTURER & MODEL	Honeywell Level 6 Model 23	Honeywell Level 6 Model 33	Honeywell Level 6 Models 43, 47	Honeywell Level 6 Models 53, 57	Honeywell Level 62
DATA FORMATS					
Word length, bits	16 + 2	16 + 2, + 6	16 + 2, + 6	16 + 2, + 6	8 + 1
Fixed-point operand length, bits	16, 32	16, 32	16, 32	16, 32	16, 32
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48	16-64
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	—	0.65 or 0.55	0.65 or 0.55	0.65 or 0.55	1.0 (2-byte fetch)
Access time, microseconds/word	—	—	—	—	0.5 (2-byte fetch)
Minimum capacity, words	16K	8K bytes	16K bytes	16K bytes	48K bytes
Maximum capacity, words	64K	64K bytes	1024K bytes	1024K bytes	992K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	Optional	Optional	Optional	Yes
Storage protection	No	No	Optional	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	7	7	7	7	16
No. of index registers	3	3	3	3	8
No. of directly addressable words	64K	64K	1024K	1024K	992K
No. of addressing modes	19	19	19	19	4
Control storage	—	ROM; 512 x 56 bits	ROM; 1K x 64 bits	ROM; 1K x 64 bits	ROM; to 30K bytes
Add time, microseconds	3.0	1.9	1.0	0.7	See Comments
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	No	Optional	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	Optional	Optional	No
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	900 KW	3 MW	3 MW	3 MW	1.587M
No. of external interrupt levels	64	64	64	64	1-14
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	4 x 256/512K	4 x 256/512K	4 x 256/512K	4 x 256/512K	256-512K bytes
Disk pack/cartridge drives	No	Cartridge; 4 x 10, 33, 66, 128, or 256 MB	Cartridge; 4 x 10, 33, 66, 128, or 256 MB	Cartridge; 4 x 10, 33, 66, 128, or 256 MB	Pack; 40-1,800M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	700 bps
Magnetic tape, ½-inch	No	25-120 KBS	25-120 KBS	25-120 KBS	10-60 KBS
Punched card input	No	300, 500 cpm	300, 500 cpm	300, 500 cpm	300-1050 cpm
Serial printer	120, 160 cps	120, 160 cps	120, 160 cps	120, 160 cps	30/120 cps
Line printer	300, 600, 900 lpm	300, 600, 900 lpm	300, 600, 900 lpm	300, 600, 900 lpm	100-1600 lpm
Data Communications interface	50-9600 bps	50-72 KB	50-72 KB	50-72 KB	To 9600 bps
CRT	1920 char.	1920 char.	1920 char.	1920 char.	80 char. by 12 lines
Other standard peripheral units	—	Card punch	Card punch	Card punch	Card punch
SOFTWARE					
Assembler	Assembler & macro-preprocessor	Assembler and macro preprocessor	Assembler and macro preprocessor	Assembler and macro preprocessor	No
Compilers	FORTRAN, COBOL, RPG	COBOL, FORTRAN, RPG	COBOL, FORTRAN, RPG	COBOL, FORTRAN, RPG	COBOL, RPG, FORTRAN
Operating system	Batch, multi-tasking, real-time	Batch, real-time, real-time, multi-task.	Multi-tasking, batch, real-time, time-shar.	Multi-tasking, batch, real-time, time-shar.	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$4,750 (16K words)	$6,300 (8K words)	43: $11,025 (16 KW); 47: $28,050 (16 KW)	53: $27,250 (16 KW); 57: $52,050 (16 KW)	$36,900 (48K bytes)
Price of memory increment	$1,500 (16K words)	$875 (8K words)	$875 (8K words)	$875 (8K words)	$4,677 (16K bytes)
Date of first delivery	1978	1976	1977	1978	June 1975
Number installed to date	100	1000	1000	25	Over 1800
COMMENTS		Model 33 is field-upgradable to Model 43, 47, 53, or 57, all use common megabus	Writable control store (2K x 64) is optional; scientific instrument processing also optional (standard on Model 47)	Models 53 and 57 are cache processors; Model 57 also includes high-speed commercial instruction processor	Business data processing system built in Italy; CPU is available with 4 different performance levels; see Report 70C-480-12 for more details

All About Minicomputers

MANUFACTURER & MODEL	IBM Series/1	IBM System/3	IBM System/7	IBM System/32	IBM System/34
DATA FORMATS					
Word length, bits	16	8-bit byte	16 + 2	8-bit byte	8-bit byte
Fixed-point operand length, bits	32	8-248	16	1-16 digits	1-16 digits
Instruction length, bits	32, 64	32, 40, 48	16, 32	24-48	32, 40, 48
MAIN STORAGE					
Storage type	MOS	Core, MOS	Bipolar	MOS	MOS
Cycle time, microseconds/word	0.6, 0.8	1.52	0.4	0.6	0.6
Access time, microseconds/word	—	—	0.15	0.250	—
Minimum capacity, words	16K bytes	8K bytes	2K	16K bytes	32K bytes
Maximum capacity, words	128K bytes	256K bytes	64K	32K bytes	128K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	Std. (Model 15)	—	No	No
Storage protection	Standard	Std. (Model 15)	No (Models A & B); Std. (Model E)	No	No
CENTRAL PROCESSOR					
No. of accumulators	—	1	4	—	—
No. of index registers	34	2	28	2	2
No. of directly addressable words	64K bytes	64K bytes	64K	32K bytes	32K bytes
No. of addressing modes	4	1	1	2	2
Control storage	No	No	No	ROM; 4K bytes	—
Add time, microseconds	2.6, 8.4 (2 bytes)	24.4	0.8	150.8 (5 digits)	68.5 (5 digits)
Hardware multiply/divide	No	No	No	No	No
Hardware floating point	Optional	No	No	No	No
Hardware byte manipulation	Standard	Standard	No	Standard	Standard
Battery backup	Optional	No	No	No	—
Real-time clock or timer	Optional	Optional	Optional	No	—
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	—	658K	2M	889K	—
No. of external interrupt levels	256	5 (Models 8, 10, 12) 8 (Model 15)	64	4	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	492-606K bytes/drive	243K bytes/drive	No	243-303K bytes	303K bytes
Disk pack/cartridge drives	Nonrem. cartridge; 9.3-258M bytes/drive	Pack & cartridge; 2.5-506M bytes	Pack & cartridge; 4.9-69.8M bytes	Nonrem. cartridge; 3.2-13.7M bytes	Nonrem. cartridge; 8.6-27.1M bytes
Drum/Fixed-head disk storage	No	No	Fixed-head; 502K bytes	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	No	20-80 KBS	No	No	No
Punched card input	No	600, 1000 cpm	300 cpm	12-50 cpm	100, 600 cpm
Serial printer	120 cps	85, 115 cps	No	40-80 cps	15 cps
Line printer	155-414 lpm	100-1100 lpm	40-155 lpm	50-155 lpm	40-1100 lpm
Data Communications interface	2400-9600 bps	Up to 50K bps	Up to 50K bps	Up to 7200 bps	Up to 4800 bps
CRT	80 char. x 24 lines	40 char. x 12 lines	No	40 char. x 6 lines	960 or 1920 char.
Other standard peripheral units	Sensor I/O	MICR reader/sorter, optical mark reader	A/D converters, sensor units	Magnetic card reader	No
SOFTWARE					
Assembler	Macro assembler	No	Assembler & macro assembler	Macro assembler	Yes
Compilers	FORTRAN, PL/1, COBOL	BASIC, RPG II, COBOL, FORTRAN	FORTRAN, APG/7	RPG II	RPG II, FORTRAN
Operating system	Real-time, multi-tasking	Batch, time-sharing	Batch, real-time	Batch (one-program)	Interactive
Language implemented in firmware	Partially	No	No	No	Partially
Operating system implemented in firmware	Partially	No	No	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$4,360	$12,560 (8K bytes)	$5,310 (2K words)	$33,560 (16K bytes)	$26,300
Price of memory increment	$1,510 (16K bytes)	$2,950 (4K bytes)	$2,285 (2K words)	$878 (8K bytes)	$1,600 (16K bytes)
Date of first delivery	—	December 1970	1st quarter 1971	March 1975	January 1978
Number installed to date	NA	30,000+	NA	15,000+	NA
COMMENTS	Offered on a purchase-only basis, nine different CPU models	Six different model lines currently available; see Report 70C-491-21 for more details	System/7's form the base for many custom systems for voice response, Touch-Tone data entry communications processing, etc.	Entry-level business computer; strong emphasis on packaged applications software; system price also includes 3.92M-byte fixed disk drive, diskette drive, CRT, keyboard, and 40-cps unidirectional printer; See Report 70C-491-25 for details	Similar to System/34, but features more processing power, larger memory, larger disk capacity, and multiple independent workstations; see Report 70C-491-27 for details

All About Minicomputers

MANUFACTURER & MODEL	IBM System/360 Model 20	IBM 1130	IBM 5100	IBM 5110	ICL System Ten/220
DATA FORMATS					
Word length, bits	8-bit byte	16 + 2	8-bit byte	8-bit byte	6
Fixed-point operand length, bits	8-128	16, 32	—	—	1-10
Instruction length, bits	16, 32, 48	16, 32	16	16	3-60
MAIN STORAGE					
Storage type	Core	Core	MOS	MOS	Core
Cycle time, microseconds/word	See Comments	2.2; 3.6	0.530	0.530	2.2
Access time, microseconds/word	—	—	0.330	0.330	1.1
Minimum capacity, words	4K bytes	4K	16K bytes	16K bytes	20K
Maximum capacity, words	32K bytes	32K	64K bytes	64K bytes	160K
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	Standard
CENTRAL PROCESSOR					
No. of accumulators	8 (see Comments)	2	64	64	1
No. of index registers	8 (see Comments)	3	0	0	3-60
No. of directly addressable words	—	32K	64K bytes	64K bytes	160K
No. of addressing modes	—	2	2	2	2
Control storage	ROM	No	ROM; 180K x 9 bits	ROM; 180K x 9 bits	—
Add time, microseconds	58	8; 4.9	1000 (approx.)	1000 (approx.)	36.3
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	No	Standard	Standard	No
Hardware byte manipulation	Standard	No	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Optional	No	No	No	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Optional	Standard	Standard	Standard
Maximum I/O rate, words/sec.	156K	278K; 455K	500K	500K	229, 166
No. of external interrupt levels	1	6	3	3	1-300
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	303K-4.8M bytes	No
Disk pack/cartridge drives	Pack; 2.7-21.6M bytes	Pack & cartridge; 512K-2.56M bytes	No	No	Pack & Cartridge
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	Cartridge; 2.85 KBS	Cartridge; 2.85 KBS	No
Magnetic tape, ½-inch	15-60 KBS	15 KBS	No	No	20KBS
Punched card input	600, 1000 cpm	100, 600 cpm	No	No	No
Serial printer	15.5 cps	15 cps	80, 120 cps	80, 120 cps	165-330 cps
Line printer	260-1100 lpm	40-1100 lpm	No	No	125-400 lpm
Data Communications interface	Up to 50K bps	Up to 4800 bps	Up to 300 bps	Up to 9600 bps	2400-9600 bps
CRT	No	74 char. x 52 lines	64 char. x 16 lines	64 char. x 16 lines	80 char. x 24 lines
Other standard peripheral units	Card punch, MICR reader/sorter	Paper tape reader, paper tape punch, optical mark reader, plotter	RS 232C interface available for non-IBM peripherals	RS 232C, IEEE interfaces available for non-IBM peripherals	—
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	No	No	Assembler & macro assembler
Compilers	RPG II, PL/1	RPG II, FORTRAN	BASIC, APL	BASIC, APL	RPG II
Operating system	Batch	Batch	Batch (one-program)	Batch (one-program)	Batch, real-time
Language implemented in firmware	No	No	Fully	Fully	No
Operating system implemented in firmware	No	No	Fully	Fully	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$8,210 (4K bytes)	$8,630 (4K words)	$6,285 (16K bytes)	$8,475 (16K bytes)	$15,000 (20K words)
Price of memory increment	$2,160 (4K bytes)	$4,390 (4K words)	$1,750 (16K bytes)	$1,750 (16K bytes)	$3,000 (20K words)
Date of first delivery	November 1964	November 1965	September 1975	February 1978	June 1970
Number installed to date	15,000+	4000+	NA	NA	5000
COMMENTS	Low end of IBM's 360 series, cycle times vary with processor models, 8 general-purpose registers are used for indexing, base addressing, and as accumulators	IBM 1800 is similar CPU with storage protection, real-time operating system, and extensive A/D and sensor units	Portable computer weighing 50 pounds; system price also includes cartridge tape drive, CRT, and BASIC language interpreter	Features floppy disk and/or magnetic tape storage, and approximately two to three times the internal computing power of the 5100	Improved version of the former Singer System Ten; CPU power fail/auto restart included in price. System Ten/220 is an entry-level business computer system with strong emphasis on packaged software

