datapro 70

the EDP buyer's bible

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Datapro 70 is easy to use . . . and here's how

What is DATAPRO 70?

DATAPRO 70 is a comprehensive hardware/software reference service for EDP management. It's compiled and edited specifically to give you the facts and evaluations you need to understand the computer hardware devices and software packages now on the market and select the ones that best fit your requirements.

What's more, DATAPRO 70 is strongly user-oriented. It's designed to be an everyday working tool—not just a status item on your bookshelf. And it's written in English you can understand—not technical jargon.

How is it organized?

DATAPRO 70 consists of seven major sections, separated and identified by the seven tabs: Index, Suppliers, Computers, Peripherals, Software, Feature Reports, and Communications. A quick scan through any of the sections will show you just what type of information it contains—and how much that information can help you.

When you need facts about specific devices, programs, or concepts, DATAPRO 70's functional Index will guide you quickly to all the pertinent reports. When you get there, you'll find that all the reports have a uniform format. This makes it easy for you to compare the strong and weak points of competitive products and their suppliers.

You'll also find that every DATAPRO 70 product report consists of two major sections: Characteristics and Management Summary. These are arranged in side-by-side columns for your convenience. You'll note that in some reports both sections extend over a number of pages, with the Management Summary in the left-hand column of each page and the Characteristics section in the right-hand column.

The Characteristics section of each equipment and software report gives you all the pertinent details about capabilities, features, configuration, compatibility, pricing, etc. The Management Summary—an exclusive DATAPRO 70 feature— gives you the all-important "big picture": a penetrating evaluation of each device or program. Read them both and you'll have a uniquely clear picture of just what each product is and how you may be able to use it.

What about updating?

Every month you'll receive a supplement that will keep your copy of DATAPRO 70 up to date—and keep you and your staff updated on important new developments in EDP hardware and software.

Each supplement includes easy-to-follow instructions for filing the new and revised reports. (You'll notice that all page numbers in DATAPRO 70 are arranged in straightforward alphanumeric sequence, although many "gaps" have been left in the numbering system to facilitate later insertions.)

How reliable is it?

DATAPRO 70 is compiled and edited by the technical staff of Datapro Research Corporation. The staff consists of experienced analysts, writers, and editors working under the direction of highly qualified professionals in the field of EDP equipment and software evaluation.

All the information in DATAPRO 70 is obtained from the most reliable sources available to our staff. Though the principal source of information for most reports is the manufacturers' own specifications, these are generally clarified and augmented through visits to or correspondence with the manufacturers and (where practical) users of the equipment and software. Prior to publication, reports describing a particular manufacturer's products are normally sent to that manufacturer for review.

Despite all our efforts to keep DATAPRO 70 accurate and up to date, however, the dynamic nature of the computer industry makes it impossible for us to guarantee the accuracy of the information.

What's the best way to use it?

Every reference you make to DATAPRO 70 should begin with the Index. You'll find it behind the Index tab, at the front of Binder 1. It's arranged in straightforward alphabetical order that makes it easy to use.

Naturally, there are Index entries for every company, computer, peripheral device, and software package—and the Index is updated regularly to keep it complete and current. In addition, you'll find "generic" entries for whole classes of equipment and software (such as "key-to-tape recorders" and "data management systems"), followed by the names and locations of all the DATAPRO 70 reports on equipment or software within each class.

Thus, whether you're looking for one specific item or surveying a whole class of equipment or software, the Index is the place to start.

The DATAPRO 70 reports themselves need no explanation. We think you'll agree that they're clear, logical, concise, and helpful. If you need any help in using DATAPRO 70, or if you have any suggestions for making it even more useful, we'll be pleased to hear from you.

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All About Minicomputers

Minicomputers continue to attract more attention than any other single 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.

The PDP-11/34, the newest minicomputer from industry leader Digital Equipment Corporation, is shown in a packaged configuration called the PDP-11T34. This system includes the 11/34 processor with 64K bytes of core or MOS memory, dual RK05 2.4-megabyte disk drives (4.8 megabytes total), and an LA36 DECwriter II console, and sells for $30,900. A standard feature of the 11/34 is memory management, which allows the system to address up to 248K bytes.

This report is designed to aid you in understanding the rapidly proliferating minicomputers and selecting the one that can best satisfy your requirements. You'll find detailed comparison charts covering the characteristics of 186 current minicomputers from 69 manufacturers.

- 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 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 69 manufacturers are summarized in 38 pages of detailed comparison 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 $50,000 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 $50,000. 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).

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All About Minicomputers

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 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, 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 Burroughs, IBM, and NCR are the leaders). DEC has delivered more than 60,000 computers to date and currently commands roughly a 35 percent share of the minicomputer market with its continually expanding product line.

Ranking next in minicomputer revenues, but well behind DEC, are Hewlett-Packard, IBM and Data General. 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. IBM, the undisputed leader in most other segments of the computer field, is currently playing a much smaller role in the minicomputer market. Although IBM is expected to unveil an important new minicomputer before this report reaches you, at this writing its only "pure" minicomputer is the System/7, a 16-bit machine, introduced in 1970, that is supported mainly for "sensor-based" applications in data acquisition and control. (The very popular IBM System/3 and System/32 fall into the small business computer category.) Data General, established in 1969, quickly earned a reputation as a supplier of reliable, low-cost minicomputers and has already delivered more than 21,000 of them.

In the second echelon of minicomputer makers are aggressive, innovative young companies such as Computer Automation, Digital Computer Controls, 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, Texas Instruments, Varian, and Westinghouse. 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.

In all, more than 70 companies are now manufacturing minicomputers. The current offerings of 69 of these companies 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.

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All About Minicomputers

> 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 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 of 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 Hewlett-Packard 21MX Series, Interdata 8/32, Microdata 3200, and Varian V70 Series.

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 Nova Eclipse Series, and the Varian V75 and V76. 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 8/32 Megamini and the SEL 32/50 and 32/55.

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 >

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All About Minicomputers

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/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 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, hardwired 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 THE BUSINESSMAN

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.

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All About Minicomputers

Minicomputers need not be mini in capabilities, size, or price, as indicated by this multi-user Eclipse C/300 system from Data General Corporation. This expanded configuration includes 512K bytes of main memory, four 92-megabyte disk drives, two 60-KBS tape drives, a 30-cps terminal console and CRT console, a 600-lpm printer, asynchronous multiplexers, and 16 CRT terminals for interactive data entry and inquiry/response. Purchase price of this configuration is approximately $294,000–a far cry from the $30,700 price tag on the basic, 64K-byte C/300 mainframe.

Yet true minicomputers–as distinguished from the less powerful electronic accounting machines–have only recently begun 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 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 on the way, in the form of three significant trends.

First, numerous manufacturers have introduced minicomputer-based systems designed primarily for business data processing applications. Most of them are included in this report, and you can find the details on dozens of other business-oriented systems in a companion DATAPRO 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, Varian, 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,

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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.

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 186 commercially available minicomputers from 69 manufacturers are presented in the accompanying comparison charts. Nearly all of the information in the charts was supplied and/or verified by the manufacturers during the months of September and October 1976; 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.

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.

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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 commercially available minicomputers late in 1970, and most minicomputer makers are now using semiconductor memory in their new products. Use of core versus semiconductor memories has almost reached a balance point this year, with approximately 50 percent of the minicomputers currently available using each type of memory. It is clear that the demand for higher performance at lower cost, together with forthcoming improvements in semiconductor technology, has accelerated 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 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.

The Burroughs B 80, an impressive new small business computer, doesn't look like a typical minicomputer. Its processor is hidden inside the cabinetry and is part of a neatly packaged system. The entry-level configuration includes 32K bytes of MOS memory, a 60-cps printer and keyboard, two floppy disk drives (1 megabyte each), a magnetic tape cassette drive, and a 256-character visual display terminal. It can be purchased for $19,510.

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 from Century Computer, Hewlett-Packard, Honeywell, Texas Instruments, and others. This feature 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.

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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 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,

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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.

An interesting solution to this problem with semiconductor memories is furnished by Computer Talk, Inc., whose battery backup feature causes the contents of memory to be recorded on the system disk if a power failure occurs. When power is restored, memory can be recreated by copying from the disk.

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 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

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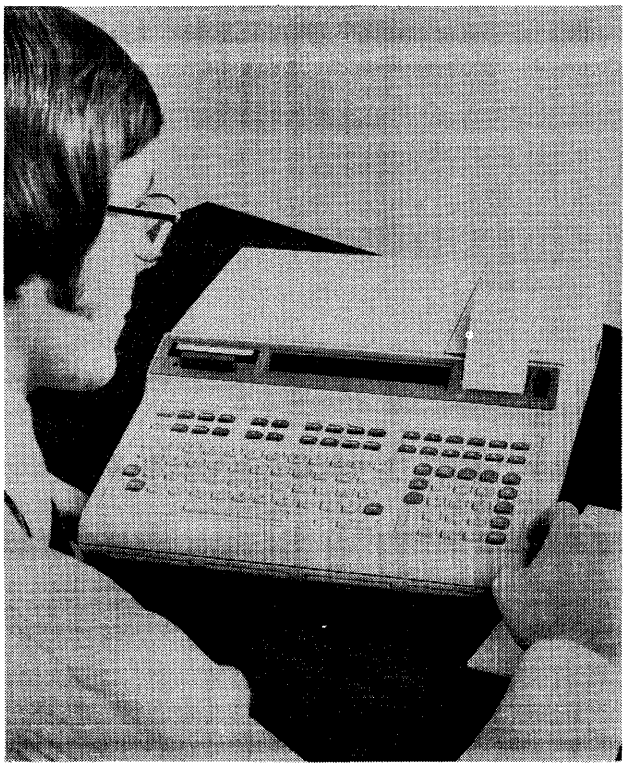

The Hewlett-Packard 9825, though called a programmable calculator by many, truly deserves minicomputer status. A basic HP 9825 includes 6844 bytes of MOS memory, a 32-character light-emitting diode display, a 16-character alphanumeric strip printer, an integrated 2.75-KBS magnetic tape cartridge drive, interrupt capability, and an HPL high-level language compiler implemented in firmware. The base price is $5,900, but the tariff can go much higher if additional peripherals such as up to 32 floppy disk drives (15 megabytes total), a 30-cps serial printer, a 240-lpm line printer, paper tape readers and punches, or plotters are interfaced to the system.

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. Unfortunately, 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.

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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, ½-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).

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

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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.

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 September 30, 1976. 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 69 suppliers whose products are listed in the comparison charts that follow.

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

Artronix Inc., 1314 Hanely Industrial Court, St. Louis, Missouri 63144. Telephone (314) 968-4740.

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All About Minicomputers

Basic/Four Corporation, P.O. Box 11383, Santa Ana, California 92711. Telephone (714) 833-9530.

Basic Timesharing Inc., 650 North Mary Avenue, Sunnyvale, California 94086. Telephone (408) 733-1122.

Bendix Corporation, Executive Office Building, Bendix Center, Southfield, Michigan 48076. Telephone (313) 352-5000.

Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000.

Cascade Data, Inc., 3000 Kraft Ave. S.E., Grand Rapids, Michigan 49508. Telephone (616) 942-1420.

Century Computer, 2339 Stanwell Circle, Concord, California 94520. Telephone (415) 798-8000.

Compagnie Internationale pour l'Informatique (CII), 68 Route de Versailles, 78 Louveciennes, France. Telephone 951-86-00.

Cincinnati Milacron, Process Control Division, Mason Marrow Road, Lebanon, Ohio 45036. Telephone (513) 494-1200.

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

Computer Hardware, Inc., 2424 Arden Way, Sacramento, California 95825. Telephone (916) 929-8731.

Computer Talk, Inc., P.O. Box 145, Idledale, Colorado 80453. Telephone (303) 697-4315.

Computer Technology Limited, Eaton Road, Hemel Hempstead, Hertfordshire HP2 7EQ, England. Telephone Hemel Hempstead (0442) 3272.

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

Data General Corporation, Route 9, Southboro, Massachusetts 01772. Telephone (617) 485-9100.

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

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

Datum, Inc., 1363 State College Boulevard, Anaheim, California 92806. Telephone (714) 533-6333.

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

Digital Computer Controls, Inc., 12 Industrial Road, Fairfield, New Jersey 07006. Telephone (201) 575-9100.

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

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

Digital Systems Corporation, 3 North Main Street, Walkersville, Maryland 21793. Telephone (301) 845-4141.

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

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

Fujitsu Limited, 6-1 Marunouchi 2-chome, Chiyoda-ku, Tokyo 100, Japan. Telephone 03-216-3211.

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

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

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

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

Hewlett-Packard, Calculator Products Division, P.O. Box 301, Loveland, Colorado 80537. Telephone (303) 667-5000.

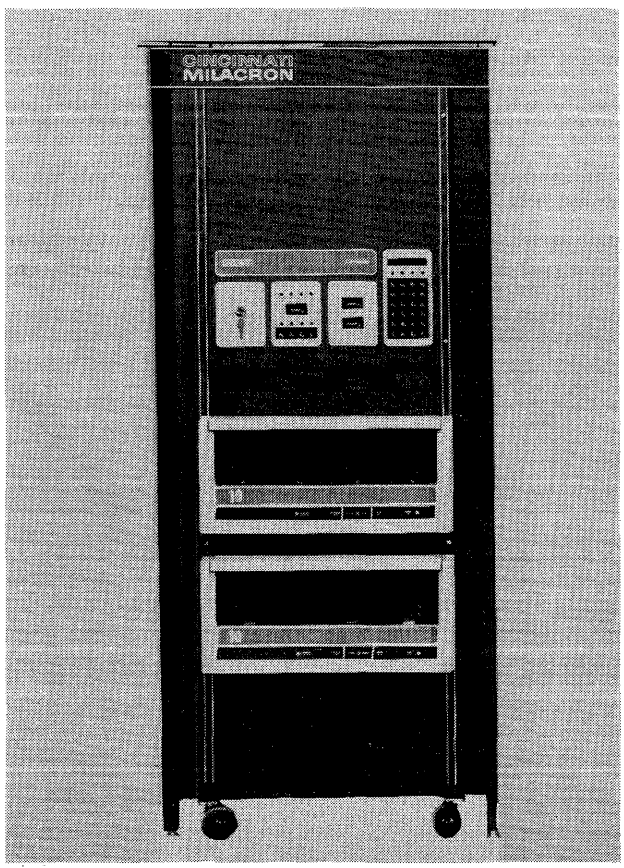
Hewlett-Packard, Data Systems Division, 11000 Wolfe Road, Cupertino, California 95014. Telephone (408) 257-7000.

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.

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



The CIP/4400 from Cincinnati Milacron is shown with a programmer's panel/debug console and two front-loading cartridge disk drives. The CIP/4400 processor can be purchased alone with 32K bytes of main memory for $16,100, or in a packaged version, the Model 80, with 64K bytes of memory, a CRT, 10-megabyte cartridge disk drive, printer controller, and interface for up to eight CRT's for $42,800.

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International Computers (USA) Limited, 555 Madison Avenue, New York, New York 10022. Telephone (212) 486-7400.

Jacquard Systems, 2502 Broadway, Santa Monica, California 90404. Telephone (213) 839-3493.

Keronix, Inc., 1752 Cloverfield Blvd., Santa Monica, California 90404. Telephone (213) 829-3594.

Litton Industries, Inc., Sweda International Division, 34 Maple Avenue, Pine Brook, New Jersey 07058. Telephone (201) 575-8100.

Lockheed Electronics Company, Data Products Division, U.S. Highway 22, Plainfield, New Jersey 07060. Telephone (201) 757-1600.

Logical Machine Corporation, 1294 Hammerwood Avenue, Sunnyvale, California 94086. Telephone (408) 744-1290.

MELCO (Mitsubishi Electric Company) U.S.A., Inc., 3030 East Victoria Street, Compton, California 90221. Telephone (213) 636-2331.

Micro Computer Machines Inc., 133 Dalton Street, Kingston, Ontario, Canada K7L 4W2. Telephone (613) 544-9860.

Microdata Corporation, 17481 Red Hill Ave., Irvine, California 92705. Telephone (714) 540-6730.

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 & K Streets, Dayton, Ohio 45409. Telephone (513) 449-2000.

Nixdorf Computer Inc., O'Hara Plaza, 5725 East River Road, Chicago, Illinois 60631. Telephone (312) 693-6600.

A/S Norsk Data-Elektronikk, Postboks 163, Okem, Oslo, 5 Norway. Telephone 21 73 71.

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

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

Prime Computer, Inc., 145 Pennsylvania Ave., Framingham, Massachusetts 01701. 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.

A/S Regnecentralen, Falkoner Alle 1–DK 2000, Copenhagen, Denmark. Telephone (01) 10-53-66.

Rolm Corporation, 18922 Forge Drive, Cupertino, California 95014. Telephone (408) 257-6440.

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

Tandem Computers, Inc., 20605 Valley Green Drive, Cupertino, California 95014. Telephone (408) 255-4800.

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

Texas Instruments, Inc., Digital Systems Division, P.O. Box 1444, Houston, Texas 77001. Telephone (713) 494-5115.

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

Varian Data Machines, 2722 Michelson Drive, Irvine, California 92664. Telephone (714) 833-2400.

Wang Laboratories Inc., 836 North St., Tewksbury, Massachusetts 08176. Telephone (617) 851-4111.

Warrex Computer Corporation, P.O. Box 943, Richardson, Texas 75080. Telephone (214) 233-8400.

Westinghouse Electric Corporation, Computer and Instrumentation Division, Computer Department, 1200 West Colonial Drive, Orlando, Florida 32804. Telephone (305) 843-7030.□

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All About Minicomputers

MANUFACTURER & MODEL	Anderson Jacobson 1500	Artronix PC-12/730	Artronix PC-12/770	Artronix Modulex	Basic Four 350
DATA FORMATS					
Word length, bits	8-bit byte	12	12	16	8-bit byte
Fixed-point operand length, bits	8, 16	12	12	16	16, 32
Instruction length, bits	8, 24	12, 60	12, 60	16, 32	8, 16, 24, 32
MAIN STORAGE					
Storage type	Core	Core	Core	Core, MOS	MOS
Cycle time, microseconds/word	1.2	1.2	0.7	0.8, 0.5	0.60
Access time, microseconds/word	0.6	0.7	0.4	0.46, 0.25	0.40
Minimum capacity, words	16K bytes	4K	16K	8K	24K bytes
Maximum capacity, words	64K bytes	64K	128K	512K	64K bytes
Parity checking	Optional	No	No	Optional	Standard
Error correction	No	No	No	No	No
Storage protection	Standard	No	No	Optional	No
CENTRAL PROCESSOR					
No. of accumulators	128	1	1	8	2
No. of index registers	3	64	64	8	1
No. of directly addressable words	64K	4K	4K	32K	64K
No. of addressing modes	2	8	8	8	8
Control storage	ROM; 4K bytes	No	No	ROM; 512 bytes	ROM; 1K x 16 bits
Add time, microseconds	4	2.4	1.4	1.4	7.4
Hardware multiply/divide	No	No	No	Optional	No
Hardware floating point	No	Optional	Standard	Optional	No
Hardware byte manipulation	Standard	No	Optional	Standard	Standard
Battery backup	No	—	—	Optional	Standard
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	606K	883K	1.25M	4.8M	1M
No. of external interrupt levels	15	1-256	1-256	Variable	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	600K-2.4M bytes	315-1260K bytes	315-1260K bytes	315K-unlimited	No
Disk pack/cartridge drives	Cartridge; 10-40M bytes	Cartridge; 3.2-13.7M bytes	Cartridge; 3.2-13.7M bytes	Cartridge; 2.5M-unlimited	Cartridge; 5M bytes
Drum/fixed-head disk storage	No	Fixed-head; 0.5-2M bytes	Fixed-head; 0.5-2M bytes	No	No
Magnetic tape cassettes/cartridges	No	Cartridge; 10 KBS	Cartridge; 10 KBS	No	No
Magnetic tape, ½-inch	No	No	No	72 KBS	10 KBS
Punched card input	No	300 cpm	300 cpm	600 cpm	No
Serial printer	45 cps	100 cps	100 cps	100 cps	165 cps
Line printer	200-600 lpm	210 lpm	210 lpm	210, 400 lpm	300, 600 lpm
Data communications interface	1200 bps; asynch.	110-9600 bps	110-9600 bps	110-9600 bps	1200 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	—	Graphics, plotter, instrumentation	Graphics, plotter, instrumentation	Graphics, plotter, instrumentation	—
SOFTWARE					
Assembler	Assembler	Assembler	Assembler	Assembler & macro assembler	No
Compilers	ESP	Comfort, FORTRAN	FORTRAN, Mumps	FORTRAN, RPG II, MUMPS	Business BASIC
Operating system	Batch	Batch, Real-time, Time-sharing	Batch, Real-time Time-sharing	Batch, Real-time, Time-sharing	Single-user interactive
Language implemented in firmware	Partially	No	No	Optional	No
Operating system implemented in firmware	Partially	No	No	Optional	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$19,500 (16K bytes)	$20,000 (16K words)	$76,000 (64K words)	$8,300 (8K words)	$34,400 (24K bytes)
Price of memory increment	$4,400 (16K bytes)	$2,700 (4K words)	$2,700 (4K words)	$1,800 (8K words)	$3,000 (8K bytes); $3,500 (16K bytes)
Date of first delivery	December 1976	September 1971	February 1974	July 1975	1971
Number installed to date	NA	Over 150	Over 20	NA	3000 (all models)
COMMENTS	System price also includes two diskettes, paper tape, reader, and serial printer			Highly modular; operating system handles multiple processors	Available as packaged systems only; system price also includes cartridge disk subsystem, serial or line printer, and CRT terminal

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All About Minicomputers

MANUFACTURER & MODEL	Basic Four 400	Basic Four 600	Basic Four 700	Basic Timesharing 4000 Series	Bendix BDX9000
DATA FORMATS					
Word length, bits	8-bit byte	8-bit byte	8-bit byte	16	16
Fixed-point operand length, bits	16, 32	16, 32	16, 32	16, 32	16
Instruction length, bits	8, 16, 24, 32	8, 16, 24, 32	8, 16, 24, 32	16	16
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	Core
Cycle time, microseconds/word	0.60	0.60	0.60	0.65	1.0
Access time, microseconds/word	0.40	0.40	0.40	0.3	0.5
Minimum capacity, words	24K bytes	32K bytes	64K bytes	64K bytes	4K
Maximum capacity, words	64K bytes	64K bytes	128K bytes	64K bytes	32K
Parity checking	Standard	Standard	Standard	Standard	Optional
Error correction	No	No	No	No	No
Storage protection	No	No	No	Standard	Optional
CENTRAL PROCESSOR					
No. of accumulators	2	2	2	2; not user-access.	16
No. of index registers	1	1	1	2; not user-access.	2
No. of directly addressable words	64K	64K	64K	—	512
No. of addressing modes	8	8	8	—	—
Control storage	ROM; 1K x 16 bits	ROM; 1K x 16 bits	ROM; 1K x 16 bits	PROM, WCS; 98K bits	No
Add time, microseconds	7.4	7.4	7.4	—	2.0
Hardware multiply/divide	No	No	No	Standard	Standard
Hardware floating point	No	No	No	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No
Battery backup	Standard	Standard	Standard	Standard	No
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	1M	1M	616,666	500K
No. of external interrupt levels	8	8	8	60	1-64
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	No
Disk pack/cartridge drives	Cartridge; 10-20M bytes	Cartridge; 10-40M bytes	Cartridge; 100-400M bytes	Pack & cartridge; 7.5-389M bytes	Pack
Drum/fixed-head disk storage	No	No	No	No	Fixed-head
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	10 KBS	10 KBS	10 KBS	To 72 KBS	Yes
Punched card input	No	No	No	No	200 cpm
Serial printer	165 cps	165 cps	165 cps	No	No
Line printer	300, 600 lpm	300, 600 lpm	300, 600 lpm	300-900 lpm	No
Data communications interface	1200 bps	1200 bps	1200 bps	2500 bps; asynch.	No
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	No	No
Other standard peripheral units	—	—	—	—	A/D & D/A converters, paper tape units
SOFTWARE					
Assembler	No	No	No	No	Yes
Compilers	Business BASIC	Business BASIC	Business BASIC	BASIC X	—
Operating system	Multi-user	Multi-user	Multi-user	Time-sharing	No
Language implemented in firmware	No	No	No	Partially	No
Operating system implemented in firmware	Partially	Partially	Partially	Partially	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$36,900 (24K bytes)	$51,400 (32K bytes)	$115,000 (64K bytes)	$35,950-$56,300	—
Price of memory increment	$3,000 (8K bytes); $3,500 (16K bytes)	$3,000 (8K bytes); $3,500 (16K bytes)	$3,000 (8K bytes); $3,500 (16K bytes)	—	—
Date of first delivery	1971	1975	1975	January 1976	1971
Number installed to date	3000 (all models)	3000 (all models)	3000 (all models)	NA	Over 25
COMMENTS	Available as packaged systems only; system price also includes cartridge disk subsystem, serial or line printer, and CRT terminal	Available as packaged systems only; system price also includes cartridge disk subsystem, serial or line printer, and CRT terminal	Available as packaged systems only; system price also includes cartridge disk subsystem, serial or line printer, and CRT terminal	Based on a modified HP 21MX; packaged system for up to 32 users includes pack or cartridge disk, magnetic tape drive, and eight terminal ports	Sold exclusively for ground support systems and not usually available commercially

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MANUFACTURER & MODEL	Burroughs L 9000 Series	Burroughs B 80	Burroughs B 730/B 720	Burroughs B 770 Series	Burroughs B 1700 Series
DATA FORMATS					
Word length, bits	64	8-bit byte	64	16	8-bit byte
Fixed-point operand length, bits	—	—	—	—	—
Instruction length, bits	Variable	Variable	Variable	Variable	Variable
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core, MOS	MOS
Cycle time, microseconds/word	1.5	1.0	1.0	1	1.5
Access time, microseconds/word	1.2	0 5	0.5	0.4; 0.63	1.0
Minimum capacity, words	4K bytes	32K bytes	32K bytes	16K bytes	24K bytes
Maximum capacity, words	48K bytes	60K bytes	80K bytes	48K; 98K bytes	128K 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	None to user
No. of index registers	4	None to user	None to user	None to user	None to user
No. of directly addressable words	—	—	—	—	—
No. of addressing modes	—	—	—	—	—
Control storage	RAM; 8K bytes	ROM; 4K bytes	ROM; 3584 bytes	RAM; 32K bytes	No
Add time, microseconds	—	—	0.43	—	—
Hardware multiply/divide	—	—	No	—	—
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	—	—
Battery backup	—	—	—	—	—
Real-time clock or timer	—	—	—	Standard	—
INPUT/OUTPUT CONTROL					
Direct memory access channel	—	—	—	Standard	—
Maximum I/O rate, words/sec	—	—	—	Standard	—
No. of external interrupt levels	—	—	—	—	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	243K-6M bytes	243K-1.5M bytes	243K bytes	No
Disk pack/cartridge drives	No	Cartridge; 4.6-27.6M bytes	Cartridge; 4.6-36.8M bytes	Cartridge; 4.6-36.8M bytes	Pack & cartridge; 2.3-697.6M bytes
Drum/fixed-head disk storage	No	No	No	No	Fixed-head disk; 1.9M bytes
Magnetic tape cassettes/cartridges	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS
Magnetic tape, ½-inch	10 KBS	No	10 KBS	10 KBS	10-120 KBS
Punched card input	480 cpm	No	600 cpm	300-800 cpm	300-1400 cpm
Serial printer	60, 90 cps	60, 180 cps	60 cps	No	No
Line printer	90-250 lpm	160, 250 lpm	85-400 lpm	85-750 lpm	85-1040 lpm
Data communications interface	9600 bps	9600 bps	9600 bps	9600 bps	9600 bps
CRT	32 char. x 8 lines	32 char. x 8 lines	80 char. x 24 lines	No	80 char. x 24 lines
Other standard peripheral units	Mag. ledger card reader	—	Card punch, card reader/punch	Up to 2 data communications processors; reader/punch/data record.	Card punch, card reader/punch
SOFTWARE					
Assembler	Assembler	No	No	Assembler	No
Compilers	COBOL	COBOL, RPG	COBOL, RPG, AEL	COBOL, RPG, NDL, MPL	COBOL,FORTRAN RPG, BASIC, UPL, NDL
Operating system	—	Batch	Real-time	Batch, real-time	Batch, real-time, time-sharing
Language implemented in firmware	Fully	Fully	Fully	Fully	Fully
Operating system implemented in firmware	—	Fully	Fully	Fully	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$16,490 (4K bytes)	$19,510 (32K bytes)	$20,900 (32K bytes)	$17,600-$23,500	$22,225
Price of memory increment	$800 (2K bytes); $1,400 (4K bytes)	$900 (4K bytes)	$2,280 (8K bytes)	$2,800 (8K bytes)	$3,000 (32K bytes)
Date of first delivery	June 1975	April 1976	March 1973	1974	3rd qtr. 1972
Number installed to date	Thousands	5500 on order	NA	NA	Over 1300 total
COMMENTS	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	See Report 70C-112-04 for more details

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MANUFACTURER & MODEL	Burroughs B 1720 Series	Cascade Data Concept II	Century Computer 200	Century Computer 400	CII Mitra 15-35
DATA FORMATS					
Word length, bits	64	16	8-bit byte	16 + 5	16 + 2
Fixed-point operand length, bits	—	16-32	8	16	16
Instruction length, bits	Variable	16-40	8, 16, 24	8, 16, 24	16
MAIN STORAGE					
Storage type	MOS	Core	MOS	MOS	Core
Cycle time, microseconds/word	1.0	1.2	0.6	0.6	0.8
Access time, microseconds/word	0.67	0.35	0.2	0.2	0.3
Minimum capacity, words	48K bytes	16K	32K bytes	32K bytes	16K
Maximum capacity, words	378K bytes	64K	64K bytes	512K bytes	64K
Parity checking	Standard	Standard	No	Optional	Standard
Error correction	No	No	No	Optional	No
Storage protection	Standard	No	No	Optional	Standard
CENTRAL PROCESSOR					
No. of accumulators	None to user	16	16	16	32
No. of index registers	None to user	3	16	16	—
No. of directly addressable words	—	32K	64K bytes	64K bytes	—
No. of addressing modes	—	2	17	17	—
Control storage	ROM; to 8K bytes	No	PROM; to 2K bytes	PROM; to 2K bytes	—
Add time, microseconds	—	8.8	2.6	2.6	2.3
Hardware multiply/divide	—	Standard	Optional	Optional	Standard
Hardware floating point	No	No	Standard	Standard	No
Hardware byte manipulation	—	Standard	Standard	Standard	Standard
Battery backup	—	No	No	Optional	—
Real-time clock or timer	—	Optional	No	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	—	Standard	Optional	Standard	Optional
Maximum I/O rate, words/sec	—	413K	1M	1M	—
No. of external interrupt levels	—	0	15; 120	120	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	4M bytes
Disk pack/cartridge drives	Pack & cartridge; 2.3-697.6M bytes	Cartridge; 40M bytes	Pack & cartridge; 10-1200M bytes	Pack & cartridge; 10-1200M bytes	Pack & cartridge; 40-600M bytes
Drum/fixed-head disk storage	Fixed head disk; 1.9-70M bytes	No	No	No	Fixed-head; 1.6M bytes
Magnetic tape cassettes/cartridges	Cassette; 1 KBS	No	Cassette; 300 cps	Cassette; 300 cps	Cassette
Magnetic tape, ½-inch	10-120 KBS	30, 60 KBS	120 KBS	120 KBS	40 KBS
Punched card input	300-1400 cpm	300 cpm	300, 600 cpm	300, 600 cpm	300, 600 cpm
Serial printer	No	55 cps	165 cps	165 cps	180 cps
Line printer	85-1040 lpm	125-600 lpm	300, 600 lpm	300, 600 lpm	200-400 lpm
Data communications interface	9600 bps	9600 bps	Up to 9600 bps	Up to 9600 bps	19.2K bps; synch
CRT	80 char. x 24 lines	80 char. x 16 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	Paper tape reader, paper tape punch	Paper tape reader	Paper tape reader	Card punch
SOFTWARE					
Assembler	No	Macro assembler	Yes	Yes	Macro assembler
Compilers	COBOL, FORTRAN, RPG, BASIC, UPL, NDL	RPG	BASIC, CPL	BASIC, CPL	COBOL, FORTRAN, PROCOL
Operating system	Batch, real-time, time-sharing	Batch, real-time, time sharing	Batch, real-time	Batch, real-time	Batch, real-time
Language implemented in firmware	Fully	No	No	No	Partially
Operating system implemented in firmware	Fully	No	No	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$87,300	$22,200 (16K bytes)	$13,070 (32K bytes)	$15,070 (32K bytes)	$28,000
Price of memory increment	$3,000 (32K bytes)	$1,200 (16K bytes) $2,700 (32K bytes)	$5,300 (32K bytes)	$5,300 (32K bytes)	NA
Date of first delivery	2nd qtr. 1973	January 1970	February 1971	March 1975	1972 (Europe)
Number installed to date	Over 1300 total	150	Over 600	117	425 (Europe)
COMMENTS	See Report 70C-112-04 for more details	Operating system provides two partitions; system price includes CRT and cartridge disk	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	Asynchronous communications at up to 1200 bps

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MANUFACTURER & MODEL	CII Mitra 105	CII Mitra 125	Cincinnati Milacron CIP/2200B	Cincinnati Milacron CIP/4400	Computer Automation Naked Milli LSI-3/05
DATA FORMATS					
Word length, bits	16 + 1	16 + 2	16	16	16
Fixed-point operand length, bits	16	16	8-32	8-32	8, 16, 32
Instruction length, bits	16	16	8-64	8-64	16, 32, 48
MAIN STORAGE					
Storage type	MOS, Core	Core	MOS	MOS	Core, MOS
Cycle time, microseconds/word	0.85; 0.6	0.9	1.1	0.9	0.98-1.6
Access time, microseconds/word	0.4; 0.35	0.35	0.66	0.6	0.5-0.8
Minimum capacity, words	4K	32K	32K bytes	32K bytes	512
Maximum capacity, words	32K	1024K	64K bytes	96K bytes	8K
Parity checking	—	—	Optional	Standard	No
Error correction	—	—	No	No	No
Storage protection	—	—	Standard	Standard	No
CENTRAL PROCESSOR					
No. of accumulators	6	64	3	3	2
No. of index registers	—	—	1	1	1
No. of directly addressable words	—	—	32K	32K	128
No. of addressing modes	—	—	9	9	8
Control storage	—	—	ROM; 3590 bytes	ROM	ROM; 512 x 24 bits
Add time, microseconds	1.75	1.9	12.43	12.43	6.25 (2 digits)
Hardware multiply/divide	—	—	No	Standard	No
Hardware floating point	—	—	No	No	No
Hardware byte manipulation	—	—	Standard	Standard	Standard
Battery backup	—	—	No	Standard	Optional
Real-time clock or timer	—	—	Standard	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	—	—	Optional	Optional	Standard
Maximum I/O rate, words/sec	—	—	909K	1.2M	250K
No. of external interrupt levels	—	—	64	64	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	1M bytes	512K bytes	630K-2.5M bytes	630K-2.5M bytes	243-972K bytes
Disk pack/cartridge drives	No	Pack & cartridge; 40-600M bytes	Cartridge; to 160M bytes	Cartridge; to 160M bytes	Cartridge; 4.92-19.68M bytes
Drum/fixed-head disk storage	No	Fixed-head; 1.6M bytes	No	No	No
Magnetic tape cassettes/cartridges	Cassette	Cassette	No	No	No
Magnetic tape, ½-inch	No	120 KBS	No	20 KBS	20 KBS
Punched card input	No	300, 600 cpm	600 cpm	600 cpm	285 cpm
Serial printer	180 cps	180 cps	165, 330 cps	165, 330 cps	100, 165 cps
Line printer	No	200-600 lpm	300, 600 lpm	300, 600 lpm	No
Data communications interface	1000 bps; synch.	100K bps; synch.	9600 bps	9600 bps	To 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 12 lines	80 char. x 12 lines	80 char. x 24 lines
Other standard peripheral units	—	Card punch	Card reader/punch	Card reader/punch	Paper tape reader, paper tape reader/punch
SOFTWARE					
Assembler	Assembler	Assembler	Macro assembler	Macro assembler	Macro assembler
Compilers	FORTRAN, LP 15	COBOL, FORTRAN, PROCOL	RPG	RPG	FORTRAN
Operating system	Batch	—	Batch, real-time	Batch, real-time	Real-time
Language implemented in firmware	Partially	Partially	Fully	Fully	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	$7,000	$35,000	$5,400 (32K bytes)	$16,100 (32K bytes)	$725 (4K MOS)
Price of memory increment	NA	NA	$2,250 (8K bytes)	$2,250 (8K bytes) $3,500 (16K bytes)	$550 (4K MOS)
Date of first delivery	June 1976 (Eur.)	1st qtr. 1976 (Eur.)	June 1973	July 1976	January 1975
Number installed to date	75 (Europe)	185 (Europe)	NA	NA	NA
COMMENTS	Asynchronous communications at up to 1200 bps	Cartridge disk and serial printer are included in basic price; asynchronous communications at up to 9600 bps	See Report M11-168-201 for more details	Packaged system including CPU with 32K bytes, 60-cps printer, dual floppy disk drives, CRT display console, and 30-inch desk; accounting software available	ROM/EPROM & RAM/ROM/PROM are available in combination; ROM, PROM, EROM available in max. capacities of 8K, 2K, & 4K words, respectively

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MANUFACTURER & MODEL	Computer Automation Naked Milli LSI-2/10 & 2/20	Computer Automation MegaByter LSI-2/60	Computer Hardware Inc. 2120	Computer Hardware Inc. 2130	Computer Hardware Inc. 3230
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16	16	16
Fixed-point operand length, bits	8, 16, 32	8, 16, 32	16	16	16
Instruction length, bits	16, 32, 48	16, 32	16-64	16-64	16-64
MAIN STORAGE					
Storage type	Core, MOS	Core, MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.85-1.2	0.85-1.2	1.8	0.8	0.8
Access time, microseconds/word	0.4-0.6	0.4-0.6	0.35	0.25	0.25
Minimum capacity, words	8K	8K	8K	8K	8K
Maximum capacity, words	262K	512K	16K	64K	256K
Parity checking	Optional	Optional	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	No	No	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	2	2	8	8	8
No. of index registers	1	1	6	6	6
No. of directly addressable words	32K	32K	16K	16K	16K
No. of addressing modes	8	8	—	—	—
Control storage	ROM; 256 x 56 bits	ROM; 512 x 56 bits	—	—	—
Add time, microseconds	4.12, 2.06	2.06	3.6	1.6	1.6
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	No	No	Optional	Optional
Hardware byte manipulation	Standard	Standard	No	No	No
Battery backup	Optional	Optional	No	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	1M	1M	625K	1.25M	1.25M
No. of external interrupt levels	3	3	8	8	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	243-972K bytes	243-972K bytes	No	No	No
Disk pack/cartridge drives	Cartridge; 4.92-19.68M bytes	Cartridge; 4.92-19.68M bytes	Pack; 20M bytes	Pack; 320M bytes	Pack; 460M bytes
Drum/fixed-head disk storage	No	No	No	No	Fixed-head; 2M bytes
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	20 KBS	20 KBS	Yes	Yes	Yes
Punched card input	285 cpm	285 cpm	300-1000 cpm	300-1000 cpm	300-1000 cpm
Serial printer	100, 165 cps	100, 165 cps	No	No	No
Line printer	No	No	300, 600 lpm	300, 600 lpm	300, 600 lpm
Data communications interface	110-50K bps	110-50K bps	To 4800 bps; synch.	To 4800 bps; synch.	To 4800 bps; synch.
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 reader/ punch	Paper tape reader, paper tape reader/ punch	Card reader/punch, paper tape reader, paper tape punch, plotter	Card reader/punch, paper tape reader, paper tape punch, plotter	Card reader/punch, paper tape reader, paper tape punch, plotter
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	FORTRAN, BASIC	FORTRAN, BASIC	RPG, COBOL, FORTRAN	RPG, COBOL, FORTRAN	RPG, COBOL, FORTRAN
Operating system	Batch, real-time, multi-tasking	Batch, real-time, multi-tasking	Batch	Batch, time-sharing	Batch, 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	$1,750 (4K 2/10); $2,765 (4K 2/20)	$6,850 (8K core)	$29,000	$60,000	$77,000
Price of memory increment	$985 (4K words core)	$1,950 (8K core) $550 (4K RAM)	—	—	—
Date of first delivery	July 1973	NA	1975	1974	1976
Number installed to date	NA	NA	NA	NA	NA
COMMENTS	ROM/EPROM & RAM/ROM/PROM are available in combination; ROM, PROM, EROM available in max. capacities of 8K, 2K, & 4K words respectively; 2/20 is identical to 2/10 but twice as fast	Used as basis for SyFA business system	Asynchronous communications to 9600 bps; system price also includes CRT and disk pack drive	Asynchronous communications to 9600 bps; system price also includes CRT and disk pack drive	Asynchronous communications to 9600 bps; system price also includes disk pack drive

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MANUFACTURER & MODEL	Computer Talk Model CT-400	Computer Technology CTL 8010	Computer Technology CTL 8030	Computer Technology CTL 8050	Control Data Cyber 18-17
DATA FORMATS					
Word length, bits	16 + 2	16	16	16 + 1	16 + 1
Fixed-point operand length, bits	16, 32	16	16	16	16
Instruction length, bits	16	16	16	16	16, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core	MOS
Cycle time, microseconds/word	0.5; 0 3	—	—	0.7	0.6, 0.9
Access time, microseconds/word	0.3; 0.15	—	—	0.4	—
Minimum capacity, words	4K	16K bytes	56K bytes	96K bytes	4K
Maximum capacity, words	512K	112K bytes	112K bytes	448K bytes	64K
Parity checking	Optional	No	No	Standard	Standard
Error correction	Optional	No	No	No	No
Storage protection	See comments	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	12 (4 more opt.)	5	5	5	2
No. of index registers	2	0	0	0	2 (1 in memory)
No. of directly addressable words	32K	112K bytes	112K bytes	—	256
No. of addressing modes	—	—	22	22	7
Control storage	PROM; 512 words	No	No	No	No
Add time, microseconds	1	2.0	1.3	1.2	1.8
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	No	No	No	Optional
Hardware byte manipulation	Standard	No	No	Optional	Optional
Battery backup	Standard	—	—	—	Optional
Real-time clock or timer	Standard	Optional	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1M	450K	600K	1.3M	1.6M
No. of external interrupt levels	1-16	8; 96	8; 96	8; 96	2-16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	10M bytes	No	No	No	262-520K bytes
Disk pack/cartridge drives	Pack & cartridge; 145K-50M bytes	No	Pack & cartridge; 9.6-192M bytes	Pack & cartridge; 9.6-384M bytes	Pack; 25-400M bytes
Drum/fixed-head disk storage	Fixed-head; 1.2-50M bytes	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette & cartridge; 30-800 cps & 4 KBS	No	No	No	No
Magnetic tape, ½-inch	5-120 KBS	No	No	120 KBS	20 KBS
Punched card input	200-1000 cpm	400 cpm	400 cpm	400, 600 cpm	300, 600 cpm
Serial printer	10-200 cps	165 cps	165 cps	165 cps	No
Line printer	125-600 lpm	300, 600 lpm	300, 600 lpm	300, 600 lpm	300, 600 lpm
Data communications interface	50-9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps
CRT	64 char. x 20 lines	80 char. x 25 lines	80 char. x 25 lines	80 char. x 25 lines	80 char. x 24 lines
Other standard peripheral units	Card punch, card reader/punch, A/D & D/A converters, plotter	Paper tape reader, paper tape punch	Paper tape reader, paper tape punch, plotter	Paper tape reader, paper tape punch, plotter	A/D & D/A converters
SOFTWARE					
Assembler	Assembler & macro assembler	No	No	Yes	Assembler & macro assembler
Compilers	BASIC, FORTRAN IV	FORTRAN, BASIC	COBOL, FORTRAN, BASIC, CORAL, RPG	COBOL, FORTRAN, BASIC, CORAL, RPG	FORTRAN, BASIC, AUTRAN
Operating system	Batch, real-time, time-sharing	Batch, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time
Language implemented in firmware	Part; all opt.	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	$24,950 (4K MOS)	$23,140 (16K bytes)	$44,500 (56K bytes)	$80,100 (96K bytes)	About $15,000
Price of memory increment	$1,600 (4K MOS)	—	—	—	—
Date of first delivery	May 1975	NA	NA	May 1976	July 1973
Number installed to date	NA	NA	NA	NA	Over 300
COMMENTS	Storage protection std. by memory partition and opt. by page; mapping to 512K opt.; 4K PROM opt.; on power failure, memory is dumped to protected disk; price includes CRT, light pen, modem, 1.2M-byte disk, & arith. & I/O processors		System price also includes 500-cps paper tape reader	System price also includes 500-cps paper tape reader	

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MANUFACTURER & MODEL	Control Data Cyber 18 Series	Data General Nova 3/4	Data General Nova 3/12, 3-D	Data General Eclipse S/100	Data General Eclipse S/200
DATA FORMATS					
Word length, bits	16 + 5 or + 1	16 + 1	16 + 1	16 + 5	16 + 5
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16, 32	16	16	16, 32	16, 32
MAIN STORAGE					
Storage type	MOS	Core, MOS	Core, MOS	Core, MOS	Core, MOS
Cycle time, microseconds/word	0.75	0.7	0.7	0.8, 0.7	0.8, 0.7
Access time, microseconds/word	0.3	0.35	0.35	0.4, 0.5	0.4, 0.5
Minimum capacity, words	16K	4K	4K	8K	16K
Maximum capacity, words	128K	32K	32K	32K	128K
Parity checking	Standard	Optional	Optional	No	No
Error correction	Optional	No	No	Optional	Optional
Storage protection	Standard	No	No; see comments	No	Optional
CENTRAL PROCESSOR					
No. of accumulators	6	4	4	4	4
No. of index registers	6	2	2	2	2
No. of directly addressable words	64K	256	256	32K	32K
No. of addressing modes	8	6	6	7	7
Control storage	ROM; 8K bytes	No	No	See comments	ROM; 256 x 56 bits
Add time, microseconds	1.76	0.7	0.7	0.6	0.6
Hardware multiply/divide	Standard	Optional	Optional	Standard	Standard
Hardware floating point	No	No	Optional	No	Optional
Hardware byte manipulation	Standard	No	No	Standard	Standard
Battery backup	Optional	Optional	Optional	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	1.2M	1.10M	1.10M	1.25M	1.25M
No. of external interrupt levels	2-16	16	16	16	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	560K bytes	315K-1.25M bytes	315K-2.5M bytes	315K-2.5M bytes	315K-2.5M bytes
Disk pack/cartridge drives	Pack; 25-400M bytes	Cartridge; 2.5-10M bytes	Pack & cartridge; 2.5-736M bytes	Pack & cartridge; 2.5-736M bytes	Pack & cartridge; 2.5-736M bytes
Drum/fixed head disk storage	No	Fixed-head; 256K-1M bytes	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M 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	20 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	No	10-165 cps	10-165 cps	10-165 cps	10-165 cps
Line printer	300, 600 lpm	240-600 lpm	240-600 lpm	240-600 lpm	240-600 lpm
Data communications interface	Up to 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	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	FORTRAN, BASIC, ALGOL	FORTRAN, BASIC, ALGOL	FORTRAN, BASIC, ALGOL	FORTRAN, BASIC, ALGOL
Operating system	Batch, real-time, time-sharing	Real-time	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	$27,840 (16K words)	$2,600 (4K MOS)	$3,600 (4K MOS)	$9,200 (8K core)	$16,300 (16K core)
Price of memory increment	—	—	—	$4,500 (16K core); $8,500 (32K MOS)	$4,500 (16K core); $8,500 (32K MOS)
Date of first delivery	May 1976	April 1976	April 1976	February 1975	February 1975
Number installed to date	NA	NA	NA	1000+ (all models)	1000+ (all models)
COMMENTS	System price also includes card reader & CRT	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	256 56-bit words of writable control store optionally available	256 56-bit words of writable control store, memory allocation and protection unit optionally available

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MANUFACTURER & MODEL	Data General Eclipse S/230	Data General Eclipse C/300	Data General Eclipse C/330	Datapoint 1100	Datapoint 2200
DATA FORMATS					
Word length, bits	16 + 5	16 + 5	16 + 5	8-bit byte	8-bit byte
Fixed-point operand length, bits	16	16	16	8	8
Instruction length, bits	16, 32	16, 32	16, 32	8-24	8-24
MAIN STORAGE					
Storage type	Core, MOS	Core , MOS	Core, MOS	MOS	MOS
Cycle time, microseconds/word	0.8, 0.7	0.8, 0.7	0.8, 0.7	3.2	3.2
Access time, microseconds/word	0.4, 0.5	0.4, 0.5	0.4, 0.5	1.6	1.6
Minimum capacity, words	16K	16K	16K	4K bytes	4K bytes
Maximum capacity, words	256K	128K	256K	16K bytes	16K bytes
Parity checking	No	No	No	No	No
Error correction	Optional	Optional	Optional	No	No
Storage protection	Optional	Optional	Optional	No	No
CENTRAL PROCESSOR					
No. of accumulators	4	4	4	5	5
No. of index registers	2	2	2	9	9
No. of directly addressable words	32K	32K	32K	16K bytes	16K bytes
No. of addressing modes	7	7	7	2	2
Control storage	ROM; 256 x 56 bits	ROM; 2K x 56 bits	ROM; 2K x 56 bits	No	No
Add time, microseconds	0.6	0.6	0.6	4.8	4.8
Hardware multiply/divide	Standard	Standard	Standard	No	No
Hardware floating point	Optional	Standard	Standard	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	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	No	No
Maximum I/O rate, words/sec	1.25M	1.25M	1.25M	195K	195K
No. of external interrupt levels	16	16	16	1	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	315K-2.5M bytes	315K-2.5M bytes	315K-2.5M bytes	256K-1M bytes	256K-1M bytes
Disk pack/cartridge drives	Pack & cartridge; 2.5-736M bytes	Pack & cartridge; 2.5-736M bytes	Pack & cartridge; 2.5-736M bytes	No	Pack & cartridge; 2.4-50M bytes
Drum/fixed-head disk storage	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	No	No
Magnetic tape cassettes/cartridges	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 1.6 KBS	Cassette; 352 cps	Cassette; 352 cps
Magnetic tape, ½-inch	10-72 KBS	10-72 KBS	10-72 KBS	9.6-20 KBS	9.6-20 KBS
Punched card input	150-1000 cpm	150-1000 cpm	150-1000 cpm	300 cpm	300 cpm
Serial printer	10-165 cps	10-165 cps	10-165 cps	120 cps	120 cps
Line printer	240-600 lpm	240-600 lpm	240-600 lpm	300, 600 lpm	300, 600 lpm
Data communications interface	Up to 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 12 lines	80 char. x 12 lines
Other standard peripheral units	Modular digital & analog data control & acquisition subsystem optional	Modular digital & analog data control & acquisition subsystem optional	Modular digital & analog data control & acquisition subsystem optional	—	—
SOFTWARE					
Assembler	Assember & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Yes	Yes
Compilers	FORTRAN, BASIC, ALGOL	FORTRAN, BASIC, ALGOL	FORTRAN, BASIC, ALGOL	BASIC, RPG II, SCRIBE, DATA-BUS, DATAFORM	BASIC, RPG II, SCRIBE, DATA-BUS, DATAFORM
Operating system	Batch, real-time time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch	Batch, 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)	$30,700 (32K core)	$30,000 (32K core)	$7,200 (4K bytes)	$8,571 (4K bytes)
Price of memory increment	$4,500 (16K core); $8,500 (32K MOS)	$4,500 (16K core); $8,500 (32K MOS)	$4,500 (16K core); $8,500 (32K MOS)	$840 (4K bytes)	$1,432 (4K bytes); $1,647 (8K bytes)
Date of first delivery	November 1976	August 1975	October 1976	January 1974	April 1972
Number installed to date	1000+ (all models)	1000+ (all models)	1000+ (all models)	6000	9000
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	Extended arithmetic processor standard; memory allocation and protection unit optional; error correction std. on MOS, opt. on core	Extended arithmetic processor standard; extended memory allocation and protection unit optional; error correction std. on MOS, opt. on core; IDEA software	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	System price also includes integral CRT/keyboard and dual cassette tape drives

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MANUFACTURER & MODEL	Datapoint 5500	Datasaab Systems 5051 & 5052	Datasaab Systems 5020	Datum Enhancer	Decision Data System/4
DATA FORMATS					
Word length, bits	8-bit byte	16	16 + 2	16	8-bit byte
Fixed-point operand length, bits	8	1-255 digits	8, 16	16	8
Instruction length, bits	8-24	16-128	16	16, 32	16-32
MAIN STORAGE					
Storage type	MOS	Core	Core	Core	MOS
Cycle time, microseconds/word	1.6	0.98; 1.2	1.2	0.80	1
Access time, microseconds/word	0.8	—	—	0.20	0.5
Minimum capacity, words	48K bytes	4K; 8K	4K	16K	32K bytes
Maximum capacity, words	48K bytes	32K	32K	64K	64K bytes
Parity checking	Standard	No	Standard	No	Standard
Error correction	No	No	No	No	No
Storage protection	Standard	Standard	Standard	Optional	No
CENTRAL PROCESSOR					
No. of accumulators	5	7	8	6	6
No. of index registers	11	7	3	4	6
No. of directly addressable words	48K bytes	32K	256	16K	64K
No. of addressing modes	2	8	3	11	3
Control storage	ROM; 4K bytes	—	—	ROM & WCS; 4.6K	ROM; 2K
Add time, microseconds	1.4	3.2	7.2	0.8	—
Hardware multiply/divide	No	Standard	No	Standard	Standard
Hardware floating point	No	No	No	Optional	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	No	Standard	Optional	Standard	Standard
Maximum I/O rate, words/sec	195K	1M	—	1.2M	400K
No. of external interrupt levels	9	5	—	64	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256K-1M bytes	No	256K-1M bytes	No	1-3M bytes
Disk pack/cartridge drives	Pack & cartridge; 2.4-200M bytes	Cartridge; 5-40M bytes	No	Cartridge; 2.5-100M bytes	Cartridge; 5-40M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 352 cps	Cassette; 756 cps	Cassette; 756 cps	Cassette & cartridge; 1 KBS	No
Magnetic tape, ½-inch	9.6-20 BKS	10 KBS	No	10-240 KBS	No
Punched card input	300 cpm	No	No	285-1000 cpm	300-1200 cpm
Serial printer	120 cps	15-330 cps	15-330 cps	No	120 cps
Line printer	300, 600 lpm	200 lpm	200 lpm	300-1200 lpm	300 lpm
Data communications interface	Up to 9600 bps	To 9600 bps	To 9600 bps	100-9600 bps	Up to 9600 bps
CRT	80 char. x 12 lines	64 char. x 16 lines	40 char. x 12 lines	—	80 char. x 24 lines
Other standard peripheral units	—	Paper tape reader, paper tape punch	Paper tape reader, paper tape punch	—	None
SOFTWARE					
Assembler	Yes	No	Yes	Micro assembler	No
Compilers	BASIC, RPG II, SCRIBE, DATABUS, DATAFORM	Logic-3/MALL	DIL-5	No	RPG, Phrase
Operating system	Batch, time-sharing	Time-sharing	Time-sharing	No	Batch, interactive
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	$33,888 (48K bytes)	$45,000 (8K words)	—	$12,975 (16K words)	$20,000 (32K bytes)
Price of memory increment	CPU cannot be expanded	$2,000 (8K words)	—	$3,400 (16K words)	$1,450 (16K bytes)
Date of first delivery	December 1974	NA	1971	March 1976	July 1975
Number installed to date	500	NA	3000	15	15
COMMENTS	System price also includes integral CRT/keyboard and dual cassette tape drives	Basis for Datasaab D15 business minicomputer system; interpreter-based system for up 16 simultaneous users; system price also includes 10-megabyte disk drive, CRT workstation, and serial printer	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	Microcomputer-based emulator of General Automation SPC-16; user-microprogrammable; can support all GA software; GA 16/440 emulator is also available	System price also includes CRT, floppy disk drive, and serial printer

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MANUFACTURER & MODEL	Digital Computer Controls D-216	Digital Computer Controls D-316	Digital Computer Controls D-416	Digital Computer Controls D-616	Digital Computer Controls Mod 5
DATA FORMATS					
Word length, bits	16 + 2 or + 5	16 + 2 or + 5	16	16 + 2 or + 5	16 + 2 or + 5
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16	16	16	16	16
MAIN STORAGE					
Storage type	MOS	MOS	Core	Core, MOS	Core, MOS
Cycle time, microseconds/word	1.6	1.6	1.6	0.66	0.8; 1.0; 1.2
Access time, microseconds/word	0.6	0.6	0.6	0.3	0.4; 0.5
Minimum capacity, words	1K	4K	4K	4K	4K
Maximum capacity, words	32K	32K	32K	1024K	128K
Parity checking	Optional	Optional	No	Optional	Optional
Error correction	Optional	Optional	No	Optional	Optional
Storage protection	No	No	No	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	8	8	8	8	8
No. of index registers	2 + 16 in memory	2 + 16 in memory	2 + 16 in memory	4 + 16 in memory	2 + 16 in memory
No. of directly addressable words	256	256	256	256	256
No. of addressing modes	6	6	6	6	6
Control storage	PROM; 512 x 33 bits	PROM; x 512 x 33 bits	PROM; 512 x 33 bits	See Comments	PROM; 512 x 48 bits
Add time, microseconds	1.57	1.57	1.57	0.66	0.8, 1.0, 1.2
Hardware multiply/divide	Standard	Standard	Standard	Optional	Optional
Hardware floating point	No	No	No	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	No	Optional	Optional
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	625K	625K	625K	1.5M	1.25M
No. of external interrupt levels	16	16	16	16	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256K-2.08M bytes	256K-2.08M bytes	256K-2.08M bytes	256K-2.08M bytes	256K-2.08M bytes
Disk pack/cartridge drives	Pack & cartridge; 2.4-640M bytes	Pack & cartridge; 2.4-640M bytes	Pack & cartridge; 2.4-640M bytes	Pack & cartridge; 2.4-640M bytes	Pack & cartridge; 2.4-640M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridge	Cassette; 1.5 KBS	Cassette; 1.5 KBS	Cassette; 1.5 KBS	Cassette; 1.5 KBS	Cassette; 1.5 KBS
Magnetic tape, ½-inch	2.5-120 KBS	2.5-120 KBS	2.5-120 KBS	2.5-120 KBS	2.5-120 KBS
Punched card input	150-600 cpm	150-600 cpm	150-600 cpm	150-600 cpm	150-600 cpm
Serial printer	30 cps	30 cps	30 cps	30 cps	30 cps
Line printer	60-600 lpm	60-600 lpm	60-600 lpm	60-600 lpm	60-600 lpm
Data communications interface	250K bps; synch.	250K bps; synch.	250K bps; synch.	250K bps; synch.	250K bps; synch.
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 punch, plot., TTY	Paper tape units, A/D & D/A converters, card punch, plot., TTY	Paper tape units, A/D & D/A converters, card punch, plot., TTY	Paper tape units, A/D & D/A converters, card punch, plot., TTY	Paper tape units, A/D & D/A converters, card punch, plot., TTY
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Macro assembler	Macro assembler	Macro assembler
Compilers	FORTRAN & BASIC	FORTRAN & BASIC	FORTRAN & BASIC	FORTRAN & BASIC	FORTRAN & BASIC
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	$2,700 (1K words)	$2,900 (4K words)	$3,400 (4K words)	$7,260 (4K words)	$3,075 (4K words)
Price of memory increment	—	—	$1,110 (4K words)	$1,860 (4K words)	$1,800 (4K words)
Date of first delivery	NA	NA	September 1975	September 1975	February 1976
Number installed to date	NA	NA	50-75	25	25-50
COMMENTS	CPU, power fail/ auto restart, TTY interface, & up to 32K words of memory on one PC board; asynch. communications to 19.2K bps	CPU, power fail/ auto restart, TTY interface, & up to 32K words of memory on one PC board; asynch. communications to 19.2K bps	CPU, power fail/ auto restart, TTY interface, & up to 32K words of memory on one PC board; asynch. communications to 19.2K bps	512 x 50-bit PROM std.; 1K x 33 bits of WCS optional; dual ported asynchronous memory; 2-speed DMA; memories can be mixed; asynch. communications to 19.2K bps	Two software-selectable interrupt modes; mixed core and MOS memories allowed; asynch. communications to 19.2K bps

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MANUFACTURER & MODEL	Digital Equipment PDP-8/A	Digital Equipment PDP-11/03	Digital Equipment PDP-11/04	Digital Equipment PDP-11/34	Digital Equipment PDP-11/35 & 11/40
DATA FORMATS					
Word length, bits	12	16	16 + 2	16 + 2	16 + 2
Fixed-point operand length, bits	12	16	16	16	16
Instruction length, bits	12	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	Core; MOS	Core; MOS	Core; MOS	Core; MOS	Core
Cycle time, microseconds/word	1.2; 1.5; 2.4	1.2; 1.2	0.98; 0.725	0.98; 0.725	0.98
Access time, microseconds/word	0.6; 0.75; 2.4	–	0.51; 0.635	0.51; 0.635	0.36
Mininum capacity, words	1K	4K	16K	16K	8K
Maximum capacity, words	32K	32K	32K	124K	124K
Parity checking	No	No	Standard	Standard	Optional
Error correction	No	No	No	No	No
Storage protection	No	No	No	Standard	Optional
CENTRAL PROCESSOR					
No. of accumulators	1	6	6	6	6
No. of index registers	8 per 4K (in mem.)	6	6	6	6
No. of directly addressable words	256	32K	32K	32K	32K
No. of addressing modes	4	8	8	8	8
Control storage	–	ROM; PROM; 1K	–	–	No
Add time, microseconds	3.0-3.8	3.5	3.17	2.03	1.07
Hardware multiply/divide	Optional	Optional	Optional	Optional	Optional
Hardware floating point	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	No	Standard	Standard	Standard	Standard
Battery backup	Optional	No	Optional	Optional	No
Real-time clock or timer	Optional	Optional	Standard	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	526-667K	833K	2M	–	2M
No. of external interrupt levels	1-64	Variable	Variable	Variable	Variable
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	128K-2M (6-bit)	256-512K bytes	256-512K bytes	256-512K bytes	256-512K bytes
Disk pack/cartridge drives	Cartridge; 3.2-12.8M (6-bit)	No	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes
Drum/fixed-head disk storage	No	No	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes
Magnetic tape cassettes/cartridges	Cassette; 562 cps	No	Cassette; 562 cps	Cassette; 562 cps	Cassette; 562 cps
Magnetic tape, ½-inch	10-36 KBS	No	10-72 KBS	10-72 KBS	10-72 KBS
Punched card input	300 cpm	No	285-1200 cpm	285-1200 cpm	285-1200 cpm
Serial printer	180 cps	180 cps	30-180 cps	30-180 cps	30-180 cps
Line printer	230 lpm	No	230-1200 lpm	230-1200 lpm	230-1200 lpm
Data communications interface	110-71K 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; 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	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, DIBOL, ALGOL, FOCAL	BASIC, FORTRAN	BASIC, FORTRAN, FOCAL	BASIC, FORTRAN, COBOL, FOCAL	BASIC, FORTRAN, COBOL, FOCOL
Operating system	Batch, real-time, time-sharing	Batch, real-time	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	$1,835-$8,295	$1,995	$7,695 (16K MOS); $8,195 (16K core)	$11,190 (16K core or MOS)	$17,800 (16K 11/40)
Price of memory increment	$2,850 (8K core); $1,230 (4K MOS)	$895 (4K core); $625 (4K MOS)	$1,700 (8K MOS); $2,000 (8K core)	$1,700 (8K MOS); $2,000 (8K core)	$8,000 (32K core); $4,400 (4K bipol.)
Date of first delivery	December 1974	NA	NA	NA	NA
Number installed to date	Over 30,000	NA	NA	NA	NA
COMMENTS	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	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

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MANUFACTURER & MODEL	Digital Equipment PDP-11/45	Digital Equipment PDP-11/55	Digital Equipment PDP-11/70	Digital Equipment XVM	Digital Scientific Meta 4
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16 + 2	18	16 + 2 parity
Fixed-point operand length, bits	16	16	16	18, 36	16-32
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	18	16-32
MAIN STORAGE					
Storage type	Core;MOS;bipolar	Core; bipolar	Core	Core	Core
Cycle time, microseconds/word	0.98; 0.50; 0.30	0.98; 0.30	0.98	0.98	0.9
Access time, microseconds/word	—	—	0.36	—	0.5
Minimum capacity, words	32K	16K	64K	32K	8K
Maximum capacity, words	124K	124K	1024K	128K	128K
Parity checking	Standard	Standard	Standard	No	Standard
Error correction	No	No	No	No	No
Storage protection	Standard	Standard	Standard	Standard	Std. on 4/1800; Opt. on 4/1130
CENTRAL PROCESSOR					
No. of accumulators	12	12	12	1	Up to 28
No. of index registers	12	12	12	1	3
No. of directly addressable words	32K	32K	32K	8K	64K
No. of addressing modes	8	8	8	4	—
Control storage	—	—	—	No	ROM; to 4K words
Add time, microseconds	0.30-0.97	0.30-0.97	0.30-1.20	1.78	2.9
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	No	No
Battery backup	No	No	No	No	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	2M(core);4M(bi.)	2M(core; 4m(bi.)	2.9M	1M	1M
No. of external interrupt levels	Variable	Variable	Variable	Variable	Up to 32
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256-512K bytes	256-512K bytes	256-512K bytes	No	No
Disk pack/cartridge drives	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-1408M bytes	Cartridge & pack; 2.5-320M bytes	Pack & cartridge; 1.2-160M bytes
Drum/fixed-head disk storage	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes	Fixed-head; 512K-8M bytes	No	Fixed-head; 1-2M bytes
Magnetic tape cassettes/cartridges	Cassette; 562 cps	Cassette; 562 cps	Cassette; 562 cps	No	No
Magnetic tape, ½-inch	10-72 KBS	10-72 KBS	10-72 KBS	9-36 KBS	30, 60 KBS
Punched card input	285-1200 cpm	285-1200 cpm	285-1200 cpm	300, 1000 cpm	600, 1000 cpm
Serial printer	30-180 cps	30-180 cps	30-180 cps	30-180 cps	No
Line printer	280-1200 lpm	230-1200 lpm	230-1200 lpm	300, 1200 lpm	300, 600 lpm
Data communications interface	50-56,000 bps	50-56,000 bps	50-56,000 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	No
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	Graphics units, laboratory interfaces	Paper tape reader; paper tape punch
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Macro assembler	Assembler & macro assembler
Compilers	BASIC, FORTRAN, COBOL, FOCAL	BASIC, FORTRAN, COBOL, FOCAL	BASIC, FORTRAN, COBOL, FOCAL	FORTRAN, ALGOL, FOCAL	COBOL, RPG, FORTRAN, BASIC, APL, SI1
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Real-time, interactive, time-sharing	Batch, real-time, multi-user	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	No	Partially
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$37,975 (32K core)	$48,000 (32K bipolar)	$60,000 (128K core)	$42,000 (32K)	$33,850 (4/1130); $39,360 (4/1800)
Price of memory increment	$8,000 (32K core); $4,400 (4K bipol.)	$8,000 (32K core); $4,400 (4K bipol.)	$17,700 (64K core)	$10,000 (32K)	$9,925 (8K words); $17,325 (16K words)
Date of first delivery	NA	NA	NA	—	1970
Number installed to date	NA	NA	NA	1200	230+ (both models)
COMMENTS	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	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	XVM systems are enhanced PDP-15 systems featuring a memory processor that performs instruction "look-ahead" using a 4-word instruction stack and a PDP-11/05 CPU as a front-end I/O processor	Can run most IBM 1130 and 1800 programs

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MANUFACTURER & MODEL	Digital Systems Galaxy/5	Financial Computer System III/10	Four Phase IV/40	Four Phase IV/70	Fujitsu Panafacom U-100
DATA FORMATS					
Word length, bits	8-bit byte	8-bit byte	24	24	16 + 2
Fixed-point operand length, bits	8-2048	8	15	15	8, 16, 32
Instruction length, bits	16, 32, 48	8	24	24	16, 32, 48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	Core, MOS
Cycle time, microseconds/word	0.75	0.6	2	2	1.5, 0.7
Access time, microseconds/word	0.50	0.2	—	—	0.5, 0.53
Minimum capacity, words	32K bytes	4K bytes	24K bytes	24K bytes	4K
Maximum capacity, words	1024K bytes	256K bytes	72K bytes	96K bytes	32K
Parity checking	Standard	Optional	Standard	Standard	Standard
Error correction	Standard	Optional	No	No	No
Storage protection	No	Optional	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	7	Software-assigned	5	5	8
No. of index registers	7	128	3	3	7
No. of directly addressable words	1M	64K bytes	73,728	98,304	32K
No. of addressing modes	2	3	—	—	6
Control storage	ROM; 512 x 40 bits	PROM, 1-16K bytes	ROM; 1K x 48 bits	ROM; 1K x 48 bits	ROM; 1.5K bytes
Add time, microseconds	20	3.2	16	16	2.8, 4.4
Hardware multiply/divide	Standard	Optional	Standard	Standard	Standard
Hardware floating point	No	Optional	Standard	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	—	—	Optional
Real-time clock or timer	Standard	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	No	No	Standard
Maximum I/O rate, words/sec	50K	960K	125K	125K	1M
No. of external interrupt levels	1	16	8	8	4
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	266K-5M bytes	354K bytes	354K bytes	243-486K bytes
Disk pack/cartridge drives	Pack; 32-240M bytes	Cartridge; 10-400M bytes	Cartridge; 2.5-10M bytes	Pack & cartridge; 2.5-270M bytes	Pack & cartridge; 2.49-10M bytes
Drum/fixed-head disk storage	No	No	No	No	Fixed-head; 1M bytes
Magnetic tape cassettes/cartridges	No	Cassette; 1.2 KBS	No	No	Cassette; 1 KBS
Magnetic tape, ½-inch	No	72 KBS	No	10, 60 KBS	9.6-120 KBS
Punched card input	No	300, 600 cpm	300, 600 cpm	300, 600 cpm	100-600 cpm
Serial printer	120 cps	165 cps	30 cps	30 cps	30-165 cps
Line printer	100-1300 lpm	300-1250 lpm	245-700 lpm	245-700 lpm	160-1100 lpm
Data communications interface	Up to 15K bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	50-48,000 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	48 char. x 6 lines	See Comments
Other standard peripheral units	None	Paper tape reader, paper tape punch	None	None	Paper tape units, optical mark reader, plotter, etc.
SOFTWARE					
Assembler	Assembler & macro assembler	Yes	Yes	Yes	Assembler & macro assembler
Compilers	None	BASIC, CPL, PL/X	None	COBOL, RPG	FORTRAN, BASIC, COBOL
Operating system	Time-sharing	Batch, real-time	Batch, interactive	Batch, interactive	Batch, real-time
Language implemented in firmware	No	No	Partially	Partially	No
Operating system implemented in firmware	No	Partially	—	—	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$25,440 (32K bytes)	$9,500 (8K bytes)	$30,315 (24K bytes)	$68,055 (24K bytes)	—
Price of memory increment	$7,000 (32K bytes)	$4,000 (8K bytes); $6,000 (16K bytes)	—	—	—
Date of first delivery	December 1975	January 1975	June 1973	February 1971	August 1975
Number installed to date	4	250+	2300+ (IV/40, 70)	2300+ (IV/40, 70)	Over 200
COMMENTS	Larger memory sizes include additional CPU's; Galaxy/5 is a rather large multiprocessing data base oriented computer utilizing many microprocessors to assist in the computer's overall functioning	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 bi-synch. communications controller	System price also includes 12 CRT's, 2.5-megabyte disk drive, and 9-track magnetic tape drive	CRT may be 40 char. x 16 lines or 80 char. x 24 lines