All About Minicomputers

MANUFACTURER & MODEL	ICL 1501/40	ICL 1503/43	ICL 2903	ICL 2904	Intelligent Systems 8031/8051
DATA FORMATS					
Word length, bits	8	8	24 + 2	24 + 2	8
Fixed-point operand length, bits	8	8	12	12	8, 16
Instruction length, bits	16	16	24	24	8, 16, 24
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.3	0.3	1.14	1.14	0.5
Access time, microseconds/word	4.0	4.0	0.57	0.57	0.5
Minimum capacity, words	16K	16K	16K	32K	32K
Maximum capacity, words	16K	32K	48K	96K	64K
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	1	1	8	8	1
No. of index registers	7	7	4	4	3
No. of directly addressable words	256K	256K	4K	4K	64K
No. of addressing modes	2	2	4	4	2
Control storage	ROM; 16 bytes	ROM; 16 bytes	8K, 12K	8K, 12K	No
Add time, microseconds	30	30	17.7	11.8	2
Hardware multiply/divide	No	No	Standard	Standard	No
Hardware floating point	No	No	Optional	Optional	No
Hardware byte manipulation	No	No	No	No	No
Battery backup	Optional	Optional	No	No	No
Real-time clock or timer	Optional	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	No
Maximum I/O rate, words/sec.	60K	60K	500K	500K	167K
No. of external interrupt levels	1	1	None	None	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	80-591K bytes
Disk pack/cartridge drives	2.5MB (fixed)	Cart.; 5MB min., 20MB max.	Cartridge & pack; 9.8-270M (6-bit)	Cartridge & pack; 9.8-270M (6-bit)	No
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cart.; 2K bytes	Cart.; 2K bytes	No	No	No
Magnetic tape, ½-inch	6.9-20K bytes	6.9-20K bytes	80 KCS	80 KCS	No
Punched card input	Optional	Optional	300 cpm	300 cpm	No
Serial printer	165, 300 cps	165, 300 cps	No	No	60-180 cps
Line printer	100-400 lpm	100-400 lpm	150-1500 lpm	150-1500 lpm	No
Data Communications interface	To 9600 bps	To 9600 bps	To 9600 bps	To 9600 bps	9600 bps
CRT	256 chars.	1920 char.	80 chars. x 25 lines	80 chars. x 25 lines	80 char. x 24 lines
Other standard peripheral units	—	—	DDE terminals, 256 chars.; hard-copy printer for CRT's	DDE terminals, 256 chars.	Light pen
SOFTWARE					
Assembler	Yes	Yes	No	No	Assembler
Compilers	BTL, COBOL, BASIC	BTL, COBOL, BASIC	COBOL, FORTRAN, BASIC, RPG, ALGOL	COBOL, FORTRAN, RPG, ALGOL	3 BASIC interp., FORTRAN, COBOL
Operating system	No	No	Batch, multitasking, data base mgmt.	Batch, multitasking, data base mgmt.	Single-user
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	Partially	Partially	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$13,600	$18,000	$85,000	$35,000	$4,495
Price of memory increment	—	$1,037 (8KB)	$7,806-19,106 (4K)	$12,116 (8K); $18,174 (12K)	$500 (8K bytes) $800 (16K bytes)
Date of first delivery	1975	1975	July 1974	NA	—
Number installed to date	10	100	20	5	—
COMMENTS			Data characters are 6 bits; Cincom's TOTAL data base management system available	Data characters are 6 bits; Culli-nane's IDMS and Cincom's TOTAL data base management systems available	Complete system with color graphics; the 8031 features a 13-inch color CRT, the 8051 a 19-inch color CRT, with 192 x 160 graphics; features also include disk BASIC and operating system

Minicomputer Specifications

MANUFACTURER & MODEL	Intelligent Systems 8070/Business	Intelligent Systems 8071/Business	Intelligent Systems 8080/Dev. Sys.	Intelligent Systems 8090	Interdata 6/16
DATA FORMATS					
Word length, bits	8	8	8	8	16 + 1
Fixed-point operand length, bits	8, 16	8,16	8, 16	8, 16	8, 16, 32
Instruction length, bits	8, 16, 24	8, 16, 24	8, 16, 24	8, 16, 24	16, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS; core
Cycle time, microseconds/word	0.5	0 5	0.5	0.5	0.6; 1.0
Access time, microseconds/word	0.5	0 5	0.5	0.5	—; 0.35
Minimum capacity, words	32K	32K	32K	56K	4K
Maximum capacity, words	64K	64K	64K	64K	32K
Parity checking	No	No	No	No	Optional
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	1	1	1	1	16
No. of index registers	3	3	3	3	15
No. of directly addressable words	64K	64K	64K	64K	32K
No. of addressing modes	2	2	2	2	3
Control storage	No	No	No	No	ROM
Add time, microseconds	2	2	2	2	0.9; 1.0
Hardware multiply/divide	No	No	No	No	Optional
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	No	No	No	No	Standard
Battery backup	No	No	No	No	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	No	No	No	No	Standard
Maximum I/O rate, words/sec.	167K	167K	167K	167K	1M
No. of external interrupt levels	8	8	8	8	1-255
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	80-591K bytes	80-591K bytes	80-591K bytes	80-591K bytes	No
Disk pack/cartridge drives	No	No	No	No	Pack & cartridge; 2.5-1024M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	Cassette. 1 KBS
Magnetic tape, ½-inch	No	No	No	No	9-120 KBS
Punched card input	No	No	No	No	400, 1000 cpm
Serial printer	60-180 cps	60-180 cps	60-180 cps	60-180 cps	10-30 cps
Line printer	No	No	No	No	60-600 lpm
Data Communications interface	9600 bps	9600 bps	9600 bps	9600 bps	To 9600 bps
CRT	80 char x 24 lines	80 char x 24 lines	80 char. x 24 lines	80 char. x 48 lines	80 char. x 24 lines
Other standard peripheral units	Light pen	Light pen	Light pen	Light pen	Paper tape units, A/D & D/A converters, graphic display
SOFTWARE					
Assembler	Assembler	Assembler	Assembler	Assembler	Assembler & macro assemblers
Compilers	3 BASIC interp., FORTRAN, COBOL	3 BASIC interp., FORTRAN, COBOL	3 BASIC interp., FORTRAN. COBOL	3 BASIC interp., FORTRAN, COBOL	FORTRAN, BASIC
Operating system	Single-user	Single-user	Single-user	Single-user	Batch, real-time
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$7,000	$7,500	$6,500	$12,000	$2,900 (4K words)
Price of memory increment	$500 (8K bytes) $800 (16K bytes)	$500 (8K bytes) $$800 (16K bytes)	$500 (8K bytes) $800 (16K bytes)	$500 (8K bytes) $800 (16K bytes)	$500 (4K words)
Date of first delivery	—	—	—	—	February 1975
Number installed to date	—	—	—	—	NA
COMMENTS	Complete business system with a 48 line x 80 char. display; includes dual 8-in. floppy disk drives, matrix printer, disk BASIC interpreter, and operating system	Complete business system with a 48 line x 80 char. 13 in. color display; also includes 5-in. mini-floppy disk drive, dual 8-in floppy disk drives, matrix printer, disk BASIC interpreter, and operating system	Microcomputer development system with 19-in. color display, 8080 assembler, editor and operating system in ROM, dual 5-in. mini-floppy disk drives; EPROM programmer, and matrix printer	System price includes 19-in. color display with medium-resolution graphics, light pen, disk BASIC, assembler, text editor, operating system in ROM, dual 8-in. double-headed floppy disk drives, matrix printer, and PROM/EPROM programmer	Single-board processor with single-board memory as large as 64K bytes; options include turn-key control panel, bootstrap loader, serial I/O port, chassis & power supply

All About Minicomputers

MANUFACTURER & MODEL	Interdata 8/16E	Interdata 7/32C	Interdata 8/32C	Interdata 5/16	Jacquard J-100
DATA FORMATS					
Word length, bits	16 + 1	32 + 2	32 + 2	16	16
Fixed-point operand length, bits	8, 16, 32	32	32	8, 16, 32	16, 32, 64
Instruction length, bits	16, 32	16, 32, 48	16, 32, 48	16, 32	16
MAIN STORAGE					
Storage type	Core	Core	Core	MOS	Core, MOS
Cycle time, microseconds/word	0.75	0.75, 1.0	0.3	0.6	1.5
Access time, microseconds/word	0.275	0.4, 0.5	0.4	—	—
Minimum capacity, words	16K	16K	32K	4K	16K
Maximum capacity, words	131K	256K	256K	32K	64K
Parity checking	Optional	Optional	Optional	No	No
Error correction	No	No	No	No	No
Storage protection	Optional	Optional	Standard	No	No
CENTRAL PROCESSOR					
No. of accumulators	16	32	32-256	16	4
No. of index registers	15	30	30-240	15	2
No. of directly addressable words	32K	256K	256K	32K	64K
No. of addressing modes	4	7	7	3	4
Control storage	ROM	ROM; 1792 x 24 bits	ROM; 1240 x 32 bits	Opt. ROM; to 48K bytes	No
Add time, microseconds	0.75	1.0	0.4	1.2	7
Hardware multiply/divide	Optional	Standard	Standard	Standard	No
Hardware floating point	Optional	Optional	Optional	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No
Battery backup	NA	No	No	No	No
Real-time clock or timer	Optional	Optional	Optional	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1.33M	500K	1.25M	475K	667K
No. of external interrupt levels	1-255	1-1023	4-1024	1-255	32
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Yes	Yes	No	Yes	512K-1M bytes
Disk pack/cartridge drives	Pack & cartridge; 2.5-1024M bytes	Pack & cartridge; 2.5-1024M bytes	Pack & cartridge; 2.5-1024M bytes	No	Pack & cartridge; 6-320M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	No
Magnetic tape, ½-inch	9-120 KBS	9-120 KBS	9-120 KBS	9-120 KBS	10-72 KBS
Punched card input	400, 1000 cpm	400, 1000 cpm	400, 1000 cpm	400, 1000 cpm	No
Serial printer	10-30 cps	10-30 cps	10-30 cps	10-30 cps	30-166 cps
Line printer	60-600 lpm	60-600 lpm	60-600 lpm	60-600 lpm	300-900 lpm
Data Communications interface	To 9600 bps	To 9600 bps	To 9600 bps	To 9600 bps	Up to 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape units, A/D & D/A converters, graphic display	Paper tape units, A/D & D/A converters, graphic display	Paper tape units, A/D & D/A converters, graphic display	Paper tape units, A/D & D/A converters, graphic display	RS-232C interface
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Yes
Compilers	FORTRAN, BASIC	FORTRAN V, BASIC, COBOL	FORTAN V, BASIC, COBOL	FORTRAN, BASIC	BASIC, DATA-RITE
Operating system	Batch, real-time	Batch, real-time	Batch, real-time	Batch, real-time	Time-sharing, multitasking
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$9,330 (16K words)	$11,695 (16K words)	$51,900 (32K words)	$2,100 (4K words)	$14,900 (16K words)
Price of memory increment	$2,500 (16K words)	$6,550 (16K words)	$19,000 (64K words)	$600 (4K words)	$2,600 (16K words)
Date of first delivery	October 1977	July 1974	June 1975	4th quarter 1976	August 1975
Number installed to date	NA	600+	100+	NA	1,500
COMMENTS	Available options include hardware single & double precision floating-point units, fixed-point multiply/divide		512 words of writable control store optional; features instruction look-ahead; ITAM software provides remote batch terminal emulators	Available as a board-based processor without chassis and peripherals	Sold only in packaged configuration consisting of a 16K-word CPU, dual floppy disk, CRT display/keyboard, real-time clock, and all software

All About Minicomputers

MANUFACTURER & MODEL	Jacquard J-500	Katcard Systems International KSL System 340	Keronix 16/8	Keronix 16/10	Keronix 16/12
DATA FORMATS					
Word length, bits	16	16	16	16	16
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16	1-3 words	16	16	16
MAIN STORAGE					
Storage type	MOS	Semiconductor	Core	Core	Core
Cycle time, microseconds/word	0.74	500 AS	0.8	1.0	1.2
Access time, microseconds/word	0.6	500 AS	—	—	—
Minimum capacity, words	16K	32K	8K	8K	8K
Maximum capacity, words	64K	128K	1024K	1024K	1024K
Parity checking	No	Yes	No	No	No
Error correction	No	Yes	No	No	No
Storage protection	No	NA	Optional	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	4	16	4	4	4
No. of index registers	2	8	2	2	2
No. of directly addressable words	64K	64K	65K	65K	65K
No. of addressing modes	4	11	8	8	8
Control storage	PROM: 28KB	Yes; 1K bytes	No	No	No
Add time, microseconds	1.6	9.0	NA	NA	NA
Hardware multiply/divide	No	Yes	NA	NA	NA
Hardware floating point	No	Optional	No	No	No
Hardware byte manipulation	No	Optional	No	No	No
Battery backup	No	Yes	No	No	No
Real-time clock or timer	Standard	Yes	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Yes	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1M	1; 1M	833K	1M	1.25M
No. of external interrupt levels	16	64	62	62	62
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	512K-4M bytes	Yes	512K-1.3M bytes	512K-1.3M bytes	512K-1.3M bytes
Disk pack/cartridge drives	Pack & cartridge; 3M-48M bytes	Yes	Cartridge & pack; 10M-24M bytes	Cartridge & pack; 10M-24M bytes	Cartridge & pack; 10M-24M bytes
Drum/Fixed-head disk storage	No	Yes	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	No	Yes	400 KBS	400 KBS	400 KBS
Punched card input	No	Yes	300-600 cpm	300-600 cpm	300-600 cpm
Serial printer	30-166 cps	Yes	10-330 cps	10-330 cps	10-330 cps
Line printer	300-1200 lpm	Yes	To 600 lpm	To 600 lpm	To 600 lpm
Data Communications interface	Up to 9600 bps	Yes	To 19.2K bytes	To 19.2K bytes	To 19.2K bytes
CRT	80 char. x 24 lines	Yes	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Auto dialer program, CRT char. generator	Yes	RS-232C interface, paper tape units, processor-to-processor	RS-232C interface, paper tape units, processor-to-processor	RS-232C interface, paper tape units, processor-to-processor
SOFTWARE					
Assembler	Yes	Yes	Assembler	Assembler	Assembler
Compilers	BASIC, DATA-RITE	COBOL, RPG II, Comm. FORTRAN, Ext. FORTRAN, BASIC	BASIC, ASGOL, COBOL	BASIC, ASGOL, COBOL	BASIC, ASGOL, COBOL
Operating system	Time-sharing, multitasking	MIBS, Time-sharing	Multi-user, time-sh., multi-tasking	Multi-user, time-sh., multi-tasking	Multi-user, time-sh., multi-tasking
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$9,200	$21,000	$5,000 (8KB)	$4,200 (8KB)	$4,200 (8KB)
Price of memory increment	$1,200 (32K bytes)	$3,100 (32K bytes)	$1,750 (8KB)	$1,500 (8KB)	$1,500 (8KB)
Date of first delivery	November 1978	January 1978	April 1974	April 1974	April 1974
Number installed to date	NA	2	Over 2000	Over 2000	Over 2000
COMMENTS		Shared logic word processing, legal time accounting, A/R, A/P, gen. lgr., payroll, order/entry, inventory control, work in process, bill of material	The Keronix 16 series is software and I/O compatible with the Data General Nova 1200 series	The Keronix 16 series is software and I/O compatible with the Data General Nova 1200 series	The Keronix 16 series is software and I/O compatible with the Data General Nova 1200 series