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MANUFACTURER & MODEL	Fujitsu Panafacom U-200	Fujitsu Panafacom U-300	Fujitsu Panafacom U-400	Fujitsu Facom R-E	General Automation SPC-16
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	16 + 2	16	16
Fixed-point operand length, bits	8, 16, 32	8, 16, 32	8, 16, 32	16	16
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16	16
MAIN STORAGE					
Storage type	Core, MOS	Core, MOS	Core, MOS	Core	Core
Cycle time, microseconds/word	0.65, 0.75	0.65, 0.75	0.65, 0.75	1.5	0.8, 0.96, 1.44
Access time, microseconds/word	0.28, 0.6	0.28, 0.6	0.28, 0.6	0.75	0.4, 0.48, 0.72
Minimum capacity, words	4K	4K	32K	4K	4K
Maximum capacity, words	32K	32K	128K	32K	128K
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	No	No	No	No	No
Storage protection	Optional	Standard	Standard	No	No
CENTRAL PROCESSOR					
No. of accumulators	8	8	8	1	16
No. of index registers	7	7	7	4	6
No. of directly addressable words	32K	32K	32K	512	32K
No. of addressing modes	6	6	6	5	11
Control storage	No	PROM; 2K bytes	PROM; 3K bytes	No	ROM; 4K words
Add time, microseconds	1.58, 3.15	0.8, 1.8	0.8, 1.8	6.0	0.8, 0.96, 1.44
Hardware multiply/divide	Standard	Standard	Standard	No	Standard
Hardware floating point	No	Optional	Optional	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	No	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Optional	Standard	Standard	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1M	1M	1M	400K	1.04M
No. of external interrupt levels	4	9	9	1	64-unlimited
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	243-486K bytes	243-486K bytes	243-486K bytes	No	294-884K bytes
Disk pack/cartridge drives	Pack & cartridge; 2.49-10M bytes	Pack & cartridge; 2.49-10M bytes	Pack & cartridge; 2.49-10M bytes	Cartridge; 131K bytes	Pack & cartridge; 5-2400M bytes
Drum/fixed-head disk storage	Fixed-head; 1M bytes	Fixed-head; 1M bytes	Fixed-head; 1M bytes	Drum; 65-262K bytes	Fixed-head; 256K-2M bytes
Magnetic tape cassettes/cartridges	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	No	No
Magnetic tape, ½-inch	9.6-120 KBS	9.6-120 KBS	9.6-120 KBS	21.6 KBS	20-60 KBS
Punched card input	100-600 cpm	100-600 cpm	100-600 cpm	100-300 cpm	300-1000 cpm
Serial printer	30-165 cps	30-165 cps	30-165 cps	No	10, 165 cps
Line printer	160-1100 lpm	160-1100 cpm	160-1100 cpm	120-440 lpm	200-600 lpm
Data communications interface	50-48,000 bps	50-48,000 bps	50-48,000 bps	50-1200 bps	75-9600 bps
CRT	See Comments	See Comments	See Comments	40 char. x 16 lines	See Comments
Other standard peripheral units	Paper tape units, optical mark reader, plotter, etc.	Paper tape units, optical mark reader, plotter, etc.	Paper tape units, optical mark reader, plotter etc.	Paper tape units, optical mark reader, plotter	TTY, A/D units, paper tape units
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler	Assembler & macro assembler
Compilers	FORTRAN, BASIC, COBOL	FORTRAN, BASIC, COBOL	FORTRAN, BASIC, COBOL	FORTRAN	FORTRAN IV, BASIC, COBOL
Operating system	Batch, real-time	Batch, real-time	Batch, real-time	No	Real-time, batch
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	–	–	–	–	$5,500 (4K words)
Price of memory increment	–	–	–	–	$2,600 (4K words)
Date of first delivery	October 1972	June 1975	August 1975	March 1969	May 1970
Number installed to date	Over 1000	Over 100	Over 50	Over 1000	5000
COMMENTS	CRT may be 40 char. x 16 lines or 80 char. x 24 lines	CRT may be 40 char. x 16 lines or 80 char. x 24 lines	CRT may be 40 char. x 16 lines or 80 char. x 24 lines		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

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MANUFACTURER & MODEL	General Automation 18/30	General Automation 16/330	General Automation 16/440	GRI System 99/50	GTE IS/1000
DATA FORMATS					
Word length, bits	16 + 1	16 + 2	16 + 2	16	16 + 2
Fixed-point operand length, bits	16, 32	16	16	–	16
Instruction length, bits	16, 32	16, 32, 48	16, 32, 48	16-48	16, 32
MAIN STORAGE					
Storage type	Core	Core	Core	Core	Core; MOS
Cycle time, microseconds/word	1.2	0.72	0.72	1.76	0.75
Access time, microseconds/word	0.6	0.225	0.225	–	0.35; 0.30
Minimum capacity, words	4K	4K	16K	32K bytes	16K; 32K
Maximum capacity, words	64K	32K	1024K	64K bytes	1024K
Parity checking	Standard	Optional	Optional	No	Optional
Error correction	No	No	No	No	No
Storage protection	Standard	Optional	Optional	No	No
CENTRAL PROCESSOR					
No. of accumulators	16	16	16	2, 8	16
No. of index registers	3	8	8	1	15
No. of directly addressable words	64K	64K	1M with MAP	32K	64K
No. of addressing modes	6	11	11	–	11
Control storage	–	ROM; 320 x 34 bits	PROM; 512 x 64 bits	–	No
Add time, microseconds	2.4	1.9	0.78	–	0.75
Hardware multiply/divide	Standard	Standard	Standard	Optional	Optional
Hardware floating point	No	Optional	Optional	No	No
Hardware byte manipulation	No	Standard	Standard	Optional	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Standard	Standard	Standard	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	480K	1.25M	1M	568K	1M
No. of external interrupt levels	6-59	64-unlimited	64-unlimited	Unlimited	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	500K-2M bytes	500K-2M bytes	No	256K-2M bytes
Disk pack/cartridge drives	Pack & cartridge; 1.02-80M bytes	Pack & cartridge; 5-2400M bytes	Pack & cartridge; 5-2400M bytes	Cartridge; 10.6-42.4M bytes	Cartridge & pack; 2.5-2400M bytes
Drum-fixed-head disk storage	No	Fixed-head; 256K-2M bytes	Fixed-head; 256K-2M bytes	No	Fixed-head & drum; 512K-40M bytes
Magnetic tape cassettes/cartridges	No	No	No	Cassette	No
Magnetic tape, ½-inch	20-60 KBS	20-60 KBS	20-60 KBS	60 KBS	10-120 KBS
Punched card input	400, 1000 cpm	400, 1000 cpm	400, 1000 cpm	300 cpm	200-1000 cpm
Serial printer	No	10, 165 cps	10, 165 cps	88-330 cps	10-330 cps
Line printer	300, 600 lpm	200-600 lpm	200-600 lpm	200-600 lpm	200-600 lpm
Data communications interface	To 9600 bps	75-9600 bps	75-9600 bps	Up to 1200 bps	66-250K bps
CRT	See Comments	80 char. x 24 lines	80 char. x 24 lines	80 char. x 8 lines	80 char. x 24 lines
Other standard peripheral units	TTY, paper tape units, card punches, 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	None	Comm. preprocessor, RS-232C and MIL 188C interfaces
SOFTWARE					
Assembler	Yes	Macro assembler	Macro assembler	Yes	Macro assembler
Compilers	APL, BASIC, COBOL, FORTRAN IV, RPG II	FORTRAN IV, BASIC, COBOL	FORTRAN IV, BASIC, COBOL	COBOL, RPG II	FORTRAN, COBOL, PL/1
Operating system	Batch, real-time, time-sharing	Batch, real-time	Batch, real-time, time-sharing	Real-time, multi-user	Real-time, multi-programming
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	$13,650 (8K words)	$4,550 (4K words)	$8,950 (16K words)	$44,376 (32K bytes)	Under $5,000 (16K)
Price of memory increment	$4,000 (8K words)	$3,000 (16K words)	$3,000 (16K words)	–	NA
Date of first delivery	June 1969	January 1976	May 1975	NA	January 1972
Number installed to date	Over 1000	NA	400	NA	Over 2000
COMMENTS	The basis of DM-200 Series; CRT may be either 80 char. x 12 lines or 74 char. x 27 lines	Software and I/O compatible with SPC-16; packaged LSI single-board computer supporting core memory; intended for OEM dedicated applications	Software and I/O compatible with SPC-16; oriented toward multi-user environment	System price also includes cartridge disk, serial printer, and CRT	

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MANUFACTURER & MODEL	Harris Slash 4	Harris Slash 6	Harris Slash 7	Hewlett-Packard Calculator Products Div. 9825	Hewlett-Packard Calculator Products Div. 9830
DATA FORMATS					
Word length, bits	24 + 2	24 + 5	24 + 2	8-bit byte	8-bit byte
Fixed-point operand length, bits	24, 48	24, 48	24, 48	—	—
Instruction length, bits	24	24	24	16	16
MAIN STORAGE					
Storage type	Core; MOS	MOS	Core; MOS	MOS	MOS
Cycle time, microseconds/word	0.75; 0.2	0.45	0.43; 0.2	—	13
Access time, microseconds/word	0.3	0.300	0.3	—	—
Minimum capacity, words	8K	16K	32K	6844 bytes	3520 bytes
Maximum capacity, words	256K	256K	256K	31,420 bytes	30,144 bytes
Parity checking	Standard	No	Standard	No	No
Error correction	No	Standard	No	No	No
Storage protection	Optional	Optional	Optional	No	No
CENTRAL PROCESSOR					
No. of accumulators	5	5	5	Software-assigned	Software-assigned
No. of index registers	3	3	3	Software-assigned	Software-assigned
No. of directly addressable words	64K	64K	64K	—	—
No. of addressing modes	4	4	4	8	4
Control storage	No	No	No	See Comments	See Comments
Add time, microseconds	0.75	0.6	0.43	300	1000
Hardware multiply/divide	Standard	Standard	Standard	No	No
Hardware floating point	Optional	Optional	Optional	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	Optional	No	No	No
Real-time clock or timer	Optional	Optional	Optional	No	No
INPUT/OUPUT CONTROL					
Direct memory access channel	Optional	Optional	Optional	Standard	No
Maximum I/O rate, words/sec	1.3M	4.5M	1.9M	400K	1.2K
No. of external interrupt levels	4-48	24	4-48	2	0
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	310K-1.2M bytes	310K-3.7M bytes	310K-1.2M bytes	468K-15M bytes	No
Disk pack/cartridge drives	Pack & cartridge; 2.7-160M bytes	Pack & cartridge; 2.7-160M bytes	Pack & cartridge; 2.7-160M bytes	No	Cartridge; 4.8-9.6M bytes
Drum/fixed-head disk storage	Fixed-head; 10.5M bytes	Fixed-head; 10.5M bytes	Fixed-head; 10.5M bytes	No	No
Magnetic tape cassettes/cartridges	Cassette; 30 cps	Cassette; 30 cps	Cassette; 30 cps	Cartridge; 2.75 KBS	Cassette; 375 bps
Magnetic tape, ½-inch	25-320 KBS	25-320 KBS	25-320 KBS	No	No
Punched card input	300-1000 cpm	300-1000 cpm	300-1000 cpm	300 cpm	300 cpm
Serial printer	30 cps	30 cps	30 cps	30 cps	30 cps
Line printer	300-900 lpm	300-900 lpm	300-900 lpm	240 lpm	165-300 lpm
Data communications interface	98K bps; synch.	98K bps; synch.	98K bps; synch.	No	Up to 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	No	80 char. x 24 lines
Other standard peripheral units	Paper tape units, card reader/ punch	Paper tape units, card reader/ punch	Paper tape units, card reader/ punch	Paper tape reader, paper tape punch, plotter	Paper tape reader, paper tape punch, plotter
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Macro assembler	No	No
Compilers	FORTRAN IV BAS., RPG II, SNOBOL	FORTRAN IV, BASIC, RPG II, SNOBOL	FORTRAN IV, BAS., RPG II, FORGO, COBOL	HPL	BASIC
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Interactive	Interactive
Language implemented in firmware	No	No	No	Fully	Fully
Operating system implemented in firmware	No	No	No	Fully	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$24,000 (8K words)	$14,500 (16K words)	$45,000 (32K words)	$5,900 (6844 bytes)	$4,900 (3520 bytes)
Price of memory increment	$7,000 (8K words)	$5,500 (16K words)	$25,000 (32K words)	$1,600 (8K bytes) $3,200 (16K bytes)	$1,000 (4K bytes) $3,000 (12K bytes)
Date of first delivery	September 1973	October 1976	November 1975	January 1976	November 1972
Number installed to date	NA	NA	NA	NA	NA
COMMENTS	Basis for the S110 & S120 packaged systems		Basis for the S210 & S220 packaged systems	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	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

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MANUFACTURER & MODEL	Hewlett-Packard Data Systems Div. 2100	Hewlett-Packard Data Systems Div. 21MX	Hewlett-Packard General Sys. Div. HP 3000 Series II	Honeywell System 700	Honeywell Level/6 Model 6/06
DATA FORMATS					
Word length, bits	16 + 1	16 + 1	16 + 5 or + 1	16 + 2	16 + 2
Fixed-point operand length, bits	16, 32	16, 32	—	16	16
Instruction length, bits	16, 32	16, 32	8, 16	16	16
MAIN STORAGE					
Storage type	Core	MOS	MOS	Core	MOS
Cycle time, microseconds/word	0.98	0.65	0.7	0.800	0.650
Access time, microseconds/word	0.49	—	0.35	0.400	—
Minimum capacity, words	8K	4K	64K	8K	8K
Maximum capacity, words	32K	256K	256K	32K	64K
Parity checking	Standard	Standard	Standard	Optional	Standard
Error correction	No	Optional	Standard	No	Optional
Storage protection	Standard	Optional	Standard	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	2	2	20	2	2
No. of index registers	0	2	1	2	2
No. of directly addressable words	2K	32K	None	512	512
No. of addressing modes	7	7	6	14	14
Control storage	ROM/RAM; 1K	ROM/RAM; 8.5K	ROM: 10K x 32 bits	No	—
Add time, microseconds	1.96	1.94	0.55	1.55	2.0
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	Standard	Standard	No	No
Hardware byte manipulation	No	Standard	Standard	Standard	Standard
Battery backup	No	No	Standard	No	No
Real-time clock or timer	Standard	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Optional	Standard	Standard	Standard
Maximum I/O rate, words/sec	1M	616K	4.5M	1M	500K
No. of external interrupt levels	60	60	To 125	54	54
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drive	No	No	No	No	No
Disk pack/cartridge drives	Cartridge & pack; 4.9-120M bytes	Cartridge & pack; 4.9-120M bytes	Pack & cartridge; 15-376M bytes	Cartridge & pack; 1.25M-30M bytes	Cartridge & pack; 1.25M-30M bytes
Drum/fixed-head disk storage	No	No	No	Fixed-head; 64K-1M bytes	Fixed-head; 64K-1M bytes
Magnetic tape cassettes/cartridges	No	No	No	Cassette; 700 cps	Cassette; 700 cps
Magnetic tape, ½-inch	20-72 KBS	20-36 KBS	72 KBS	5.2-20.8 KBS	5.2-20.8 KBS
Punched card input	200-600 cpm	200-600 cpm	600 cpm	300-1050 cpm	300-1050 cpm
Serial printer	10, 120 cps	10, 120 cps	30, 120 cps	10-165 cps	10-165 cps
Line printer	240-1250 lpm	240-1250 lpm	200-1250 lpm	240-1100 lpm	240-1100 lpm
Data communications interface	50K-2.5M bps	50K-2.5M bytes	To 4800 bps; syn.	45-10,800 bps	45-10,800 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	Plotters	Plotters	Paper tape units, punched card reader/punch	Paper tape units, process control interfaces	Paper tape units, process control interfaces
SOFTWARE					
Assembler	Assembler	Assembler & micro assembler	Assembler & macro assembler	Macro assembler	Macro assembler
Compilers	FORTRAN, ALGOL	FORTRAN, BASIC, ALGOL	COBOL, RPG II, FORTRAN IV, BASIC	BASIC, FORTRAN	BASIC, FORTRAN
Operating system	Real-time, time-sharing	Real-time, time-sharing, data base	Batch, real-time, time-sharing	Batch; real-time; multi-programming	Batch; real-time; multi-programming
Language implemented in firmware	No	Partially	Partially	No	No
Operating system implemented in firmware	No	No	Partially	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$10,000 (4K words)	$5,560 (4K MOS)	$110,000 (64K words)	$10,800 (8K words)	$7,900 (8K words)
Price of memory increment	$2,500 (4K or 8K)	$1,500 (8K MOS)	—	$3,200 (8K words)	$2,400 (8K words)
Date of first delivery	May 1973	May 1974	June 1976	NA	January 1976
Number installed to date	Over 12,000	4000+	225 (3000 Series)	2000	NA
COMMENTS	Succeeded by 21MX series; now marketed primarily to existing accounts	21MX includes the 21MX-K microcomputer and the 21MX-E high-performance CPU; packaged systems include System 1000 computation system and 9600 & 9700 measurement and control systems	Asynchronous communications speeds to 2400 bps; 3000 Series II is an upgrade from previous 3000CX Series; sold only as a packaged system	Succeeded by Level 6, Model 6/06	Replacement for Model 700; microprogrammed emulator for Model 700 based on Level 6 CPU

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MANUFACTURER & MODEL	Honeywell Level 6 Model 6/34	Honeywell Level 6 Model 6/36	Honeywell Level 61 Model 61/58	Honeywell Level 61 Model 61/60	Honeywell Level 62 Model 62/40
DATA FORMATS					
Word length, bits	16 + 2	16 + 2	8-bit byte	8-bit byte	8-bit byte + 1
Fixed-point operand length, bits	16	16	16	16	16
Instruction length, bits	16, 32, 48	16, 32, 48	8-64	8-64	16-64
MAIN STORAGE					
Storage type	MOS	MOS	Core	MOS	MOS
Cycle time, microseconds/words	0.650	0.650	1.2	1.2	1 (2-byte fetch)
Access time, microseconds/word	—	—	—	—	—
Minimum capacity, words	8K	8K	5K bytes	10K bytes	64K bytes
Maximum capacity, words	32K	64K	10K bytes	10K bytes	128K bytes
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	Optional	No	No	Standard
Storage protection	No	No	No	No	Standard
CENTRAL PROCESSOR					
No. of accumulators	7	7	100	100	16
No. of index registers	7	7	10	10	8
No. of directly addressable words	64K	64K	10K bytes	10K bytes	128K bytes
No. of addressing modes	14	14	1	1	4
Control storage	—	—	ROM; 7.68K bytes	ROM; 10K bytes	Bipolar; to 30K words
Add time, microseconds	1.9	1.9	115	115	—
Hardware multiply/divide	Standard	Standard	No	No	Standard
Hardware floating point	Standard	Standard	No	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	No	No	No
Real-time clock or timer	Standard	Standard	No	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1.5M	1.5M	312K	312K	1.587M
No. of external interrupt levels	64	64	—	—	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256K-1M bytes	256K-1M bytes	No	No	No
Disk pack/cartridge drives	Cartridge; 2.5-40M bytes	Cartridge; 2.5-40M bytes	Pack; 3.5-92M bytes	Pack; 3.5-92M bytes	Pack & cartridge; 11.6-160M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	Cassette; 700 bps
Magnetic tape, ½-inch	No	No	No	No	10.4-60 KBS
Punched card input	300, 500 cpm	300, 500 cpm	100-300 cpm	100-300 cpm	300-1050 cpm
Serial printer	10-165 cps	10-165 cps	No	No	30 cps
Line printer	300-600 lpm	300-600 lpm	100-650 lpm	100-650 lpm	400-1600 lpm
Data communications interface	50-72,000 bps	50-72,000 bps	Up to 9600 bps	Up to 4800 bps	Up to 9600 bps
CRT	80 char. x 12 lines	80 char. x 12 lines	See Comments	See Comments	See Comments
Other standard peripherals	—	—	Card punch, extended memory (16K-64K bytes; 312 KBS)	Card punch, extended memory (16K-64K bytes; 312 KBS)	Card punch
SOFTWARE					
Assembler	Assembler & macro-preprocessor	Assembler & macro-preprocessor	No	No	No
Compilers	FORTRAN	FORTRAN	COBOL	COBOL, BASIC	COBOL, RPG, FORTRAN
Operating system	Batch, multi-tasking	Batch, multi-tasking	Batch, time-sharing	Batch, 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	$3,990 (8K words)	$5,600 (8K words)	$20,060 (5K bytes)	$25,380 (10K bytes)	$51,950 (64K bytes)
Price of memory increment	$1,600 (8K words)	$1,600 (8K words)	$7,010 (5K bytes)	CPU cannot be expanded	$1,960 (8K bytes) $3,840 (16K bytes)
Date of first delivery	January 1976	January 1976	November 1974	2nd quarter 1975	June 1975
Number installed to date	NA	NA	90 (Level 61)	90 (Level 61)	600+ (Level 62)
COMMENTS	Intended for OEM small system market	Enhanced version of Model 6/36 for larger OEM systems	GE, Hazeltine, and other terminals can be interfaced; see Report 70C-480-14 for more details	GE, Hazeltine, and other terminals can be interfaced; see Report 70C-480-14 for more details	GE, Hazeltine, and other terminals can be interfaced; system price also includes I/O peripheral controller, 6 I/O channels, 30-cps console printer, and 1 magnetic tape cassette drive; see Report 70C-480-13 for more details

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MANUFACTURER & MODEL	Honeywell Level 62 Model 62/60	IBM 5100	IBM System/32	IBM System/3	IBM 1130
DATA FORMATS					
Word length, bits	8-bit byte + 1	8-bit byte	8-bit byte	8-bit byte	16 + 2
Fixed-point operand length, bits	16	—	1-16 digits	8-248	16, 32
Instruction length, bits	16-64	16	24-48	32, 40, 48	16, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core, MOS	Core
Cycle time, microseconds/words	1 (2-byte fetch)	0.530	0.6	1.52	2.2; 3.6
Access time, microseconds/word	—	0.330	0.250	—	—
Minimum capacity, words	64K bytes	16K bytes	16K bytes	8K bytes	4K
Maximum capacity, words	256K bytes	64K bytes	32K bytes	256K bytes	32K
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	Standard	No	No	Std. (Model 15)	No
Storage protection	Standard	No	No	Std. (Model 15)	No
CENTRAL PROCESSOR					
No. of accumulators	16	64	—	1	2
No. of index registers	8	0	2	2	3
No. of directly addressable words	256K bytes	64K bytes	32K bytes	64K bytes	32K
No. of addressing modes	4	2	2	1	2
Control storage	Bipolar; to 30K words	ROM; 180K x 9 bits	ROM; 4K bytes	No	No
Add time, microseconds	—	1000 (approx.)	72 (5 bytes)	24.4	8; 4.9
Hardware multiply/divide	Standard	Standard	No	No	Standard
Hardware floating point	Optional	Standard	No	No	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No
Battery backup	No	No	No	No	No
Real-time clock or timer	No	No	No	Optional	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Optional
Maximum I/O rate, words/sec	1.587M	500K	889K	658K	278K; 455K
No. of external interrupt levels	—	3	4	5 (Models 8, 10, 12) 8 (Model 15)	6
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	243-303K bytes	243K bytes	No
Disk pack/cartridge drives	Pack & cartridge; 11.6-480M bytes	No	Nonrem. cartridge; 3.2-13.7M bytes	Pack & cartridge; 2.5-506M bytes	Pack & cartridge; 512K-2.56M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 700 bps	Cartridge; 2.85 KBS	No	No	No
Magnetic tape, ½-inch	10.4-60 KBS	No	No	20-80 KBS	15 KBS
Punched card input	300-1050 cpm	No	12-50 cpm	600, 1000 cpm	100, 600 cpm
Serial printer	30 cps	80, 120 cps	40-80 cps	85, 115 cps	15 cps
Line printer	400-1600 lpm	No	50-155 lpm	100-1100 lpm	40-1100 lpm
Data communications interface	Up to 9600 bps	Up to 300 bps	Up to 7200 bps	Up to 50K bps	Up to 4800 bps
CRT	See Comments	64 char. x 16 lines	40 char. x 6 lines	40 char. x 12 lines	74 char. x 52 lines
Other standard peripheral units	Card punch	RS-232C interface available for non-IBM peripherals	Magnetic card reader	MICR reader/ sorter, optical mark reader	Paper tape reader, paper tape punch, optical mark reader, plotter
SOFTWARE					
Assembler	No	No	Macro assembler	No	Assembler & macro assembler
Compilers	COBOL, RPG, FORTRAN	BASIC, APL	RPG II	BASIC, RPG II, COBOL, FORTRAN	RPG II, FORTRAN
Operating system	Batch, real-time, time-sharing	Batch (one-program)	Batch (one-program)	Batch, time-sharing	Batch
Language implemented in firmware	No	Fully	No	No	No
Operating system implemented in firmware	No	Fully	Partially	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$75,410 (64K bytes)	$8,975 (16K bytes)	$33,560 (16K bytes)	$12,560 (8K bytes)	$10,150 (4K words)
Price of memory increment	$3,840 (16K bytes)	$2,700 (16K bytes)	$1,350 (8K bytes)	$4,060 (4K bytes); $4,550 (8K bytes)	$5,160 (4K words)
Date of first delivery	June 1974	September 1975	March 1975	December 1970	November 1965
Number installed to date	600 + (Level 62)	NA	5500	30,000+	4000
COMMENTS	GE, Hazeltine, and other terminals can be interfaced; system price also includes I/O peripheral controller, 6 I/O channels, 30-cps console printer, and 1 magnetic tape cassette drive; see Report 70C-480-13 for more details	Portable computer weighing 50 pounds; sys-price also includes cartridge tape drive, CRT, and BASIC language interpreter	IBM's entry-level business computer; strong emphasis on packaged applications software; system price also includes 3.92M-bytes fixed disk drive, diskette drive, CRT, keyboard, and 40-cps unidirectional printer; see Report 70C-491-25 for details	Six different model lines currently available; see Report 70C-491-21 for more details	IBM 1800 is similar CPU with storage protection, real-time operating system, and extensive A/D and sensor units; see Report 70C-491-11 for more details

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MANUFACTURER & MODEL	IBM System/360 Model 20	IBM System/7	ICL 2903	ICL 2904	Interdata 5/16
DATA FORMATS					
Word length, bits	8-bit byte	16 + 2	24 + 2	24 + 2	16
Fixed-point operand length, bits	8-128	16	12	12	8, 16, 32
Instruction length, bits	16, 32, 48	16, 32	24	24	16, 32
MAIN STORAGE					
Storage type	Core	Bipolar	MOS	MOS	MOS
Cycle time, microseconds/word	See Comments	0.4	1.14	1.14	0.6
Access time, microseconds/word	—	0.15	0.57	0.57	—
Minimum capacity, words	4K bytes	2K	16K	32K	4K
Maximum capacity, words	32K bytes	64K	48K	96K	32K
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	No	—	No	No	No
Storage protection	No	No (Models A & B);Std. (Model E)	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	8 (see Comments)	4	8	8	16
No. of index registers	8 (see Comments)	28	4	4	15
No. of directly addressable words	—	64K	4K	4K	32K
No. of addressing modes	—	1	4	4	2
Control storage	ROM	No	8K, 12K	8K, 12K	Opt. ROM; to 48K bytes
Add time, microseconds	58	0.8	17.7	11.8	1.2
Hardware multiply/divide	Standard	No	Standard	Standard	Standard
Hardware floating point	No	No	Optional	Optional	Optional
Hardware byte manipulation	Standard	No	No	No	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Optional	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	156K	2M	500K	500K	450K
No. of external interrupt levels	1	64	None	None	1-255
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	Yes
Disk pack/cartridge drives	Pack; 2.7-21.6M bytes	Pack & cartridge; 4.9-69.8M bytes	Cartridge & pack; 9.8-270M (6-bit)	Cartridge & pack; 9.8-270M (6-bit)	No
Drum/fixed-head disk storage	No	Fixed-head; 502K bytes	No	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	Cassette; 1 KBS
Magnetic tape, ½-inch	15-60 KBS	No	80 KCS	80 KCS	9-120 KBS
Punched card input	600, 1000 cpm	300 cpm	300 cpm	300 cpm	400, 1000 cpm
Serial printer	15.5 cps	No	No	No	10-30 cps
Line printer	260-1100 lpm	40-155 lpm	150-1500 lpm	150-1500 lpm	60-600 lpm
Data communications interface	Up to 50K bps	Up to 50K bps	To 9600 bps	To 9600 bps	To 9600 bps
CRT	No	No	80 chars. x 25 lines	80 chars. x 25 lines	80 char. x 24 lines
Other standard peripheral units	Card punch, MICR reader/ sorter	A/D converters, sensor units	DDE terminals, 256 chars.; hard-copy printer for CRT's	DDE terminals, 256 chars.	Paper tape units, A/D & D/A converters, graphic display
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	No	No	Assembler & macro assembler
Compilers	RPG II, PL/1	FORTRAN, APG/7	COBOL, FORTRAN, BASIC, RPG, ALGOL	COBOL, FORTRAN, RPG, ALGOL	FORTRAN, BASIC
Operating system	Batch	Batch, real-time	Batch; multitask., data base mgmt.	Batch; multitask., data base mgmt.	Batch, real-time
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	$9,120 (4K bytes)	$5,900 (2K words)	$85,000	$35,000	$2,100 (4K words)
Price of memory increment	$2,400 (4K bytes); $6,380 (8K bytes)	$2,535 (2K words); $5,060 (4K words)	$7,806-19,106 (4K)	$12,116 (8K); $18,174 (12K)	$600 (4K words)
Date of first delivery	November 1964	1st quarter 1971	July 1974	NA	4th quarter 1976
Number installed to date	15,000	NA	20	5	NA
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; see Report 70C-491-02 for more details	System/7's form the base for many custom systems for voice response, Touch-Tone data entry, communications processing, etc.	Data characters are 6 bits; Cincom's TOTAL data base management system available	Data characters are 6 bits; Cullinane's IDMS and Cincom's TOTAL data base management systems available	Available as a board-based processor without chassis and peripherals

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MANUFACTURER & MODEL	Interdata 6/16	Interdata 8/16	Interdata 7/32	Interdata 8/32	Jacquard J-100
DATA FORMATS					
Word length, bits	16 + 1	16 + 1	32 + 2	32 + 2	16
Fixed-point operand length, bits	8, 16, 32	8, 16, 32	32	32	16, 32, 64
Instruction length, bits	16, 32	16, 32	16, 32, 48	16, 32, 48	16
MAIN STORAGE					
Storage type	MOS; core	Core	Core	Core	Core
Cycle time, microseconds/word	0.6; 1.0	0.75	0.75, 1.0	0.3	1.5
Access time, microseconds/word	—; 0.35	0.275	0.4, 0.5	0.4	—
Minimum capacity, words	4K	16K	16K	32K	16K
Maximum capacity, words	32K	32K	256K	256K	64K
Parity checking	Optional	Optional	Optional	Optional	No
Error correction	No	No	No	No	No
Storage protection	No	No	Optional	Standard	No
CENTRAL PROCESSOR					
No. of accumulators	16	16	32	32-256	4
No. of index registers	15	15	30	30-240	2
No. of directly addressable words	32K	32K	256K	256K	256
No. of addressing modes	2	2	7	7	4
Control storage	ROM	ROM	ROM; 1792 x 24 bits	ROM; 1240 x 32 bits	No
Add time, microseconds	1.0	0.75	1.0	0.4	7
Hardware multiply/divide	Optional	Optional	Standard	Standard	No
Hardware floating point	No	Optional	Optional	Optional	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No
Battery backup	Optional	No	No	No	No
Real-time clock or timer	Optional	Optional	Optional	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1M	1.33M	500K	1.25M	667K
No. of external interrupt levels	1-255	1-255	1-1024	4-1024	32
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	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	Pack & cartridge; 2.5-1024M bytes	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	10-40 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, BASIC	FORTRAN V, BASIC, COBOL	FORTRAN V, BASIC, COBOL	BASIC
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	$2,900 (4K words)	$6,250 (16K words)	$13,900 (16K words)	$51,900 (32K words)	$14,900 (16K words)
Price of memory increment	$600 (4K words)	$3,400 (16K words)	$3,950 (16K words)	$19,000 (64K words)	$3,000 (16K words)
Date of first delivery	February 1975	4th quarter 1976	July 1974	June 1975	August 1975
Number installed to date	180	NA	400	100	Over 100
COMMENTS	Singleboard processor with single-board memory as large as 64K bytes; options include turnkey control panel, bootstrap loader, serial I/O port, chassis & power supply	Available options include hardware single & double precision floating-point units, fixed-point multiply/divide, list processing instructions, power fail/auto restart, turnkey console		512 words of writable control store optional; features instruction look-ahead; ITAM software provides remote batch terminal emulators	Sold only in packaged configuration consisting of a 16K-word CPU, dual floppy disk, CRT display/keyboard, real-time clock, and all software

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MANUFACTURER & MODEL	Keronix IDS 16 Series	Litton 1300	Lockheed LEC 16	Lockheed SUE	Logical Machine Corp. ADAM
DATA FORMATS					
Word length, bits	16	16	16 + 1	16	16 + 1
Fixed-point operand length, bits	16	8, 16	8, 16	8,16	14 digits
Instruction length, bits	16	8-56	16	16, 32	Variable
MAIN STORAGE					
Storage type	Core	Core	Core	Core	MOS
Cycle time, microseconds/word	1.2; 1.0; 0.80	1.2	1.0	0.8	0.55
Access time, microseconds/word	—	0.5	0.5	0.4	0.25
Minimum capacity, words	4K	8K bytes	8K	4K	32K bytes
Maximum capacity, words	1024K	40K bytes	64K	32K	64K bytes
Parity checking	No	Optional	Optional	No	Standard
Error correction	No	No	No	No	No
Storage protection	Optional	No	Optional	No	Standard
CENTRAL PROCESSOR					
No. of accumulators	4	—	1	7	16
No. of index registers	2	16	1	7	16
No. of directly addressable words	64K	—	1K	256	—
No. of addressing modes	8	—	4	19	—
Control storage	—	ROM; 8-24K bytes	No	ROM; 512 x 36 bits	ROM; 512 x 32 bits
Add time, microseconds	1.2; 1.0; 0.80	225	2.0	2.79	1.0
Hardware multiply/divide	Optional	Standard	Optional	Standard	Standard
Hardware floating point	Optional	No	No	No	No
Hardware byte manipulation	Optional	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Optional	No	Standard	Standard	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	No
Maximum I/O rate, words/sec	833K;1M;1.25M	833K	333K	590K	1.25M
No. of external interrupt levels	62	—	8-64	Variable	None
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	256-512K bytes	500K-3M bytes	No	No	No
Disk pack/cartridge drives	Cartridge & pack; 2.5-1200MB	No	No	Cartridge; 5-20M bytes	Cartridge; 10M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	Cassette; 1.25 KBS	No	No	No
Magnetic tape, ½-inch	400 KBS	36 KBS	No	No	No
Punched card input	300-600 cpm	No	No	285 cpm	No
Serial printer	10-330 cps	140 cps	No	10, 100 cps	165, 330 cps
Line printer	To 1800 lpm	No	No	200-600 lpm	No
Data communications interface	To 9600 bps	No	110-9600 bps	75-9600 bps	No
CRT	80 char. x 25 lines	48 char. x 22 lines	No	No	80 char. x 24 lines
Other standard peripheral units	—	None	—	Paper tape units	None
SOFTWARE					
Assembler	Yes	Yes	Yes	Macro assembler	No
Compilers	BASIC, FORTRAN, COBOL	BASIC	FORTRAN	FORTRAN	ADAM
Operating system	Multi-user, multi-task	—	Real-time	Batch, multi-tasking	Real-time
Language implemented in firmware	No	Fully	No	No	Fully
Operating system implemented in firmware	No	Fully	No	No	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$2,900 (4K words)	$15,465 (12K bytes)	$7,615 (8K words)	$4,350 (4K words)	$39,995 (32K bytes)
Price of memory increment	$1,500 (8K words)	—	$2,475 (4K words)	$2,000 (4K words); $2,200 (8K words)	NA
Date of first delivery	April 1974	September 1974	February 1969	November 1972	April 1975
Number installed to date	Over 500	1050	Over 2000	Over 2000	About 100
COMMENTS	Keronix IDS 16 CPU's are software, memory, and I/O-compatible with Data General Nova Series CPU's	System price also includes a serial printer and magnetic tape cassette drive	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	CPU available only in ADAM small business system

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MANUFACTURER & MODEL	Melco U.S.A. Inc. Melcom 80 Series Model 31	Melco U.S.A. Inc. Melcom 80 Series Model 11	Melco U.S.A. Inc. Melcom 80 Series Model 11/M	Melco U.S.A. Inc. Melcom 80 Series Model 8	Micro Computer Machines MCM/700
DATA FORMATS					
Word length, bits	8	48 + 6	48 + 6	48	8 + 1
Fixed-point operand length, bits	8	8	8	8	8-64
Instruction length, bits	16, 32, 48	48	48	48	Variable
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.8 (2 bytes)	0.8 (1 byte)	0.8 (1 byte)	0.8 (1 byte)	0.55
Access time, microseconds/word	—	—	—	—	—
Minimum capacity, words	16K	1K	1K	1K	2K bytes
Maximum capacity, words	64K	1K	4K	4K	8K bytes
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	2	3	3	3	1
No. of index registers	2	0	0	0	0
No. of directly addressable words	64K bytes	1K bytes	1K bytes	1K bytes	16K
No. of addressing modes	2	1	1	1	—
Control storage	ROM; 6K x 8 bits	—	—	—	ROM; 32K bytes
Add time, microseconds	57.5	670	670	900	—
Hardware multiply/divide	No	No	No	No	Standard
Hardware floating point	No	No	No	No	Standard
Hardware byte manipulation	Standard	—	—	—	Standard
Battery backup	Yes	No	No	No	Standard
Real-time clock or timer	Optional	No	No	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	No	No	No	Standard
Maximum I/O rate, words/sec	1.2M	70KB	70KB	40KB	—
No. of external interrupt levels	7	1	1	1	No
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	250-500K bytes	250-500K bytes	250K-1M bytes	250K-1M bytes	250K-2M bytes
Disk pack/cartridge drives	Pack & cartridge; 10-160M bytes	Cartridge; 10-40M bytes	Cartridge; 10-40M bytes	No	No
Drum/fixed-head disk storage	Fixed-head; 380K bytes	Fixed-head; 60-420K bytes	Fixed-head; 60-420K bytes	No	No
Magnetic tape cassettes/cartridges	Cassette; 750 cps	Cassette; 750 cps	Cassette; 750 cps	Cassette; 750 cps	Cassette; 810 cps
Magnetic tape, ½-inch	20K, 40K bps	No	No	No	No
Punched card input	300, 600 cpm	300 cpm	300 cpm	No	400 cpm
Serial printer	165 cps	30, 120 cps	30, 120 cps	30, 120 cps	45 cps
Line printer	200, 400 lpm	60, 200 lpm	60, 200 lpm	No	No
Data communications interface	9600 bps	9600 bps; synch.	9600 bps; synch.	9600 bps; synch.	To 1200 bps
CRT	80 char. x 25 lines	32 char. x 16 lines	32 char. x 16 lines	32 char. x 16 lines	80 char. x 24 lines
Other standard peripheral units	Paper tape units	Paper tape units	Paper tape units	Paper tape units	GP interface; programmable RS-232C interface
SOFTWARE					
Assembler	Assembler	Assembler	Assembler	Assembler	No
Compilers	COBOL, PROGRESS	PROGRESS, COOL	PROGRESS, COOL	PROGRESS, COOL	APL
Operating system	Batch, real-time	Batch, real-time	—	—	Virtual memory, interactive
Language implemented in firmware	No	No	No	Fully	Fully
Operating system implemented in firmware	—	—	—	—	Fully
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	About $40,000	About $30,000	About $30,000	About $15,000	$4,985 (2K bytes)
Price of memory increment	NA	NA	NA	NA	$650 (2K bytes)
Date of first delivery	May 1975 (Japan)	April 1975 (Japan)	April 1975 (Japan)	July 1976 (Japan)	January 1975
Number installed to date	5000+ (all models)	5000+ (all models)	5000+ (all models)	5000+ (all models)	Over 200
COMMENTS					Features virtual storage capacity of up to 256K bytes using cassette tape or diskette; system price also includes an integral cassette drive, display, and keyboard