All About Minicomputers

MANUFACTURER & MODEL	Lockheed LEC 16	Lockheed SUE/System III	MCM Computers MCM/800	MCM Computers MCM/900	Melcom Business Systems Inc. Metcom 80 Series Model 8
DATA FORMATS					
Word length, bits	16 + 1	16	8 + 1	8	48 + 8 (sign) + 7
Fixed-point operand length, bits	8, 16	8, 16	8-64	8-64	12 digits
Instruction length, bits	16	16, 32	Variable	Variable	48
MAIN STORAGE					
Storage type	Core	Core, MOS	MOS	MOS	MOS
Cycle time, microseconds/word	1.0	1.8-0.6	1.2	0.3	0.8
Access time, microseconds/word	0.5	0.5, 0.425	—	—	NA
Minimum capacity, words	8K	16K MOS, 8K core	4K bytes	8K bytes	16K bytes
Maximum capacity, words	64K	256K on SUE	16K bytes	24K bytes	24K bytes
Parity checking	Optional	Optional	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	Optional	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	1	7	1	1	3
No. of index registers	1	7	0	0	0
No. of directly addressable words	1K	32K	16K	24K	7K bytes
No. of addressing modes	4	19	—	—	1
Control storage	No	ROM; 52 x 36 bits	ROM, 32K bytes	ROM; 40K bytes	ROM; 1.5K bytes
Add time, microseconds	2.0	2.85-3.0 on SUE	—	—	900 (12 digits)
Hardware multiply/divide	Optional	Optional	No	No	Standard
Hardware floating point	No	No	Standard	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No
Battery backup	No	No	Standard	No	No
Real-time clock or timer	Standard	Standard	No	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	No	No	No
Maximum I/O rate, words/sec.	333K	1M	—	—	40K bytes
No. of external interrupt levels	8-64	Variable	No	None	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	256K-512K bytes	250K-2M bytes	250K-1M bytes	486-972K bytes
Disk pack/cartridge drives	No	Pack & cartridge; 5.0- (4) 150M bytes	No	No	No
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	Cassette, 810 cps	No	No
Magnetic tape, ½-inch	No	80/1600 bpi	No	No	No
Punched card input	No	285 cps	400 cpm	400 cpm	No
Serial printer	No	120, 180 cpm	45 cps	45-180 cps	120 cps
Line printer	No	300, 600 lpm	No	300 lpm	No
Data Communications interface	110-9600 bps	110-9600 bps	To 1200 bps	To 4800 bps	9600 bps
CRT	No	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	512 (32 x 16)
Other standard peripheral units	—	—	GP interface; programmable RS-232C interface	GP interface; programmable RS-232C interface	None
SOFTWARE					
Assembler	Yes	Macro assembler	No	No	Yes
Compilers	FORTRAN	FORTRAN, RPG II	No	No	NA
Operating system	Real-time	Multi-tasking	Virtual memory, interactive	Virtual memory	NA
Language implemented in firmware	No	No	Fully	Fully interpretive	Fully
Operating system implemented in firmware	No	No	Fully	Fully	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$7,615 (8K words)	$10,780 (16K MOS)	$9,200 (8K bytes)	$9,200	$16,000
Price of memory increment	$2,475 (4K words)	$3,350 (16K MOS); $1,950 (8K core)	$1,600 (8K bytes)	—	NA
Date of first delivery	February 1969	November 1972	July 1976	October 1978	December 1976
Number installed to date	Over 2000	Over 2000	150+	—	9000+ (all models)
COMMENTS	Formerly known as MAC; sold for OEM usage only. peripherals supplied only on special request	Used as the basis for Lockheed System III business minicomputer system	MSI implementation of MCM/700 CPU; provides 8 to 10 times the performance levels of the MCM/700; features virtual storage capacity of up to 256K bytes using cassette tape or diskette; system price also includes an integral cassette drive, display, keyboard, and RS-232 interface	The MCM/900 CPU is four times faster than the MCM/800 CPU; it features APL firmware and is MCM 800-compatible	

All About Minicomputers

MANUFACTURER & MODEL	Melcom Business Systems Inc. Melcom 80 Series Model 38	Microdata Micro-One	Microdata 1600 Series	Modular Computer Systems Classic 7860	Modular Computer Systems Modcomp II
DATA FORMATS					
Word length, bits	8 + 1	8-bit byte	16	16	16 + 1
Fixed-point operand length, bits	1-16 digits	8, 16, 24, 32	8, 16, 24, 32	8, 16, 32	16, 32
Instruction length, bits	16, 32, 48	8, 16, 24, 32	8, 16, 24, 32	16, 32, 48, 64	16, 32, 48
MAIN STORAGE					
Storage type	MOS	Core, MOS	Core	Core; MOS	Core
Cycle time, microseconds/word	0.75 (2 bytes)	1.1	1.0	250	0.8
Access time, microseconds/word	NA	0.44	0.4	250	0.4; —
Minimum capacity, words	32K bytes	8K	4K	64K	16K
Maximum capacity, words	192K bytes	32K	32K	625	64K
Parity checking	Standard	No	No	Standard (Core)	Standard
Error correction	No	No	No	Standard (MOS)	No
Storage protection	Standard	No	No	Standard	Optional
CENTRAL PROCESSOR					
No. of accumulators	2	15	3	16 blocks of 15	15
No. of index registers	2	Firmware-controlled	1	16 blocks of 7	7
No. of directly addressable words	64K bytes	32K	16K	64K	64K
No. of addressing modes	2	Firmware-controlled	8	9	7
Control storage	ROM; 7.7K bytes	4K-byte ROM & PROM	4K-byte ROM & PROM	No	No
Add time, microseconds	51.0 (5 digits)	6.38	6.38	0.2	0.8
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	No	No	Standard	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	No	No	Optional	No
Real-time clock or timer	Optional	Standard	Standard	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Optional	Optional	Standard	Standard
Maximum I/O rate, words/sec.	2.35M bytes	1M	1M	4M	1.93M
No. of external interrupt levels	7	2; 128	2; 128	Up to 128	Up to 128
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	243-486K bytes	No	No	315-630K bytes	315-630K bytes
Disk pack/cartridge drives	Pack & cartridge; 10-400M bytes	Cassette; 10-40M bytes	Cartridge; 10-40M bytes	Pack & cartridge	Pack & cartridge; 2.4-168M bytes
Drum/Fixed-head disk storage	No	No	No	Fixed-head; 262K-2M bytes	Fixed-head; 262K-2M bytes
Magnetic tape cassettes/cartridges	Cassette; 750 bps	No	No	No	No
Magnetic tape, ½-inch	20KB/sec.;40KB/sec.	40KBS	40KBS	120 KBS	120 KBS
Punched card input	300, 600 cpm	200-1000 cpm	200-1000 cpm	300-1000 cpm	300, 1000 cpm
Serial printer	No	165 cps	165 cps	30-132 cps	30-165 cps
Line printer	110, 600 lpm	300-600 lpm	300-600 lpm	300-1000 lpm	280-600 lpm
Data Communications interface	9600 bps	To 9600 bps	To 9600 bps	50-56K bps	50-56K bps
CRT	2000 char. (80 x 25)	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	None	Paper tape reader/punch	Paper tape reader/reader/punch	Printer/plotter, A/D & D/A converters & discrete I/O and memory	Printer/plotter, A/D & D/A converters & discrete I/O
SOFTWARE					
Assembler	Yes	Yes	Yes	Assembler & macro assembler	Assembler & macro assembler
Compilers	COBOL, RPG, PROGRESS	BASIC	BASIC	FORTRAN, BASIC, RPG II, COBOL, CORAL	FORTRAN, BASIC, RPG II, COBOL, CORAL 66, TOTAL
Operating system	Batch, real-time	No	No	Batch, real-time	Batch, real-time, comm. exec.
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$45,000 (std. config.)	$3,060 (8K words)	$5,550 (4K words)	$37,000 (128K bytes)	$13,000 (32K words)
Price of memory increment	NA	$75 (1K bytes)	$1,400 (4K words)	$10,000 (128K bytes)	$8,000 (32K words)
Date of first delivery	August 1977	December 1974	November 1971	June 1978	March 1971
Number installed to date	9000+ (all models)	150+	6000+	NA	Over 2000
COMMENTS		Single-board processor, compatible with Microdata 800 and 1600 computers	1600 Series features stack processing and character string manipulation; also available in packaged version called REALITY	First member of Modcomp's Classic multi-word architecture family, which will range both upwards and downwards from the 7860	4-port memory available for multi-processor and I/O processor configurations; high-speed communications processor available

All About Minicomputers

MANUFACTURER & MODEL	Modular Computer Systems Modcomp IV	Mylee Digital Sciences 3000	Nanodata QM/1	NCR 299-100	NCR 299-200
DATA FORMATS					
Word length, bits	16 + 1	16	18 + 2	64	64
Fixed-point operand length, bits	16, 32	8-128	Variable	16 digits	16 digits
Instruction length, bits	16, 32, 48	16-48	Variable	Variable	Variable
MAIN STORAGE					
Storage type	Core	MOS	Core	Core	Core
Cycle time, microseconds/word	0.5	0.8	0.75-1.25	7 per bit	7 per bit
Access time, microseconds/word	0.4	—	0.35	—	—
Minimum capacity, words	64K	12K	16K	512 bytes	1K bytes
Maximum capacity, words	1024K	72K	1,024K	1K bytes	2K bytes
Parity checking	Standard	No	Standard	Standard	Standard
Error correction	No	No	Optional	No	No
Storage protection	Standard	No	Optional	No	No
CENTRAL PROCESSOR					
No. of accumulators	16 blocks of 15	4	32	10-50 (in memory)	30-100 (in memory)
No. of index registers	16 blocks of 7	4	32	—	—
No. of directly addressable words	64K	28K	256K	—	—
No. of addressing modes	7	—	Variable	—	—
Control storage	No	ROM	RAM; 40K x 18; 1K x 360	ROM; 12K words	ROM; 12K words
Add time, microseconds	0.56	20	0.75	220 milliseconds	220 milliseconds
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	No	Standard	No	No
Hardware byte manipulation	Standard	Standard	Standard	No	No
Battery backup	No	Yes	Optional	No	No
Real-time clock or timer	Standard	No	Optional	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Optional	No	No
Maximum I/O rate, words/sec.	3.5M	1M	1M	—	—
No. of external interrupt levels	Up to 128	1-18	2,048	None	None
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	315-630K bytes	Yes	No	No	No
Disk pack/cartridge drives	Pack & cartridge; 2.4-168M bytes	Cartridge; 48-96M bytes	Pack & cartridge; 12-60M	No	No
Drum/Fixed-head disk storage	Fixed-head; 262K-2M bytes	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	Cartridge; 2.5M bytes	No	Cassette, 750 cps
Magnetic tape, ½-inch	120 KBS	No	200 KBS	No	No
Punched card input	300, 1000 cpm	300 cpm	200-1000 cps	No	No
Serial printer	30-165 cps	165 cps	120 cps	15 cps	15 cps
Line printer	280-600 lpm	300 lpm	600-1250 lpm	No	No
Data Communications interface	50-56K bps	9600 bps	Up to 50K bps	No	1200 bps
CRT	80 char. x 24 lines	32 char. x 11 lines	Yes	No	No
Other standard peripheral units	Printer/plotter, A/D & D/A convert-ers & discrete I/O and memory	None	IBM 360 and Univac 1100 compatible channel	Paper tape punch	Paper tape punch, mag. ledger card reader
SOFTWARE					
Assembler	Assembler & macro assembler	No	Assembler and macro assembler	Assembler	Assembler
Compilers	FORTRAN, BASIC, RPG II, COBOL, CORAL 66, TOTAL	ACE	PASCAL, APL/SV, see Comments	No	No
Operating system	Batch, real-time	Real-time	See Comments	No	No
Language implemented in firmware	No	Partially	Yes	Fully	Fully
Operating system implemented in firmware	No	Partially	No	Fully	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$46,750 (64K words)	$24,950 (56K bytes)	$176,000	$7,250 (512 bytes)	$9,300 (1K bytes)
Price of memory increment	$17,400 (64K words)	—	$4,960 (16K words)	$325	$325
Date of first delivery	June 1974	May 1976	1975	November 1974	March 1975
Number installed to date	Over 300	150	14	3000 both types	3000 both types
COMMENTS	Features 32-bit parallel internal op-eration; 2048 relo-cating registers and eight map files	System price also in-cludes a CRT (32 x 11 or 24 x 80), 16MB of disk storage, a 165-cps printer, system software, and an in-ventory control appli-cations package	Emulations offered include IBM 360, 370, 7094; Univac 1106; DEC 11/05-11/40; DG Nova; CDC 160A; Delco 352; RCA 234SCP, UYK-7, -20; and microprocessors; emulation lab soft-ware provided; both vertical and hori-zontal control storage spacing	Replacement for electromechanical accounting ma-chines	Replacement for electromechanical accounting ma-chines