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MANUFACTURER & MODEL	Micro Computer Machines MCM/800	Microdata Express I	Microdata Express II	Microdata Express X	Microdata Micro-One
DATA FORMATS					
Word length, bits	8 + 1	16	16	16	8-bit byte
Fixed-point operand length, bits	8-64	1, 2, 4, 8, 16, 32	1, 2, 4, 8, 16, 32	1, 2, 3, 8, 16, 32	8, 16, 24, 32
Instruction length, bits	Variable	8, 16, 32, 40	8, 16, 32, 40	8, 16, 32, 40	8, 16, 24, 32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	Core, MOS
Cycle time, microseconds/word	1.2	0.54	0.54	0.54	1.1
Access time, microseconds/word	—	0.4	0.4	0.4	0.44
Minimum capacity, words	4K bytes	32K	32K	32K	8K
Maximum capacity, words	16K bytes	64K	512K	512K	32K
Parity checking	Standard	Standard	Standard	Standard	No
Error correction	No	Optional	Optional	Optional	No
Storage protection	No	Standard	Standard	Standard	No
CENTRAL PROCESSOR					
No. of accumulators	1	5 (stack)	5 (stack)	5 (stack)	15
No. of index	0	5 (stack)	5 (stack)	5 (stack)	Firmware-contrld.
No. of directly addressable words	16K	64K	512K	512K	32K
No. of addressing modes	—	8	8	8	Firmware-contrld.
Control storage	ROM; 32K bytes	4K-byte ROM & PROM	4K-byte ROM & PROM	ROM & PROM; 4K bytes	4K-byte ROM & PROM
Add time, microseconds	—	0.405	0.405	0.405	6.38
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	Optional	Optional	Optional	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Standard	Optional	Optional	Optional	No
Real-time clock or timer	No	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Optional
Maximum I/O rate, words/sec	—	2M	2M	2M	1M
No. of external interrupt levels	No	1024 maximum	1024 maximum	1024 maximum	2; 128
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	250K-2M bytes	No	No	No	No
Disk pack/cartridge drives	No	Pack; 10M-50M bytes	Pack & cartridge; 10-800M bytes	Cartridge; 10-160M bytes	Cartridge; 10-40M bytes
Drum/fixed-head disk storage	No	No	Fixed head; 500K-8M bytes	No	NO
Magnetic tape cassettes/cartridges	Cassette; 810 cps	Cartridge; 2.4 KBS	Cartridge; 2.4 KBS	No	No
Magnetic tape, ½-inch	No	No	40 KBS	40 KBS	40 KBS
Punched card input	400 cpm	200-1000 cpm	200-1000 cpm	200-1000 cpm	200-1000 cpm
Serial printer	45 cps	165 cps	165 cps	165 cps	165 cps
Line printer	No	300-600 lpm	300-600 lpm	125-600 lpm	300-600 lpm
Data communications interface	To 1200 bps	To 9600 bps	To 9600 bps	To 9600 bps	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	GP interface; programmable RS-232C interface	—	—	—	Paper tape reader/punch
SOFTWARE					
Assembler	No	Yes	Yes	Yes	Yes
Compilers	APL	FORTRAN, BASIC, EPL, COBOL	FORTRAN, BASIC, EPL, COBOL	FORTRAN, BASIC, EPL, COBOL	BASIC
Operating system	Virtual memory, interactive	Time-sharing	Time-sharing	Time-sharing	No
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	$8,400 (4K bytes)	$19,950 (32K words)	$27,650 (32K words)	$21,550 (32K words)	$2,175 (8K words)
Price of memory increment	$800 (4K bytes)	$4,500 (32K words); $5,500 (w. ECC)	$4,500 (32K words); $5,500 (w. ECC)	—	$75 (1K bytes)
Date of first delivery	July 1976	1st quarter 1977	1st quarter 1977	November 1976	December 1974
Number installed to date	75	NA	NA	NA	150
COMMENTS	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	System price also includes 10M-byte disk drive, magnetic tape cartridge drive, CRT, line printer, interface, desk cabinet, and all systems software	System price also includes 50M-byte disk drive, magnetic tape cartridge drive, CRT, line printer, interface, upright cabinet, 4 RS-232C lines, and all systems software	System price also includes 10M-byte disk drive, reel-to-reel magnetic tape drive, CRT line printer interface, upright cabinet, 4 RS-232C lines, and all systems software	Single-board processor; compatible with Microdata 800 and 1600 computers

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MANUFACTURER & MODEL	Microdata 1600 Series	Microdata 32/S	Microdata 3200	Modular Computer Systems Modcomp II	Modular Computer Systems Modcomp IV
DATA FORMATS					
Word length, bits	16	16	16	16 + 1	16 + 1
Fixed-point operand length, bits	8, 16, 24, 32	1, 2, 4, 8, 16, 32	8, 16	16, 32	16, 32
Instruction length, bits	8, 16, 24, 32	8, 16, 24, 32, 40	32 (micro)	16, 32, 48	16, 32, 48
MAIN STORAGE					
Storage type	Core	MOS	MOS	Core; MOS	Core
Cycle time, microseconds/word	1.0	0.35	0.35	0.8; 0.6	0.5
Access time, microseconds/word	0.4	0.3	0.3	0.4; –	0.4
Minimum capacity, words	4K	4K	4K	8K	16K
Maximum capacity, words	32K	128K	128K	64K	512K
Parity checking	No	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	Standard	No	Optional	Standard
CENTRAL PROCESSOR					
No. of accumulators	3	5 (stack)	32	15	16 blocks of 15
No. of index registers	1	5 (stack)	32	7	16 blocks of 7
No. of directly addressable words	16K	128K	128K	64K	64K
No. of addressing modes	8	8	8	7	7
Control storage	4K-byte ROM & PROM	4K-byte ROM & PROM	4K-byte ROM & PROM	No	No
Add time, microseconds	6.38	0.405	0.405	0.8; 0.6	0.56
Hardware multiply/divide	Standard	Standard	No	Standard	Standard
Hardware floating point	No	Optional	No	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	Optional	No	No	No
Real-time clock or timer	Standard	Standard	Standard	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1M	2.5M	2.5M	1.93M	4.8M
No. of external interrupt levels	2; 128	4; 1024	4; 1024	Up to 128	Up to 128
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	315-630K bytes	315-630K bytes
Disk pack/cartridge drives	Cartridge; 10-40M bytes	Cartridge; 10-40M bytes	Cartridge; 10-40M bytes	Pack & cartridge; 2.4-84M bytes	Pack & cartridge; 2.4-84M bytes
Drum/fixed-head disk storage	No	No	No	Fixed-head; 262K-2M bytes	Fixed-head; 262K-2M bytes
Magnetic tape cassettes/cartridges	No	Cartridge; 2.4 KBS	Cartridge; 2.4 KBS	No	No
Magnetic tape, ½-inch	40 KBS	40 KBS	40 KBS	120 KBS	120 KBS
Punched card input	200-1000 cpm	200-1000 cpm	200-1000 cpm	300, 1000 cpm	300, 1000 cpm
Serial printer	165 cps	165 cps	165 cps	30-132 cps	30-132 cps
Line printer	300-600 lpm	300-600 lpm	300-600 lpm	300-600 lpm	300-600 lpm
Data communications interface	To 9600 bps	To 9600 bps	To 9600 bps	50-19.2K bps	50-19.2K 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	Paper tape reader/punch	Paper tape reader/punch	Printer/plotter, A/D & D/A converters & discrete I/O	Printer/plotter, A/D & D/A converters & discrete I/O
SOFTWARE					
Assembler	Yes	Yes	Cross assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	BASIC	MPL	No	FORTRAN IV, Extended BASIC	FORTRAN IV, Extended BASIC
Operating system	No	Batch	No	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	$5,850 (4K words)	$11,380 (4K words)	$9,630 (4K words)	$3,995 (8K words)	$42,500 (64K words)
Price of memory increment	$1,400 (4K words)	$2,930 (4K words)	$2,930 (4K words)	$1,100 (8K words)	$14,500 (64K words)
Date of first delivery	November 1971	March 1974	October 1973	March 1971	June 1974
Number installed to date	6000	50	10	Over 1000	Over 500
COMMENTS	1600 Series features stack processing and character string manipulation; also available in packaged version called REALITY	Software-level emulator that runs on 3200 for implementing MPL, a subset of PL/I	General-purpose system for emulation of specialized architecture such as the 32/S	4-port memory available for multiprocessor and I/O processor configurations; high-speed communications processor available	Features 32-bit parallel internal operation; 2048 relocating registers and eight map files

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MANUFACTURER & MODEL	Mylee Digital Sciences 3G	Nanodata QM-1	NCR 299-100	NCR 299-200	NCR 499
DATA FORMATS					
Word length, bits	16	16 + 2	64	64	16 + 1
Fixed-point operand length, bits	8-128	Variable	16 digits	16 digits	12
Instruction length, bits	16-48	Variable	Variable	Variable	Variable
MAIN STORAGE					
Storage type	MOS	Core	Core	Core	Core
Cycle time, microseconds/word	0.8	0.75, 1.25	7 per bit	7 per bit	1.2
Access time, microseconds/word	—	0.38, 0.63	—	—	0.65
Minimum capacity, words	12K	16K	512 bytes	1K bytes	12K
Maximum capacity, words	72K	1024K	1K bytes	2K bytes	32K
Parity checking	No	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	No	Standard	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	4	32	10-50 (in memory)	30-100 (in memory)	—
No. of index registers	4	12	—	—	—
No. of directly addressable words	28K	1024K	—	—	—
No. of addressing modes	—	—	—	—	—
Control storage	ROM	WCS; 32K x 36 bits	ROM; 12K words	ROM; 12K words	ROM 64K words
Add time, microseconds	20	0.75	220 milliseconds	220 milliseconds	1.7 milliseconds
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	Standard	No	No	No
Hardware byte manipulation	Standard	Standard	No	No	No
Battery backup	No	Optional	No	No	No
Real-time clock or timer	No	Optional	No	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Optional	No	No	Standard
Maximum I/O rate, words/sec	1M	1M	—	—	833K
No. of external interrupt levels	1-18	2,048	None	None	8
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	No
Disk pack/cartridge drives	Cartridge; 48-96M bytes	Pack & cartridge	No	No	Cartridge; 4.9-9.8M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	No	Cartridge	No	Cassette; 750 cps	Cassette; 750 cps
Magnetic tape, ½-inch	No	Yes	No	No	No
Punched card input	300 cpm	1000 cpm	No	No	300 cpm
Serial printer	165 cps	No	15 cps	15 cps	75, 130 cps
Line printer	300 lpm	400-1000 lpm	No	No	55-300 lpm
Data communictions interface	To 1200 bps	2M bps	No	1200 bps	300-9600 bps
CRT	32 char. x 11 lines	—	No	No	No
Other standard peripheral units	None	Paper tape units	Paper tape punch	Paper tape punch, mag. ledger card reader	Paper tape units, mag. ledger card reader
SOFTWARE					
Assembler	No	Assembler & macro assembler	Assembler	Assembler	NEAT/AM
Compilers	ACE	BASIC, ALGOL, COBOL, RPG, PL/1	No	No	No
Operating system	Real-time	Batch, real-time, time-sharing	No	No	No
Language implemented in firmware	Partially	—	Fully	Fully	No
Operating system implemented in firmware	Partially	—	Fully	Fully	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$37,500 (28K words)	$125,000	$7,250 (512 bytes)	$9,300 (1K bytes)	$17,900 (12K bytes
Price of memory increment	—	—	$325	$325	$1,100 (2K bytes)
Date of first delivery	May 1976	April 1974	November 1974	March 1975	February 1976
Number installed to date	18	10	3000 both types	3000 both types	400
COMMENTS	System price also includes 2 CRT's, 48M bytes of disk storage, a 165-cps printer, system software, and an inventory control applications package	Oriented toward emulation; emulators available for Data General Nova and others; up to 1K words of "nanostore" memory available	Replacement for electromechanical accounting machines	Replacement for electromechanical accounting machines	Replacement for NCR 399

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MANUFACTURER & MODEL	NCR 8200	NCR Century 75	NCR Century 50	NCR Century 100	NCR Century 101
DATA FORMATS					
Word length, bits	16 + 2	8 + 1	8 + 1	8 + 1	8 + 1
Fixed-point operand length, bits	16	8, 16	1-256 digits	1-256 digits	1-256 digits
Instruction length, bits	16, 32, 48	32-64	32-64	32-64	32-64
MAIN STORAGE					
Storage type	Core	Core	Thin film	Thin film	Core
Cycle time, microseconds/word	1.2	1.2	0.80	0.80	1.2
Access time, microseoncds/word	0.65	0.65	—	—	0.60
Minimum capacity, words	32K bytes	16K bytes	16K bytes	16K bytes	16K bytes
Maximum capacity, words	128K bytes	64K bytes	32K 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	27 (in memory)	63 (in memory)	63 (in memory)	63 (in memory)	63 (in memory)
No. of directly addressable words	—	—	—	—	—
No. of addressing modes	—	—	—	—	—
Control storage	No	No	No	No	No
Add time, microseconds	2.4 (8 digits)	25.2 (5 digits)	59 (5 digits)	59 (5 digits)	28.8 (5 digits)
Hardware multiply/divide	Standard	Optional	No	No	Optional
Hardware floating point	No	Standard	Standard	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	No	Optional	No	No	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	833K	120K & 416K	40K & 108K	40K & 108K	120K & 416K
No. of external interrupt levels	8	8	2	2	9
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	No
Disk pack/cartridge drives	Cartridge; 4.9-39.2M bytes	Cartridge; 4.9-9.8M bytes	Pack; 8.4-33.5M bytes	Pack; 8.4-33.5M bytes	Pack; 8.4-381.6M bytes
Drum/fixed-head disk storage	No	No	No	No	
Magnetic tape cassettes/cartridges	Cassette; 750 cps	No	Cassette; 750 cps	Cassette; 750 cps	Cassette; 750 cps
Magnetic tape, ½-inch	No	10-320 KBS	10-40 KBS	10-80 KBS	10-320 KBS
Punched card input	300 cpm	300 cpm	300-750 cpm	300-1200 cpm	300-1200 cpm
Serial printer	173 cps	6 cps	6 cps	6 cps	6 cps
Line printer	100-300 lpm	200-450 lpm	125-900 lpm	450-3000 lpm	450-3500 lpm
Data communications interface	1200, 9600 bps	45-50,000 bps	45-50,000 bps	45-50,000 bps	45-50,000 bps
CRT	80 char. x 24 lines	Interface only	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	—	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	No	No	No	No	No
Compilers	NEAT/3, COBOL	COBOL, BASIC, FORTRAN, RPG, NEAT/3	COBOL, BASIC, FORTRAN, NEAT/3	COBOL, BASIC, FORTRAN, NEAT/3	COBOL, BASIC, FORTRAN, NEAT/3
Operating system	Batch, multiprogramming	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, and min. mem. in chassis	$17,425 (32K bytes)	$56,850 (16K bytes)	$47,000 (16K bytes)	$71,500 (16K bytes)	$69,520 (16K bytes)
Price of memory increment	$2,000 (8K bytes)	$5,000 (8K bytes)	$4,995 (16K bytes)	$4,995 (16K bytes)	$5,000 (8K bytes)
Date of first delivery	September 1974	May 1976	December 1970	March 1963	August 1972
Number installed to date	300-400	50	1100 (50's & 100's)	1100 (50's & 100's)	1200
COMMENTS	8200 simulates a Century 101 computer and can execute all non-time-dependent software for the 101	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; 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

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MANUFACTURER & MODEL	NCR Century 151	Nixdorf 154	A/S Norsk Data Elektronikk Nord-10	A/S Norsk Data Elektronikk Nord-12	A/S Norsk Data Elektronikk Nord-50
DATA FORMATS					
Word length, bits	8 + 1	12	16 + 2	16 + 2	32
Fixed-point operand length, bits	1-256 digits	12	1, 8, 16, 32	1, 8, 16, 32	32
Instruction length, bits	32-64	12-48	16, 32, 48	16, 32, 48	32
MAIN STORAGE					
Storage type	MOS	Core	Core; MOS	MOS	MOS
Cycle time, microseconds/word	0.75 (1 or 2 bytes)	2	0.90; 0.50	0.50	0.5
Access time, microseconds/word	—	1	0.4; 0.40	0.40	0.4
Minimum capacity, words	64K bytes	6K	8K	4K	4K
Maximum capacity, words	128K bytes	24K	256K	64K	128K
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	Optional	No	Optional	No	Standard
CENTRAL PROCESSOR					
No. of accumulators	—	2	32	32	32
No. of index registers	63 (in memory)	3	32	32	16
No. of directly addressable words	—	—	256	256	4K
No. of addressing modes	—	—	8	8	—
Control storage	No	See comments	ROM	ROM	No
Add time, microseconds	18.0 (5 digits)	8	1.1	2.5	0.85
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	No	No	Standard	Standard	Standard
Hardware byte manipulation	Standard	No	Standard	Standard	Standard
Battery backup	No	No	—	—	—
Real-time clock or timer	Optional	No	Standard	Standard	No
INPUT/OUTPUT CONTROL					
Direct memory access control	Standard	No	Standard	Standard	Standard
Maximum I/O rate, words/sec	120K & 545K	144K	830K	1.2M	—
No. of external interrupt levels	9	—	2048	2048	No
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drive	No	No	256K bytes	256K bytes	No
Disk pack/cartridge drives	Pack; 8.4-381.6M bytes	Pack	Pack & cartridge; 10-66M bytes	Pack & cartridge; 10-66M bytes	No
Drum/fixed-head disk storage	No	No	Fixed-head; 2M bytes	No	No
Magnetic tape cassettes/cartridges	Cassette; 750 cps	Cassette; 435 cps	Cassette; 800 cps	Cassette; 800 cps	No
Magnetic tape, ½-inch	10-320 KBS	10, 20 KBS	36-144 KBS	36-144 KBS	No
Punched card input	300-1200 cpm	60 cpm	285 cpm	28 5 cpm	No
Serial printer	6 cps	100, 165 cps	30, 180 cps	30, 180 cps	No
Line printer	450-3500 lpm	No	60-1500 lpm	60-1500 lpm	No
Data communications interface	45-50K bps	To 2400 bps	To 9600 bps	To 9600 bps	No
CRT	80 char. x 24 lines	No	80 char. x 24 lines	80 char. x 24 lines	No
Other standard peripherals units	Paper tape units, MICR/OCR units	Paper tape reader, paper tape punch, mag. ledger card reader	Paper tape units, card punch, plotters	Paper tape units, card punch, plotters	No
SOFTWARE					
Assembler	No	Yes	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	COBOL, BASIC, FORTRAN, NEAT/3	BOSS	RPG, FORTRAN, BASIC, N-PL, NODAL	RPG, FORTRAN, BASIC, N-PL, NODAL	FORTRAN
Operating system	Batch, multiprogramming	—	Batch, real-time, time-sharing	Batch, real-time, time-sharing	None
Language implemented in firmware	No	Fully	No	No	No
Operating system implemented in firmware	No	Fully	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$119,925 (64K (bytes)	$22,490 (6K words)	$115,000	$34,000	—
Price of memory increment	$20,000 (64K bytes)	—	—	—	—
Date of first delivery	February 1975	Nov. 1973 (840's)	June 1973	May 1975	NA
Number installed to date	50	3000 (840's)	NA	NA	NA
COMMENTS	See Report 70C-656-01 for more details	Control storage can be from 4K x 18 bits to 8K x 18 bits of ROM; system price is for the 840 system and includes a 100-cps printer; Model 154 processor is used in 800 Series (840 is most recent member)	System price includes floppy disk, pack disk, serial printer, & reel-to-reel mag. tape; sold only in Europe	System price includes punched card reader, line printer & CRT; sold only in Europe	High-speed arithmetic processor for use with Nord-10 host CPU; this system shares all peripherals with the host system

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MANUFACTURER & MODEL	Olivetti A5	Olivetti A6	Olivetti A7	Philips P300	Philips P350
DATA FORMATS					
Word length, bits	64	64	8 + 1	8	64
Fixed-point operand length, bits	64	64	6	Variable	64
Instruction length, bits	16	16	16, 32	8, 56	64
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core	Core
Cycle time, microseconds/word	1.5	1.5	0.9	1.5	1.5
Access time, microseconds/word	—	—	0.8	0.6	0.6
Minimum capacity, words	512	2K	16K	8K bytes	600
Maximum capacity, words	4K	4K	48K	16K bytes	1200
Parity checking	No	No	Standard	No	No
Error correction	No	No	No	No	No
Storage protection	No	No	No	No	No
CENTRAL PROCESSOR					
No. of accumulators	47	111-485	—	8	Software-assigned
No. of index registers	0	0	0	8	0
No. of directly addressable words	4K	4K	48K	—	1200
No. of addressing modes	—	—	—	—	—
Control storage	ROM; 8-16K x 16 bits	ROM	ROM;8K x 16 bits	ROM; 64K x 8 bits	No
Add time, microseconds	10	10	6.1	—	1.5
Hardware multiply/divide	No	No	No	No	Standard
Hardware floating point	No	No	No	No	No
Hardware byte manipulation	—	—	Standard	Standard	—
Battery backup	No	No	No	No	No
Real-time clock or timer	No	No	No	No	No
INPUT/OUTPUT CONTROL					
Direct memory access channel	—	—	—	Standard	Standard
Maximum I/O rate, words/sec	1M	1M	650K	—	—
No. of external interrupt levels	None	None	None	None	None
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	1.2M	512K	No	No
Disk pack/cartridge drives	No	No	Cartridge; 10-40M bytes	No	Cartridge; 256K-9.2M bytes
Drum/fixed-head disk storage	No	No	Fixed-head; 160K bytes	No	No
Magnetic tape cassettes/cartridges	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS	Cassette; 1 KBS
Magnetic tape, ½-inch	No	No	No	No	No
Punched card input	No	No	400 cpm	No	280 cpm
Serial printer	16 cps	16 cps	40-175 cps	50 cps	40 cps
Line printer	60 lpm	60, 300 lpm	300, 600 lpm	No	120-600 lpm
Data communications interface	4800 bps; synch.	4800 bps; synch.	9600 bps; synch.	To 9600 bps; synch.	To 9600 bps; synch.
CRT	No	No	No; see Comments	No	No
Other standard peripheral units	Paper tape units, mag. ledger card reader	Paper tape units, mag. ledger card reader	Paper tape units, card punch, mag. ledger card reader	Paper tape punch, card punch, mag. ledger card reader	Paper tape units, card punch, mag. ledger card reader
SOFTWARE					
Assembler	Yes	Yes	Assembler & macro assembler	Yes	Yes
Compilers	APCO	APCO	RPG, PL/1	—	—
Operating system	Batch (one program)	Batch (one program)	Batch (two programs)	Batch (one program)	Batch (one program)
Language implemented in firmware	Fully	Fully	Fully	Partially	No
Operating system implemented in firmware	Fully	Partially	Partially	Partially	No
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$4,900 (512 bytes)	$8,820 (2K bytes)	$15,500 (16K bytes)	$7,000 (8K bytes)	$15,500 (600 words)
Price of memory increment	$600 (1K bytes)	—	$1,000 (4K bytes)	$1,200 (8K bytes)	$8,500 (400 words)
Date of first delivery	February 1975	January 1976	March 1975	June 1975	June 1970
Number installed to date	NA	NA	NA	300	2000
COMMENTS	Asynch. communications speed is 1200 bps; integral but optional mag. ledger units allows mag. cards to be used for program storage	Asynch. communications speed is 1200 bps; integral but optional mag. ledger unit allows mag. cards to be used for program storage	Asynch. communications speed is 1200 bps; A7 includes integral 16-character numeric display	Asynch. communications speed to 2400 bps	Asynch. communications speed to 2400 bps

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MANUFACTURER & MODEL	Prime 100	Prime 200	Prime 300	Prime 400	Qantel Q7
DATA FORMATS					
Word length, bits	16	16 + 2	16 + 2	16 + 2 or + 5	8-bit byte
Fixed-point operand length, bits	16, 32	16, 32	16, 32	16, 32	—
Instruction length, bits	16, 32	16, 32	16, 32	16, 32, 48	24-48
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS; bipolar cache	MOS
Cycle time, microseconds/word	1.0	0.750	0.750	0.760	1.5
Access time, microseconds/word	0.680	0.600	0.600	0.600	—
Minimum capacity, words	4K	4K	8K	64K	32K
Maximum capacity, words	64K	64K	256K	4096K	64K
Parity checking	No	Standard	Standard	Standard	No
Error correction	No	No	No	Optional	No
Storage protection	No	No	Std.; 3 levels	Std.; 3 levels	No
CENTRAL PROCESSOR					
No. of accumulators	1	1	1	1 (32-bit)	17 (in memory)
No. of index registers	1	1	1	2 (32-bit)	0
No. of directly addressable words	64K	64K	64K	64K	32K
No. of addressing modes	4	4	4	4	—
Control storage	No	No	PROM; 512 x 64 bits	PROM; 2K x 64 bits	ROM; 1.5K bytes
Add time, microseconds	2.44	1.96	1.56	0.56	127.5 (5 digits)
Hardware multiply/divide	Optional	Optional	Standard	Standard	No
Hardware floating point	No	Optional	Optional	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	Optional	No	No
Real-time clock or timer	Optional	Optional	Optional	Standard	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	694K	1.0M	1.137M	1.25M	667K
No. of external interrupt levels	64	64	64	64	1
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	512K-2.0M bytes	512K-2.0M bytes	512K-2.0M bytes	512K-2.0M bytes	No
Disk pack/cartridge drives	Pack & cartridge; 2.9-1200M bytes	Pack & cartridge; 2.9-1200M bytes	Pack & cartridge; 2.9-1200M bytes	Pack & cartridge; 2.9-1200M bytes	Pack & cartridge; 6-122.8M bytes
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 72 KBS	To 72 KBS	To 72 KBS	To 72 KBS	20, 36 KBS
Punched card input	300 cpm	300 cpm	300 cpm	300 cpm	500 cpm
Serial printer	165 cps	165 cps	165 cps	165 cps	165 cps
Line printer	To 600 lpm	To 600 lpm	To 600 lpm	To 600 lpm	300-1200 lpm
Data communications interface	To 56K bps	To 56K bps	To 56K bps	To 56K bps	50K bps; synch.
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	72 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	Paper tape, A/D and D/A conv., card reader/punch	Paper tape, A/D and D/A conv., card reader/punch	Paper tape reader
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Macro and micro assemblers	Macro and micro assemblers	Yes
Compilers	BASIC, FORTRAN	BASIC, FORTRAN	BASIC, FORTRAN, COBOL, RPG II	BASIC, FORT., RPG II, COBOL, ALGOL	QIC (BASIC)
Operating system	Batch, real-time, multi-user	Batch, real-time, multi-user	Real-time, multi-user, virtual mem.	Real-time, multi-user, virtual mem.	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	$4,600 (4K words)	$5,600 (4K words)	$12,500 (8K words)	$48,700 (64K words)	$32,000 (32K words)
Price of memory increment	$1,900 (4K words); $3,400 (8K words)	$1,200 (4K words); $3,900 (8K words)	$3,000 (8K words); $4,000 (16K wds.)	$12,000 (32K wds.) $22,500 (64K wds.)	$2,225 (8K bytes)
Date of first delivery	June 1973	November 1972	September 1973	March 1976	1st quarter 1974
Number installed to date	1300 (all models)	1300 (all models)	1300 (all models)	1300 (all models)	450
COMMENTS		Basis for Create/ 1.2 packaged business system	Basis for Create/ 2.2, Create/2.4, Create/3.4, and Create/4.2 packaged business systems; virtual memory management system permits addressing up to 128K bytes per user	Basis for Create/ 4.2 packaged business system; virtual memory management system permits addressing up to 512M bytes per user; 2K-byte cache memory std.; 2 to 1 memory interleaving std.	Processor used in Models 800, 900, 950, 1200; system price includes serial printer & cartridge disk

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MANUFACTURER & MODEL	Qantel Q7.5	Randal 200	Raytheon PTS-1200	Raytheon RDS-500	A/S Regnecentralen RC 6000
DATA FORMATS					
Word length, bits	8-bit byte	16	16	16 + 2	24
Fixed-point operand length, bits	–	Variable	8, 16, 24	16	24, 48
Instruction length, bits	24-48	16, 32, 48	16, 32	8, 16, 32	12
MAIN STORAGE					
Storage type	MOS	MOS	MOS	Core	Core
Cycle time, microseconds/word	1.1	0.3	1.28	0.70; 0.80; 0.90	20
Access time, microseconds/word	–	0.3	0.80	–	10
Minimum capacity, words	40K	32K bytes	24K	8K	16K
Maximum capacity, words	128K	64K bytes	64K	64K	16K
Parity checking	No	No	No	Optional	No
Error correction	No	No	No	No	No
Storage protection	No	Standard	No	Optional	No
CENTRAL PROCESSOR					
No. of accumulators	6 (+17 in mem.)	4	1	8	4
No. of index registers	–	2	2	1	3
No. of directly addressable words	64K	512	32K	64K	4K
No. of addressing modes	–	4	10	6	–
Control storage	ROM	ROM; 256 x 64 bits	No	No	–
Add time, microseconds	–	1.2	2.8	1.4; 1.6; 1.8	50
Hardware multiply/divide	No	Optional	No	Standard	No
Hardware floating point	No	No	No	Optional	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	No
Battery backup	No	Optional	No	No	No
Real-time clock or timer	Optional	Standard	Standard	Optional	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	909K	800K	125 KBS	1.0	500K
No. of external interrupt levels	2	–	16	16	1-14
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	No	Yes
Disk pack/cartridge drives	Pack & cartridge; 6-122.8M bytes	Cartridge; 10-40M bytes	Cartridge; 2.6-20.8M bytes	Cartridge & pack; 2.5-207.8M bytes	Cartridge
Drum/fixed-head disk storage	No	No	No	Fixed-head; 770K-25.2M bytes	Fixed-head
Magnetic tape cassettes/cartridges	No	No	Cassette; 600 cps	No	Cassette & cartridge
Magnetic tape, ½-inch	20, 36 KBS	10-72 KBS	No	20.8-200 KBS	Yes
Punched card input	500 cpm	450 cpm	300 cpm	300, 1000 cpm	600 cpm
Serial printer	165 cps	30, 180 cps	10-165 cps	10 cps	–
Line printer	300-1200 lpm	300, 600 lpm	300 lpm	300, 1250 lpm	To 600 lpm
Data communications interface	50K bps; synch.	Up to 9600 bps	To 9600 bps	110-9600 bps	Yes
CRT	72 char. x 24 lines	80 char. x 12 lines	40 char. x 12 lines	72 char. x 35 lines	No
Other standard peripheral units	Paper tape reader	Paper tape reader, paper tape punch	–	Appollo Array Processor, plotters, A/D and D/A converters	Card punch
SOFTWARE					
Assembler	Yes	No	No	Macro assembler	Yes
Compilers	QIC (BASIC)	BASIC	MACROL, AUTOQUERY	FORTRAN	FORTRAN, ALGOL
Operating system	Time-sharing	Time-sharing	Multiprogramming	Batch, real-time, multiprogramming	Batch, real-time, time-sharing
Language implemented in firmware	Partially	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	$42,500 (40K bytes)	$20,000 (16K bytes)	$30,580 (24K words)	$7,300 (8K words)	$18,000 (16K words)
Price of memory increment	–	$1,500 (16K bytes)	$750-$3,000	$2,300 (8K words)	–
Date of first delivery	January 1976	August 1976	November 1974	February 1973	May 1975
Number installed to date	20	NA	150-200	Over 200	NA
COMMENTS	Processor used in Model 1300; system price includes serial printer & cartridge disk	Available only in packaged business system; price also includes CRT and 10-megabyte disk drive	Display-oriented system for up to 12 Raytheon PTS-100 programmable terminals	Appolo Array Processor can perform 22 specialized array operations; widely used in seismic data processing	Based on RC 3600; emulates RC 8000

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MANUFACTURER & MODEL	A/S Regnecentralen RC 8000	A/S Regnecentralen RC 3600	Rolm 1602 (AN/UYK-19)	Rolm 1603 (AN/UYK-27)	Rolm 1664 (AN/UYK-28)
DATA FORMATS					
Word length, bits	24	24	16	16	16
Fixed-point operand length, bits	24, 48	24, 48	16, 32	16	16, 32
Instruction length, bits	12	12	16, 32	16, 32	16, 32, 48
MAIN STORAGE					
Storage type	Core	Core	Core	Core	Core
Cycle time, microseconds/word	0.8	1.0	1.0	1.2	1.0
Access time, microseconds/word	0.4	0.5	0.5	0.6	0.5
Minimum capacity, words	4K	8K	8K	8K	8K
Maximum capacity, words	4096K	32K	256K	32K	256K
Parity checking	Standard	No	No	No	No
Error correction	No	No	No	No	No
Storage protection	Standard	No	Optional	Optional	Optional
CENTRAL PROCESSOR					
No. of accumulators	4	4	4	4	12
No. of index registers	3	2	2	2	2
No. of directly addressable words	4K	256	64K	32K	64K
No. of addressing modes	—	—	5	4	6
Control storage	—	—	ROM; 2K x 32 bits	—	ROM; 4K x 32 bits
Add time, microseconds	1.8	1.4	1.0	5.9	1.0
Hardware multiply/divide	Standard	No	Standard	Optional	Standard
Hardware floating point	Standard	No	Optional	No	Standard
Hardware byte manipulation	Standard	No	Standard	Standard	Standard
Battery backup	No	No	No	No	No
Real-time clock or timer	Standard	Standard	Optional	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Maximum I/O rate, words/sec	1M	500K	1M	768K	1M
No. of external interrupt levels	1-256	1-14	16	16	16
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Yes	Yes	No	No	No
Disk pack/cartridge drives	Pack & cartridge	Cartridge	Cartridge; 5-10M bytes	Cartridge; 5-10M bytes	Cartridge; 5-10M bytes
Drum/fixed-head disk storage	Fixed-head	Fixed-head	Fixed-head; 2M bytes	Fixed-head; 2M bytes	Fixed-head; 2M bytes
Magnetic tape cassettes/cartridges	Cassette & cartridge	Cassette & cartridge	No	No	No
Magnetic tape, ½-inch	Yes	Yes	60 KBS	60 KBS	60 KBS
Punched card input	600 cpm	600 cpm	300 cpm	300 cpm	300 cpm
Serial printer	—	—	15 cps	15 cps	15 cps
Line printer	To 1800 lpm	To 1800 lpm	1100 lpm	1100 lpm	1100 lpm
Data communications interface	Yes	Yes	20K bps	20K bps	20K bps
CRT	No	No	80 char. x 24 lines	80 char. x 24 lines	80 char. x24 lines
Other standard peripheral units	Card punch	Card punch	Paper tape units, D/A & A/D converters	Paper tape units, D/A & A/D converters	Paper tape units, D/A & A/D converters
SOFTWARE					
Assembler	Yes	Yes	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler
Compilers	FORTRAN, ALGOL	MUSIL	ALGOL, BASIC, FORTRAN	ALGOL, BASIC, FORTRAN	ALGOL, BASIC, FORTRAN
Operating system	Batch, real-time, time-sharing	Batch, real-time, time-sharing	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	$68,500 (4K words)	$35,000 (8K words)	$22,250 (8K words)	$9,245 (8K words)	$36,850 (8K words)
Price of memory increment	—	—	$6,000 (8K words)	$5,000 (8K words)	$6,250 (8K words)
Date of first delivery	April 1976	June 1971	1972	1974	1976
Number installed to date	NA	Over 150	300	45	15
COMMENTS	Designed for multiprocessor operation; minimum configuration includes RC 3600 front end	Principally a satellite system for RJE, front end, data entry, data collection, and media conversion	Qualified to Mil-E-5400 & Mil-E-16400 specif.; ATR chassis; microprogrammed militarized CPU, upward-compatible with DG Nova	Qualified to Mil-E-5400 & Mil-E-16400 specif.; ATR chassis; low-priced, faster version of previously offered Model 1601; compatible with DG Nova	Designed to meet Mil-E-5400 & & Mil-E-16400 specif. ATR chassis; tri-processor militarized supercomputer, upward-compatible with other Rolm computers