All About Minicomputers

MANUFACTURER & MODEL	NCR 499	NCR Century 50	NCR Century 75	NCR Century 100	NCR Century 101
DATA FORMATS					
Word length, bits	16 + 1	8 + 1	8 + 1	8 + 1	8 + 1
Fixed-point operand length, bits	12	1-256 digits	8, 16	1-256 digits	1-256 digits
Instruction length, bits	Variable	32-64	32-64	32-64	32-64
MAIN STORAGE					
Storage type	Core	Thin film	Core	Thin film	Core
Cycle time, microseconds/word	1.2	0.80	1.2	0.80	1.2
Access time, microseconds/word	0.65	—	0.65	—	0.60
Minimum capacity, words	12K	16K bytes	16K bytes	16K bytes	16K bytes
Maximum capacity, words	32K	32K bytes	64K bytes	32K bytes	128K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	Optional
CENTRAL PROCESSOR					
No. of accumulators	—	—	—	—	—
No. of index registers	—	63 (in memory)	63 (in memory)	63 (in memory)	63 (in memory)
No. of directly addressable words	—	—	—	—	—
No. of addressing modes	—	—	—	—	—
Control storage	ROM, 64K words	No	No	No	No
Add time, microseconds	1.7 milliseconds	59 (5 digits)	25 (5 digits)	59 (5 digits)	28.8 (5 digits)
Hardware multiply/divide	Standard	No	Optional	No	Optional
Hardware floating point	No	Standard	Standard	Standard	Standard
Hardware byte manipulation	No	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	No	No	Optional	No	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	833K	40K & 108K	120K & 416K	40K & 108K	120K & 416K
No. of external interrupt levels	8	2	8	2	9
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	No
Disk pack/cartridge drives	Cartridge 4.9-9.8M bytes	Pack; 8.4-33.5M bytes	Cartridge; 4.9-9.8M bytes	Pack; 8.4-33.5M bytes	Pack; 8.4-381.6M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette, 750 cps	Cassette; 750 cps	No	Cassette; 750 cps	Cassette; 750 cps
Magnetic tape, ½-inch	No	10-40 KBS	10-320 KBS	10-80 KBS	10-320 KBS
Punched card input	300 cpm	300-750 cpm	300 cpm	300-1200 cpm	300-1200 cpm
Serial printer	75, 130 cps	6 cps	6 cps	6 cps	6 cps
Line printer	55-300 lpm	125-900 lpm	200-450 lpm	450-3000 lpm	450-3500 lpm
Data Communications interface	300-9600 bps	45-50,000 bps	45-50,000 bps	45-50,000 bps	45-50,000 bps
CRT	No	80 char. x 24 lines	Interface only	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape units, mag. ledger card reader	Paper tape units; MICR/OCR units	Paper tape units; MICR/OCR units	Paper tape units; MICR/OCR units	Paper tape units; MICR/OCR units
SOFTWARE					
Assembler	NEAT/AM	No	No	No	No
Compilers	No	COBOL, BASIC, FORTRAN, NEAT/3	COBOL, BASIC, FORTRAN, RPG, NEAT/3	COBOL, BASIC, FORTRAN, NEAT/3	COBOL, BASIC, FORTRAN, NEAT/3
Operating system	No	Batch, multiprogramming	Batch, multiprogramming	Batch, multiprogramming	Batch, multiprogramming
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel min. mem. in chassis	$17,900 (12K bytes)	$47,000 (16K bytes)	$56,850 (16K bytes)	$71,500 (16K bytes)	$69,520 (16K bytes)
Price of memory increment	$1,100 (2K bytes)	$3,500 (16K bytes)	$5,000 (8K bytes)	$3,500 (16K bytes)	$5,000 (8K bytes)
Date of first delivery	February 1976	December 1970	May 1976	March 1963	August 1972
Number installed to date	4000	800 (50's and 100's)	50	800 (50's & 100's)	900
COMMENTS	Replacement for NCR 399	System price also includes line printer, 8.4 MB disk drive, and card reader; no longer manufactured; available only in used or used-refurbished units; see Report 70C-656-01 for more details	System price also includes a card reader, line printer, disk drive, TTY and cabinet: can be upgraded to Century 101; see Report 70C-656-01 for more details	System price also includes line printer, 8.4 MB disk drive, and card reader; no longer manufactured; available only in used or used-refurbished units; see Report 70C-656-01 for more details	System price also includes line printer, 8.4 MB disk drive, and card reader; see Report 70C-656-01 for more details

All About Minicomputers

MANUFACTURER & MODEL	NCR Century 151	NCR 8200	NCR 8130/8150	NCR 8230	NCR 8250
DATA FORMATS					
Word length, bits	8 + 1	16 + 2	16 + 2	16 + 2	16 + 2
Fixed-point operand length, bits	1-256 digits	16	16	16	16
Instruction length, bits	32-64	16, 32, 48	32, 64	16, 32	16, 32
MAIN STORAGE					
Storage type	MOS	Core	MOS	MOS	MOS
Cycle time, microseconds/word	0.75 (1 or 2 bytes)	1.2	0.6	0.8	0.8
Access time, microseconds/word	—	0.65	—	—	—
Minimum capacity, words	64K bytes	32K bytes	48K bytes	64K bytes	64K bytes
Maximum capacity, words	128K bytes	128K bytes	64K bytes	96K bytes	128K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	Optional	No	Optional	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	—	—	None	1	1
No. of index registers	63 (in memory)	27 (in memory)	None	27 (in memory)	27 (in memory)
No. of directly addressable words	—	—	64K	64K words	64K words
No. of addressing modes	—	—	—	7	7
Control storage	No	No	None	No	No
Add time, microseconds	18.0 (5 digits)	24 (8 digits)	—	—	—
Hardware multiply/divide	Standard	Standard	—	Standard	Standard
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	Optional	No	No
Real-time clock or timer	Optional	No	—	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	120K & 545K	833K	NA	833K	833K
No. of external interrupt levels	9	8	NA	8	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	900K-3.6M bytes	250K-1M bytes	250K-1M bytes
Disk pack/cartridge drives	Pack; 8.4-381.6M bytes	Cartridge; 4.9-39.2M bytes	4.9-39.2M bytes	Cartridge; 4.9-39.2M bytes	Cartridge; 9.8-80M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 750 cps	Cassette; 750 cps	Cassette; 327K bytes	Cassette; 450K bytes	Cassette; 450K bytes
Magnetic tape, ½-inch	10-320 KBS	No	No	10-20 KBS	10-20 KBS
Punched card input	300-1200 cpm	300 cpm	No	300 cpm	300 cpm
Serial printer	6 cps	50, 70, 125 cps	50-125 lpm	173 cps	173 cps
Line printer	450-3500 lpm	See Comments	200 lpm	100-300 lpm	100-300 lpm
Data Communications interface	45-50K bps	1200, 9600 bps	—	1200, 9600 bps	1200, 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	32 char. x 16 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape units; MICR/OCR units	—	Visual record printer	—	—
SOFTWARE					
Assembler	No	No	No	No	No
Compilers	COBOL, BASIC, FORTRAN, NEAT/3	NEAT/3, COBOL	COBOL	NEAT/3, COBOL	NEAT/3, COBOL
Operating system	Batch, multiprogramming	Batch, multiprogramming	Interactive	Batch, multiprogramming	Batch, multiprogramming
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$119,925 (64K bytes)	Available only used	$14,065/$22,960	$14,755	$16,775
Price of memory increment	$20,000 (64K bytes)	—	$1,800 (16K bytes)	—	—
Date of first delivery	February 1975	September 1974	January 1978	June 1977	March 1977
Number installed to date	300	300-400	NA	NA	NA
COMMENTS		Line printers; 50, 70, and 125 lpm matrix, 200, 300 and 600 lpm band			

All About Minicomputers

MANUFACTURER & MODEL	New England Digital Corp. ABLE/20	New England Digital Corp. ABLE/40	New England Digital Corp. ABLE/60	New England Digital Corp. ABLE/80	Olivetti P3030
DATA FORMATS					
Word length, bits	16	16	16	16	16
Fixed-point operand length, bits	16, 32	16, 32	16, 32	16, 32	16
Instruction length, bits	16, 32	16, 32	16, 32	16, 32	16-32
MAIN STORAGE					
Storage type	MOS, BIP	MOS, BIP	MOS, BIP	MOS, BIP	MOS
Cycle time, microseconds/word	0.9 max.; 0.59 avg.	0.9 max.; 0.59 avg.	0.9 max.; 0.59 avg.	0.9 max.; 0.59 avg.	—
Access time, microseconds/word	0.59 avg.	0.59 avg.	0.59 avg.	0.59 avg.	—
Minimum capacity, words	2K	2K	2K	2K	40K bytes
Maximum capacity, words	64K	64K	64K	64K	56K bytes
Parity checking	No	No	No	No	No
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	4	4	4	4	1
No. of index registers	16	16	16	16	16
No. of directly addressable words	65,536	65,536	65,536	65,536	3500
No. of addressing modes	8	8	8	8	4
Control storage	16 x 256	16 x 256	16 x 256	16 x 256	No
Add time, microseconds	0.25	0.25	0.25	0.25	—
Hardware multiply/divide	No	Optional	Optional	Optional	—
Hardware floating point	No	Optional	Optional	Optional	—
Hardware byte manipulation	Standard	Standard	Standard	Standard	—
Battery backup	No	No	No	No	No
Real-time clock or timer	Standard	Standard	Standard	Standard	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	No	No	No	No	Standard
Maximum I/O rate, words/sec.	2.8M bytes	2.8M bytes	2.8M bytes	2.8M bytes	—
No. of external interrupt levels	12	12	12	12	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	90K bytes	180-360K bytes	0.64-2.56M bytes	180-360K bytes	256K-1024K bytes
Disk pack/cartridge drives	No	No	Winchester; 10-160M bytes	Winchester; 10-160M bytes	Cart.; 10-20MB; Nonrem.; 2.5-20MB
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	Cart.; 192KB/sec.	Cart.; 192KB/sec.	Cassette; 1 KBS
Magnetic tape, ½-inch	No	No	60 KB/sec.	60 KB/sec.	800-1600 bpi
Punched card input	No	No	100-600 cpm	30-120 cps	300 cpm
Serial printer	No	30-120 cps	30-275 cps	No	90-175 cps
Line printer	No	No	150-600 lpm	150-600 lpm	300-600 lpm
Data Communications interface	Asynch.; 9600 bps	—	—	—	Up to 9600 bps
CRT	1920 char.	1920 char.	1920 char.	1920 char.	80 char. x 24 lines
Other standard peripheral units	None	None	None	None	None
SOFTWARE					
Assembler	Yes	Yes	Yes	Yes	Macro assembler
Compilers	Cross-compiler (XPL)	XPL	XPL, BXPL, S/BASIC	XPL	MINI PL/1, RPG II
Operating system	Partly (Auto-load)	Partly (Auto-load)	Partly (auto-load)	Partly (auto-load)	Interactive, batch
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	—	—	—	—	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$2,895	$4,650	$5,700	$6,000	$11,000
Price of memory increment	$327 (2K bytes)	$750 (8K bytes)	$750 (8K bytes)	$750 (8K bytes)	$850 (8K bytes)
Date of first delivery	March 1976	June 1977	April 1978	April 1976	March 1978
Number installed to date	10	20			NA
COMMENTS	Basic price also includes single mini-floppy, 4KB memory, RS-232 port	Basic price also includes single mini-floppy, 32KB memory, RS-232 port	Basic price also includes single mini-floppy, 32KB memory, RS-232 port	Basic price also includes 16-channel, 12-bit A/D, 32-bit digital I/O, dual 10-bit DAC, oscilloscope driver, scientific timer, dual mini-floppy disk drives with 32 KB memory, and RS-232 port	

All About Minicomputers

MANUFACTURER & MODEL	Olivetti P6060	Philips P300	Philips P330	Philips P350	Plessey Peripheral Systems Syst-1
DATA FORMATS					
Word length, bits	—	8	8	64	16
Fixed-point operand length, bits	—	Variable	Variable	64	16
Instruction length, bits	—	8, 56	1-8	64	16, 32, or 48
MAIN STORAGE					
Storage type	MOS	Core	Core	Core	MOS or core
Cycle time, microseconds/word	—	1.5	1.5	1.5	0.5
Access time, microseconds/word	—	0.6	0.6	0.6	0.375
Minimum capacity, words	16K bytes	8K bytes	24K bytes	600	4K (MOS); 16K (core)
Maximum capacity, words	48K bytes	16K bytes	32K bytes	1200	32K
Parity checking	No	No	No	No	No
Error correction	No	No	No	No	No
Storage protection	No	No	Standard	No	No
CENTRAL PROCESSOR					
No. of accumulators	—	8	16	Software-assigned	8
No. of index registers	—	8	8	0	8
No. of directly addressable words	—	—	16	1200	32K
No. of addressing modes	—	—	3	—	8
Control storage	—	ROM; 64K x 8 bits	ROM; 64K bits	No	No
Add time, microseconds	—	—	1.2	1.5	3.5
Hardware multiply/divide	—	No	No	Standard	Optional
Hardware floating point	—	No	No	No	No
Hardware byte manipulation	—	Standard	Standard	—	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	No	No	No	No	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	—	—	—	—	833K
No. of external interrupt levels	—	None	None	None	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256K-512K bytes	1M bytes	2M bytes	No	256-512KB
Disk pack/cartridge drives	Cart.; 10-20 MB; nonrem.; 2.5-20 MB	No	No	Cartridge; 256K-9.2M bytes	2.5-192 MB
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	No
Magnetic tape, ½-inch	800-1600 bpi	No	No	No	36-200 KBS
Punched card input	300 cpm	No	No	280 cpm	No
Serial printer	30-175 cps	100 cps	80-100 cps	40 cps	30-180 cps
Line printer	Optional	70 lpm	70 lpm	120-600 lpm	150-600 lpm
Data Communications interface	Up to 9600 bps	To 9600 bps; synch.	To 9600 bps; synch.	To 9600 bps; synch.	110-9600 bps
CRT	80 char. x 24 lines	No	80 char. x 24 lines	No	24 char. x 80 lines
Other standard peripheral units	Paper tape reader, paper tape punch	Paper tape punch, card punch, mag. ledger card reader	Card punch	Paper tape units, card punch, mag. ledger card reader	A/D, 16-chan. 12-bit; D/A, 4-output 12-bit
SOFTWARE					
Assembler	No	Yes	Yes	Yes	Yes
Compilers	BASIC	—	PHOCAL	—	DIBOL (DBL), BASIC, FORTRAN
Operating system	Interactive, batch	Transaction	Transaction	Batch (one program)	TSX (time-sharing), RT-11
Language implemented in firmware	Partially	Partially	Partially	No	No
Operating system implemented in firmware	Partially	Partially	Partially	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$9,950	$7,500 (8K bytes)	$18,990 (24K bytes)	$13,500 (600 words)	$4,590 (64K bytes)
Price of memory increment	$850 (8K bytes)	$1,200 (8K bytes)	$1,500 (8K bytes)	$6,900 (6 words)	$1,050 (32K bytes)
Date of first delivery	January 1977	June 1975	July 1977	June 1970	January 1977
Number installed to date	NA	1550	275	2100	300
COMMENTS	Desktop computer features integrated 80-cps/80-col thermal printer, single floppy disk drive display, 16K user memory, and full typewriter keyboard with BASIC keywords and operating system commands	Asynch. communications speed to 2400 bps	Transaction-oriented business computer with strong emphasis on packaged application software	Asynch. communications speed to 2400 bps	The System-1 series is based on the DEC LSI-11/2 microcomputer; configurations come with all Q BUS and Unibus devices

All About Minicomputers

MANUFACTURER & MODEL	Plessey Peripheral Systems Syst-04	Plessey Peripheral Systems Syst-34	Plessey Peripheral Systems PM-1150/5RP	Prime 100	Prime 200
DATA FORMATS					
Word length, bits	16	16	16	16	16 + 2
Fixed-point operand length, bits	16	16	16	16, 32	16, 32
Instruction length, bits	16, 32, or 48	16, 32 or 48	16, 32, or 48	16, 32	16, 32
MAIN STORAGE					
Storage type	MOS or core	MOS or core	MOS or core	MOS	MOS
Cycle time, microseconds/word	0.5	0.5	0.5	1.0	0.750
Access time, microseconds/word	0.375	0.375	0.375	0.680	0.600
Minimum capacity, words	4K (MOS); 16K (core)	4K (MOS); 16K (core)	4K (MOS); 16K (core)	16K bytes	16K bytes
Maximum capacity, words	32K	128K	128K	128K bytes	128K bytes
Parity checking	Optional	Standard	Standard	No	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	8	8	8	1	1
No. of index registers	8	8	8	1	1
No. of directly addressable words	32K	32K	32K	64K	64K
No. of addressing modes	8	8	8	4	4
Control storage	No	No	No	No	No
Add time, microseconds	3.17	2.03	2.03	2.44	1.96
Hardware multiply/divide	Optional	Standard	Standard	Optional	Optional
Hardware floating point	No	Optional	Optional	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	Optional	Optional	Optional
Real-time clock or timer	Optional	Standard	Standard	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	2M	2M	2M	694K	1.0M
No. of external interrupt levels	Variable	Variable	Variable	64	64
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256-512 KB	256-512 KB	256-512 KB	512K-2.0M bytes	5.12K-2.0M bytes
Disk pack/cartridge drives	2.5-2032 MB	2.5-2032 MB	2.5-2032 MB	Pack & cartridge; 12-2400M bytes	Pack & cartridge; 12-2400M bytes
Drum/Fixed-head disk storage	No	No	No	Fixed-head; 512K-1M bytes	Fixed-head; 512K-1M bytes
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	36-200 KBS	36-200 KBS	36-200 KBS	To 120 KBS	To 120 KBS
Punched card input	No	No	No	285 cpm	285 cpm
Serial printer	30-180 cps	30-180 cps	30-180 cps	165 cps	165 cps
Line printer	150-600 lpm	150-600 lpm	150-600 lpm	To 1220 lpm	To 1220 lpm
Data Communications interface	110-9600 bps	110-9600 bps	110-9600 bps	To 56K bps	To 56K bps
CRT	24 char x 80 lines	24 char x 80 lines	24 char x 80 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	—	—	—	Paper tape, A/D and D/A conv., card reader/punch	Paper tape, A/D and D/A conv., card reader/punch
SOFTWARE					
Assembler	Yes	Yes	Yes	Macro assembler	Macro assembler
Compilers	BASIC, FORTRAN	BASIC, FORTRAN	BASIC, FORTRAN	BASIC, FORTRAN	BASIC, FORTRAN
Operating system	RSX-11M, RT-11	RSX-11M, RSTS/E, RT-11	RT-11, RSX-11M, RSTS/E	Batch, real-time, multi-user	Batch, real-time, multi-user
Language implemented in firmware	No	No	No	Partially	Partially
Operating system implemented in firmware	No	No	No	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	Available as systems only	Available as systems only	$19,500 (32KB)	$5,500 (16K bytes)	$6,800 (16K bytes)
Price of memory increment	$1,385 (32 KB)	$1,480 (32 KB), $2,130 (64 KB)	$1,480 (32 KB); $2,130 (64 KB)	$3,400 (16K bytes)	$3,900 (16K bytes)
Date of first delivery	June 1977	June 1977	November 1976	June 1973	November 1972
Number installed to date	100	350	175	650	300
COMMENTS	The System-04 series is based on the DEC PDP-11/04 minicomputer	The System-34 series is based on the DEC PDP-11/34 minicomputer	The PM-1150/5RP is a ruggedized version of the PDP-11/04 minicomputer		

All About Minicomputers

MANUFACTURER & MODEL	Prime 300	Prime 350	Prime 400	Prime 500	Qantel 210
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16 + 2 or + 6	16 + 2 or + 6	8
Fixed-point operand length, bits	16, 32	16, 32	16, 32	16, 32	—
Instruction length, bits	16, 32	16, 32, 48	16, 32, 48	16, 32, 48	24-48
MAIN STORAGE					
Storage type	MOS	MOS; bipolar	MOS; bipolar cache	MOS; bipolar cache	MOS
Cycle time, microseconds/word	0.750	0.750	0.760	0.760	0.8
Access time, microseconds/word	0.600	0.600	0.600	0.600	—
Minimum capacity, words	16K bytes	64K bytes	128K bytes	256K bytes	48K
Maximum capacity, words	128K bytes	768K bytes	8M bytes	8M bytes	64K
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	Optional	Standard	No
Storage protection	Std., 3 levels	Standard	Std.; 3 levels	Std.; 3 levels	No
CENTRAL PROCESSOR					
No. of accumulators	1	1 (32 bit)	1 (32-bit)	1 (32-bit)	1
No. of index registers	1	2 (32-bit)	2 (32-bit)	2 (32-bit)	0
No. of directly addressable words	64K	64K	64K	64K	64K
No. of addressing modes	4	4	4	4	3
Control storage	PROM; 512 x 64 bits	PROM; 2K x 64 bits	PROM; 2K x 64 bits	PROM; 2K x 64 bits	ROM
Add time, microseconds	1.56	Standard	0.56	0.56	22
Hardware multiply/divide	Standard	Standard	Standard	Standard	No
Hardware floating point	Optional	Standard	Standard	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	—	No	No	No
Real-time clock or timer	Optional	Standard	Standard	Standard	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	No
Maximum I/O rate, words/sec.	1.137M	1.2M	1.25M	1.25M	—
No. of external interrupt levels	64	64	64	64	None
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	512K-2.0M bytes	512K-2.0M bytes	512K-2.0M bytes	512-2.0M bytes	1.3-5.2MB
Disk pack/cartridge drives	Pack & cartridge; 12-2400M bytes	Pack & cartridge; 12-2400M bytes	Pack & cartridge; 2.9-1200M bytes	Pack & cartridge; 12-2400M bytes	No
Drum/Fixed-head disk storage	Fixed-head; 512K-1M bytes	Fixed-head; 512K-1M bytes	Fixed-head; 512K-1M bytes	Fixed-head; 512K-1M bytes	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	To 120 KBS	To 120 KBS	To 120 KBS	To 120 KBS	No
Punched card input	285 cpm	285 cpm	285 cpm	285 cpm	No
Serial printer	165 cps	165 cps	165 cps	165 cps	45-120 cps
Line printer	To 1220 lpm	To 1220 lpm	To 1220 lpm	To 1220 lpm	300 lpm
Data Communications interface	To 56K bps	To 56K bps	To 56K bps	To 56K bps	1200 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	64 char. x 27 lines
Other standard peripheral units	Paper tape, A/D and D/A conv. card reader/punch	Paper tape, A/D and D/A conv., card reader/punch	Paper tape, A/D and D/A conv., card reader/punch	Paper tape, A/D and D/A conv., card reader/punch	None
SOFTWARE					
Assembler	Macro and micro assemblers	Macro assembler	Macro and micro assemblers	Macro and micro assemblers	Yes
Compilers	BASIC, FORTRAN, COBOL, RPG II	BASIC, FORTRAN, COBOL, RPG II	BASIC, FORTRAN, RPG II, COBOL, FORMS	BASIC, FORTRAN, RPG, COBOL, FORMS	QIC (BASIC)
Operating system	Real-time, multi-user, virtual memory	Virtual memory, batch, real-time	Real-time, multi-user; virtual memory	Real-time, multi-user, virtual memory	Time-sharing
Language implemented in firmware	Partially	Partially	Partially	Partially	Partially
Operating system implemented in firmware	Partially	Partially	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$17,600 (16K bytes)	$35,000 (64KB)	$65,100 (128K bytes)	$125,500 (256K bytes)	$11,950 (system price)
Price of memory increment	$8,500 (64K bytes)	$8,500 (64KB); $31,000 (256KB)	$8,500 (64K bytes)	$30,000 (256K bytes)	$1,450 (16K bytes)
Date of first delivery	September 1973	April 1978	March 1976	March 1976	4th qtr. 1977
Number installed to date	450	50	250	10	Over 2000 (all models)
COMMENTS	Virtual memory management system permits addressing up to 128K bytes per user	Virtual memory management system permits addressing up to 128K bytes per user. Monthly maintenance $110; system has 90-day warranty	Virtual memory management system permits addressing up to 512M bytes per user; 2K-byte cache memory std.; 2 to 1 memory interleaving std.	Virtual memory management system permits addressing up to 512M bytes per user; 2K-byte cache memory std.; 2 to 1 memory interleaving std.	Basic system price includes 48K bytes of memory, CRT, and 1.3M-byte disk unit

All About Minicomputers

MANUFACTURER & MODEL	Qantel 950	Qantel 960	Qantel 970	Qantel 1400	Qantel 1400-2
DATA FORMATS					
Word length, bits	8	8	8	8	8
Fixed-point operand length, bits	—	—	—	—	—
Instruction length, bits	24-48	24-48	24-48	24-48	24-48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	1.5	1.5	0.8	1.1	1.1
Access time, microseconds/word	—	—	—	—	—
Minimum capacity, words	48K	48K	128K	40K	48K
Maximum capacity, words	48K	64K	256K	128K	128K
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	1	1	1	1	1
No. of index registers	0	0	0	0	0
No. of directly addressable words	48K	64K	256K	128K	128K
No. of addressing modes	3	4	4	4	4
Control storage	ROM	ROM	ROM	ROM	ROM
Add time, microseconds	18	8	4	8	8
Hardware multiply/divide	No	No	Standard	No	No
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	NA	No	No
Real-time clock or timer	Optional	Optional	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	667K	909K	375K	909K	909K
No. of external interrupt levels	1	1	1	1	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	1.3-5.2 MB	1.3-5.2 MB	1.3-5.2 MB	1.3-5.2 MB	1.3-5.2 MB
Disk pack/cartridge drives	Cart.; 6-36 MB	Cart; 6-36 MB	Cart; 12-36 MB	Cart; 12-48 MB	Fixed; moving heads; 25-600 MB
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	36-72 KBS	36-72 KBS	36-72 KBS	36-72 KBS	36-72 KBS
Punched card input	500 cpm	500 cpm	500 cpm	500 cpm	500 cpm
Serial printer	45-120 cps	45-120 cps	45-120 cps	45-120 cps	45-120 cps
Line printer	300-600 lpm	300-600 lpm	300-600 lpm	300-600 lpm	300-600 lpm
Data Communications interface	To 50K bps	To 50K bps	To 50K bps	Up to 50K bps	Up to 50K bps
CRT	64 char. x 27 lines	64 char. x 27 lines	64 char. x 27 lines	64 char. x 27 lines	64 char. x 27 lines
Other standard peripheral units	None	None	None	None	None
SOFTWARE					
Assembler	Yes	Yes	Yes	Yes	Yes
Compilers	QIC (BASIC)	QIC (BASIC)	QIC (BASIC)	QIC (BASIC)	QIC (BASIC)
Operating system	Time-sharing	Time-sharing	Time-sharing	Time-sharing	Time-sharing
Language implemented in firmware	Partially	Partially	Partially	Partially	Partially
Operating system implemented in firmware	Partially	Partially	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$27,900 (system price)	$27,900 (system price)	$69,900	$43,900 (system price)	$64,900 (system price)
Price of memory increment	$1,450 (16K bytes)	$1,450 (8K bytes)	See Comments	$1,450 (8K bytes)	$1,450 (8K bytes)
Date of first delivery	1st qtr. 1975	3rd qtr. 1976	Avail. 1st qtr. 1979	2nd qtr. 1977	2nd qtr. 1977
Number installed to date	Over 2000 (all models)	Over 2000 (all models)	Over 2000 (all models)	Over 2000 (all models)	Over 2000 (all models)
COMMENTS	Basic system price includes 48K bytes of memory, CRT, 6-MB disk unit, and 45-cps printer	Basic system price includes 48K bytes of memory, CRT, 6-MB disk unit, and 45-cps printer	Basic system price includes 128K bytes of memory, CRT, 12-MB disk unit, and 50-100-lpm printer; Memory increment prices are $1,000 for initial purchase of 32 KB, $2,950 for up-grading an existing system with 32 KB	Basic system price includes 40K memory, 12-MB disk, CRT, and 300-lpm printer	Basic system price includes 48K memory, 25-MB disk, 2 CRTs, and 300-lpm printer