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MANUFACTURER & MODEL	Rolm 1650 (AN/UYK-34)	Systems Engineering Laboratories 32/35	Systems Engineering Laboratories 32/50	Systems Engineering Laboratories 32/55	Tandem T16/1102
DATA FORMATS					
Word length, bits	16	32 + 4	32 + 4	32 + 4	16 + 1
Fixed-point operand length, bits	16, 32	8, 16, 32, 64	8, 16, 32, 64	8, 16, 32, 64	8, 16, 32
Instruction length, bits	16, 32	16, 32	16, 32	16, 32	16
MAIN STORAGE					
Storage type	Core	Core	Core	Core	Core
Cycle time, microseconds/word	1.0	0.9	0.6	0.6	0.80
Access time, microseconds/word	0.5	0.45	0.3	0.3	0.50
Minimum capacity, words	16K	16K	8K	8K	32K
Maximum capacity, words	32K	128K	16K	256K	256K
Parity checking	No	Standard	Standard	Standard	Standard
Error correction	No	No	No	No	No
Storage protection	Optional	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of accumulators	4	8	8	8	8
No. of index registers	2	3	3	3	3
No. of directly addressable words	32K	128K	128K	128K	1K
No. of addressing modes	5	6	6	6	—
Control storage	PROM; 1K x 52 bits	PROM; 2K x 48 bits	PROM; 4K x 48 bits	PROM; 4K x 48 bits	—
Add time, microseconds	1.05	0.90	1.2	1.2	0.50
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Standard	Standard	Standard	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	No	No
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	666K	6.67M	6.67M	6.67M	1.25M
No. of external interrupt levels	16	16-112	16-128	16-128	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drive	No	No	No	No	No
Disk pack/cartridge drives	Cartridge; 5-10M bytes	Pack & cartridge; 5-320M bytes	Pack & cartridge; 5-320M bytes	Pack & cartridge; 5-320M bytes	Cartridge & pack; 10-200M bytes
Drum/fixed-head disk storage	Fixed-head; 2M bytes	Fixed-head; 1-4M bytes	Fixed-head; 1-4M bytes	Fixed-head; 1-4M bytes	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	60 KBS	25-120 KBS	25-120 KBS	25-120 KBS	36 KBS
Punched card input	300 cpm	300-1000 cpm	300-1000 cpm	300-1000 cpm	600 cpm
Serial printer	15 cps	No	No	No	No
Line printer	1100 lpm	125-600 lpm	125-600 lpm	125-600 lpm	125-1500 lpm
Data communications interface	20K bps	50K bps; synch.	50K bps; synch.	50K bps; synch.	50-56K 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	Paper tape units, D/A & A/D units	Paper tape units, card punch, TTY	Paper tape units, card punch, TTY	Paper tape units, card punch, TTY	—
SOFTWARE					
Assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	Assembler & macro assembler	No
Compiler	ALGOL, BASIC, FORTRAN	RPG, FORTRAN IV, BASIC	RPG, FORTRAN IV, BASIC	RPG, FORTRAN IV, BASIC	COBOL, TAL
Operating system	Batch, real-time	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Batch, real-time, time-sharing	Virtual mem., multiproc., multiprog.
Language implemented in firmware	No	No	No	No	Partially
Operating system implemented in firmware	No	No	No	No	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, front panel, and min. mem. in chassis	$26,250 (16K words)	$25,000 (16K words)	$18,000 (8K words)	$25,000 (8K words)	$18,500 (32K words)
Price of memory increment	$7,000 (16K words)	—	$6,300 (8K words)	$6,300 (8K words)	$8,000 (32K words)
Date of first delivery	NA	August 1976	October 1975	October 1975	May 1976
Number installed to date	NA	NA	NA	NA	10 (both models)
COMMENTS	Designed to meet Mil-E-5400 & Mil-E-16400 specif.; half ATR version of Rolm 1602	Asynch. communications to 9600 bps; instruction look-ahead utilized	Asynch. communications to 9600 bps	Asynch. communications to 9600 bps	Multiprocessor systems containing from 2 to 16 CPU's for failure resistance; all system components are dual-ported, and CPU's have dual buses

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MANUFACTURER & MODEL	Tandem T16/1402	Tektronix 4051	Texas Instruments 960B	Texas Instruments 980B
DATA FORMATS				
Word length, bits	16 + 6	8-bit byte	16 + 6	16 + 6
Fixed-point operand length, bits	8, 16, 32	8	8, 16	8, 16
Instruction length, bits	16	8, 16, 24	32	16, 32, 48
MAIN STORAGE				
Storage type	MOS	MOS	MOS	MOS
Cycle time, microseconds/word	0.50	1.2	0.75	0.75
Access time, microseconds/word	0.50	0.45	—	—
Minimum capacity, words	32K	8K bytes	8K	8K
Maximum capacity, words	256K	32K bytes	64K	64K
Parity checking	No	No	No	No
Error correction	Standard	No	Standard	Standard
Storage protection	Standard	No	Standard	Standard
CENTRAL PROCESSOR				
No. of accumulators	8	2	16	2
No. of index registers	3	1	16	1
No. of directly addressable words	1K	32K	64K	64K
No. of addressing modes	—	7	15	15
Control storage	—	ROM; 36K-156K bytes	ROM; 256 x 16 bits	ROM; 256 x 16 bits
Add time, microseconds	0.50	2.0	3.6	1.75
Hardware multiply/divide	Standard	No	Optional	Standard
Hardware floating point	No	No	No	No
Hardware byte manipulation	Standard	Standard	No	Standard
Battery backup	No	Optional	Optional	Optional
Real-time clock or timer	Standard	Optional	Optional	Optional
INPUT/OUTPUT CONTROL				
Direct memory access channel	Standard	Optional	Standard	Standard
Maximum I/O rate, words/sec	2M	3.5K	1.3M	1M
No. of external interrupt levels	—	No	3-2048	4-32
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	No	No	No	No
Disk pack/cartridge drives	Cartridge & pack; 10-200M bytes	No	Cartridge & pack; 2.28-392M bytes	Cartridge & pack; 2.28-392M bytes
Drum/fixed-head disk storage	No	No	Fixed-head; 458-916K bytes	Fixed-head; 458-916K bytes
Magnetic tape cassettes/cartridges	No	Cartridge	Cassette; 800 cps	Cassette; 800 cps
Magnetic tape, ½-inch	36 KBS	No	30 KBS	30 KBS
Punched card input	600 cpm	No	300 cpm	300 cpm
Serial printer	No	180 cps	30-330 cps	30-330 cps
Line printer	120-1500 lpm	No	365 lpm	365 lpm
Data communications interface	50-56K bps	110-2400 bps asynch.	110-9600 bps	110-9600 bps
CRT	80 char. x 24 lines	72 char. x 35 lines	80 char. x 24 lines	80 char. x 24 lines
Other standard peripheral units	—	Plotter, CRT hard-copy device	Process control interfaces, A/D & D/A converters	Paper tape units
SOFTWARE				
Assembler	No	No	Assembler & macro preprocessor	Assembler & macro preprocessor
Compilers	COBOL, TAL	BASIC	FORTRAN	FORTRAN, BASIC
Operating system	Virtual mem., multi-prog., multiprog.	Batch	Single-user, real-time, multiprogramming	Single-user, multi-programming
Language implemented in firmware	Partially	Fully	No	No
Operating system implemented in firmware	Partially	Fully	No	No
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel, and min. mem. in chassis	$19,500 (32K words)	$6,995 (8K bytes)	$4,350 (8K words)	$4,975 (8K words)
Price of memory increment	$6,500 (32K words)	$2,390 (8K bytes)	$1,400 (8K words)	$1,400 (8K words)
Date of first delivery	May 1976	December 1975	May 1974	May 1974
Number installed to date	10 (both models)	NA	NA	NA
COMMENTS	Multiprocessor systems containing from 2 to 16 CPU's for failure resistance; all system components are dual-ported, and CPU's have dual buses	Based on Motorola/ AMI 6800; specifications are transparent to user since all programming is in BASIC	Heavily supported for process control applications	

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MANUFACTURER & MODEL	Texas Instruments 990/4	Texas Instruments 990/10	Univac 9200 & 9300	Univac 90/30
DATA FORMATS				
Word length, bits	16 + 1	16 + 1 or + 6	8-bit byte	8-bit byte
Fixed-point operand length, bits	8, 16	8, 16	1-32	1-32
Instruction length, bits	16, 32, 48	16, 32, 48	16, 32, 48	16, 32, 48
MAIN STORAGE				
Storage type	MOS	MOS	Plated wire	MOS
Cycle time, microseconds/word	0.65	0.65	1.2; 0.6	0.6 (2-byte fetch)
Access time, microseconds/word	—	—	—	—
Minimum capacity, words	1K	8K	8K bytes	32K bytes
Maximum capacity, words	32K	1024K	32K bytes	524K bytes
Pairty checking	Optional	Optional	Standard	Standard
Error correction	No	Optional	No	No
Storage protection	Optional	Optional	No	Optional
CENTRAL PROCESSOR				
No. of accumulators	Unlimited (memory)	Unlimited (memory)	8	16
No. of index registers	Unlimited (memory)	Unlimited (memory)	8	16
No. of directly addressable words	64K	64K	—	—
No. of addressing modes	8	8	—	—
Control storage	ROM	No	No	ROM; 1K x 82 bits
Add time, microseconds	4.7	3.6	40.8; 20.4 (16 bits)	5.4 (32 bits)
Hardware multiply/divide	Standard	Standard	See comments	Standard
Hardware floating point	No	No	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard
Battery backup	—	—	No	No
Real-time clock or timer	Standard	Standard	No	Standard
INPUT/OUTPUT CONTROL				
Direct memory access channel	No	Standard	Optional	Standard
Maximum I/O rate, words/sec	1.5M	4M	312K	1.8M
No. of external interrupt levels	8-2048	16-2048	—	—
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	242-968K bytes	242-968K bytes	No	No
Disk pack/cartirdge drives	Cartridges; 3-12M bytes	Cartridge; 3-12M bytes	Pack & cartridge; 3.2-1860M bytes	Pack; 29M-1600M bytes
Drum/fixed-head disk storage	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 800 cps	Cassette; 800 cps	No	No
Magnetic tape, ½-inch	No	No	34, 68 KBS	8.5-320 KBS
Punched card input	400 cpm	400 cpm	400-1000 cpm	600, 1000 cpm
Serial printer	30-120 cps	30-120 cps	30 cps	30 cps
Line printer	No	No	250-2000 lpm	500-2000 lpm
Data communications interface	75-9600 bps	75-9600 bps	To 250K bps	To 50K bps
CRT	80 char. x 12 lines	80 char. x 12 lines	—	—
Other standard peripheral units	PROM programmer	PROM programmer	Paper tape reader/ punch, card punch, optional scanner	Paper tape reader/ punch, card punch, optical scanner
SOFTWARE				
Assembler	No	Assembler & macro assembler	Yes	Yes
Compilers	No	FORTRAN, BASIC, COBOL	COBOL, FORTRAN, RPG	COBOL, FORTRAN, RPG II
Operating system	Real-time, multi-task	Real-time, multi-task	Batch, real-time, timesharing	Batch, real-time, time-sharing
Language implemented in firmware	No	No	No	Partially
Operating system implemented in firmware	No	No	No	Partially
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel, and min. mem. in chassis	$575 (256 words)	$1,975 (8K words)	$34,176 (8K—9200) $57,120 (8K—9300)	$78,480 (32K bytes)
Price of memory increment	$625 (4K words)	$1,000 (8K words); $1,950 (8K ERCC)	$13,008 (4K—9200) $15,120 (4K—9300)	$6,720 (16K bytes) $13,440 (32K bytes)
Date of first delivery	March 1976	March 1976	3rd quarter 1966	1st quarter 1975
Number installed to date	1000+ (990 Series)	1000+ (990 Series)	NA	NA
COMMENTS	Based on TI's TMS9900 16-bit microprocessor	MSI implementation of 990/4 CPU with enhancements	Multiply & divide are optional on 9200 & 9300 card system, and standard on all others; no longer being manufactured; see Report 70C-877-01 for more details	Smallest member of Univac Series 90; system price also includes integrated peripheral channel, 2 interval timers, CRT/keyboard, and Univac 9200/ 9300 & IBM 360/20 compatibility; see Report 70C-877-04 for more details

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All About Minicomputers

MANUFACTURER & MODEL	Varian V73	Varian V75	Varian V76	Wang PCS
DATA FORMATS				
Word length, bits	16 + 2	16 + 2	16 + 2	8-bit byte
Fixed-point operand length, bits	16 (8, 32 opt.)	8, 16, 32	8, 16, 32	8
Instruction length, bits	16, 32	16, 32	16, 32	8
MAIN STORAGE				
Storage type	Core; MOS	Core; MOS	MOS	MOS
Cycle time, microseconds/word	0.66; 0.33	0.99, 0.66; 0.33	0.66	1.6
Access time, microseconds/word	—	—	—	—
Minimum capacity, words	8K	64K	16K	8K bytes
Maximum capacity, words	256K	256K	1024K	32K bytes
Parity checking	Optional	Optional	Optional	No
Error correction	No	No	No	No
Storage protection	Standard	Standard	Standard	No
CENTRAL PROCESSOR				
No. of accumulators	3	8	8	32; not user-access.
No. of index registers	1	7	7	32; not user-access.
No. of directly addressable words	2K	2K	2K	—
No. of addressing modes	8	8	8	—
Control storage	WCS; 4K x 64 bits	WCS; 4K x 64 bits	WCS; 4K x 64 bits	ROM; 24K words
Add time, microseconds	1.32; 0.66	1.98; 1.32; 0.66	1.32	800
Hardware multiply/divide	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Standard
Hardware byte manipulation	Optional	Standard	Standard	Standard
Battery backup	Optional	Optional	Optional	No
Real-time clock or timer	Standard	Standard	Optional	No
INPUT/OUTPUT CONTROL				
Direct memory access channel	Standard	Standard	Standard	No
Maximum I/O rate, words/sec	1M	1M	1M	10K
No. of external interrupt levels	8-64	8-64	8-64	None
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	No	No	No	No
Disk pack/cartridge drives	Cartridge & pack; 2.34-373.6M bytes	Cartridge & pack; 2.34-373.6M bytes	Cartridge & pack; 2.34-373.6M bytes	No
Drum/fixed-head disk storage	Fixed-head; 123-492K bytes	Fixed-head; 123-492K bytes	Fixed-head; 123-492K bytes	No
Magnetic tape cassettes/cartridges	No	No	No	Cassette; 326 bps
Magnetic tape, ½-inch	20, 30 KBS	20, 30 KBS	20 , 30 KBS	No
Punched card input	300 cpm	300 cpm	300 cpm	No
Serial printer	10, 165 cps	10, 165 cps	10, 165 cps	120 cps
Line printer	300-2000 lpm	300-2000 lpm	300-2000 lpm	250 lpm
Data communications interface	To 50K bps	To 50K bps	To 50K bps	To 9600 bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 char. x 24 lines	64 char. x 16 lines
Other standard peripheral units	Statos line of printer/ plotters; A/D & D/A converters	Statos line of printer/ plotters; A/D & D/A converters	Statos line of printer/ plotters; A/D & D/A converters	Plotter
SOFTWARE				
Assembler	Macro assembler & micro assembler	Macro assembler & micro assembler	Macro assembler & micro assembler	No
Compilers	FORTRAN, BASIC, COBOL, RPG	FORTRAN, BASIC, COBOL, RPG	FORTRAN, BASIC, COBOL, RPG	BASIC
Operating system	Batch, real-time, multi-task	Batch, real-time, multi-task	Batch, real-time, multi-task	Interactive
Language implemented in firmware	No	No	No	Fully
Operating system implemented in firmware	No	No	No	Partially
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel, and min. mem. in chassis	$15,530 (8K words)	$39,000 (64K words)	$8,400 (16K words)	$5,400 (8K bytes)
Price of memory increment	$5,000 (8K MOS); $3,500 (8K core)	$16,000 (64K core); $5,000 (8K MOS)	$2,900 (16K words)	$1,600 (8K bytes); $3,000 (16K bytes)
Date of first delivery	November 1972	August 1975	January 1976	May 1976
Number installed to date	NA	NA	NA	NA
COMMENTS	Dual-ported memories; odd/even interleaving for core memories standard; TOTAL data base management system available	Single- and 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	Portable computer weighing 57 lbs.

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All About Minicomputers

MANUFACTURER & MODEL	Wang 2200S	Wang 2200T	Warrex Centurion IV	Westinghouse 2500
DATA FORMATS				
Word length, bits	8-bit byte	8-bit byte	8 + 1	16
Fixed-point operand length, bits	8	8	8, 16	16, 32
Instruction length, bits	8	8	8, 16, 24	16, 32
MAIN STORAGE				
Storage type	MOS	MOS	MOS	Core
Cycle time, microseconds/word	1.6	1.6	0.800	0.75; 0.95
Access time, microseconds/word	—	—	—	0.33; 0.38
Minimum capacity, words	4K bytes	4K bytes	20K	8K
Maximum capacity, words	32K bytes	32K bytes	256K	1M
Parity checking	No	No	Optional	Standard
Error correction	No	No	No	No
Storage protection	No	No	No	Optional
CENTRAL PROCESSOR				
No. of accumulators	32; not user-access.	32; not user-access.	128	1
No. of index registers	32; not user-access.	32; not user-access.	96	2
No. of directly addressable words	—	—	256	256
No. of addressing modes	—	—	7	14
Control storage	ROM; 24K words	ROM; 42.5K words	No	No
Add time, microseconds	800	800	—	1.7
Hardware multiply/divide	Standard	Standard	No	Standard
Hardware floating point	Standard	Standard	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	No
Battery backup	No	No	No	No
Real-time clock or timer	No	No	Standard	Optional
INPUT/OUTPUT CONTROL				
Direct memory access channel	No	No	Standard	Standard
Maximum I/O rate, words/sec	10K	10K	600K	1M
No. of external interrupt levels	None	None	16	4-128
PERIPHERAL EQUIPMENT				
Floppy disk (diskette) drives	262-786K bytes	262-786K bytes	1.2M bytes	No
Disk pack/cartridge drives	Cartridge; 1.2-20M bytes	Cartridge; 1.2-20M bytes	Cartridge; 10.5-42.5M bytes	Pack & cartridge; 2.4-67M bytes
Drum/fixed-head disk storage	No	No	No	Fixed-head; 128K-2M bytes
Magnetic tape cassettes/cartridges	Cassette; 326 bps	Cassette; 326 bps	Cassette; 200 cps	No
Magnetic tape, ½-inch	10 KBS	10 KBS	24 KBS	20-40 KBS
Punched card input	300 cpm	300 cpm	300 cpm	300, 600 cpm
Serial printer	200 cps	200 cps	175 cps	10, 30 cps
Line printer	250 lpm	250 lpm	125-600 lpm	200, 700 lpm
Data communications interface	To 9600 bps	To 9600 bps	75-9600 bps	9600 bps; synch.
CRT	64 char. x 16 lines	64 char. x 16 lines	80 char. x 24 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	Paper tape reader	Paper tape units, plotter, D/A & A/D converters, process I/O
SOFTWARE				
Assembler	No	No	Yes	Assembler & macro assembler
Compilers	BASIC	BASIC	FORTRAN, BASIC, CPL1, CPL2	FORTRAN, BASIC, RPG
Operating system	Interactive	Interactive	Multi-tasking	Batch, real-time
Language implemented in firmware	Fully	Fully	No	No
Operating system implemented in firmware	Partially	Partially	No	No
PRICING & AVAILABILITY				
Price of CPU, power supply, front panel, and min. mem. in chassis	$2,400 (4K bytes)	$4,000 (4K bytes)	$26,950 (20K bytes)	$15,000 (32K words)
Price of memory increment	$1,200 (4K bytes); $2,000 (8K bytes)	$2,000 (8K bytes)	$1,250 (4K bytes)	$3,500 (8K words); $8,000 (32K words)
Date of first delivery	February 1975	February 1975	1970	June 1971
Number installed to date	NA	NA	150 (all models)	300
COMMENTS	Requires options for high-speed I/O and disk capabilities; can be upgraded to 2200T status; also available in packaged system WCS-10	Also available in packaged systems WCS-20 & WCS-30	Microcomputer-based system to be introduced in 1st quarter 1977 as enhanced version of Centurion IV; available only in packaged systems; system price also includes 10.4MB cartridge disk drive, one CRT display/keyboard, and one 175-cps printer	Virtual addressing used with 1M-word memory; multiple CPU's with shared memory up to 4M words; asynchronous communications speeds to 1800 bps

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Itel Advanced Systems

MANAGEMENT SUMMARY

When it introduced the Advanced System computers in October 1976, Itel became the second vendor to offer what are essentially "plug-compatible" replacements for IBM central processing units. The Advanced System family consists of six models built around two central processing units, and all are described by Itel as "100 percent functionally compatible with the IBM System/360's and 370's."

Manufactured by National Semiconductor Corporation (through its Exsysco subsidiary), the two central processing units are designated the AS/4 and AS/5 and are offered as alternatives to the IBM System/370 Models 148 and 158, respectively. There are three uniprocessor models designated the AS/4, AS/5-1, and AS/5-3, and three multiprocessor models designated the AS/4 MP, AS/5-1 MP, and AS/5-3 MP. All of the AS systems are field-upgradable without exchanging CPU's.

Itel claims that the AS/4 has 1.4 times the performance capability of an IBM 148, and that the AS/5-1 and AS/5-3 are equal in performance to the IBM 158-1 and 158-3, respectively. The AS/5-1 MP is rated equal in performance to a 158-1 MP, and the AS/5-3 MP equal to a 158-3 MP. The AS/4 MP offers slightly better performance than the AS/5-3 and the IBM 158-3, according to Itel.

Purchase prices for the CPU's with the minimum one megabyte of memory are $800,000 for the AS/4, $1.3 million for the AS/5-1, and $1.5 million for the AS/5-3. The multiprocessor versions are priced at twice as much as the corresponding uniprocessor models, plus $250,000 for a coupler for tightly coupled MP configurations. Memory increments are available in one-megabyte modules, and these are priced at $95,000 across the board. Itel plans to market the AS systems on a variety of leasing plans, none of which will involve Itel as the owner of the systems. The only lease price figures ➢

The Itel Advanced System computers are designed to compete directly against the IBM System/370 Models 148, 158-1, and 158-3. Itel claims that its processors provide increased performance and/or cost savings while maintaining complete functional compatibility with the IBM software and peripheral equipment.

CHARACTERISTICS

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

MANUFACTURER: National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, California 95051. Telephone (408) 737-5000.

MODELS: AS/4, AS/4 MP, AS/5-1, AS/5-1 MP, AS/5-3, and AS/5-3 MP.

DATA FORMATS

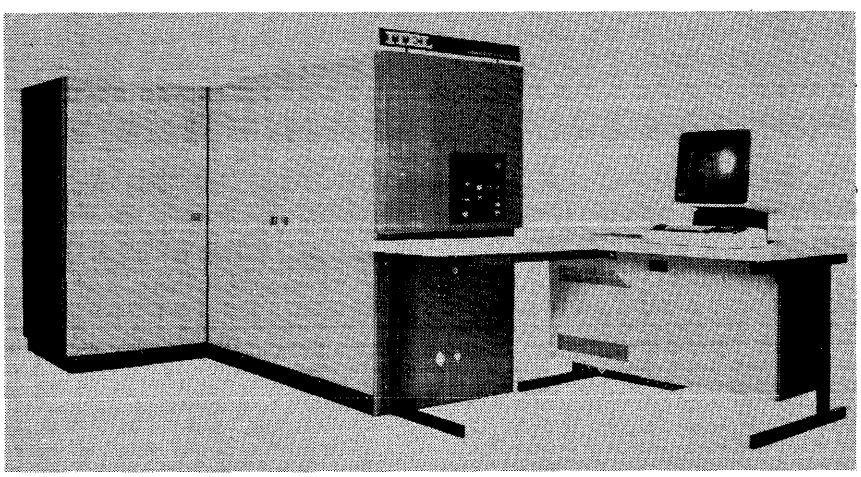
All data formats, instruction formats, and other architectural features completely follow the IBM System/370 architecture.

BASIC UNIT: 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

FIXED POINT OPERANDS: Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

FLOATING-POINT OPERANDS: 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponent, in "long" format; or 4 words in "extended precision" format.

INSTRUCTIONS: 2, 4, or 6 bytes in length, which usually specify 0, 1, or 2 memory addresses, respectively. ➤



The Itel Advanced Systems are fully compatible with the IBM System/370 processors but are said to require only about one-half the components of an IBM 370/158, use only 40 percent of the power, and run about 9 degrees cooler. Not shown in this photo is the standard 180-cps console matrix printer which augments the standard CRT console.

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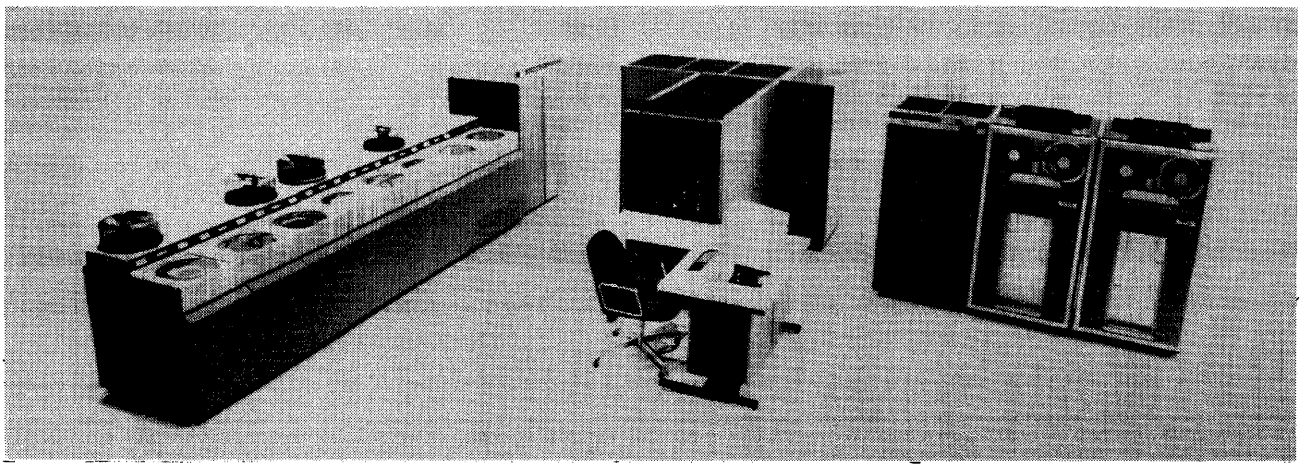
Itel Advanced Systems



Here the Advanced System mainframe is flanked by Itel disk and tape subsystems. Itel Corporation is a major third-party lessor of IBM computer equipment and claims to be the leading independent supplier of 3330-style disk drives and monolithic add-on main memory.

the company has released to date show an AS/5-1 system for $42,707 per month under a 4-year conditional sale agreement and $30,435 per month under a 7-year conditional sale agreement, both financed at 11 percent interest.

Initial customer deliveries of the AS systems are scheduled for the second quarter of 1977.

Each AS CPU has a processor cycle time of 115 nanoseconds, seven I/O channels (one of which is a spare that can be used as either a byte or block multiplexer channel), and a minimum of one megabyte of main memory. Maximum memory capacity and number of I/O channels double in MP configurations. With the standard increments of one megabyte, memory capacity can be expanded to a maximum of four megabytes in the AS/4 and to eight megabytes in the AS/5-1 and AS/5-3. MP versions can be doubled to a maximum of 8 and 16 megabytes of memory for the AS/4 and AS/5 systems, respectively. Like their IBM counterparts, the AS/5 machines use bipolar buffer (or cache) memories, the AS/5-1 with 8K bytes and the AS/5-3 with 16K bytes. Standard features for all AS models include a CRT with light pen and a 180-cps hard-copy printer.

According to Itel, IBM operating systems and program products, as well as all user-written programs that operate on an IBM 370/158 (except for those containing time-dependent code), will run on all the AS models. The IBM operating systems run in native mode, and any IBM or Itel plug-compatible peripheral device that is designed to attach to an IBM 370/158 can be used with all AS models. Principal operating systems for the three uniprocessor models are IBM's DOS/VS, OS/VS1, OS/VS2, and MVS, while MVS is the main operating system for the MP versions.

Itel claims that the AS processing units have only about one-half the number of components found on an IBM 370/158, thus enabling them to utilize about 40 percent

INTERNAL CODE: EBCDIC (Extended Binary-Coded Decimal Interchange Code).

MAIN STORAGE

STORAGE TYPE: Metal oxide semiconductor (MOS).

CAPACITY: From 1 to 16 million bytes, in 1-million-byte increments, housed in a single cabinet. (See table for capacities of the individual models.)

CYCLE TIME: See table.

CHECKING: Error checking and correction (ECC) circuitry in main memory performs automatic correction of all single-bit errors and detection of all double-bit and most other multiple-bit memory errors.

A reconfiguration capability is standard with all AS models. In the event of an unrecoverable error, or any other problem with a memory module, the operaor can "dial out" the problem module (one-half million or one million bytes) and reconfigure the remaining memory for continuous operation.

STORAGE PROTECTION: The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard in all models.

CENTRAL PROCESSOR

INDEX REGISTERS: Sixteen 32-bit general registers, used for indexing, base addressing, and as accumulators, plus four 64-bit floating-point registers per processor.

INSTRUCTION REPERTOIRE: The AS instruction set consists of the complete System/370 Universal Instruction Set, including the five S/370 instructions for Dynamic Address Translation.

INSTRUCTION TIMES: Itel states that individual instruction times are not currently available, but that average execution times for the AS systems will equal or exceed the performance of the comparable System/370 processors (see Management Summary).

OPERATIONAL MODES: Like the System/370, the Itel AS computers can operate in either the Basic Control (BC) mode or Extended Control (EC) mode. The BC mode maintains general upward compatibility with the

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Itel Advanced Systems

CHARACTERISTICS OF THE ADVANCED SYSTEM PROCESSOR MODELS

	Model AS/4	Model AS/4MP	Model AS/5-1	Model AS/5-1 MP	Model AS/5-3	Model AS/5-3 MP
SYSTEM CHARACTERISTICS						
Date of introduction	Oct. 1976	Oct. 1976	Oct. 1976	Oct. 1976	Oct. 1976	Oct. 1976
Virtual storage capability	Yes	Yes	Yes	Yes	Yes	Yes
Number of central processors	1	2	1	2	1	2
Principal operating systems	DOS/VS, OS/VS1, OS/VS2, MVS	MVS	DOS/VS, OS/VS1, OS/VS2, MVS	MVS	DOS/VS, OS/VS1, OS/VS2, MVS	MVS
MAIN STORAGE						
Storage type	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)	Semiconductor (MOS)
Read cycle time, nanoseconds	1035	1035	1035	1035	920	920
Write cycle time, nanoseconds	690	690	690	690	690	690
Bytes fetched per cycle	16	16	16	16	16	16
Minimum capacity, bytes per system	1,048,576	2,097,252	1,048,576	2,097,252	1,048,576	2,097,252
Maximum capacity, bytes per system	4,194,304	8,388,608	8,388,608	16,777,216	8,388,608	16,777,216
Increment size, bytes	1,048,576	1,048,576	1,048,576	1,048,576	1,048,576	1,048,576
BUFFER STORAGE						
Cycle time, nanoseconds	—	—	115	115	115	115
Bytes fetched per cycle	—	—	4	4	4	4
Minimum capacity, bytes	None	None	8,192	16,384	16,384	32,768
Maximum capacity, bytes	None	None	8,192	16,384	16,384	32,768
PROCESSING UNIT						
Machine cycle time, nanoseconds	115	115	115	115	115	115
Processing unit features:						
Clock Comparator & CPU Timer	Standard	Standard	Standard	Standard	Standard	Standard
Direct Control	Standard	Standard	Standard	Standard	Standard	Standard
Dynamic Address Translation	Standard	Standard	Standard	Standard	Standard	Standard
Floating Point	Standard	Standard	Standard	Standard	Standard	Standard
Extended Precision Floating Point	Standard	Standard	Standard	Standard	Standard	Standard
High-Speed Multiply	Standard	Standard	Standard	Standard	Standard	Standard
Compatibility features:						
IBM 1401/1440/1460 Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
IBM 1410/7010 Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
IBM 7070/7074 Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
OS/DOS Compatibility	Standard	Standard	Standard	Standard	Standard	Standard
CHANNELS						
No. of Selector Channels per system	None	None	None	None	None	None
No. of Block Multiplexer Channels	5 or 6	10 or 12	5 or 6	10 or 12	5 or 6	10 or 12
No. of Byte Multiplexer Channels	1 or 2	2 or 4	1 or 2	2 or 4	1 or 2	2 or 4

of the power required and be considerably smaller. The company also stated that an AS system runs about 9 degrees cooler than a 370/158, thereby increasing reliability.

Incorporated in 1967, Itel Corporation is a specialized business and financial services organization. Its operating groups arrange capital equipment lease transactions, lease Itel-owned equipment, and process business data. The company states that it has approximately $700 million worth of IBM 370 systems and Itel-supplied peripherals on finance leases written over the last five years, and that it is the originator of tax-oriented partnerships, which now have $50 million in System/370 operating lease portfolios. Itel also claims to be the largest independent supplier of 3330-type disk drives and monolithic main memories, and is the sole-source supplier of 3330-type disk drives for the U.S. Government.

At the time of the announcement, Itel said that it had firm orders from six customers for a total of seven systems. The company sees its market for the AS systems as being four-tiered:

System/360 architecture and programming. In the EC mode, the Program Status Word (PSW) and the layout of the permanently assigned lower main storage area are altered to support Dynamic Address Translation and other system control functions; therefore, the virtual-storage-oriented operating systems must be used.

PROCESSOR FEATURES: The timing features of the System/370 achitecture are included in the AS central processors. These include a CPU timer and a Clock Comparator; the latter provides a means for causing an interrupt when the standard Time-of-Day Clock reaches a program-specified value. Additional instructions are provided to set and store the Time-of-Day Clock, Clock Comparator, and CPU Timer.

The Standard Direct Control feature provides six external interrupt lines which operate independently of the normal data channels, plus the Read Direct and Write Direct instructions which provide for single-byte data transfers between an external device and main storage.

The Floating-Point Arithmetic feature provides instructions to perform floating-point arithmetic operations on both short (1-word) and long (2-word) operands.

The Extended Precision Floating-Point feature provides seven instructions for performing floating-point arithmetic

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Itel Advanced Systems

- Current single-system IBM System/370 Model 135 and 145 users considering an upgrade to a System/370 Model 148.

- Current single-system IBM Model 50, 65, and 155 users considering an upgrade to a System/370 Model 158.

- Current single-system IBM System/370 Model 158 users who want to reduce hardware costs, while maintaining performance.

- Multiple-system users of two or three IBM computers who want to retain IBM support on their "prime" system, but who are willing to expose themselves on their "backup" systems to a non-IBM alternative.

For users concerned about the continued availability of IBM software and support, Itel offers some encouragement. The company has several letters from IBM, addressed jointly to Itel and National Semiconductor, which state that, for existing operating systems only, those systems are considered in the public domain and can be used by anyone on any system, whether of IBM or non-IBM manufacture. Documentation, tapes containing new releases, and systems engineering support are available to anyone for those current operating systems at fees commensurate with typical fees charged by IBM for similar services.

While there is no assurance that IBM will maintain this posture for new operating systems, Itel points to its own history of supporting DOS/VS on System/360's, enhancements to OS/VS, and general support of users having OS/VS problems as evidence that it has an in-house capability to support OS/VS in the event of future policy changes by IBM that limit the present support availability.□

on 4-word (16-byte) operands that provide a precision of up to 28 hexadecimal or 34 decimal digits.

High-Speed Multiply reduces the time required for long-precision floating-point and fixed-point multiply instructions.

The Channel-to-Channel Adapter permits direct communication between an AS processor and a System/370 via a standard I/O channel. It can be attached to either a selector channel or a block multiplexer channel and uses one control unit position on either channel. Either system can be equipped with the Channel-to-Channel Adapter, and it is required on only one of the interconnected channels.

MULTIPROCESSING CONFIGURATIONS: The AS/4 MP (Multiprocessing), AS/5-1 MP, and AS/5-3 MP systems each consist of two identical uniprocessor models, coupled by means of an Itel 7058 Multisystem Unit. Memory sizes for the two CPU's need not be identical. Minimum main memory size for an MP system is 2 million bytes, while the maximum is 16 million bytes. Buffer storage capacity for the AS/5-1 MP is 16K bytes, and for the AS/5-3 MP, 32K bytes. The number of I/O channels available in every MP system is 14, including the spare channel in each CPU. The 7058 Multisystem Unit interconnects the two processing units and houses a configuration control panel which the operator can use to reconfigure the system.