All About Minicomputers

MANUFACTURER & MODEL	Qantel 1450	Qantel 1450-2	Randal Link 100	Randal Link 200	Randal Link 500
DATA FORMATS					
Word length, bits	8	8	16	16	16
Fixed-point operand length, bits	—	—	Variable	Variable	Variable
Instruction length, bits	24-48	24-48	16, 32, 48	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.8	0.8	0.3	0.3	0.3
Access time, microseconds/word	—	—	0.3	0.3	0.3
Minimum capacity, words	128K	128K	16K	16K bytes	16K
Maximum capacity, words	1024K (1 MB)	1024K (1 MB)	32K	32K bytes	64K
Parity checking	Standard	Standard	No	No	No
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	1	1	4	4	4
No. of index registers	0	0	2	2	2
No. of directly addressable words	1024K (One MB)	1024K (One MB)	512	512	512
No. of addressing modes	4	4	4	4	4
Control storage	ROM	ROM	ROM; 256 × 64 bits	ROM; 256 × 64 bits	ROM; 256 × 64 bits
Add time, microseconds	4	4	1.2	1.2	1.2
Hardware multiply/divide	Standard	Standard	No	No	No
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	Standard	Standard	No	No	No
Battery backup	—	—	No	No	No
Real-time clock or timer	Optional	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	No	No	Standard	Standard	Standard
Maximum I/O rate, words/sec.	—	—	800K	800K	800K
No. of external interrupt levels	1	1	1	1	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	1.3-5.2 MB	1.3-5.2 MB	4K-2.4M bytes	400K-6M bytes	4K-2.4M bytes
Disk pack/cartridge drives	Fixed, moving heads; 25-600 MB	Fixed, moving heads; 25-600 MB	Cartridge; 4-40M bytes	Cartridge; 10-40M bytes	Cartridge; 4-40M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	36-72 KBS	36-72 KBS	10-72 KBS	10-72 KBS	10-72 KBS
Punched card input	500 cpm	500 cpm	450 cpm	450 cpm	450 cpm
Serial printer	45-120 cps	45-120 cps	30-180 cps	30-180 cps	30-180 cps
Line printer	300-600 lpm	300-600 lpm	300 lpm	300 lpm	300 lpm
Data Communications interface	Up to 50K bps	Up to 50K bps	9600 bps	Up to 9600 bps	9600 bps
CRT	64 char. × 27 lines	64 char. × 27 lines	84 char. × 24 lines	80 char. × 12 lines	84 char. × 24 lines
Other standard peripheral units	None	None	—	—	—
SOFTWARE					
Assembler	Yes	Yes	No	No	No
Compilers	QIC (BASIC)	QIC (BASIC)	No	No	No
Operating system	Time-sharing	Time-sharing	Time-sharing	Time-sharing	Time-sharing
Language implemented in firmware	Partially	Partially	No	No	No
Operating system implemented in firmware	Partially	Partially	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$44,900	$69,900	$12,750	$12,750 (16K bytes)	$45,900
Price of memory increment	$2,950 (52K bytes)	See Comments	$1,900 (16K bytes)	$1,900 (16K bytes)	$2,950 (32K bytes)
Date of first delivery	1st qtr. 1979	1st qtr. 1979	October 1975	August 1976	October 1977
Number installed to date	—	—	225	225	3
COMMENTS	Basic system price includes 128K bytes of memory, 2 CRT's, 12-MB disk, and 300-lpm printer	Basic system price includes 128K bytes of memory, 2 CRT's, 25-MB sealed disk unit, 1600-bpi tape drive, and 300-lpm printer, memory increment prices are the same as for Qantel 970 system	Sold as packaged business system only; includes hard-copy terminal and 630K-byte diskette drive	Available only in packaged business system; price also includes CRT and 10-megabyte disk drive	Sold as packaged business system only; includes 180-cps printer, CRT, 50M-byte disk drive, and 1.2M-byte floppy drive

All About Minicomputers

MANUFACTURER & MODEL	Raytheon RDS-500	Raytheon RDS-5000	Rolm 1602A (AN/UYK-19)	Rolm 1603A (AN/UYK-12)	Rolm 1606 (AN/UYK-19)
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16	16	16
Fixed-point operand length, bits	16	16	16, 32	16	16, 32
Instruction length, bits	16, 32	16, 32	16, 32	16, 32	16, 32, 48
MAIN STORAGE					
Storage type	Core or MOS	Core or MOS	Core	Core	Core
Cycle time, microseconds/word	0.700	0.700	1.0	1.2	1.0
Access time, microseconds/word	0.450	0.450	0.5	0.6	0.5
Minimum capacity, words	16K	64K	16K	16K	16K
Maximum capacity, words	64K	448K	64K	32K	1024K
Parity checking	Standard	Standard	No	No	No
Error correction	Standard (MOS)	Standard (MOS)	No	No	No
Storage protection	Standard	Standard	No	No	Standard
CENTRAL PROCESSOR					
No. of accumulators	8 G.P. registers	8 G.P. registers	4	4	4
No. of index registers	8 G.P. registers	8 G.P. registers	2	2	2
No. of directly addressable words	64K	64K	64K	32K	64K
No. of addressing modes	2	3	5	4	6
Control storage	No	No	ROM; 1K x 56 bits	—	ROM; 4K x 36 bits
Add time, microseconds	1.4	1.4	1.0	5.9	1.0
Hardware multiply/divide	Standard	Standard	Standard	Optional	Standard
Hardware floating point	Optional	Optional	Optional	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	No	No	No
Real-time clock or timer	Optional	Standard	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	2M	14M	666K	768K	1M
No. of external interrupt levels	16	16/112	16	16	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	Yes	Yes	0.6-1.2M bytes
Disk pack/cartridge drives	Cartridge & pack; 2.5-920 bytes	Pack; 8 drives; 60-2000M bytes	Cartridge; 5-10M bytes	Cartridge; 5-10M bytes	Cartridge & Pack; 5-160M bytes
Drum/Fixed-head disk storage	Fixed-head; 770K-25.2M bytes	No	Fixed-head; 2M bytes	Fixed-head; 2M bytes	Fixed-head; 0.5-4M bytes
Magnetic tape cassettes/cartridges	Cassette	Cassette	No	No	No
Magnetic tape, ½-inch	30-468 KBS	8 drives; 468 KBS	60 KBS	60 KBS	60 KBS
Punched card input	300, 1000 cpm	300, 1000 cpm	300 cpm	300 cpm	300 cpm
Serial printer	10-165 cps	10-165 cps	60 cps	60 cps	60 cps
Line printer	300-1250 lpm	300-1250 lpm	1100 lpm	1100 lpm	1100 lpm
Data communications interface	To 19.2K bps	To 19.2 bps	20K bps	20K bps	20K bps
CRT	80 char. × 24 lines	1920 characters	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines
Other standard peripheral units	Apollo Array Processor, plotters, A/D and D/A converters	A/D converters, plotters, array processor, bulk memory	Paper tape units D/A & A/D converters, NTDS 1533	Paper tape units, D/A & A/D converters	Paper tape units, D/A & A/D converters, NTDS 1533
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	FORTRAN	FORTRAN	ALGOL, BASIC, FORTRAN	ALGOL, BASIC, FORTRAN	ALGOL, BASIC, FORTRAN
Operating system	Batch, real-time multiprogramming	Multiprocessing	Batch, real-time	Batch, real-time	Batch, real-time
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$15,800 (32K words)	$18,300 (32KB)	$25,250 (16K words)	$13,400 (16K words)	$43,900
Price of memory increment	$3,750 (16K words)	$3,750 (16 KW)	$7,000 (16K words)	$6,000 (16K words)	$7,000 (16 KW)
Date of first delivery	February 1973	1977	1977	1976	1978
Number installed to date	Over 750	NA	Approx. 500	90	100
COMMENTS	Apollo Array Processor can perform 22 specialized array operations	Multiprocessing system	Qualified to Mil-E-5400 & Mil-E-16400 specif.; ATR chassis; micro-programmed militarized CPU	Qualified to Mil-E-5400 & Mil-E-16400 specif.; ATR chassis; low-priced, faster version of previously offered Model 1603; Model compatible with DG Nova	Qualified to Mil-E-16400; system used on Navy DPEWS (AN/SLQ-32); same as 1666 except for floating-point capability

All About Minicomputers

MANUFACTURER & MODEL	Rolm 1650 (AN/UYK-19)	Rolm 1664 (AN/UYK-19)	Rolm 1666 (AN/UYK-19)	Systems Approach Ltd. IM/70	Systems Approach Ltd. IM/70 Designer's Workbench
DATA FORMATS					
Word length, bits	16	16	16	16	16
Fixed-point operand length, bits	16, 32	16, 32	16, 32	8, 16	8, 16
Instruction length, bits	16, 32	16, 32, 48	16, 32, 48	8, 16	8, 16
MAIN STORAGE					
Storage type	Core	Core	Core	MOS, core	MOS, core
Cycle time, microseconds/word	1.0	1.0	1.0	0.6/1.2	0.6/1.2
Access time, microseconds/word	0.5	0.5	0.5		
Minimum capacity, words	16K	16K	16K	1K	1K
Maximum capacity, words	32K	64K	1024K	32K	32K
Parity checking	No	No	No	NA	NA
Error correction	No	No	No	No	No
Storage protection	Optional	Optional	Standard	No	No
CENTRAL PROCESSOR					
No. of accumulators	4	12	4	1	1
No. of index registers	2	2	2	1	1
No. of directly addressable words	32K	64K	64K	512 × 256	512 × 256
No. of addressing modes	5	6	6	12	12
Control storage	PROM; 1K × 52 bits	ROM; 4K × 32 bits	ROM; 4K × 36 bits	ROM; 256 words	ROM; 256 words
Add time, microseconds	1.05	1.0	1.0	5.4	5.4
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Standard	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Optional	Optional	Optional	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	666K	1M	1M	1.7M	1.7M
No. of external interrupt levels	16	16	16	3	3
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Yes	Yes	Yes; 0.6-1.2 MB	4 × 0.33 M bytes	4 × 0.33 M bytes
Disk pack/cartridge drives	Cartridge; 5-10M bytes	Cartridge; 5-10M bytes	Pack & Cartridge; 5-160M bytes	4 × 40M bytes	4 × 40M bytes
Drum/Fixed-head disk storage	Fixed-head; 2M bytes	Fixed-head; 2M bytes	Fixed-head; 0.5-4.0M bytes	No	No
Magnetic tape cassettes/cartridges	NA	No	No	No	No
Magnetic tape, ½-inch	60 KBS	60 KBS	60 KBS	NA	No
Punched card input	300 cpm	300 cpm	300 cpm	1,100 cpm	No
Serial printer	60 cps	60 cps	60 cps	No	1
Line printer	1100 lpm	1100 lpm	1100 lpm	7,900 lpm	1,300-900 lpm
Data Communications interface	20K bps	20K bps	20K bps	12, up to 19.2K bps	Yes
CRT	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines	NA	Yes
Other standard peripheral units	Paper tape units, D/A & A/D units, NTDS, 1533	Paper tape units, D/A & A/D converters	Paper tape units, D/A & A/D converters, NTDS, 1533	OMR card reader	Graphics terminal
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	No	No
Compilers	ALGOL, BASIC, FORTRAN	ALGOL, BASIC, FORTRAN	ALGOL, BASIC, FORTRAN	FORTRAN, BASIC, PASCAL	GRAPPLE
Operating system	Batch, real-time	Batch, real-time	Batch, real-time	Time-sharing	Interactive
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$26,250 (16K words)	$39,450 (16K words)	$48,900	$19,145	$19,145
Price of memory increment	$7,000 (16K words)	$7,000 (16K words)	$7,000 (16K words)	$5,845 (32K bytes)	$5,845 (32K bytes)
Date of first delivery	1976	1976	1977	3rd qtr. 1975	3rd qtr. 1975
Number installed to date	NA	100	40	30	16
COMMENTS	Designed to meet Mil-E-5400 & Mil-E-16400 specif.; half ATR version of Rolm 1602-A	Designed to meet Mil-E-5400 & Mil-E-16400 specif.; ATR chassis; tri-processor militarized computer, upward-compatible with other Rolm computers	Qualified to Mil-E-5400 & Mil-E-16400; Std. 64K-bit floating-point arithmetic; std. memory mgmt. for up to 10 words; complete protection and security features	Features include simultaneous RJE communications to 3 mainframes; RJE concurrent with multi-user WILBUR program development; batch submission capability from a local or remote user CRT terminal; prices are Canadian	The Designer's Workbench is a low-cost, stand-alone graphics minicomputer suited to interactive design and drafting; prices are Canadian