INPUT/OUTPUT CONTROL

The AS/4 and AS/5 Processing Units include one or two byte multiplexer channels and four or five block multiplexer channels, plus one spare channel which can substitute for a failing byte or block multiplexer channel. Each byte multiplexer channel provides 256 nonshared subchannels or 8 shared and 120 nonshared subchannels. Each block multiplexer channel provides 16 shared and 480 nonshared subchannels and can accommodate a data rate of 1.5 million bytes per second.

PERIPHERAL EQUIPMENT

The Itel systems can utilize all IBM System/360 and System 370 input/output and mass storage devices, as well as their plug-compatible counterparts from independent vendors.

SOFTWARE

The AS systems offer complete functional compatibility with IBM System/360 and System/370 software. Itel intends to support users of current IBM system software by providing new releases of the software and supplying software support services for its customers.

PRICING

Detailed prices for the AS systems have not been released by Itel to date. See the Management Summary for the pricing information that is currently available.■

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Ampex ARM Series Add-On Main Memory

The Ampex ARM-2365 main memory unit allows up to 8 megabytes of memory to be attached to an IBM System/360 Model 65 computer.

Ampex offers replacement or add-on core memory for IBM System/360 Models 40 through 75 and System/370 Models 155 and 165, for Univac 1100 Series computers, and for DECsystem-10 computers.

MANAGEMENT SUMMARY

Ampex, a major manufacturer of main memory for end users, provides a broad line of add-on and replacement memories for IBM System/360 Models 40 through 75, IBM System/370 Models 155 and 165, Univac 1100 Series, and DECsystem-10 computers. The Ampex ARM Series magnetic core memories are designed to extend the storage capacity of existing main memory and/or to replace all memory down to the minimum storage capacity specified for the particular processing unit. All of the existing mainframe manufacturers' memory can be replaced by Ampex memory in the case of the System/360 Models 65, 67, and 75; System/370 Models 155 and 165; and Univac 1100 Series.

Ampex memory for the various System/360 models is available in all IBM-standard incremental capacities, as well as in enhanced capacities that provide up to twice the maximum memory capacity available from IBM for the Model 40, three times the maximum IBM capacity for the Model 50, and eight times the maximum IBM capacity for Models 65, 67, and 75.

Ampex memories for System/370 Models 155 and 165 are available in 512K-byte increments only.

CHARACTERISTICS

MANUFACTURER: Ampex Corporation, Memory Products Division, 200 N. Nash Street, El Segundo, California 90245. Telephone (213) 640-0150.

MODELS

IBM System/360: Three models are available—ARM-40, ARM-50, and ARM-2365. Each model is available in standard IBM and enhanced module capacities.

IBM System/370: Two models—ARM-3360 Model 3 for the 370/155 and Model 5 for the 370/165.

Univac 1100 Series: Two models—ARM-1108 and ARM-7033.

DECsystem-10: One model—ARM-10.

COMPATIBILITY

IBM System/360: The ARM Series core memories, Models ARM-40, ARM-50, and ARM-2365, are designed as add-on and/or replacement memories for IBM System/360 Model 40, 50, 65, 67, and 75 computers. The Ampex core memory can be used to extend the core storage capacity of an existing IBM System/360 processing unit and/or to replace all core storage down to the minimum mainframe capacity as specified for the particular processing unit. In addition to the standard capacities available from IBM, Ampex offers enhancement capacities that, combined with existing mainframe storage, provide storage capacities ranging up to 448K bytes for the Model 40, up to 1536K bytes for the Model 50, and up to 8192K bytes for Models 65, 67, and 75. The ARM-2365 is designed as a direct replacement for IBM 2365-2 and -3 Processor Storage, which is used with IBM System/360 Models 65, 67, and 75. Like its IBM counterparts, the ARM-2365 is available in module capacities of 256K bytes.

Effective cycle times of the 360-compatible Ampex memories are the same as those of the corresponding IBM processing units: 2.5 microseconds per 2 bytes for Model 40, 2.0 microseconds per 4 bytes for Model 50, and 750 nanoseconds per 8 bytes for Models 65, 67, and 75.

IBM System/370: The ARM-3360 core memory is designed as a direct replacement for the IBM 3360 Processor Storage used with IBM System/370 Models 155 and 165, and can be used to extend the existing storage capacity of a System/370 processing unit and/or to replace all of the unit's existing core storage. The ARM-3360 is available in storage capacities of 512K bytes per module. The System/370 Model 155 can accommodate up to four ARM-3360 Model 3 modules of 512K bytes each to provide a total storage capacity of 2048K bytes; Model 165 can accommodate up to six ARM-3360 Model 5 modules to provide a total storage capacity of 3072K bytes.

Effective cycle times of the ARM-3360 memories are the same as those of the corresponding IBM processing units: 2.07 microseconds per 16 bytes for Model 155 and 2.0 microseconds per 8 bytes for Model 165. The ARM-3360

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Ampex ARM Series Add-On Main Memory

The ARM Series product line also includes replacement memories for the Univac 1100 Series computers. Salient features of these units include storage protection, interleaved or overlapping operation, and error detection.

The ARM-10L product line is a replacement for the DECsystem-10 memory and is available for processors models KA, KI, and KL. Salient features include two- or four-way storage interleaving, two to eight ports, and expansion to 256K words in 128K-word increments.

Each of the ARM Series memories is equipped with a sophisticated off-line diagnostic capability, including a maintenance panel, to facilitate the isolation of malfunctions by service personnel.

Deliveries of the Ampex ARM Series memories began in 1971. Initial deliveries of the ARM-2365 were made in May 1971, with the ARM-40 and ARM-50 following in July 1971.

Ampex installed the industry's first IBM System/370 replacement memory on May 14, 1972. To date, Ampex has installed over 200 of its System/360 and 370 replacement memories. Initial customer deliveries of the ARM 1108 memories for the Univac 1108 were made in late 1972.

Service is provided by Ampex through its own maintenance organization, with service points throughout the U.S. and Canada.

USER REACTION

In Datapro's 1976 survey of add-on main memory users, 17 users reported on their experience with a total of 28 Ampex replacement memories, including 19 units for System/360 computers having a total capacity of 7.5 megabytes, 7 units for System/370 computers having a total capacity of 5.0 megabytes, and 2 units for DEC computers. These 28 Ampex replacement units represented a total of 12.6 megabytes of memory. The users' ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	8	7	0	0	3.5
Equipment reliability	8	8	1	0	3.4
Maintenance service	4	4	6	3	2.5
Ease of installation	5	6	6	0	2.9

*Weighted Average on a scale of 4.0 for Excellent.

These users were well satisfied with the overall performance and reliability of their Ampex memories. No serious problems were cited in installation and testing. But seven of the users reported minor problems and four cited serious problems in diagnosing malfunctions and obtaining the necessary service. One user reported a low inventory of spare parts, while another claimed that the memory was "reliable but slow." Another user stated that reliable maintenance was hard to obtain, adding, "We hired our own maintenance personnel."

Model 3 memories also include 8192 bytes of bipolar monolithic (semiconductor) "bump" storage, which is dedicated to the storage of Unit Control Words and is inaccessible to the user.

Univac 1100 Series: The ARM-1108 core memory is designed as add-on or replacement mainframe memory for the Univac 1108 computer, and can be used to extend the computer's existing main memory capacity and/or to replace all of the existing main storage. The memory is available in a module capacity of 64K words. Compatibility features include overlapped/interleaved main storage access, access by any combination of up to three processors and/or I/O controllers, parity generation and checking, and storage protection. Three ports (data paths) are standard, and five are optional.

The Univac ARM-7033 core memories are designed as add-on or replacement mainframe memory for the Univac 1106 or 1100/20 systems or as extended memory for the 1110 and 1100/40 systems. The extended storage for the 1100 and 1100/40 systems operates through the multiple access interface. For multi-processor applications, a Univac or equivalent multi-module access unit is used. The ARM-7033 memory is available in 128K-word increments, with each word containing 45 bits—36 data bits, 2 parity bits, and 7 error correction bits. The Ampex unit is designed to operate at a cycle speed of 800 nanoseconds with a maximum access time of 425 nanoseconds. The memory checks half-word parity of data received for storage. When an error is detected, a parity error is sent to the processor. When data is retrieved, the error correction code is compared and any single-bit error is identified and corrected. If a multiple-bit error occurs, a memory fault signal is sent to the processor along with the data.

DECsystem-10: The ARM-10L core memory is designed as add-on or replacement main memory for all models of Digital Equipment Corporation's DECsystem-10 computers. The ARM-10L memories are plug-to-plug-compatible with DEC's MG—10, MF-10, ME-10, MB-10, MD-10, and MA-10, and can be used to expand the main memory capacity in 128K- or 256K-word increments up to the maximum capacities for the KA, KI, and KL processors. Each ARM-10L cabinet accommodates up to 256K words of memory in 128K-word increments. A 256K-word ARM-10L memory is equipped with two- or four-way internal interleaving capabilities, and a 128K-word unit provides for two-way internal interleaving. Either capacity can be equipped with up to eight ports, in two-port increments. The system panel provides controls and indicators for power port priority, port activity status, sector address, sector status, two- or four-way interleave control, address status, data status, parity error status, memory hang indicator, and hang reset-control. Parity checks are made on memory modules during both the read and write cycles. The memory cycle time of 880 nanoseconds is compatible with that of the DEC processors. All logic is implemented via semiconductor circuits; the memory stack consists of 18-mil lithium ferrite cores. The ARM-10L interface is completely transparent to the KA, KI, and KL processors.

All Ampex memories contain integral power supplies that satisfy the memory power requirements and diagnostic circuitry that, via an external maintenance panel, allows simulation of the processing unit in an off-line mode. Power supply voltages can be switched to plus or minus five percent of the normal operating voltage to determine marginal operating conditions. The external maintenance panel provides controls for addressing any memory location, reading from the addressed memory location, or writing new data entered via panel switches. Indicators are provided for reading the current memory address, the data

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Ampex ARM Series Add-On Main Memory

On a more positive note, a user with six 512K-byte Ampex memory units installed on his 360/50 mainframe said, "We are very pleased with the Ampex add-on core." He further stated, "We had installation problems, but most were not directly Ampex problems."

A user with 128K bytes of Ampex memory on his 360/50 expressed a desire for a manual explaining minor trouble-shooting techniques. In Datapro's conversations with a multitude of users of independent add-on memory, we learned that many of them have successfully developed their own trouble-shooting techniques for minor problems.

Installation time for the Ampex memory averaged 1.8 days, with about 13 hours of on-line testing. Approximately one-half of the users surveyed had purchased their Ampex memory units.

The mixed ratings for maintenance service suggest that Ampex could improve in that area. Nevertheless, the overall ratings indicate user satisfaction with the reliability and performance of the company's add-on memory products.□

stored at the current address, and error status. Controls are also provided for writing a specific data pattern and for selecting specific memory operating models.

Physical specifications and heat dissipation for each of the Ampex memory cabinets are presented in the following table:

Model	Maximum Storage, bytes	Cabinet Size: Depth, inches	Width, inches	Height, inches	Weight, inches	Heat Dissipation, BTU/hr.
ARM-40	256K	32	23	60	550	3,500
ARM-50	256K	32	23	60	550	4,000
ARM-50	512K	28	60	64	700	7,000
ARM-50	1024K	28	78.5	64	1,200	10,000
ARM-2365	1024K	32.5	35.6	71	1,650	11,935
ARM-3360	512K	31.5	62	60	1,200	10,000
ARM-1108	512K*	28.5	63	64	700	10,000
ARM-7033	256K*	25.7	52.4	65	850	—
ARM-10L	256K*	32	48	68	1,234	15,345

*Storage capacity per cabinet in 36-bit words.

Ampex Models ARM-2365, ARM-3360, ARM-1108, ARM-7033, and ARM-10 are powered from a 208-volt, three-phase source. All other models are powered from a 115-volt, single-phase source. Model ARM-3360 for the 370/155 can also be powered from a 230-volt, single-phase source.

PRICING: Ampex memories are available for lease or purchase; conversion from lease to purchase is available through a purchase-credit arrangement. Ampex offers lease contracts for one to five years. Lease rates include all cables, installation, diagnostic performance checks, unlimited usage, and complete maintenance. A separate maintenance contract is available for purchased units.

Model & Storage Capacity, bytes	Monthly Rental (1): 2-Year Lease	3-Year Lease	Purchase	Monthly Maint. (2)
ARM-40:				
64K	$ 645	$ 550	$19,000	$172
128K	930	790	27,000	257
192K	1,230	1,040	35,000	343
256K	1,560	1,320	42,000	429
320K	2,100	1,772	53,000	515
384K	2,325	1,970	60,000	600
ARM-50:				
128K	980	885	27,000	240
256K	1,510	1,360	41,000	360
384K	2,400	2,150	68,000	450
512K	2,865	2,555	83,000	485
640K	3,600	3,130	104,000	600
768K	4,200	3,735	125,000	620
896K	5,000	4,460	145,000	825
1,024K	5,600	5,000	162,000	900
ARM-2365:				
256K	2,200	1,250	44,000	465
512K	3,300	2,660	73,000	669
768K	4,500	3,600	102,000	892
1,024K	5,700	4,600	132,000	1,109
ARM-3360:				
For 370/155—				
512K	3,000	2,600	50,000	550
For 370/165—				
512K	3,600	3,000	80,000	575
370/155 Expansion (3):				
From 512K to:				
768K	450	—	16,400	40
1024K	475	—	17,200	45
1536K	695	—	25,200	65
2048K	915	—	33,200	85
From 1024K to:				
1536K	220	—	8,000	20
2048K	430	—	15,600	40
ARM-1108:				
65K words	3,600	3,200	80,000	600
ARM-10L (4):				
128K words				
(2 ports, 2 sectors)	NA	NA	50,000	—
(2 ports, 4 sectors)	NA	NA	60,000	—
256K words				
(2 ports, 4 sectors)	NA	NA	90,000	—

(1) Monthly rental under a 2- or 3-year lease includes maintenance for 24 hours/day, 7 days/week.

(2) Complete maintenance for 24 hours/day, 7 days/week, excluding national holidays.

(3) For attaching more than 1024K bytes to a single Storage Adapter of the 370/155. These lease, purchase, and maintenance prices are to be added to the prices for the ARM-3360. This upgrade does not apply to the 370/165.

(4) ARM-10L memory is available for purchase only.■

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Consolidated Computer Key-Edit 50 and 60

MANAGEMENT SUMMARY

Consolidated Computer was founded in 1968 as a result of a Canadian government effort to develop a native data processing industry. With delivery of its first system in late 1969, Consolidated became one of the pioneer key/disk manufacturers. Initially, the company's Key-Edit family of shared-processor key/disk systems was not widely available in the United States, but it generated considerable interest nonetheless.

Despite the company's financial backing by the Canadian government, the economic slowdown in 1970 and 1971 caught up with Consolidated as it did with many companies of all sizes. By 1972, end-user marketing had been virtually abandoned. Substantial OEM contracts with ICL (Europe), Fujitsu (Japan), and Ecodata of Brazil (South America) permitted the continued existence of the company. Although its marketing effort was reduced, the company strongly emphasizes that an unbroken continuity of engineering and systems work was maintained.

Consolidated's re-entry into the end-user market in North America was made possible by a line of credit (backed by the Canadian government) for financing leased systems, a vital necessity to successful penetration of the lease-oriented U.S. and Canadian user base.

Today, the Key-Edit systems are readily available and fully supported in the U.S. Sales and service are handled out of regional offices in Waltham, Massachusetts; Wayne, Pennsylvania; Worthington, Ohio; Silver Springs, Maryland; Cleveland, Ohio; Atlanta, Georgia; New York, New York; Chicago, Illinois; Los Angeles, ➢

These shared-processor key-to-disk systems provide low- to medium-volume users with a way to ease the load on their mainframes. The Key-Edit 60 is an enhanced version of the earlier Key-Edit 50 with additional hardware and software features, including a recently announced package that provides more powerful editing and processing capabilities.

CHARACTERISTICS

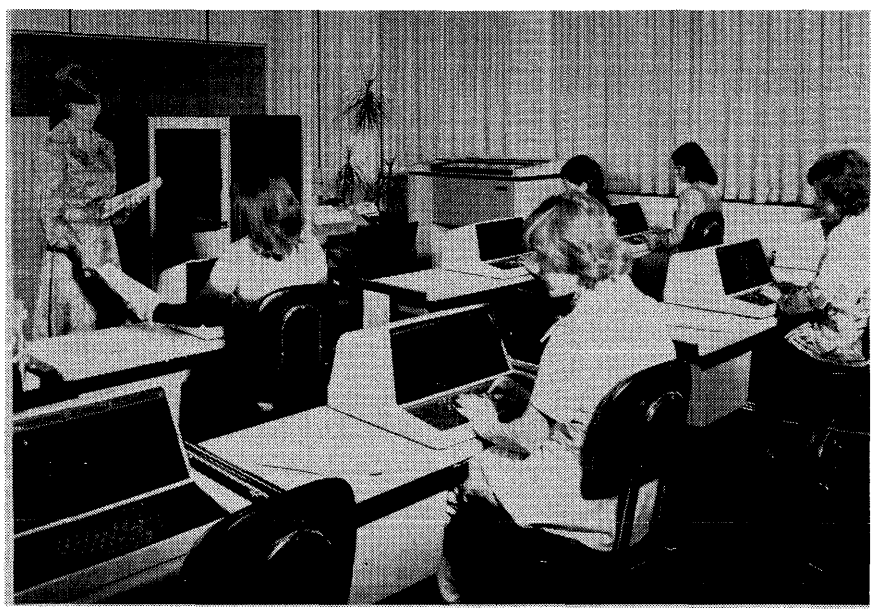
MANUFACTURER: Consolidated Computer Inc., 50 Gervais Drive, Don Mills, Ontario, Canada M3C 1Z3. Telephone (416) 449-1120.

CONFIGURATION

There are two basic *Key-Edit 50* configurations. Model 501 includes 4 to 8 CRT keystations and a 1.4-million-character disk unit. Model 502 includes 9 to 16 CRT keystations and a 2.8-million-character disk unit.

Both Key-Edit 50 configurations are built around the same processor. Either configuration can include 1 to 4 magnetic tape units with a 7-track, 556/800-bpi; 9-track, 800-bpi; or 9-track, 1600-bpi format. Either configuration can be expanded to include a total of 5.6 million characters of disk storage. The basic processor includes 24K words (12 bits per word) of core memory; an 8K-word expansion module is required for large output tape blocks and/or data communications. Every configuration includes a Model 33 ASR teletypewriter for supervisory functions. A serial matrix printer or a 300-lpm line printer can be added. A bisync (BSC) communications interface can also be added.

The *Key-Edit 60* system consists of 4 to 24 CRT keystations and a disk unit with a capacity of from 1.4 to 5.6 million ➤



At the rear of this typical Key-Edit 50/60 work area are the processor cabinet, magnetic tape drive, supervisory console, and optional line printer.

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Consolidated Computer Key-Edit 50 and 60

California; and San Francisco, California. Additional service offices are located in Hartford, Connecticut; Harrisburg, Pennsylvania; Akron, Ohio; Springfield, Illinois; and Macon, Georgia.

Consolidated's first key/disk systems, the Series 100, earned the company a reputation for comprehensive facilities for data manipulation and the capability to install large systems. The Series 100 could handle up to 32 keystations—a large system in 1970.

The original Key-Edit Series 100 has been retired in the U.S. It has been replaced by a family of key/disk systems that provide a graduated capability of up to 56 keystations per system.

The Key-Edit 50 resembles the Series 100 systems, but the maximum number of keystations is limited to 16. An intermediate system, the Key-Edit 60, was introduced in 1975. The Key-Edit 60 is essentially an expanded 50 that handles up to 24 keystations. The Key-Edit 1000, also introduced in 1975, is the premier member of the Key-Edit family. The 1000 is not program-compatible with the 50 or 60 and is separately described in Report 70D-257-03.

The Key-Edit 50 supports up to 16 CRT keystations and seems to address the needs of the small-to-medium key entry environment where low volume does not mean reduced complexity of the data entry operations. While computational capabilities are limited to totaling and simple multiplication by repetitive addition, data movement and logical operations permit meeting complex data entry requirements. The capabilities are oriented specifically toward simplifying the task of converting human-generated documents into computer-readable records. The flexibility of the programming system would permit tasks such as report generation to be coded, but it would take a dedicated programmer to generate efficient programs.

The Key-Edit 60, introduced in April 1975, is a direct outgrowth of the Key-Edit 50. Capable of supporting up to 24 keystations, the 60 is physically and operationally almost an identical twin of the earlier system. Additional hardware and software features inherent in the Key-Edit 60 system, however, make it a more powerful and sophisticated tool, and thus more attractive to the key-to-disk user who wants more than just data entry capability. Customer deliveries of the Key-Edit 60 began in July 1975.

The Key-Edit 60 system includes a processor with a basic 32K words of memory and a disk capacity of up to 5.6 million characters. An optional hardware feature allows an aggregate of up to 32 keystations to be switched among a maximum of three Key-Edit 60 systems, thus affording the user backup protection as well as versatility (provided each system has sufficient capacity to handle the additional terminals—a maximum of 24 on any one system). Another feature

characters, built around a processor with 32K words (12 bits per word) of core memory.

The Key-Edit 60 system can also include 1 to 4 magnetic tape units with a 7-track, 556/800-bpi; 9-track, 800-bpi; or 9-track, 1600-bpi format. A Model 33 ASR teletypewriter is provided for supervisory functions. A serial matrix printer or either of two line printers, rated at 300 or 600 lpm, can be added. A bisync (BSC) communications interface can also be added.

COMPONENTS

KEYSTATIONS: The CRT monitor and nonseparable keyboard are integrated into a single package.

The CRT monitor for the Key-Edit 50 displays 64 symbols using an 8-by-12 dot matrix arrangement in 11 lines of 40 characters each; a total of 422 characters can be displayed. For the Key-Edit 60, the monitor also displays 64 symbols using an identical dot matrix arrangement, but in 12 lines of 40 characters each; a total of 472 characters can be displayed.

For both the Key-Edit 50 and 60, the top six lines display the data record being keyed or examined. The seventh line is used for display of batch and record status information. The eighth and ninth lines are used to display control commands as they are entered. Since the last 18 positions of the ninth line of the Key-Edit 50 display are not used, only 62 positions in the eighth and ninth lines are available. The tenth and eleventh lines display English-language error messages. The twelfth line (available only on the Key-Edit 60) is used to display messages to the operator from the supervisor's console; these messages can be up to 32 characters long.

Field delimiters when entering or verifying data are shown as a vertical bar between character positions. The cursor appears as an underscore.

The basic keyboard for either system provides 49 keys arranged in data entry (IBM 29 keypunch) layout, including upper case alphabetics, numerics, special characters, and some control keys. An additional row of nine keys across the top of the keyboard provides additional control functions. Control keys include two levels of automatic dup/skip; character, field, record, and document forward or reverse advance; and character, field, or record correct. Some of the control keys, such as auto dup/skip and auto release, are switches that activate or deactivate a particular function. An optional numeric pad can be added to the keyboard of the Key-Edit 60. This numeric pad is available in two different key arrangements.

The keystations can be separated from the processor by up to 500 feet. An optional hardware feature, available only for the Key-Edit 60, allows up to four keystations per controller to be directly connected at distances of up to 6000 feet from the processor.

DISK STORAGE: For either system, a fixed-head single disk unit with a capacity of 1.4 or 2.8 million characters is provided. The disk rotates at 3600 rpm, giving a rotational time of 16.7 milliseconds and an average access time of 8.5 milliseconds.There are 128 tracks per disk and 128 sectors per track. The data transfer rate is 4 million bits per second. The maximum 5.6-million-character disk storage capacity is achieved by installing two 2.8-million-character units.

MAGNETIC TAPE DRIVES: Up to four tape drives of the same or intermixed recording formats can be attached to a Key-Edit 50 or 60 system. Available recording formats include 7-track, 556/800-bpi; 9-track, 800-bpi; and 9-track,

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Consolidated Computer Key-Edit 50 and 60

enables up to four keystations per controller to be directly connected at distances of up to 6000 feet from the processor. As many as four tape units and a printer can be attached to the system, and a communications capability enables the system to communicate with another Key-Edit system (50/60 or 1000) or a central computer in IBM 2780 or 3780 mode. Data communications is concurrent with data entry from the keystations. Data can be transmitted from disk or magnetic tape and received on disk, magnetic tape, or line printer.

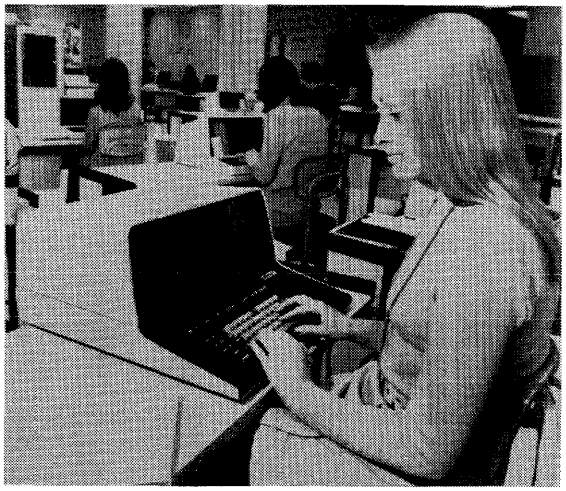
Software for the Key-Edit 60 includes a sort/merge package. The sort/merge programs are executed under control of the supervisor as a console function and provide the following features: records in any batch or file not exceeding 30,000 records can be sorted in ascending or descending sequence by user-specified sort fields; multiple sort fields can be specified; sorted data can be writted to magnetic tape or disk; and up to three sorted tape or disk input files can be merged with output to disk or tape. The software also 1) enables format selection from the entire library of formts as needed; 2) allows the supervisor to send messages to any keystation; 3) enables print-image tapes produced on the mainframe to be printed on the Key-Edit system in background mode; and 4) enables batches or files to be input from disk or tape for processing and output to disk, tape, line printer, or supervisory console.

The editing software of the Key-Edit family permits extensive validation and editing at both the data terminal and supervisory level. The three main components of this software are:

- Input Programs—These programs control the keyboard data formats in order to assist in data entry and verification.
- Input Editor—These programs edit, validate, or process data as it is being entered.
- Output Editor—These programs edit, validate, and reformat, in the background, previously entered data. Operating at the batch or file level, Output Editor programs provide access to look-up tables and perform a multitude of preprocessing functions prior to output to a user-selected peripheral.

USER REACTION

Datapro contacted three current users of the Key-Edit 50 and two current users of the Key-Edit 60. Four of these users were U.S. businesses, and the fifth was Canadian. These five users had a total of six processors and 52 CRT keystations. The average installation had a single processor with about eight keystations. Three of the five users were using the 9-track, 1600-bpi magnetic tape format, and most were taking advantage of the available data editing and validation features. The average length of a keyed record ranged from 80 to 150 characters.



The Key-Edit 50 system can include from 4 to 16 of these CRT keystations, located up to 500 feet from the processor. The Key-Edit 60 system supports a maximum of 24 keystations, some of which can be located up to 6,000 feet from the processor.

1600-bpi (phase encoded). All formats are industry-standard. All drives operate at 25 inches per second and can accommodate reels up to 10.5 inches in diameter (2400 feet). Rewind speed is 150 inches per second. Vertical and longitudinal parity checks and read-after-write checks are provided on all tape units, as well as cyclic redundancy checks on all 9-track tape units.

PRINTERS: Either of two printers can be attached to the Key-Edit 50 or the Key-Edit 60. One is a 165-character-per-second serial matrix printer, and the other is a 300-lpm line printer. In addition to these two printers, a 600-lpm line printer can be used only with the Key-Edit 60. All three units can print a 64-character set.

The matrix printer can accommodate sprocket-fed forms with up to 5 parts and up to 14.375 inches wide. Horizontal pitch is 10 characters per inch, and the maximum print line is 132 characters. Vertical pitch is 6 lines per inch. A two-channel vertical format control unit provides top-of-form and tabulation functions. Effective printing speed ranges between 60 and 150 lines per minute, depending on the number of characters printed per line.

The two line printers available are functionally identical except for speed; one is capable of 300 lpm, the other 600 lpm. Both have 136 print positions per line. They can accommodate up to 6-part forms from 4 to 14.875 inches wide. Vertical spacing is 6 or 8 lines per inch, and horizontal pitch is 10 characters per inch.

PROCESSOR: Manufactured by Consolidated Computer, the processor uses an architecture similar to that of the DEC PDP-8, which was used in the company's original Series 100 Key-Edit systems. It uses a 12-bit word. Main memory cycle time is 1.2 microseconds. Memory size for the Key-Edit 50 is 24K words in the basic configuration, and can be expanded to 32K words to accommodate large tape blocks (up to 4,096 characters) and/or communications operations. Memory size for the Key-Edit 60 is 32K words.

SUPERVISORY CONSOLE: A Teletype Model 33 ASR serves as the input station for entering supervisory commands and output for system error messages, statistics, program-generated data or messages, and operator-originated messages. The Model 33 prints 10 characters per second with a maximum of 74 characters on each line. A

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The ratings given by these users were as follows:

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	3	2	0	0	3.6
Ease of operation	2	3	0	0	3.4
Hardware reliability	3	2	0	0	3.6
Promptness of maintenance	3	2	0	0	3.6
Quality of maintenance	2	3	0	0	3.4
Software	2	3	0	0	3.4
Technical support	3	2	0	0	3.6

*Weighted Average on a scale of 4.0 for Excellent.

As the ratings indicate, these users were well pleased with their systems. One user, who assigned six excellent grades and one good, was extremely pleased with his Key-Edit 60. His current plans involve the conversion of the majority of his company's data entry work to the Key-Edit system. Another user indicated that he was considering an upgrade from a Key-Edit 50 to a Key-Edit 1000.

The reputation that Consolidated has acquired as a company willing to work with its users to resolve any problems was reinforced by the comments of two users. A third user commended the fine training given by the company prior to installation of his system. During the preparation of this report, Datapro visited a Consolidated ales office while the company was training future users. The training involved both formal classroom instruction and hands-on experience with the Key-Edit system, and appeared to be excellent.

The quietness of operation was praised by one user, and a Datapro representative who witnessed a system in operation agreed.

In summary, low- to medium-volume users who need data manipulation capabilities should consider this family of key/disk systems.□

keystation may operate as a supervisory console but would not produce hard-copy output.

COMMUNICATIONS

Batch-oriented data communications hardware and software are optional. Transmission emulates the IBM 2780 or 3780, using bisync (BSC) protocol, via switched network or common-carrier facilities at up to 9600 bps. External modems must be provided separately by the user. Leased lines or the public telephone network (DDD) can be used. Transmission between two Key-Edit systems (50/60 or 1000) is supported, as well as transmission between a Key-Edit system and a remote computer supporting batch communications with IBM 2780/3780 terminals.

Data can be transmitted from disk or tape, and received on disk, tape, or printer. Additionally, IBM 360/370 HASP messages can be directed to the supervisor's console. Space Compress/Decompress features as used in IBM 3780 communications are also supported. Parameter programs allow the user to specify the remote system, the mode of transmission, the terminal control program options, and output device selection at execution time. Line code may be ASCII or EBCDIC. Batch transmissions are initiated by the supervisor and can proceed concurrently with key entry and verification.

Unlike the Key-Edit 1000, neither the Key-Edit 50 nor 60 can support remote keystations connected to the processor via communications lines and modems. However, the Key-Edit 60 can support hard-wired keystations located up to 6000 feet from the processor.

SYSTEM OPERATION

OVERVIEW: All operations of the Key-Edit 50 and 60 systems run under the MASTER control program. Data entry/verification/validation is initiated and controlled at the keystations. Data transfers between disk and tape, as well as to and from a communications line, are controlled from the supervisory station.

The central data group is the batch or output from one keystation. Subordinate data groupings include documents, records, fields, and characters. "Combine" allows the supervisor to initiate operations on a sequence of related batches. The key to data flow for the Key-Edit 50/60 is either the batch name or a six-character assignment to a file made by the supervisor when the file is formed. All batches which are combined in a file can be returned to their original batch form by use of "Split."

During key entry or verification, two levels of programming control operations. The Input program delimits fields and specifies data types; the Input Editor program controls data validation or computation. The operator specifies the Input program in control when a batch is opened. Any Input Editor programming is called from the Input program. After batches have been closed, output processing can be initiated by the supervisor by invoking an Output Editor program. All three levels can be composed of multiple sections or segments to handle varying requirements. A full range of data validation and reformating procedures can be handled through the three software levels.

OPERATOR FUNCTIONS: In either Key-Edit system, the operator's primary responsibility is the key entry and verification of data. Supportive functions include corrections made in the entry or verify mode and the initiation of balance routines for documents or batches. The operator originally enters batch names, but the supervisor can rename a batch if desired. The operator can locate records by record number within a batch or by data content of one to four record segments. Specifications for segment contents can be linked by logical AND or OR conditions, but the two cannot be mixed in the same specification.

The operator names the controlling Input Program when opening or reopening a data batch for data entry or verification. Both source editing programs and application data are treated as data batches and are keyed by the operator. During the course of keying operations, the operator can manually select a program section or can enter data free-form under no control other than a record length specification.

Batches can be suspended in either the entry or verify mode. Batches cannot be opened or reopened in either mode if the batch is open at another keystation. In the verify mode, records can be added or deleted from within a batch (i.e., not at the end). A group of records can be added to the end of a batch in the entry mode.

In general, the operator is guided as to the status of operations through the status line displayed on the CRT. Information displayed includes next column number to be keyed (location of cursor), the last keyed character, the

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Consolidated Computer Key-Edit 50 and 60

mode of operation, current record number, batch name, current Input Program section number, data type, status of the two keyboard automatic dup/skip keyswitches, and a two-character error code. System error codes are provided for violations of data types in the Input Program and various illegal procedural steps. Failures to meet the validation checks in the Input Editor program can also generate error codes if programmed. The operator can use the Assist key to display a two-line English message explaining the error code. Provision is included in the Input Editor program to generate error messages for programmed error codes.

Prior to executing a balance program, the operator can input up to 40 data characters (typically a set of balance totals) for use by the program prior to reading the first record in a document or batch.

One special mode of operation permits the operator to key in a message of up to 60 characters that will be printed on the supervisor's console.

SUPERVISORY FUNCTIONS: The supervisor's responsibilities include start-up and system program loading; initiating translation of Input, Input Editor, and Output Editor programs and Look-Up tables; maintaining program libraries by linking Input Editor programs with Input programs and Look-Up tables with Input/Output Editor programs; controlling batches through listing, grouping, force-closing, renaming, and releasing batches and initiating the execution of Output Editor programs; controlling data transfer between disk and tape and to and from the communications line; managing disk space; and monitoring system statistics. Data transfers to tape can be initiated individually by batch or file. In addition, batches can be transferred selectively if they meet certain specifications or automatically as soon as they meet certain specified conditions such as balanced, unbalanced, verified, and previously transferred to tape (peeled).

For the Key-Edit 60 supervisor, the following additional responsibilities are assigned: initiating and executing sort/merge programs; listing source programs on the console or line printer; reproducing system tapes; initiating the tape-to-printer program; and reproducing source codings from the object program libraries.

Disk space management operations include reorganizing the disk to compact data and free disk space, writing the contents of the disk to tape for system backup, and reading a system backup tape into disk storage.

OPERATING MODES

- Data Entry—Data is keyed into the system under control of an Input program that defines fields and data types. Automatic links to an Input Editor program provide data validation checks. Some data type specifications can be overridden, but in general the operator cannot force the acceptance of data not meeting type and validation checks. However, such action could be programmed in the Input Editor program if desired. Additional processing can be performed through an Output Editor program.

- Data Verification—Data is verified by rekeying. Selective verification is achieved by alternating use of the two automatic dup/skip switch-keys or Input Editor. Only closed batches can be verified. Visual verification is possible.

- Data Additions and Deletions—A data batch can be reopened in the Entry mode to add records at the end of a batch. In the Verify mode, records can be added or deleted in the middle of a batch.

- Search—In the Verify mode, a record within a batch can be located by record number or by the contents of up to four record segments, which can be linked by logical AND or OR operations. Data in a located record can be modified in the Verify mode, which may require reverification of modified fields if programmed.

- Background—Includes batch transfers to tape, Output Editor programs, and data transfers to and from the communications line. Background tasks and key entry/verification can proceed simultaneously if there is no conflict in device selection.

KEY-EDIT 50 SYSTEM PROFILE

- Keystations—4 to 16 local CRT keystations plus supervisor teletypewriter.

- Record length—20 to 240 characters; up to 240 fields per record.

- Formats—An Input program can include up to nine sections or individual formats. Each Input program can be linked to one Input Editor program which can have up to 99 data checking segments and 1 balance segment; branching between segments is not permitted. Output Editor programs are specified separately. The number of Input, Input Editor, and Output Editor programs permitted is a function of their length and the amount of disk space available.

- Output block length—Any blocking factor up to a maximum block size of 4096 characters.

- Data storage—The amount of space available for storing data records is dependent on the number and size of Input, Input Editor, and Output Editor programs. Allowing for system code and a modest number of editing programs, the 1.4-million-character disk should be adequate for a day's output from 8 operators, and the 2.8-million-character disk should handle a day's output from 16 operators. Extensive editing programs or leaving batches on disk for more than one day will decrease the data capacity.

KEY-EDIT 60 SYSTEM PROFILE

- Keystations—4 to 24 local CRT keystations plus supervisor teletypewriter.

- Record length—20 to 240 characters; up to 240 fields per record.

- Formats—An Input program can include up to nine sections or individual formats. Input programs can be loaded at any time by entering a command from the keystation or by an Input Editor command. Any number of input programs can be called from the Input Editor, thus giving the Key-Edit 60 a virtually unlimited number of formats without any operator intervention. Each Input program can be linked to one Input Editor program which can have up to 99 data checking segments and 1 balance segment; branching between segments is not permitted. Output Editor programs are specified separately. The number of Input, Input Editor, and Output Editor programs permitted is a function of their length and the amount of disk space available.

- Output block length—Any length up to a maximum block size of 4096 characters.

- Data storage—The amount of space available for storing data records is dependent on the number and

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Consolidated Computer Key-Edit 50 and 60

size of sort/merge, Input, Input Editor, and Output Editor programs. Allowing for system code and a modest number of editing programs, the 1.4-million-character disk should handle a day's output from 16 operators. Extensive editing programs or leaving batches on disk for more than one day will decrease the data capacity.

SOFTWARE

Both Key-Edit systems run under the overall control of the MASTER operating system. Facilities for user programming include the Input, Input Editor, and Output Editor program capabilities.

Additional capabilities for the Key-Edit 60 include sort/merge facilities and a debugging aid which enables the programmer to display or change the buffer, accumulators, or registers at pre-selected times during program execution. Also, a COBOL subset is available.

INPUT PROGRAM: Required for formatted data entry and checking. An input program consists of one to nine sections. Each section specifies a format. If an Input Editor program is used and the need arises, an Input program segment need not carry definitions for the entire record. Capabilities available in an Input program include data type specification, record length, duplication, skipping, check digit generation or checking, automatic linking to another section of the same Input program, and branching to a segment within the associated Input Editor program. A field can also carry a specification forcing a reverification if a change is made in the verify operation for this record.

A total of 12 different data types can be specified. They can be grouped into four cases (lower, upper, alphabetic, and numeric), operator override permitted or not, zero fill, and sign convention. Special types are permitted for sign overkey.

Automatic duplication and skipping are keyed to the status of the two Auto Dup/Skip keyswitches on the keyboard. Two levels permit different assignments for key entry and verification using the same Input program.

Several types of check digit calculations can be specified, including modulo 10, 11, or 7. Further, modulo 11 checking can be specified so that either a checking digit of 10 is not allowed or when a 10 is called for an "X" or "-" is used.

Automatic or manual record release is controlled by the status of a keyboard keyswitch. If automatic, release occurs only at the end of a record.

INPUT EDITOR: An Input Editor program consists of a group of up to 99 Check segments and 1 Balance segment. Each segment is in effect a closed subroutine with one entry point and the potential for one or multiple exits. An Input Editor program can be shared among several Input programs, i.e., multiple copies of the Input Editor programs need not be stored on disk.

A Check segment is entered from the Input program following the entry of a field. Exit from a Check segment can be to any defined position, including the beginning of a field that did not pass the check, in any of the up to nine sections (formats) of an Input program. Four 15-digit accumulators for the Key-Edit 50 and twelve 15-digit accumulators for the Key-Edit 60 are available within a Check segment. These accumulators are automatically cleared when the segment is entered. For the Key-Edit 50, only literal constants can be introduced into the record being keyed. Therefore, no data can be passed from one segment to another except constants. While a direct branch cannot be made from one segment to another, an indirect branch can be arranged through the use of additional Input program sections containing the branch to the desired segment.

Only a few procedural statements are provided in the construction of the Input Editor language, but they are quite flexible. The central arithmetic and logical statements are add, subtract, conditional branch, and unconditional branch. The first operand of an arithmetic statement can be an accumulator, numeric literal, or an input field from the data record; the second operand is always an accumulator. Two types of conditional branch statements are provided: one for numeric operands and one for string (alphanumeric) operands. The statement is in the form of an If comparison, with a statement number serving as the destination of the branch if the comparison specified is true. The first operand of a string-oriented If statement is an input field; the second operand is an input field or constant. The numeric version adds the capability to specify an accumulator as the first and/or second operand. lator as the first and/or second operand. The same operators are provided for both versions of the statement and include equal, not equal, greater than, less than, greater than or equal, and less than or equal.

The enhanced software of the Key-Edit 60 provides three additional commands. A Display command allows the keyboard buffer to be programmed to contain messages to assist the operator. A Move command allows literals, fields, and accumulators to be transferred into the data record. A Call/Exit command allows subroutines within a check segment.

With these statements, coupled with the capability to branch back and forth among various Input program sections, virtually any type of data validation routine can be programmed, including conditional data entry. The simplicity of the statements, while convenient to understand, also means that complex validation routines will be rather lengthy.

The Balance segment includes all the capabilities of the Check segment plus a Read statement, a facility for setting a status flag, and the capability to accept up to 40 characters of data from the operator to be used in the execution of the Balance segment. The Balance segment is entered manually by the operator during data entry or verification. Execution causes the records contained in a batch (or document, if that organization is being used) to be reread on command, with the specified logical and numeric operations being performed on each record. The normal organization provides a loop for reading and calculating with a branch to a comparative operation when all the records have been read. Typically, a total or totals are first entered by the operator when the Balance segment is initiated. A flag indicating in or out of balance can be set as a result of the final comparison. This flag is available to the supervisor to use in conditional transfer of batches to tape.

During document or batch balancing with the Key-Edit 60 system, the user can read records from disk, flag error records, and rewrite the records back to the same disk file, thereby saving disk space.

The entire Input Editor program is limited to 2047 statements. Each setment can contain up to 999 labeled statements.

OUTPUT EDITOR: An Output Editor program bears no direct linkage with an Input or Input Editor program. Execution of an Output Editor program is initiated by the supervisor by program name.

Output Editor arithmetic and logical statements include add, subtract, multiply (Key-Edit 60 only), divide (Key-

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Consolidated Computer Key-Edit 50 and 60

Edit 60 only), conditional branch, and unconditional branch. Four 15-digit accumulators are standard for the Key-Edit 50, with expansion to ten 19-digit accumulators and two special 19-digit accumulators that serve as record counters. For the Key-Edit 60 system, twenty 19-digit accumulators and ten registers are available. The contents of these accumulators and registers may be used for data manipulation. Subroutines are supported on the Key-Edit 60 through the use of the Call/Exit command.

In general, programming takes the form of manipulating data fields from an input record (the record keyed by the operator) and writing the results in an output record (the record that will end up on tape). The output records can be written selectively to two independent disk files on the Key-Edit 50 system or to three independent disk files on the Key-Edit 60 system, to the system console typewriter, to tape (Key-Edit 60 only), or to a line printer. The output disk files must be given unique batch names by the supervisor.

The data movement capabilities include moving the contents of an input field, literal, accumulator, or record counter to an output field; moving an output field back to an input field; and data substitution using an input field as the argument in a table look-up. Further control is provided through the capability to reread a batch or portion of a batch starting at the first record or at a program-set flag for additional processing. Coupled with the capability to write to disk at any time (to two independent files in the Key-Edit 50 or three independent files in the Key-Edit 60), this permits unlimited data record implosion or explosion; i.e., the number of output records generated from a given set of input records is a function of the programming. A special instruction permits the supervisor to enter up to 34 characters of data to be used by the Output Editor program.

A Look-Up table consists of up to 2047 entries. Each entry is a pair of alphanumeric values, and the maximum combined size of the pairs is 80 characters. Up to 100 tables can be linked to a single Output Editor program. Look-up tables can be shared among several Output Editor programs; i.e., multiple copies need not be stored on disk. A move operation referencing a Look-Up table causes the first value of each entry to be compared with the input field; when a match is found, the second value is transferred to the output record. The capability is most frequently used to allow abbreviated or coded keyed input fields to generate longer output fields.

The maximum output record size is 240 characters. An Output Editor program can include up to 2047 statements, 999 of which can be labeled. Any of the disk files can be designated as batches, which can include up to 2047 records.

SORT/MERGE PROGRAMS: Sort/Merge programs, which are available only for the Key-Edit 60 system, can sort disk input and output to both magnetic tape and disk, and can merge up to three tape or disk input files with output to tape or disk. Multi-volume files are supported by both utilities. User-written sort parameters are maintained in source format as a data batch. A sort/merge support program translates the source program into executable format for storage in the program library. Records are sorted by field in ascending or descending sequence, as specified by the user, using standard ASCII collating sequence; multiple fields can be specified.

The maximum size of the file which can be input to the sort is 30,000 records, and the maximum physical record block size which can be output to magnetic tape is 1040 characters. Sort fields can span the entire record, but no part of one sort field may overlap part of another sort field within a record. During execution, the sort program uses unused tracks on the disk for temporary work space. Space left on the disk, above sort requirements, is reported to the user. Disk work space required is equal to about 3% of the size of the input file.

PRICING

Key-Edit 50 and Key-Edit 60 systems are available on a one-, two-, three-, or five-year lease arrangement or for purchase. The rental prices listed below include maintenance. A separate maintenance agreement is available for purchased units. Discounted rates are available to municipal and state governments.

	Monthly Rental 1-Year Lease*	Monthly Rental 3-Year Lease*	Purchase	Monthly Maint.
Model 501 system (includes 1.4-megabyte disk, 4 keystations, and controller for up to 8 keystations)	$ 816	$ 781	$28,770	$131
Each additional keystation	74	71	2,520	14
Model 502 system (includes 2.8-megabyte disk, 9 keystations, and controller for up to 16 keystations)	1,223	1,171	43,220	194
Each additional keystation	103	99	3,530	19
Memory expansion (8K words)	124	119	4,370	20
Key-Edit 60 system with 32K bytes of memory, 4 keystations, 800-bpi tape drive, 1.4-megabyte disk, supervisor's console	1,109	1,062	39,480	169
Each additional keystation (up to 8)				
Key-Edit 60 system with 32K bytes of memory, 9 keystations, 800-bpi tape drive, 2.8-megabyte disk, supervisor's console	1,533	1,468	54,685	231
Each additional keystation (up to 24)				
Operator desk	9	9	380	—
Disk expansion:				
From 1.4 to 2.8 megabytes	296	283	10,260	53
From 2.8 to 5.6 megabytes	415	397	14,785	63
Peripherals				
Magnetic tape drives:				
7-track, 556/800-bpi	197	188	6,890	33
9-track, 800 bpi	197	188	6,890	33
9-track, 1600-bpi	438	420	15,120	78
Printers:				
Matrix, 165 cps	312	299	10,880	53
Line printer, 300 lpm	481	460	17,475	65
Line printer, 600 lpm** (132-column)	558	533	19,740	88
Synchronous communications unit	190	181	6,890	26

*Includes maintenance.
**Available with Key-Edit 60 only.■

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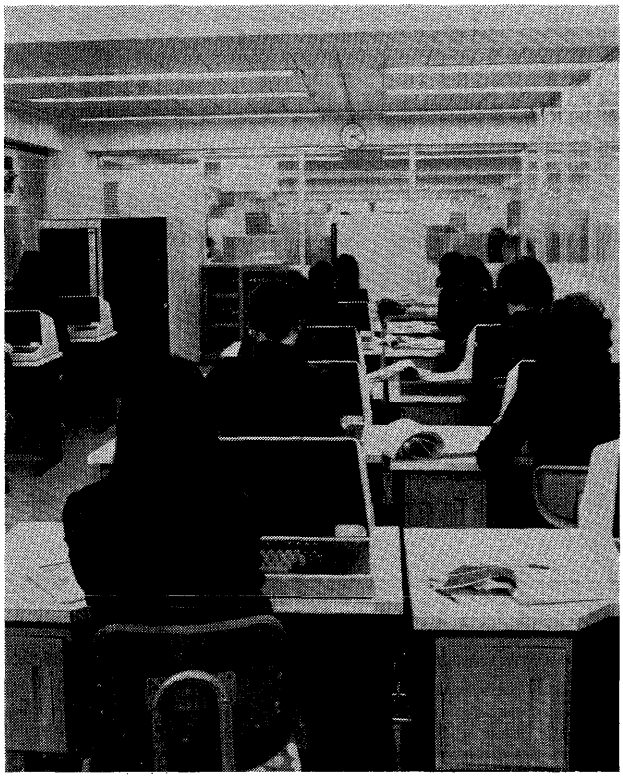
Consolidated Computer Key-Edit 1000



The Key-Edit 1000 can accommodate a maximum of 56 of these CRT keystations. The magnetic tape drive can be seen in the background at left.

The Key-Edit 1000 shared-processor key-to-disk system supports up to 56 data entry CRT keystations. The 1000 also offers a flexible, powerful programming language that features many data entry options as standard.

MANAGEMENT SUMMARY

Consolidated Computer introduced its first key/disk system, the Key-Edit 100, in late 1969. The 100 was a large system that could handle up to 32 keystations. Now the Key-Edit 100 has gone to that great DP shop in the sky and has been succeeded by a family of key/disk stations that provide a graduated capability of up to 56 keystations per system.

The Key-Edit 100's immediate successor was the Key-Edit 50. This system resembled the 100, but the maximum number of keystations was limited to 16. Another system, the Key-Edit 60, was introduced in 1975 and is essentially an expanded 50. The Key-Edit 50 and 60 systems are described in Report 70D-257-01. The premier member of the family is the Key-Edit 1000. Introduced in 1975, the 1000 is not program-compatible with either the Key-Edit 50 or 60, but offers increased capabilities over both.

Capable of supporting up to 55 data entry stations plus a supervisor's station, the Key-Edit 1000 provides sufficient power through flexible software to tempt system designers into unloading more than just data input validation from the mainframe. For data entry operations, the Key-Edit 1000 can control the data validation checking of complex record structures, including conditional field entry. For output processing on data already keyed, the Key-Edit 1000 system can accommodate up to five input/output files to provide comprehensive data restructuring. Hardware can include up to four 29.2-million-byte disk pack ▷

CHARACTERISTICS

MANUFACTURER: Consolidated Computer Inc., 50 Gervais Drive, Don Mills, Ontario, Canada M3C 1Z3. Telephone (416) 449-1120.

CONFIGURATION

The principal components of the Key-Edit 1000 system are 1 to 56 local CRT data entry stations (Data Terminals), a minicomputer central processor, 1 to 8 magnetic tape drives, 1 to 4 disk pack drives, and a 30-character-per-second printer. Any one of the CRT stations can be designated as the supervisory station. In addition, a 300- or 600-lpm line printer can be added. The central system can be equipped to operate as a remote batch terminal emulating an IBM 2780, 3780, or 360/20 HASP workstation.

Data Terminals are connected through Data Terminal Concentrators. One local Concentrator can accommodate up to 8 Data Terminals. The Concentrator can be located up to 6000 feet from the processor, and the Data Terminals can be located up to 100 feet from the Concentrator. A remote Concentrator can accommodate up to 4 Data Terminals located up to 100 feet from the Concentrator. A maximum of seven local and remote Concentrators can be connected to the processor.

The processor includes three high-speed DAC (Direct Access Control) I/O channels. Each can accommodate one tape or disk controller. Each controller can accommodate four tape or disk drives. Presently, only one channel can be used for disk devices.

COMPONENTS

KEYSTATIONS: Each keystation (Data Terminal) consists of a CRT display and a keyboard.

The same basic display is used for both operator and supervisory functions. It displays 12 lines of 40 characters each. Characters are formed by an 8-by-12 dot matrix within the 10-by-16 matrix allocated for each character position on a 9-inch display screen. The memory associated with the screen stores 480 characters and has a refresh cycle of 16.6 milliseconds. A total of 64 characters can be displayed.

At the operator stations, the CRT displays operating mode, operator ID, batch name, current location, next location, status, etc., in the first two lines in a highly formatted arrangement; field descriptors as well as values are displayed. The next two lines are used to display error codes and system messages or programmed error messages. The next eight lines are used to display keyed data by character (normal), field, or record (320 characters maximum display). Vertical and horizontal lines are displayed to provide separation of display areas.

The supervisory station utilizes a different organization for the display. The top line shows the station identification, percent of disk capacity in use, and time of day. The next five lines are used to display portions of data batches or system files. The next two lines are used to display system- or program-generated messages. The next three lines display up to three pending system requests for supervisor action or response. The bottom line displays supervisor-entered commands or answers to system requests. ▶

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drives, up to eight tape drives, up to 192K bytes of 900-nanosecond main memory, and a line printer. The character printer is standard. The outstanding characteristic of the software supporting this impressive array of hardware is its flexibility. The data entry operator can be drawn heavily into decision-making about entering data, or the decisions can be preprogrammed, depending on how predictable the data entry operations are. The system supervisor has the opportunity to closely regulate background functions or to catalog standard procedures which require minimum input, again depending on the predictability of the situations. For data manipulation itself, strong emphasis has been placed on the capability for conditional execution of data checking instructions.

USER REACTION

Datapro contacted five current users of the Key-Edit 1000 system. These five users had installed a total of six processors with 145 CRT keystations. Most of these users were U.S. businesses, whereas in previous surveys conducted by Datapro, more Canadian Key-Edit users had responded than American. The largest configuraton was a single-processor, 31-keystation arrangement. The average configuration employed 25 keystations. All of the users we contacted used 9-track, 800 bpi magnetic tape. In addition, with very few exceptions, almost every data editing and validation feature was employed by these users. None of the current Key-Edit users indicated that they were considering any major changes in their key entry operations. One had recently upgraded from a smaller Key-Edit system and was very happy with its operation.

The ratings assigned by these users are presented below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	1	5	0	0	3.2
Ease of operation	0	6	0	0	3.0
Hardware reliability	1	5	0	0	3.2
Promptness of maintenance	1	3	2	0	2.8
Quality of maintenance	1	3	2	0	2.8
Software	0	6	0	0	3.0
Technical support	0	3	3	0	2.5

*Weighted Average on a scale of 4.0 for Excellent.

One of the first Key-Edit 1000 users assigned "fair" ratings to the quality of maintenance and the technical support, and felt that the field engineers were competent but were given little support from the factory technicians. This user had experienced a multitude of problems until the source was traced to the DEC PDP-11 minicomputer. In discussions with Consolidated Computer, Datapro learned that other Key-Edit 1000 systems had experienced similar problems with the minicomputer. DEC then provided Consolidated with a new processor, which was retrofitted in the existing Key-Edit 1000's. After this new processor was installed, the problems ceased and have not recurred.

The above-mentioned user agreed that his problems were satisfactorily resolved when the processor was replaced, and he is currently satisfied with his Key-Edit 1000. Datapro feels that this particular problem was not the result of poor design on the part of Consolidated, and no other serious problems were mentioned by the users we contacted.□

Three keyboard styles are available: data entry (keypunch), upper/lower case typewriter, or typewriter. The typewriter-style keyboard includes a 10-key, adding machine-style numeric keypad to the right of the main keyboard to facilitate entry of numeric data. The principal difference, other than the dissimilar location of particular special symbols and numerics, is the handling of the shift specification in input control programs. Upper/lower shift specification is available only for the upper/lower case typewriter keyboard. The three types of keyboards can be intermixed on the same system. A number of control keys are provided in a row at the top of the keyboard and in a dual column to the left of the keyboard for controlling functions. A numeric pad is optional for both typewriter keyboards.

DISK STORAGE: The disk pack drive uses IBM 2316-style disk packs. The 11 platters provide 20 recording surfaces. A total of 203 tracks are recorded per surface. Each track is divided into 24 sectors of 204 bytes each. The actual total storage capacity is 19.9 million bytes. (The maximum formatted storage capacity for this type of disk pack is usually reported as 29.2 million bytes, which is based on one record per track without sectoring.) Up to four drives can be included in a Key-Edit 1000 system. The average positioning time is 35 milliseconds, the rotational time is 25 milliseconds per revolution, and the average access time is 47.5 milliseconds.

MAGNETIC TAPE: Up to eight drives can be attached to a Key-Edit 1000 system. Available formats include 7-track, 556/800 bpi; 9-track, 800 bpi; and 9-track, 1600 bpi (phase-encoded). Drives with different formats can be intermixed in the same system. All drives accommodate reels up to 10.5 inches in diameter (2400 feet) and operate at 25 or 37.5 inches per second. Rewind speed for all models is 150 inches per second. A variety of data codes can be implemented for domestic or foreign computers; data codes are specified when the system is ordered. Read-after-write error checking appropriate to the particular tape format is performed.

PRINTERS: The standard printer included with all systems is a 30-character-per-second serial character printer. The maximum print line is 132 positions. Effective speed ranges between 60 and 200 lines per minute, depending on the length of the printed lines. Horizontal pitch is 10 characters per inch, and vertical pitch is 6 lines per inch. Up to 5-part sprocket-fed forms as wide as 14.375 inches can be used.

Three different line printers can be obtained in addition to the character printer. If desired, the line printers can be shared between four Key-Edit 1000 systems. Two of the line printers have similar specifications except for speed. One model operates at a nominal speed of 300 lines per minute; the other operates at a nominal speed of 600 lines per minute. Both printers print up to 136 positions and accept up to 6-part sprocket-fed forms from 4 to 14.875 inches wide. Horizontal pitch is 10 characters per inch; vertical pitch is 6 or 8 lines per inch. A high-speed 1200 line-per-minute printer is also available.

PROCESSOR: The main processor is a 16-bit minicomputer. Basic memory size is 96K bytes. Memory cycle time is 900 nanoseconds. Memory can be expanded in 16K-byte increments to a maximum of 192K bytes. While the memory size required to support a given number of key entry stations is dependent on the number and size of programs used, Consolidated Computer makes the following general recommendations. The basic 96K-byte memory will handle up to 16 stations. For a configuration of 17 to 32 stations, 112K bytes of memory are recommended. A configuration of from 33 to 44 stations requires 128K bytes of memory. A configuration including between 45 and 56 stations would require at least 144K bytes of memory. The processor includes a real-time clock and incorporates a power-fail/restart capability.

COMMUNICATIONS

REMOTE KEYSTATION TO SYSTEM: Communication between a Key-Edit 1000 processor and a remote Data Terminal Concentrator is synchronous, full-duplex at up to 9600 bits per second. Timing for transmission is supplied by the modem. Standard RS-232C interfaces are provided to accommodate Bell System or independent data sets. Multipoint operation is not supported. Normal operation is via

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leased (private) lines, but full-duplex operation using two dialed connections and modem pairs at each end can be achieved. The remote cluster is limited to four Data Terminals per Concentrator. The communications interface is completely transparent to the supervisor and operators; remote key entry, verification, and data searching are performed identically with local operations.

SYSTEM TO SYSTEM: A utility program coupled with a binary synchronous communications interface enables a Key-Edit 1000 system to operate as a remote batch terminal emulating an IBM 2780 or 3780. Point-to-point communication between a Key-Edit 1000 and a Key-Edit 50, 60, another 1000 system, and some 100 systems is supported, as well as batch communication with an IBM System/360 or 370 computer under HASP, ASP, or the equivalent. Half duplex transmission at up to 9600 bps is supported; clocking is provided by the modem supplied by the user. The data source/destination for communications operations is magnetic tape. Multiple data batches can be combined for transmission. Establishment of the communications connection is performed manually by the supervisor, who also handles the handshaking protocol from the supervisor's station.

SYSTEM OPERATION

OVERVIEW: All operations of the Key-Edit 1000 run under a central operating system. Data entry/verification/validation is initiated and controlled at the keystations. Data transfers between disk and tape as well as batch transmissions are controlled from the supervisory station. The supervisory station can be any terminal, as designated when the system is started from a power-off condition. The central data group is the batch or output from one keystation. Subordinate data groups include documents, records, fields, and characters. Supergroups, composed of multiple batches, can be formed by the supervisor for convenience in building output files. The key to batch flow is the batch identifier, a 17-character assignment made by the keystation operator the first time data is entered. It can be any combination of job name, batch name, and date.

There are two levels of programming. One is operative during data entry and verification operations. It is referred to as UPL1 (Users' Programming Language One). It can be triggered automatically through a link based on the job name in the batch identifier or can be called manually by the keystation operator. The second programming level is UPL2. It operates on completed batches of data and is called by the supervisor. Both programming facilities provide comprehensive capabilities for setting up data validation checks. UPL2 is an expanded version of UPL1 and includes input/output facilities for reformatting, as well as facilities for table-oriented data handling operations. UPL2 allows handling of up to a combined total of five individual files (data batches), at least one of which must be an input file.

OPERATOR FUNCTIONS: The operator's primary responsibility is the key entry and verification of data. Errors can be corrected as made, or can be bypassed, if the UPL1 program permits, with an error flag inserted for later discovery and correction. The level of decision-making required of the operator is controlled through the UPL1 program and the system. The operator may have to select a controlling input program, choose the controlling format, initiate the execution of a special routine in the input program for handling conditions not recognizable by examining the data keyed, and/or react to a message displayed as a result of an error or condition identified in the data by the input program. Or the operator may only have to initialize the operation and key data. For occasional keying tasks, the operator may create a two-format input program at the keystation that delimits fields and controls data types but does not include any data validation checks other than check digits.

A keystation can operate in one of four modes: Entry, Verify, Correct, and Examine. Correct is a special mode that permits searches to be made for records containing error flags. Examine is a special mode that allows multiple operators to search a data batch (file) for information retrieval purposes but prohibits data alteration; data is displayed by field. Within these modes, the operator has facilities for three important control operations: positioning, searching, and data insertion/deletion. In any mode, the operator can advance or backspace by character, field, record, or document (a collection of records entered from the same source document). Special provisions are made to inhibit nonmeaningful positioning operations, such as forward-spacing when in the Entry mode beyond the point where data has been entered. The positioning is activated by control keys on the keyboard. A special provision is made to permit positioning to skip from one field in a document to the corresponding field in the next document without having to skip over intervening fields manually.

Three Search modes are implemented. One is a search by document number (sequential position within the batch). A second is a masked search by field. The masked search can be qualified by format level, field number, or just the mask. A mask is limited to the first 16 character positions of a field. The masked search is not permitted in the Verify mode. The third mode is a search for records containing error flags; it is operative in the Correct mode only.

Data can be inserted or deleted by character, field, record, or document in any mode other than Examine. A data batch can be open for data entry at one keystation and open for verificcation or correction (Correct mode) at a second keystation. The system inhibits the key entry operator from backspacing into the verify/correct segment, and forces a suspension if the verify/correct operator catches up to the key entry operator.

SUPERVISOR FUNCTIONS: The supervisor's responsibilities include: 1) system start-up and system program loading; 2) initiating translation of UPL1 and UPL2 programs; 3) maintaining system libraries; 4) controlling data batches through listing, grouping, and releasing batches and initiating the execution of UPL2 programs; 5) controlling transfers between disk and tape and to and from the communications line; and 6) monitoring system statistics. Data transfers to tape can be initiated individually by batch or by group. In addition, batches can be transferred automatically as soon as they meet certain specified conditions as determined by the setting of indicators. (A total of 60 indicators is available to each UPL1 and UPL2 program; the first 7 of these are retained in the information header for each batch.) UPL2 programs can also transmit a message to the supervisor's station as an advisory comment or with a request for a data response, such as the control total for a batch balance operation.

In general, the supervisor conducts a dialog with the system to initiate system commands, such as compile a UPL1 or UPL2 program, transfer a data batch to tape (peel), list a data batch, etc. Associated with each system command are a group of keywords and corresponding parameters. A command is initiated by name. The system will then display the keywords one by one, and the supervisor will key in the parameters or default to a system-defined value. In some cases, parameters are required, and the system will reprompt until the supervisor fills in the necessary parameter. Since some of the commands include a list of 25 or more keywords, this can be a time-consuming procedure. In addition, the supervisor will frequently wish to apply several system commands to the same data batch. Included in the Key-Edit software repertoire is a cataloguing facility for easing the supervisor's task. Basically, this facility permits the creation of new system commands which may include the specifications for the parameters and may be composed of several basic system commands. Initiation is started the same way, by keying in the procedure name. Only those parameters, if any, that need to be specified will be requested.

OPERATING MODES

- Data Entry—Data is keyed into the system under control of a UPL1 program that specifies fields, data types, and validation checks. Data type specifications cannot be overridden. Validation check violations are handled according to the UPL1 program specifications and may require rekeying, or an error flag may be inserted. Prompting with field names is provided in line 2 of the operator display if desired. Prompting with descriptors is not included as a direct capability, but could be implemented through the use of the error message display

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capability; such usage, however, would extract a heavy performance penalty.

- Data Verification—Data is verified by rekeying. Selective verification using the same UPL1 program can be accomplished by programming and the use of the two automatic dup/skip keys. Visual verification is possible. Verification can be performed on a batch that is open for data entry. A special Correct mode is provided to search for fields containing an error flag.

- Data Additions and Deletions—Characters, fields, records, and documents can be inserted or deleted freely when entering or verifying data, subject to field length restrictions.

- Search—Data can be located by document number within batch or by field content (mask) within batch. Positioning operations can be performed freely within the Entry and Verify modes. In the Examine mode, multiple operators can access the same data batch simultaneously. In the Correct mode, a search can be made for fields containing error flags.

- Background—Includes batch transfers between tape and disk, UPL2 programs, and batch communications to another Key-Edit data entry system or computer. Multiple background, data entry, and verification operations can proceed simultaneously subject to the rules for data entry/verification and the availability of system resources.

SYSTEM PROFILE

- Keystations—Up to 56 local CRT keystations, including the supervisor's station. A group of four remote keystations can replace a group of eight local keystations.

- Record length—1 to 4096 characters; up to 80 fields per record; up to 120 characters per field; up to 99 records per document; up to 9999 documents per batch. If output processing via UPL2 is used, maximum record length is between 842 and 948 characters.

- Formats—One format per record type; up to 32 record types (format levels) per document; multiple records of the same type in the same document are permitted.

- Output block length—Any blocking factor up to a maximum block length of 4096 characters.

- Data storage—The amount of space available for storing new data batches is dependent on the number and extent of UPL1 input and UPL2 output programs and the number and extent of data files retained for on-line inquiry in the Examine mode. The basic disk (29.2 million characters nominal, 19.9 million characters actual) could handle the output of the maximum complement of operators (55) if data batches were not retained for extended periods before peeling to tape.

SOFTWARE

The system runs under the overall control of the operating system. Facilities for user programming include UPL1 (Users Programming Language One) and UPL2.

UPL1: The organization of a UPL1 program is based around a "document," a collection of data records usually keyed from the same source document. For example, the keying for an invoice could contain three record formats: header record with Bill To and Ship To information; detail records giving product, quantity, and cost; and totals record. Each of these three types of records would be assigned a format, or, as Consolidated Computer calls it, a level. The code for the three levels would comprise a UPL1 program. Changing from one level to another can be automatic, with or without conditional requirements, or manually by the operator. Automatic repetition of a single level can be programmed (e.g., the detail level in the example above) with manual escape when the last record of this type is keyed. Up to 32 different levels can be defined in one program.

Programming in UPL1 centers around fields. Two types of operations are specified for each field; format and edit procedure. Field names can be added for annotation purposes, but are not addressable. The basic field parameters are the number (for identification), length, and type. Permissible field types include variable length and fixed length with no end-of-field delimiter, and operator-entered end-of-field, or a system-entered end-of-field. All variable-length fields imply an operator-entered end-of-field indication. Variable-length fields require the specification of a maximum size. The variable-length capability can be used to simplify the handling of fields, such as name or address, known to be variable by eliminating the requirement for justification and space-filling. The main computer must be programmed to look for the end-of-field delimiter, or the spaces must be inserted by a UPL2 program. Other format parameters are indicated by a single letter in a column of the input coding form, including keyboard shift (upper, lower); data type; left fill character (zero or space); check digit type (modulo 10 or 11); skip/stop identification; sign convention; and control of automatic skipping and duplication.

Data types include alphabetic only, alphabetic plus a few punctuation marks and space, signed or unsigned numeric only, signed or unsigned numeric and a few punctuation marks and blanks, alphabetic and numeric only, alphanumeric and a few punctuation marks plus space, and all characters. The skip/stop identification permits a field to be identified by a single alphabetic character as the skip-to location for an operator-initiated selective skip.

The edit procedures are composed of four types of information: mode; indicator controls; commands with associated operands and parameters, if any; and error handling controls. The positional sequence of the edit procedure statements governs the time at which the command is executed; i.e., execution occurs following the entry of the field specified on the same line as the edit statement. Only that field and/or registers or indicators can be an operand in that edit procedure.

The edit mode specification simply identifies whether the error handling procedures, including message display, are to be performed in the Entry, Verify, or all modes.

A total of 60 two-condition indicators is available to each program. The conditions are set (on) and clear (off). Indicator control includes making the execution of the associated edit statement conditional on whether a specified indicator is on or off, as well as setting or clearing a specific indicator depending on the results of a comparison or test specified by the associated edit statement. The status of the first seven indicators is carried with other batch information and is usable by the supervisor in controlling data transfers to tape.

The commands available in UPL1 can be grouped into program flow and system control, including handling of message display, arithmetic/data handling, and comparing/testing.

For computation, data manipulation, and comparisons, a total of eight 14-digit numeric registers and one 32-character alphanumeric register is provided. The alphanumeric register and the current field can be partially addressed.

Add, subtract, multiply, and divide arithmetic operations are provided, as are string move, shift left, and shift right logical operations. A rich variety of comparison and test commands is implemented, including comparisons for equal, not equal, greater than, less than, greater than or equal, and less than or equal; and testing for the presence or absence of non-space characters (several variations); positive or negative; presence of a divide remainder; arithmetic overflow; if all of a specified set of indicators are set; if any one of a specified set of indicators is set; if all of a set of characters are present; if any of a set of characters is present; if within a range or group of ranges; and if not within a range or group of ranges. In general, the commands operate on the current field or a register. In addition, indicators can be cleared, and an error flag can be set.

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Consolidated Computer Key-Edit 1000

Program flow control includes identifying the end of a record and batch, setting up subroutines, linking among levels, and limited branching capability. Special routines can be coded for end-of-record and end-of-batch situations. Subroutines can be identified and coded once; when the program is compiled, the subroutine code is inserted in place. Branching is limited to bypassing the remaining edit procedures on a field (usually conditional on presence or absence of a field) and skipping to the end of a record (all intervening edit routines are executed, with default values supplied as necessary). One special routine, called Sub-Batch, can be coded for calling by the operator when encountering a situation not recognizable by data edit procedures.

System control commands include copying batch identification information and inhibiting data insert or delete functions for individual format levels.

Error handling consists of specifying one of five types of control to be executed and whether or not an error flag is to be set when associated edit conditions are not met. The types of control include: must correct; correct at operator's option (acceptance of the error requires depressing the Acceptance key); two alternatives for correct at operator's option (correction requires depressing the Correct key); and none. Each of the five types generates a different prefix word for the error message displayed to the operator. User-generated messages can be displayed to further clarify the problem; the current field or any of the registers can be incorporated into the message. The maximum user message displayable is 57 characters. Message display is normally used in error situations, but is not limited to situations where an edit command is not satisfied.

UPL2: The structure of a UPL2 program basically consists of a series of up to 47 record format definitions identifying field number, length, type, and sign convention followed by a single block of code defining the manipulation, arithmetic computation, and validation checks to be performed. This contrasts with the style of a UPL1 program which sets up individual procedural blocks for each record type (format level). UPL2 is coded in free form, also in contrast to the rigid format of UPL1 program statements. UPL2 omits the data-type checking and other key-entry-oriented checking (no data is being keyed) and adds capabilities for reformatting, including combining and exploding data groupings.

Data flow control is principally achieved through buffers which serve as storage for records read in, records to be written out, and working areas. Buffer size is limited to 999 characters, including from 51 to 157 bytes of non-data-control information such as UPL1 registers. Input and output devices are not named directly in a UPL2 program. A logical assignment is made by the supervisor when execution is performed. Record flow in and out is completely dictated by the program.

Each separate usage of the data, whether in the same format or different, requires the assignment of a file device. For example, reading a data batch from disk, performing some data manipulation and checks, then writing the batch out to tape and also printing the data batch would require the assignment of three files. Buffers can be reassigned dynamically as needed, but reassignment cannot be performed with retention of the data in the buffer.

Program flow control is established through the use of conditional or unconditional GO TO constructions, conditional instruction execution, and indirect addressing. Program statements can include a one- or two-character label (tag) that can serve as the destination for a GO TO construction. All data-oriented instructions can be used to form compound conditional statements of the form IF...ELSE. Several test or comparison instructions can be chained to serve as the conditions for executing a particular instruction or set of instructions. The ELSE construction can be used to initiate the execution of an instruction or set if all the associated test and comparison conditions fail. If the ELSE construction is not used, and the specified comparisons and tests fail, execution passes to the next statement. While this compound statement structure provides no more programming power than a single instruction form, it is more convenient and less time-consuming. Indirect addressing permits the use of the contents of a register to specify fields to be used as operands rather than requiring an explicit identification in the instruction. This permits convenient programming of the processing of the sequential fields of a record as well as computed selection of operand fields.