All About Minicomputers

MANUFACTURER & MODEL	Systems Engineering Laboratories 32/35	Systems Engineering Laboratories 32/55	Systems Engineering Laboratories 32/75	Tandem Computers TI6/1102	Tandem Computers TI6/1403
DATA FORMATS					
Word length, bits	32 + 4	32 + 4	32 + 4	16 + 1	16 + 1
Fixed-point operand length, bits	16, 32	16, 32	16, 32	8, 16, 32, 48	8, 16, 32, 48
Instruction length, bits	16, 32	16, 32	16, 32	16	16
MAIN STORAGE					
Storage type	Core	Core	Core	Core	MOS
Cycle time, microseconds/word	0.9	0.6	0.6/0.9	0.8	0.5
Access time, microseconds/word	0.45	0.3	0.3/0.45	0.5	0.5
Minimum capacity, words	16K	8K	32K	32K	32K
Maximum capacity, words	128K	256K	4M	256K	256K
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	No	No	No	No	Standard
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	8	8	8	8	8
No. of index registers	3	3	3	3	3
No. of directly addressable words	128K	128K	128K	128K	128K
No. of addressing modes	4	4	4	5	5
Control storage	PROM; 2K × 48 bits	PROM; 4K × 48 bits	ROM	PROM; 4K × 32 bits	PROM; 4K × 32 bits
Add time, microseconds	1.8	1.2	1.2/1.8	0.5	0.5
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	Standard	Standard	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	Standard
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	6.67M	6.67M	6.67M	NA	NA
No. of external interrupt levels	6-112	6-112	6-112	16	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	No
Disk pack/cartridge drives	Pack & cartridge; 5-1200M bytes	Pack & cartridge; 5-1200M bytes	Pack & cartridge; 5-1200M bytes	Pack & cartridge; 10M-24M bytes	Pack & cartridge; 10M-24M bytes
Drum/Fixed-head disk storage	Fixed-head; 1-8M bytes	Fixed-head; 1-8M bytes	Fixed-head; 1-8M bytes	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	72-120 KBS	72-120 KBS	72-120 KBS	36-120 KBS	36-120 KBS
Punched card input	300-1000 cpm	300-1000 cpm	400-1000 cpm	600 cpm	600 cpm
Serial printer	No	No	No	Yes	Yes
Line printer	125-600 lpm	125-600 lpm	125-600 lpm	300-1500 lpm	300-1500 lpm
Data Communications interface	50K bps; synch.	50K bps; synch.	50K bps; synch.	50-80K bps	50-80K bps
CRT	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines
Other standard peripheral units	Card punch, TTY, A/D, D/A equip.	Card punch, TTY, A/D, D/A equip.	Paper tape equip.	None	None
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler, macro assembler	Assembler, macro assembler
Compilers	FORTRAN IV, BASIC, COBOL	FORTRAN IV, BASIC, COBOL	BASIC, FORTRAN, COBOL	COBOL, TAL, FORTRAN	COBOL, TAL, FORTRAN
Operating system	Real-time	Real-time	Real-time	Multiprocessing, multiprog., virt. mem.	Multiprocessing, multiprog., virt. mem.
Language implemented in firmware	No	No	No	Partially	Partially
Operating system implemented in firmware	No	No	No	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$27,000	$49,000	$72,300	$20,400	$22,000
Price of memory increment	$13,000 (128K bytes	$21,000 (128K bytes)	$8,500 (128K bytes)	$8,000 (64K bytes)	$9,600 (96K bytes with ECC)
Date of first delivery	August 1976	October 1975	January 1978	May 1976	May 1976
Number installed to date	10	250	—	206 processors	206 processors
COMMENTS	Asynch. communications to 9600 bps; instruction look-ahead utilized	Asynch. communications to 9600 bps	600 and 800-nanosecond memory; minimum configuration is CPU with 32K words of memory, real-time clock, control panel, power supplies, cabinet, chassis, tie controller	Multiprocessor system containing from 2 to 16 CPU's for fault-tolerance; all system components are dual-ported; CPU's have dual buses	Multiprocessor system containing from 2 to 16 CPU's for fault-tolerance; all system components are dual-ported; CPU's have dual buses

All About Minicomputers

MANUFACTURER & MODEL	Tektronix 4051	Texas Instruments 960B	Texas Instruments 980B	Texas Instruments 990/4	Texas Instruments 990/10
DATA FORMATS					
Word length, bits	8-bit byte	16 + 6	16 + 6	16 + 1	16 + 1 or + 16
Fixed-point operand length, bits	8	8, 16	8, 16	8, 16	8, 16
Instruction length, bits	8, 16, 24	32	16, 32, 48	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	1.2	0.75	0.75	0.65	0.65
Access time, microseconds/word	0.45	—	—	—	—
Minimum capacity, words	8K bytes	8K	8K	1K	8K
Maximum capacity, words	32K bytes	64K	64K	32K	1024K
Parity checking	No	No	No	Optional	Standard
Error correction	No	Standard	Standard	No	Optional
Storage protection	No	Standard	Standard	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	2	16	2	Unlimited (memory)	Unlimited (memory)
No. of index registers	1	16	1	Unlimited (memory)	Unlimited (memory)
No. of directly addressable words	32K	64K	64K	64K	32K
No. of addressing modes	7	15	15	8	8
Control storage	ROM; 36K-156K bytes	ROM; 256 × 16 bits	ROM; 256 × 16 bits	ROM	No
Add time, microseconds	2.0	3.6	1.75	4.7	3.6
Hardware multiply/divide	No	Optional	Standard	Standard	Standard
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	Standard	No	Standard	Standard	Standard
Battery backup	No	Optional	Optional	—	—
Real-time clock or timer	No	Optional	Optional	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Standard	Standard	No	Standard
Maximum I/O rate, words/sec.	3.5K	1.3M	1M	1.5M	3M
No. of external interrupt levels	No	3-2048	4-32	8 vectored interrupts	16 vectored interrupts
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	630K-1.9M bytes	No	No	242-968K bytes	242-968K bytes
Disk pack/cartridge drives	No	Cartridge & pack; 2.28-392M bytes	Cartridge & pack; 2.28-392M bytes	No	Cartridge; 3-200M bytes
Drum/Fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	300K bytes each	Cassette; 120 cps	Cassette; 120 cps	Cassette; 120 cps	Cassette; 120 cps
Magnetic tape, ½-inch	No	30 KBS	30 KBS	No	30-60 KBS
Punched card input	No	300 cpm	300 cpm	400 cpm	400 cpm
Serial printer	60, 180 cps	30-330 cps	30-330 cps	30-150 cps	30-150 cps
Line printer	No	No	No	300-600 lpm	300-600 lpm
Data Communications interface	2400 asyn.; 9600 sync.	110-9600 bps	110-9600 bps	75-9600 bps	75-9600 bps
CRT	72 char. × 35 lines	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines
Other standard peripheral units	Plotters, RS-232C printer interface, CRT hard-copy unit, graphic joystick	Process control interfaces, A/D & D/A converters	Paper tape units	PROM programmer	PROM programmer
SOFTWARE					
Assembler	No	Assembler & macro preprocessor	Assembler & macro preprocessor	Yes	Assembler & macro assembler
Compilers	No	FORTRAN	FORTRAN, BASIC	FORTRAN	FORTRAN, BASIC, COBOL, PASCAL, RPG II
Operating system	Single-user, real-time	Single-user, real-time, multiprgrming.	Singler-user, multi-programming	Real-time, multi-task	Real-time, multi-task
Language implemented in firmware	Fully	No	No	No	No
Operating system implemented in firmware	Fully	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$5,995 (8K bytes)	$4,500 (8K words)	$5,150 (8K words)	$1,525 (256 words)	$3,450 (8K words)
Price of memory increment	$1,400 (8K bytes)	$1,400 (8K words)	$1,400 (8K words)	$575 (4K words)	$900 (8K words); $1,500 (8K ERCC)
Date of first delivery	December 1975	May 1974	May 1974	March 1976	March 1976
Number installed to date	NA	NA	NA	NA	NA
COMMENTS	Based on Motorola/AMI 6800; processor is transparent to user since all programming is in extended BASIC; extensions in BASIC include device-independent key words for I/O, polling and interrupt handling on built-in IEEE interface bus	Heavily supported for process control applications		Based on TI's TMS9900 16-bit microprocessor	MSI implementation of 990/4 CPU with enhancements; can have up to 16 disk controllers per CPU; 2M bytes with memory mapping

All About Minicomputers

MANUFACTURER & MODEL	Univac BC/7 600	Univac BC/7 700	Univac BC/7 800	Univac V73	Univac V76
DATA FORMATS					
Word length, bits	8	8	8	16 + 2	16 + 2
Fixed-point operand length, bits	8	8	8	16 (8, 32 opt.)	8, 16, 32
Instruction length, bits	8, 16, 24	8, 16, 24	8, 16, 24	16, 32	16, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core; MOS	MOS
Cycle time, microseconds/word	1.0	1.0	1.0	0.66; 0.33	0.66
Access time, microseconds/word	0.5	0.5	0.5	—	—
Minimum capacity, words	48K bytes	48K bytes	128K bytes	8K	16K
Maximum capacity, words	64K bytes	64K bytes	128K bytes	256K	1024K
Parity checking	Standard	Standard	Standard	Optional	Optional
Error correction	No	No	No	No	No
Storage protection	No	No	No	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	1	1	1	3	8
No. of index registers	6	6	6	1	7
No. of directly addressable words	64K bytes	64K bytes	64K bytes	2K	2K
No. of addressing modes	3	3	3	8	8
Control storage	4K bytes	4K bytes	4K bytes	WCS; 4K × 64 bits	WCS; 4K × 64 bits
Add time, microseconds	106 (5 digits)	106 (5 digits)	106 (5 digits)	1.32; 0.66	1.32
Hardware multiply/divide	—	—	—	Standard	Standard
Hardware floating point	—	—	—	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Optional	Standard
Battery backup	No	No	No	Optional	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	1M bytes	1M bytes	1M bytes	1M	1M
No. of external interrupt levels	5	5	5	8-64	8-64
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	2M-6M bytes	2M-6M bytes	2M-6M bytes	No	No
Disk pack/cartridge drives	No	Cartridge; 5M-40M bytes	Cartridge; 10M-40M bytes	Cartridge & pack; 2.34-373.6M bytes	Cartridge & pack; 2.34-373.6M bytes
Drum/Fixed-head disk storage	No	No	No	Fixed-head; 123-492K bytes	Fixed-head; 123-492K bytes
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	No	20, 40 KBS	20, 40 KBS	20, 30 KBS	20, 30 KBS
Punched card input	300-600 cpm	300-600 cpm	300-600 cpm	300 cpm	300 cpm
Serial printer	200 cps	200 cps	200 cps	10, 165 cps	10, 165 cps
Line printer	125 lpm	125-600 lpm	125-600 lpm	300-2000 lpm	300-2000 lpm
Data Communications interface	9600 bps	9600 bps	9600 bps	To 50K bps	To 50K bps
CRT	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines	80 char. × 24 lines
Other standard peripheral units	Punched card reader	Punched card reader	Punched card reader	Statos line of printer/plotters; A/D & D/A converters	Statos line of printer/plotters; A/D & D/A converters
SOFTWARE					
Assembler	No	No	No	Macro assembler & micro assembler	Macro assembler & micro assembler
Compilers	RPG II, ESCORT	RPG II, ESCORT	RPG II, ESCORT	FORTRAN, BASIC, COBOL, RPG	FORTRAN, BASIC, COBOL, RPG
Operating system	Interactive, batch	Interactive, batch	Interactive, batch	Batch, real-time, multi-task	Batch, real-time, multi-task
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel and min. mem. in chassis	$21,795 (48K bytes)	$31,200 (48K bytes)	$35,475 (128K bytes)	$15,530 (8K words)	$8,400 (16K words)
Price of memory increment	$1,100 (16K bytes)	$1,100 (16K bytes)	$1,100 (16K bytes)	$5,000 (8K MOS); $3,500 (8K core)	$2,900 (16K words)
Date of first delivery	April 1977	April 1977	July 1978	November 1972	January 1976
Number installed to date	NA	NA	NA	NA	NA
COMMENTS	System price includes CRT workstation, dual diskette drives, 200-cps printer, and I/O controllers	System price includes CRT workstation, 5-megabyte disk drive, 200-cps printer, and I/O controllers	System price includes CRT workstation, 10-megabyte disk drive, 200-cps printer, and I/O controllers	Dual-ported memories; odd/even interleaving for core memories standard; TOTAL data base management system available	Dual-ported memories; optional 1K-word cache memory; TOTAL data base management system available

All About Minicomputers

MANUFACTURER & MODEL	Univac V77-200	Univac V77-400	Univac V77-600	Univac 9200 & 9300
DATA FORMATS				
Word length, bits	16	16	16	8-bit byte
Fixed-point operand length, bits	16	16	16	1-32
Instruction length, bits	16, 32	16, 32	16, 32	16, 32, 48
MAIN STORAGE				
Storage type	MOS	MOS	MOS	Plated wire
Cycle time, microseconds/word	0.66	0.66	0.66	1.2; 0.6
Access time, microseconds/word	0.56	0.56	0.56	—
Minimum capacity, words	8K	8K	16K	8K bytes
Maximum capacity, words	32K	1024K	1024K	32K bytes
Parity checking	Optional	Optional	Optional	Standard
Error correction	No	No	No	No
Storage protection	Optional	Std., with mega map	Standard	No
CENTRAL PROCESSOR				
No. of accumulators	2	8	8	8
No. of index registers	2	7	7	8
No. of directly addressable words	32K	32K	2048	—
No. of addressing modes	8	8	8	—
Control storage	ROM; 512 x 24	ROM	WCS, 4K x 64 bits	No
Add time, microseconds	2.31	2.64	0.66-2.15	40.8; 20.4 (16 bits)
Hardware multiply/divide	Standard	Standard	Standard	See Comments
Hardware floating point	No	Optional	Optional	No
Hardware byte manipulation	Standard	Standard	Standard	Standard
Battery backup	Optional, 1.5 hrs.	Optional, 8 hrs	Optional	No
Real-time clock or timer	Standard	Standard	Standard	No
INPUT/OUTPUT CONTROL				
Direct memory access channel	Standard	Standard	Standard	Optional
Maximum I/O rate, words/sec.	319K	1.5M	1.51M	312K
No. of external interrupt levels	8-64	8-64	8-64	—
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	No	No	No	No
Disk pack/cartridge drives	Cartridge & pack; 2.34-312M bytes	Cartridge & pack; 2.34-1031M bytes	Cartridge & pack; 515.6 words	Pack & cartridge; 3.2-1860M bytes
Drum/Fixed-head disk storage	No	No	Fixed-head; 246K words	No
Magnetic tape cassettes/cartridges	No	No	No	No
Magnetic tape, ½-inch	135 KBS	135 KBS	20, 30 KBS	34, 68 KBS
Punched card input	300 cpm	300 cpm	300 cpm	400-1000 cpm
Serial printer	165 cps	165 cps	165 cps	30 cps
Line printer	300/600 lpm	300 600 lpm	300-600 lpm	250-2000 lpm
Data Communications interface	50K bytes	50K bytes	50K bytes	To 250K bytes
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	—
Other standard peripheral units	Consult mfr.	Consult mfr.	Paper tape units, plotters	Paper tape reader/ punch, card punch
SOFTWARE				
Assembler	Assembler, macro assembler	Assembler, macro assembler	Macro assembler & micro assembler	Yes
Compilers	FORTRAN IV, BASIC, RPG II	FORTRAN IV, BASIC, COBOL, RPG II	FORTRAN, BASIC COBOL, RPG	COBOL, FORTRAN, RPG
Operating system	Batch, real-time	Batch, real-time	Batch, real-time, multi-tasking	Batch real-time timesharing
Language implemented in firmware	No	No	No	No
Operating system implemented in firmware	No	No	No	No
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel and min. mem. in chassis	$5,350 (8K words)	$7,850 (8K words)	$13,950 (16K words)	$34,176 (8K—9200) $57,120 (8K-9300)
Price of memory increment	$1350 (8K words)	$1,350 (8K words)	$2,900 (16K words)	$13,008 (4K—9200) $15,120 (4K—9300)
Date of first delivery	NA	NA	December 1976	3rd quarter 1966
Number installed to date	NA	NA	NA	NA
COMMENTS				Multiply & divide are optional on 9200 & 9300 card system, and standard on all others; no longer being manufactured

All About Minicomputers

MANUFACTURER & MODEL	Univac 90/25	Univac 90/30	Univac 90/40	Wang PCS-II
DATA FORMATS				
Word length, bits	8-bit	8-bit byte	8-bit byte	8-bit byte
Fixed-point operand length, bits	1-32	1-32	1-32	8
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	8
MAIN STORAGE				
Storage type	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.65	0.6 (2-byte fetch)	0.5 (2-byte fetch)	1.6
Access time, microseconds/word	—	—	—	—
Minimum capacity, words	64K bytes	64K bytes	512K bytes	8K bytes
Maximum capacity, words	163K bytes	524K bytes	1024K bytes	32K bytes
Parity checking	Standard	Standard	Standard	No
Error correction	No	No	No	No
Storage protection	Optional	Optional	Optional	No
CENTRAL PROCESSOR				
No. of accumulators	16	16	16	NA
No. of index registers	16	16	16	NA
No. of directly addressable words	—	—	—	—
No. of addressing modes	—	—	—	—
Control storage	ROM; 1K x 32 bits	ROM, 1K x 82 bits	ROM; 1K x 82 bits	ROM; 425K bytes
Add time, microseconds	7.8 (32 bits)	5.4 (32 bits)	4.1 (32 bits)	800
Hardware multiply/divide	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No
Real-time clock or timer	Standard	Standard	Standard	Optional
INPUT/OUTPUT CONTROL				
Direct memory access channel	Standard	Standard	Standard	No
Maximum I/O rate, words/sec.	760K bytes	1.8M	1.8M	10K
No. of external interrupt levels	6	6	6	None
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	972K	972K bytes	972K bytes	89-178K bytes
Disk pack/cartridge drives	Pack, cartridge; 33-116M bytes	Pack; 33-3200M bytes	Pack; 33-3200M bytes	No
Drum/Fixed-head disk storage	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	Cassette 326 bps
Magnetic tape, ½-inch	40 KBS	5-320 KBS	5-320 KBS	No
Punched card input	300 cpm	300-1000 cpm	300-1000 cpm	300 cpm
Serial printer	30 cps	70-160 cps	70-160 cps	200 cps
Line printer	300-500 lpm	300-2000 lpm	300-2000 lpm	600 lpm
Data Communications interface	50K bps	To 50K bps	To 50K bps	To 9600 bps
CRT	64 char x 16 lines	64 char x 16 lines	64 char x 16 lines	64 char x 16 lines
Other-standard peripheral units	Paper tape, card punch	Paper tape reader/punch, card punch	Paper tape reader/punch, card punch	Plotter
SOFTWARE				
Assembler	Assembler & macro assembler	Yes	Yes	No
Compilers	COBOL, FORTRAN, RPG II, BASIC	COBOL, FORTRAN, RPG II	COBOL, FORTRAN, RPG II	BASIC
Operating system	Batch, real-time	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Interactive
Language implemented in firmware	No	No	No	Fully
Operating system implemented in firmware	Partially	Partially	Partially	Partially
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel and min. mem. in chassis	$66,096	$82,728 (65KB)	$304,272 (512KB) $34,560 (131KB)	$6,200 (8K bytes) $1,700 (8K bytes)
Price of memory increment	$14,256 (32K bytes)	$10,800 (32KB)		
Date of first delivery	July 1977	January 1975	NA	March 1977
Number installed to date	NA	Over 2000	NA	NA
COMMENTS	Smallest member of Univac Series 90 family; see Report 70C-877-04 for more details	System price also includes integrated peripheral channel, interval timers, CRT/keyboard, and Univac 9200/9300 & IBM 360/20 compatibility; see Report 70C-877-04 for more details	Features full compatibility with the Univac 90/30 plus an internal performance increase of about 33 percent	Portable computer weighing 62 lbs.

All About Minicomputers

MANUFACTURER & MODEL	Wang 2200 VP/MVP	Wang 2200S/2200T	Wang 2200VS	Warrex Centurion I/IA
DATA FORMATS				
Word length, bits	8-bit byte	8-bit byte	32	8+1
Fixed-point operand length, bits	8	8	32	8, 16
Instruction length, bits	8	8	Variable	8, 16, 24
MAIN STORAGE				
Storage type	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.6	1.6	0.66	0.8
Access time, microseconds/word	—	—	—	—
Minimum capacity, words	16K bytes	4K bytes	64K bytes	32K
Maximum capacity, words	64K bytes	32K bytes	512K bytes	64K
Parity checking	No	No	Standard	Optional
Error correction	No	No	Standard	No
Storage protection	No	No	Standard	No
CENTRAL PROCESSOR				
No. of accumulators	---	32; not user-access	—	128
No. of index registers	—	32; not user-access	32	16
No. of directly addressable words	—	—	512K bytes	256
No. of addressing modes	—	—	—	7
Control storage	ROM; 48K words	ROM, 42.5K words	—	No
Add time, microseconds	13	800	—	3.6 (16 bits)
Hardware multiply/divide	Standard	Standard	—	No
Hardware floating point	Standard	Standard	—	No
Hardware byte manipulation	Standard	Standard	—	Standard
Battery backup	No	No	No	No
Real-time clock or timer	Optional	No	Optional	Standard
INPUT/OUTPUT CONTROL				
Direct memory access channel	No	No	Standard	Standard
Maximum I/O rate, words/sec.	100K	10K	—	600K
No. of external interrupt levels	None	None	5	16
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	262-786K bytes	262-786K bytes	315.4K bytes	Standard
Disk pack/cartridge drives	Cartridge; 1.5-20M bytes	Cartridge; 1.2-20M bytes	2,304M bytes	No
Drum/Fixed-head disk storage	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 326 bps	Cassette; 326 bps	No	No
Magnetic tape, ½-inch	10 KBS	10 KBS	120 KBS	No
Punched card input	300 cpm	300 cpm	No	No
Serial printer	200 cps	200 cps	30, 120, 200 cps	300 cps
Line printer	600 lpm	250 lpm	300,600 lpm	125-600 lpm
Data Communications interface	To 9600 bps	To 9600 bps	To 9600 bps	Optional
CRT	64 char. x 16 lines	64 char. x 16 lines	80 char. x 16 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape reader, paper tape punch, card punch, plotter	Paper tape reader, paper tape punch, card punch, plotter	None	None
SOFTWARE				
Assembler	No	No	Yes	Yes
Compilers	BASIC	BASIC	BASIC, COBOL, RPG II	None
Operating system	Interactive	Interactive	Interactive	Multi-tasking
Language implemented in firmware	Fully	Fully	Fully	No
Operating system implemented in firmware	Partially	Partially	Partially	No
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel and min. mem. in chassis	$9.000 (16K bytes)	$4,000 (4K bytes)	$25,000	$14,900/$20,000
Price of memory increment	$3,000 (16K bytes)	$2,000 (8K bytes)	$6,000	$1,250
Date of first delivery	November 1977	February 1975	December 1977	NA
Number installed to date	NA	NA	NA	NA
COMMENTS		Also available in packaged systems WCS-20 & WCS-30		

All About Minicomputers

MANUFACTURER & MODEL	Warrex Centurion IIA	Warrex Centurion IIB/III	Warrex Centurion VI	Westinghouse 2500
DATA FORMATS				
Word length, bits	8 + 1	8 + 1	8 + 1	16
Fixed-point operand length, bits	8, 16	8, 16	4, 8	16, 32
Instruction length, bits	8, 16, 24	8, 16, 24	4, 8, 16	16, 32
MAIN STORAGE				
Storage type	MOS	MOS	MOS	Core
Cycle time, microseconds/word	0.8	0.8	0.6	0.75; 0.95
Access time, microseconds/word	—	—	—	0.33; 0.35
Minimum capacity, words	32K	32K	32K	8K
Maximum capacity, words	60K	60K	252K	1M
Parity checking	Optional	Optional	Optional	Standard
Error correction	No	No	Standard	No
Storage protection	No	No	No	Optional
CENTRAL PROCESSOR				
No. of accumulators	128	128	128	1
No. of index registers	16	16	16	2
No. of directly addressable words	256	256	256	256
No. of addressing modes	7	7	7	14
Control storage	No	No	No	PROM, 1K words
Add time, microseconds	3.6 (16 bits)	3.6 (16 bits)	2.2	1.7
Hardware multiply/divide	No	No	No	Standard
Hardware floating point	No	No	No	Standard
Hardware byte manipulation	Standard	Standard	Standard	No
Battery backup	No	No	No	No
Real-time clock or timer	Standard	Standard	Standard	Optional
INPUT/OUTPUT CONTROL				
Direct memory access channel	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec.	600K	600K	600K	1M
No. of external interrupt levels	16	16	16	4-128
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	Standard	Optional	Optional	250-1000K bytes
Disk pack/cartridge drives	Pack; 10.4-41.6M bytes	Cartridge 10.4-41.6M bytes	Cartridge; 10.4-77.6M bytes	Pack & cartridge; 2.4-67M bytes
Drum/Fixed-head disk storage	No	No	No	Fixed-head; 128K-2M bytes
Magnetic tape cassettes/cartridges	No	No	No	No
Magnetic tape, ½-inch	No	No	No	20, 40 KBS
Punched card input				
Serial printer	No	300 cpm	300 cpm	300, 600 cpm
Line printer	175 cps	175 cps	Optional	10, 30 cps
Data Communications interface	125-600 lpm	125-600 lpm	125-600 lpm	300, 700 lpm
CRT	Optional	Optional	Optional	9600 bps; synch.
Other standard peripheral units	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
	None	None	None	Paper tape units, plotter, D/A & A/D converters, process I/O
SOFTWARE				
Assembler	Yes	Yes	Yes	Assembler & macro assembler
Compilers	None	None	No	FORTRAN, BASIC, RPG
Operating system	Multi-tasking	Multi-tasking	Multi-tasking	Batch, real-time
Language implemented in firmware	No	No	No	No
Operating system implemented in firmware	No	No	No	No
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel and min. mem. in chassis	$30,000	$36,000/$40,000	—	$14,700 (32K words)
Price of memory increment	$1,250	$1,250	—	$3,500 (8K words); $8,000 (32K words)
Date of first delivery	NA	NA	1st qtr. 1978	June 1971
Number installed to date	NA	NA	NA	750
COMMENTS				Virtual addressing used with 1M-word memory; multiple CPU's with shared memory up to 4M words; asynchronous communications speeds to 1800 bps; energy mgmt. and computer numerical control packages also available