A total of twelve 14-digit numeric registers is available to a UPL2 program. Buffers can be used for alphanumeric string operations.

Essentially the same arithmetic, data manipulation, comparison, and testing instructions are available in UPL2 as in UPL1, including a complement of 60 settable and testable indicators. Addressing of data fields used as operands is accomplished by naming the buffer and relative field number. Partial fields can be addressed by naming the first position and specifying the length; the contents of a register can be used for either or both of these specifications. One major enhancement added to UPL2 is table-oriented operations. Two types of tables can be created. One is a list of keys. The second is a list of pairs of keys and values. One type of table operation checks the operand to see if it is one included in the table. The second type of table operation implemented uses the operand as a key to access the table, with the corresponding value being transferred to the program. Tables are maintained in a separate system file and are linked to a UPL2 program through a name specification.

Several specialized instructions are included to simplify programming. For example, the maximum length of a field can be loaded into a register; a disk file can be backspaced one record at a time all the way back to the beginning of the data batch if desired; a message of up to 56 characters can be displayed on the supervisor's screen with or without a reply requested from the supervisor; data formats can be checked with one instruction; etc.

PRICING

A Key-Edit 1000 system is available on a one-, two-, three-, or five-year lease arrangement or for purchase. Rental prices below include maintenance. A separate maintenance agreement is available for purchased units.

	Monthly Rental*			
	1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Key-Edit 1000 basic system (includes 6 Data Terminals, 30-cps printer, and one 29.2-megabyte disk)	$2,345	$2.247	$82,110	$390
Memory Module, 16K bytes	240	230	8,400	40
Data Terminal	92	88	3,234	15
Data Terminal Concentrator, local (accommodates 8 Data Terminals)	NC	NC	NC	NC
Data Terminal Concentrator, remote				
At remote end (accommodates 4 Data Terminals)	115	110	3,990	20
At system end	150	143	5,250	25
Additional 29.2-megabyte disk pack drive	630	605	22,100	105
Magnetic Tape Controller	NC	NC	NC	NC
Magnetic Tape Drives—				
9-track, 800 bpi, 37.5 ips	204	196	7,100	34
9-track, 1600 bpi, 37.5 ips	480	460	16,800	80
Line Printers—				
300 lpm	481	460	17,475	65
600 lpm	689	659	24,990	94

*Includes maintenance.

NC—no charge.■

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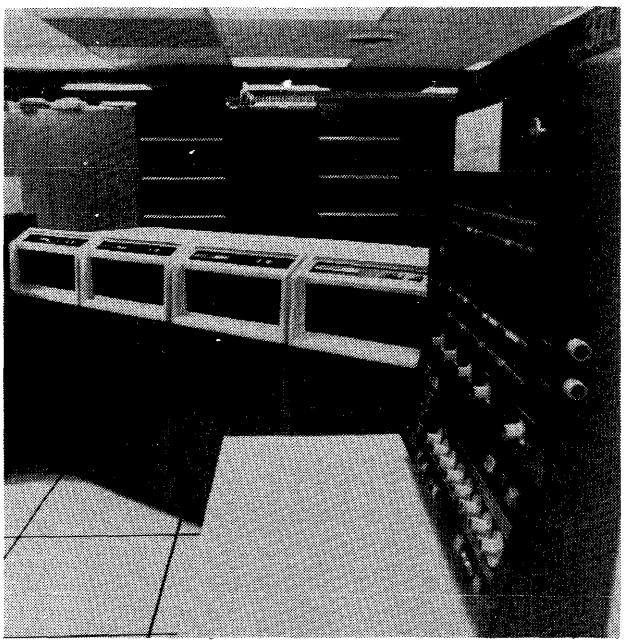
Control Data 33801 Disk Subsystem



The CDC 33801 Disk Subsystem provides up to 12.8 billion bytes of storage for users of IBM System/370 Model 145 and larger computers.

The CDC 33801 Disk Subsystem offers IBM System/370 users up to 12.8 billion bytes of on-line storage. Aimed at the current or potential IBM 3350 user, this fixed-media subsystem offers increased capacity at reduced costs.

MANAGEMENT SUMMARY

Control Data Corporation introduced the 33801 Disk Subsystem in July 1976. This new system, like the CDC 33401 Disk Subsystem, employs fixed media based on the "Winchester" data module technology. IBM was first to use this technology with its 3348 Data Module. The most outstanding feature of the "Winchester" design is the inclusion of the recording disks, moving arm, and read/write heads directly in the environmentally-sealed data module. The principal advantage of this feature is the inherent increase in reliability over conventional, unsealed units by eliminating the potential damage caused by airborne particles. These particles on the recording surface of the disk can interfere with the read/write capabilities. A disadvantage of the CDC 33801 implementation is that the data modules can be removed only by a customer engineer; but according to CDC, this can be accomplished in approximately 15 minutes.

Each 33801 Disk Storage Unit consists of two 400-megabyte drives, and one to four units (two to eight drives) can be configured in a single string. Up to four strings can be attached to the CDC 38302 Storage Control Unit. Thus, a maximum of 32 drives with a total capacity of 12.8 billion bytes can be connected to the 38302. This far surpasses the IBM 3350 capacity of 317 megabytes per drive and eight drives per subsystem for a total capacity of 2.5 billion bytes.

The 38302 Controller is also used with the company's other disk units. The 33801 Disk Storage Unit can be ▷

CHARACTERISTICS

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

DISK CONTROLLER: Model 38302 Storage Control Unit.

CONFIGURATION: The 33801 Disk Subsystem is composed of a CDC 38302 Storage Control Unit and one or more fixed-media 33801 Disk Storage Units. The 33801 is available in six models. Models A2 and A2F each contain two drives and associated control logic to attach to the 38302 Controller. Models B2 and B2F also contain two drives each and attach to the 33801 Models A2/A2F; up to three 33801 Model B2/B2F units can be attached to a 33801 Model A2/A2F. Models C2 and C2F each contain two drives plus alternative control logic to attach to a 38302 Controller. The alternate control logic in Models C2 and C2F is manually selected to provide back-up in the event of a logic failure in the A2 or A2F units. Models A2F, B2F, and C2F contain fixed-head storage in addition to the movable-head storage found in the other models.

The optional Two- or Four-Channel Switch allows multiple central processor to access a single 33801 subsystem.

The optional String Switch feature permits program-controlled switching between storage control units and drive strings.

COMPATIBILITY:The CDC 33801 Disk Subsystem is designed to operate with IBM System/370 computers, Model 145 and up, running under OS, DOS, OS/VS, or DOS/VS. The 33801 provides complete compatibility with the IBM 3330-11 command structure and requires no change to the existing software.

STORAGE CAPACITY: Each movable-head storage drive contains 400,072,000 eight-bit bytes of data (800 megabytes per dual-drive unit). In addition, each Model A2F, B2F, or C2F storage drive contains 1,237,850 eight-bit bytes of fixed-head storage (2.48 megabytes per dual-drive unit). The complete subsystem provides from 800 million to 12.8 billion bytes of on-line storage per 38302 Storage Control Unit.

DISK PACK: The 33801 subsystem is configured with two spindles or drives per unit. It uses a fixed-media data module based on the "Winchester" recording technology. This data module can only be removed by CDC customer engineers.

PERFORMANCE: The CDC 33801 has an average head positioning time of 25 milliseconds (fixed-head models have zero seek time), an average rotational delay of 8.4 milliseconds, and a data transfer rate of 1.2 million bytes per second. The characteristics of the CDC data module and the IBM 3350 module are compared in the following table: ➤

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Control Data 33801 Disk Subsystem

intermixed on the same 38302 Controller with the CDC 33301 Disk System (Report 70D-263-06), 33302 Disk Subsystem (Report 70D-263-12), and 33401 Disk Subsystem. The 33801 can also serve as a staging device for the CDC 38500 Mass Storage System (Report 70D-263-21).

The 33801 Disk Subsystem is available in movable-head only and optional movable-head plus fixed-head configurations. There are six models—three basic types, each offered in a movable-head and movable/fixed-head configuration. Models A2 and A2F each include two drives, control logic, and the modules. Models C2 and C2F each include two drives and the modules as well as control logic that can be manually activated as backup for the A2 or A2F units, respectively. The B2 and B2F models contain no control logic and function as slaves to the A2 or A2F units, respectively; both the B2 and B2F units include two drives. The F suffix denotes the models with fixed heads.

CDC's new subsystem can be used with IBM System/370 computers, Model 145 and up, operating under OS/VS and DOS/VS. Also, those OS and DOS systems which support the CDC 33302-11 Disk Storage Unit can also support the 33801 Subsystem. Each 400-megabyte drive logically appears to be two CDC 33302-11 (IBM 3330-11-compatible) disk storage units of 200 megabyte drive logically appears to be two CDC 33302-11 (IBM 3330-11-compatible) disk storage units of 200 for storage on the 33801.

Data is transferred at 1.2 megabytes per second, and the average head positioning time is 25 milliseconds for the movable-head units. The fixed-head units (A2F, B2F, and C2F) contain 2.48 million bytes of storage with zero seek time.

The 33801 subsystem features Rotational Position Sensing (RPS), which permits the channel to disconnect during rotational delay; Multiple Requesting, which enables the subsystem to have multiple active channel programs; and Command Retry, which provides automatic error recovery without invoking software error recovery procedures. Also standard is Write Format Release, which provides an automatic padding facility after certain write commands; this frees the channels, control unit, and other drives on the string during this operation. A Read-Only switch and a Full-Track Read command are other standard features.

Unlike the CDC 33401 Disk System and the CDC 33441 Disk System, which the company recently dropped, the 33801 cannot be attached to either the IBM mainframe Integrated Storage Controller (ISC) or the IBM 3830 Controller. The cancelled 33441 system incorporated the IBM 3350-type recording code, while the 33801 will not.

Deliveries of the 33801 are scheduled to begin in mid-1977.□

	CDC Module	IBM 3350 Module
Bytes per logical track	13,030	19,069
Logical data cylinders per logical volume	808	555
Logical tracks per logical cylinder	19	30
Capacity per logical volume (megabytes)	200	317
Maximum system capacity (billion bytes)	12.8	2.5

CHARACTERISTICS: The physical characteristics of the 33801 subsystem are presented in the following table:

	38302 Controller	33801 Models A2/A2F/ C2/C2F	33801 Models B2/B2F
Height (inches)	28	50	50
Width (inches)	44	42	42
Depth (inches)	60	33	33
Weight (pounds)	700	1100	900
Heat dissipation (BTU/hr)	—	6000	4875
Power (KVA)	—	2.0	1.7

PRICING: The 33801 Disk Subsystem is available on a three-year lease arrangement or for purchase. Separate maintenance agreements are available for either leased or purchased equipment. Prime-shift maintenance will range from $150 to $260 per month depending on the drive unit selected.

	Monthly Rental, 3-Year Lease*	Purchase
38302 Controller**	$1,000	$38,000
33801-A2	1,180	44,840
33801-A2F	1,500	57,000
33801-B2***	945	35,910
33801-B2F***	1,265	48,070
33801-C2	1,220	46,360
33801-C2F	1,540	58,520

*** With the exception of the lease price for the 38302 Controller, which includes complete maintenance coverage for 24 hours/day, 7 days/week, no maintenance costs are included in these figures.**

**** A maximum of sixteen 33801 disk units (32 disk drives) can be attached to a single 38302 Controller. This controller is required for operation of the 33801 Disk Subsystem.**

*****Models B2 and B2F are slave units; Models A2 and A2F, respectively, are required for operation of the B2 or B2F.■**

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Datapoint 1100, 1150, 2200, and 5500

MANAGEMENT SUMMARY

Couple a CRT/keyboard with a miniprocessor and you have all the elements required to perform data proessing. Add a communications interface and you can tie the miniprocessor in to your central computer's more powerful processing capability and on-line file storage. But it is inconvenient if you have to run to the tube every time you want a number, and writing the numbers down by hand is frowned upon. So you add a printer to produce printed copies. But semiconductor memory is too expensive to store a series of records (i.e., a file). So you add a low-cost storage device such as a cassette or diskette drive. Presented with the pleasure and convenience of manipulating small files, users want to be able to accommodate larger files. So you add a larger disk unit, such as a cartridge-type device.

Since keyboard-oriented data processing does not place large demands on the processor's time, you find that it's quite feasible to rive multiple tubes from one processor. Along the way, one user decides that local generation of input files on half-inch magnetic tape would be very useful. And of course, some users need card-reading capability. Still others need even larger files that can be contained only on 2314-style disk pack drives, and there are numerous demands for faster printing capability. Competition from other vendors with specialized product lines compels you to offer specialized configurations with reduced capabilities to permit competitive pricing. And there is always the desire to expand the product line

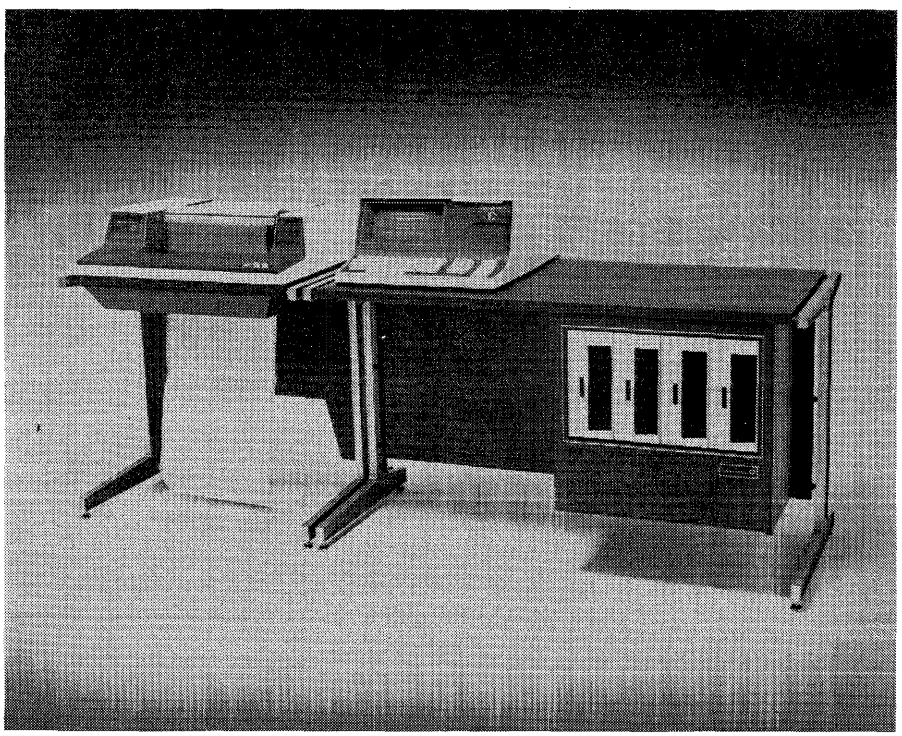
Datapoint, a pioneer and leader in intelligent terminals, has steadily upgraded the capabilities of its systems. Using two basic processors, Datapoint currently markets four systems ranging from a data-entry-oriented intelligent terminal up through a 16-user shared-processing system. All of the systems provide capabilities for free-standing processing as well as communications.

CHARACTERISTICS

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

CONFIGURATION

The Datapoint product line includes five models: Diskette 1100, Cassette 1100, 1150, 2200, and 5500. The two 1100 models and the 1150 can be used as intelligent terminals or free-standing systems. The Diskette 1100 and the 1150 can also be used as remote job entry terminals. The 2200 can be used as a free-standing system for single or multiple users and as a remote job entry terminal. The 5500 is marketed primarily as a free-standing multiple-user system. The two 1100's and the 2200 use essentially the same processor; there are minor differences in the chassis that reflect intended differences in the peripheral complement. The differences are primarily marketing restrictions aimed at tailoring the devices to specific application functions. The 5500 employs a faster,



The latest in Datapoint's look-alike family of intelligent terminals and small business systems is the 1150. It is shown here with the company's own "Freedom" matrix printer and two standard and two optional diskette drives. The 1150 is built around Datapoint's most powerful processor, the 5500, but lacks the flexibility of a 5500 system to handle multi-user processing.

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Datapoint 1100, 1150, 2200, and 5500

CHARACTERISTICS OF THE DATAPOINT SYSTEMS

	Diskette 1100	Cassette 1100	1150	2200	5500
Memory size, bytes	16K	4-8K	28K	4-16K	64K
Fast display	Std.	Opt.	Std.*	Opt.	Std.*
Peripherals—					
Cassette drives	—	2 std.	—	2 std.	2 std.
Diskette drives	1 std.; 4 max.	—	2 std.; 4 max.	Up to 4	Up to 4
Cartridge disk drives	—	—	—	Up to 4	2 std.
Disk pack drives	—	—	—	Up to 2	Up to 8
7- or 9-track tape drives	Up to 1	—	Up to 1	Up to 1	Up to 1
Printers	Up to 2	Up to 2	Up to 2	Up to 2	Up to 2
Card reader	Up to 1	Up to 1	Up to 1	Up to 1	Up to 1
Communications Adapters—					
Asynchronous	Opt.	Opt.	Opt.	Opt.	Opt.
Synchronous	Opt.	Opt.	Opt.	Opt.	Opt.
Multi-port adapter	—	—	—	Opt.	Opt.
Software—					
DATAFORM	Yes	Yes	Yes	Yes	Yes
DATABUS	Yes	Yes	Yes	Yes	Yes
BASIC	Yes	Yes	Yes	Yes	Yes
RPG II	Yes	—	Yes	Yes	Yes
COBOL	—	—	—	—	Yes
Assembler	Yes	Yes	Yes	Yes	Yes
CTOS	—	Yes	—	Yes	Yes
DOS	Yes	—	Yes	Yes	Yes
DATASHARE	—	—	—	8 terminals	16 terminals
MULTILINK	—	—	Yes	—	Yes
SCRIBE	Yes	Yes	Yes	Yes	Yes
SORT	Yes	Yes	Yes	Yes	Yes
DATAPOLL	Yes	Yes	Yes	Yes	Yes
UNITERM	Yes	Yes	Yes	Yes	Yes
RBT Emulators	Yes	—	Yes	Yes	Yes

*The user memory space is 24K in the 1150 and 48K in the 5500.

upward to broaden its application scope and marketing possibilities.

Datapoint entered this chronology of a system designer's life at the second level; i.e., with a CRT/keyboard/minicomputer/cassette intelligent terminal. The Datapoint 2200 was introduced in late 1970, and first deliveries were made in April 1971. The product line and customer list have blossomed. The current version of the 2200 processor was delivered in April 1972. In November 1973, the Datapoint 1100 and 5500 were announced. The 1100 employs essentially the same processor as the 2200, but with limitations on memory size and peripheral attachments. The 5500 is about twice as fast as the 2200. The 1100 was first delivered in early 1974, and deliveries of the 5500 began during the last few days of 1974.

The diskette 1100 was announced in January 1975 for delivery in March 1975. Datapoint was one of the early promoters of the use of cassette tape for small-computer input/output. The introduction of the Diskette 1100, which does not include nor allow the use of cassettes, marked the company's first departure from this medium. Datapoint cited the potential for large performance

expanded processor that is upward-compatible with the 1100's and the 2200. The 1150 uses the 5500 processor.

An overview of the general hardware and software configurational restrictions is presented in the accompanying table. The hardware configuration required for each software package is described in the individual paragraphs under SOFTWARE.

Each processor can logically address 16 peripheral subsystems, although power requirements may prevent the full complement from being implemented. Insofar as possible, common addressing assignments are used across the product line in the standard software; e.g., the diskette controller uses the same address in all four processor models. The CRT and keyboard share one address. The two, four, or eight disk drives in a subsystem share a common address. The two cassette drives share one address. Otherwise, each peripheral device, including 7- and 9-track magnetic tape drives, requires an individual device address assignment.

COMMUNICATIONS

The Datapoint systems are quite flexible in the arrangements for communications because much of the protocol for line and error control is performed by software. The hardware provided consists of one of two basic types of adapters and provisions for multiple connections to communications lines.

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Datapoint 1100, 1150, 2200, and 5500

improvements with the diskette (as compared to the cassette) as the reason behind the new direction. The company provides a very attractive lease rate for the Diskette 1100 (as opposed to purchase price comparisons) as an inducement to new customers.

The latest Datapoint system, introduced in August 1976, is the 1150, which uses a reduced-memory version of the 5500 processor and diskette drives to provide more processing power than the Diskette 1100 but without the full flexibility of the 5500.

Omitted from the above discussion of the current Datapoint hardware was any mention of software support. Along with the development of a line of computer hardware, a commensurate software development effort is needed to make the hardware tools conveniently usable. Datapoint has developed a host of processing languages, operating systems, terminal emulators, and utilities that offer the user great flexibility in implementing a system.

The accompanying table presents some basic comparative facts that distinguish the five Datapoint processors from one another.

The Cassette 1100 is intended for data entry and intelligent terminal applications. Under special circumstances, software support for functions beyond these basic applications can be acquired. In general, the restriction on main memory size reduces the capability of the 1100 for free-standing data processing.

The Diskette 1100 seems to be intended to provide single-user data processing capabilities in addition to the data entry and intelligent terminal applications of the Cassette 1100. Relaxation of the restrictions on software and peripheral support can be negotiated in special situations.

The 1150 is intended for those users for whom the Diskette 1100 did not have enough processing power. The 1150 can be used effectively as a free-standing system or as an intelligent terminal.

The 2200 is intended to provide free-standing data processing capabilities in a single-user or multi-user environment. The 2200 DATASHARE facility supports up to eight simultaneous users. The 2200 can also emulate many popular remote batch terminals and serve as a remote job entry work station, with independent (off-line) processing capabilities.

The 5500 provides a substantial increase in free-standing processing capability and can service up to 16 users simultaneously. It can also be used as a remote job entry work station. In general, the Datapoint systems are upward-compatible, with a few changes required in some programs to move from one system to another.

All of the software support we've mentioned is of the systems variety; i.e., tools to assist a user in coding his

The Synchronous Communications Adapter can provide compatibility with the IBM BSC (Bisync) protocol using 8-level ASCII or EBCDIC transmission code, or other protocols can be programmed. The transmission code is fixed when the system is ordered. A discussion of the routines provided to emulate various protocols is given under the SOFTWARE heading. Half- or full-duplex operation can be implemented. The transmission rate is limited by the choice of modem, which supplies the timing signals to clock the data transfer. The I/O bus can sustain a speed of up to 60,000 bits per second. Typical transmission rates are up to 4800 bps over the public telephone network (DDD) and up to 9600 bps over a leased voice-grade line. The interface is RS-232C.

A newly available microprocessor-based synchronous adapter reduces the load imposed on the processor in handling high-speed synchronous communications. Built around a Datapoint-manufactured component, the 9481 MFCA interface accommodates EBCDIC or ASCII code and procedures. The MFCA functions as a front-end or peripheral between the Datapoint processor and a modem. Error checking, such as CRC, is performed automatically. Data transmission speeds of up to 9600 bps are supported. The logical limit of the component is 56,000 bits per second and any 4- to 8-bit code.

Asynchronous Communications Adapters are available with or without built-in modems. The code structure is programmable and can have from 7 to 11 bits per character, including start and stop bits. The transmission code is also programmable. There are four models of adapters. The 9400 provides an RS-232C interface and can be operated in a half- or full-duplex mode; transmission speed is programmable from 37.5 to 9600 bits per second, although asynchronous operation at over 1800 bits per second is rare. The 9401 includes a full-duplex modem equivalent to the Bell System 103, which can operate at up to 450 bits per second; this adapter also includes an automatic answer and an automatic dialing capability, and can be used over a leased voice-grade line as well as the public telephone network. The 9402 includes a modem equivalent to the Bell System 202, which can operate at up to 1800 bits per second; a 150-bit-per-second reverse channel capability is provided. This adapter also includes an automatic answering and dialing facility. Connection of the 9401 and 9402 Adapters to the DDD network is through the Bell System 1001B Data Access Arrangement; a handset is not required because programmed dialing is provided. The 9403 Adapter permits direct connection to a neutral or polar high-level telegraph arrangement. A special version of the Asynchronous Communications Adapter (9410) is available for use in European countries or other locations requiring a CCITT V.24 interface; the 9410 can also accommodate an automatic calling unit that meets that interface.

The Datapoint 2200 and 5500 processors can be connected to multiple communications lines if multiple communications adapters are installed or if the 8-line Multiple Port Communications Adapter (9460) is used. The processors can drive up to two communications adapters, including 9460 Multiple Port Adapters. If more than two Adapters are desired, a 9455 Communications Power Supply Unit is required; it can accommodate up to four adapters in any mix.

The 9460 Multiple Port Communications Adapter provides for connection to up to eight independent communications lines. Operation is half- or full-duplex at 110, 300, or 1200 bits per second. The transmission code is programmable and can have 7 to 11 bits per character, including start and stop bits. The interface to external modems is RS-232C.

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Datapoint 1100, 1150, 2200, and 5500

own applications programs. With one exception, Datapoint does not provide applications programming support. The exception is DATACCOUNTANT, a client accounting system for the Diskette 1100.

There are several software houses that specialize in programming for the Datapoint processors. They offer many applications packages as well as custom programming services.

Datapoint has installed about 9000 systems, including over 6000 Datapoint 2200's.

USER REACTION

In the summer of 1976, Datapro mailed a questionnaire to its subscribers soliciting their experience with computer systems. A total of 24 users responded with information on Datapoint systems. Eight of these users had a total of 23 Datapoint 1100 systems installed; 11 users had 103 Datapoint 2200 systems installed; and 5 users had 7 Datapoint 5500 systems installed. This represents a total of 133 systems. These users were asked to rate the equipment, software, and support in a comprehensive list of categories. A summary of their responses is shown below.

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	9	12	2	1	3.2
Ease of operation	17	6	1	0	3.7
Reliability of mainframe	13	8	3	0	3.4
Reliability of peripherals	10	7	6	1	3.1
Maintenance service:					
Responsiveness	7	9	3	3	2.9
Effectiveness	6	10	3	3	2.9
Technical support	2	11	7	2	2.6
Manufacturer's software:					
Operating system	12	10	1	1	3.4
Compilers & assemblers	10	11	3	0	3.3
Applications programs	4	6	2	1	3.0
Ease of programming	7	13	3	1	3.1
Ease of conversion	3	6	2	4	2.5

*Weighted Average on a scale of 4.0 for Excellent.

Specific comments by the users generally followed the ratings. Of the 24 users, only one "regretted" acquiring a Datapoint system. Positive comments centered around the concepts of small systems, distributed processing, and intelligent terminals; a total of 17 users mentioned favorable price/performance, flexibility, concept, and accessibility as advantages. Negative comments, which were not as numerous as the positive ones, centered around capacity and performance; a total of 13 users made comments pertaining to lack of capacity, slow peripherals, file handling, and/or applications languages. A synthesized comment summarizing all the comments we received might go: "It sure does a lot for the price, but I wish it could do more." Most of the comments about lack of capacity were made by Diskette 1100 and 2200 users, but two of the 5500 users also mentioned a desire for more performance.

SOFTWARE

A rich variety of software is provided for Datapoint systems, including several languages, operating systems, functional packages, and utilities. But not every software package is supported for every processor model, and there are some differences among the packages provided for different processors. The table on the second page of this report provides an overview of the software available for each system. It is possible to obtain some of the nonstandard items for use with the 1100's, but it may cost extra depending on the modifications and support required.

In addition to the systems software provided by Datapoint, a number of independent software houses specialize in application programming for Datapoint systems; packages available include applications such as payroll, general ledger, accounts receivable, route accounting, etc. Datapoint does not officially support these applications packages, but will provide a listing of the companies involved and the packages they offer. Typical costs of the applications packages from the independents range between a few hundred dollars and a thousand dollars. Datapoint, itself, offers and supports an accounting application package under the name DATACCOUNTANT.

Two factors complicate the presentation of descriptive information about the Datapoint software range. One is its scope. Functional support is provided for a broad range of application types from keypunch replacement to emulation of remote batch terminals to small, file-oriented business data processing. The second factor is time. Software development has been an ongoing effort since the first 2200 was delivered in April 1972. For example, at least nine versions of the DATABUS package and seven versions of the Assembly language have been delivered, each providing support for a different range of computational facilities and peripheral configurations. Many of the older versions are dormant, with no continuing marketing or technical development emphasis, but they are still available for special sales opportunities.

Further complicating the software picture is the need to distinguish between the configuration required to perform program generation and that required to perform program execution. For example, an RPG II program requires one of the larger 2200 configurations (or an 1150 or 5500) to perform program generation, but programs can be generated that require substantially fewer facilities to execute. On the other hand, DATABUS is an interpretive system, and its execution requirements are essentially the same as those for generation.

The full extent of software support takes a Datapoint system far beyond the scope of an intelligent terminal or of a typical "peripheral device." Yet some mention of all the capabilities is required to put the systems in perspective. To meet this need, a summary of each major software facility is presented in the following paragraphs.

OPERATING SYSTEMS: Because Datapoint systems are used for all aspects of a data processing task (i.e., program generation, program execution, data entry, and program maintenance), software facilities have been developed to simplify the operator's job. Two principal operating systems are provided, which differ in the location or residency of the system code and in the facilities provided to the operator.

CTOS (Cassette Operating System) resides on the rearmost of the two standard cassette drives in a Cassette 1100 or 2200. The chief visible operating system characteristic is the provision for interactive communications between the operator and the systems software for tasks such as program

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Datapoint 1100, 1150, 2200, and 5500

Further information about Datapoint user satisfaction was gained in Datapro's latest survey of remote batch terminal users, made in late 1976. A total of 11 Datapoint 1100 and 2200 users responded with ratings on a total of 54 systems. A quick summary of these users' ratings shows a similar pattern to the above responses, though somewhat lower in most categories: overall performance: 2.9; ease of operation: 3.3; hardware reliability: 2.7; maintenance service: 2.6; and software and technical support: 3.0. The fact that the ratings for the Datapoint systems evaluated as batch terminals are lower than those for the same equipment evaluated as data processing systems probably reflects the more stringent requirements for simplicity of operation and reliability that are typically applied to a terminal.□

creation, data entry/file creation, execution of application programs, and execution of communications or other utilities. CTOS allows building and maintaining a library of up to 30 programs which can be called by the operator. CTOS requires 8K bytes of memory, most of which is available to user programs by overlay once the program is initiated. CTOS can also be used with conventional reel-to-reel tape systems.

DOS (Disk Operating System) requires at least 16K bytes and provides a number of capabilities in addition to interactive system control. DOS provides sequential, random, or indexed sequential access to disk-based data files. It also provides extensive restart facilities for capturing essential system information and copies of data files to permit convenient restarting of an application program in the event something happens that causes the system to go down (such as power failure) and the contents of main memory to be lost. Individual versions are provided for specific configuration.

DATASHARE runs under DOS and controls the simultaneous execution of up to 8 (2200) or 16 (5500) user programs entered interactively from independent terminals. Using virtual-memory techniques, each user operates as if he had access to a full 16K Datapoint system. Remote terminals supported include Teletype Model 33 or 35 units and Datapoint 3000 series CRT terminals, or Datapoint 1100's or 2200's emulating these terminals. Diskette 1100, 1150, 2200, and 5500 systems can function as intelligent terminals connected to the central system under one version. DATASHARE requires a 16K 2200 and will run on any 5500. In the 2200, a total space of 4K bytes is available for user programs and is allocated equally among the active terminals. Memory pagination is in 256-byte segments. The 5500 provides a user program space of 48K bytes, which is divided up among the active terminals. When using DATASHARE, the user is constrained to using a version of the DATABUS language, described below, for programming applications.

PROGRAMMING LANGUAGES: The two principal programming languages used by Datapoint systems are DATAFORM for data entry/validation and DATABUS for data processing. In addition, BASIC, RPG II, COBOL, and an assembler are also available.

DATAFORM can be used on a Datapoint system of any configuration. In effect, DATAFORM is a specialized form of CTOS that includes provisions for creating data entry formats, creating format libraries, and controlling data entry operations using the formats. For diskette or disk-based systems, the same functions are provided, except that the input/output medium is the diskette or disk rather than the cassette. For applications using a lot of formats (forms), the diskette offers substantial performance improvement. In addition to defining record formats, various checks and arithmetic manipulations can be programmed. In defining a form, up to 126 fields can be identified. Each field carries a name that is displayed during data entry. Each field is displayed on one line.

Creation of a form with DATAFORM requires several steps for assigning (1) field type, (2) required fields, (3) constants, (4) semi-constants, and (5) links to another form. Field types include alphabetic; numeric; signed numeric with decimal and left or right justification and zero or space fill; and alphanumeric. The maximum signed numeric field is 16 digits (12 to the left and 4 to the right of the decimal point). Checking is performed during data entry to ensure that entered data agrees with the restrictions imposed by the field type. Required entry can be imposed with or without field completion required; a field can also be reserved for computed use and inhibited from manual entry. A distinction is made between constants and semi-constants in that for semi-constants the stored value is displayed during data entry, but the operator can override the entry and insert different data; constant fields cannot be overriden. Links to another form can be automatic or manual. During the form preparation stage, the numeric pad is used with the Display key to generate two-character control codes in order to perform special functions such as cursor movement; character, word, line, or screen delete; character insert; and character duplication. A field program can be attached to any field for execution after that field has been entered. Fields are addressed by the labels assigned in the form. Labeled work areas and constants can be defined, and existing data entry fields can be redefined for convenience in data manipulation.

The four common arithmetic operations are provided in DATAFORM. Table operations including in-or-out-of-range and equal-or-not-equal-to table entries are included. Unconditional branches and subroutine calls provide for sequence control, in addition to conditional branches based on comparisons of two fields. Check digits (modulo 10 or 11) can be generated and verified. A common area of up to 100 bytes can be established to transfer information between forms. With the exception of the common area, all processing is applied to the record being entered. A maximum of 26 field programs can be associated in one form. A maximum of 125 labels is permitted for one program. Up to 245 data characters can be entered per form. The maximum size for a form, including data, field names, and field programs, is 1550 bytes. The convenient means for linking forms reduces the impact of size limitations.

DATAFORM also includes provisions for retrieving and modifying records previously recorded.

DATABUS is a generic name for a family of interpretive compilers using the same general language. DATABUS is a COBOL-like language in that statements are primitive forms of English sentences with verbs, nouns, and connectives that add sense to the statements by contextually identifying a source, destination, or event. In general, the language provides for specifying simple data formats for fields (fixed-point arithmetic and character strings); simple files accessible sequentially or indexed sequentially (disk-based files only) by record number; conditional or unconditional branches, subroutine calls, subroutine returns, and halts; character string moves and comparisons; arithmetic operations (add, subtract, multiply, divide, and compare); and automatic chaining from program to program. Conditions can be based on the results of an arithmetic or compare operation. A common area can be established to transfer information from program to program. Input/output operations are provided to accept data from the keyboard to control the display, and to provide formatting for printed

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output. The principal versions of DATABUS are described in the following paragraphs.

DATABUS 2 is as described above, without the capabilities for disk-based operation; it runs on an 8K configuration under CTOS.

DATABUS 3 includes capabilities for handling asynchronous communications at up to 1200 bps and includes all capabilities of DATABUS 2, except that the full arithmetic facilities are replaced with integer arithmetic operations. In addition, DATABUS 3 can operate with 7- or 9-track reel-to-reel tape drives.

DATABUS 4 is a free-standing package that requires an 8K configuration for program generation, but can generate programs that run in 4K. Character string handling is limited, and only integer arithmetic is provided.

DATABUS 6 runs in a 4K configuration and is intended as a keypunch replacement facility; it has largely been replaced by DATAFORM.

DATABUS 11 runs under DOS in a 16K configuration and includes capabilities for handling communications. Generated programs run under DATASHARE and MULTILINK or alone.

MULTILINK is an enhanced version of DATABUS for a DATASHARE 5500 system or an 1150 system. The 1150 version permits the simultaneous execution of two DATABUS programs. One program utilizes the console, display, and keyboard and is intended for "intelligent" data entry. The second program can utilize any other input/output devices and would generally be used for printing or communications operations. For the DATASHARE 5500, MULTILINK permits intercommunication between any two terminals connected to the system. A separate facility for both versions permits the 5500 or 1150 running MULTILINK to communicate with an IBM computer system by imitating an IBM 3770 terminal; the 1150 can function as two 3770 terminals; the 5500, as up to 16.

BASIC is patterned after the Dartmouth BASIC language and utilizes an interpretive compiler to provide a 16K Datapoint processor with an interactive compiler/execute program capability. Data files can be maintained on cassette or disk. Programs can be executed line-by-line as entered, or a program can be compiled and stored for later execution. Provisions for floating-point arithmetic and two-dimensional arrays are included.

Datapoint RPG II is similar to IBM RPG II for the System/3, a parameter-driven language especially oriented to the production of formatted reports from data files maintained on disk storage. Configuration requirements include 16K bytes of main memory and 2.4 million bytes of disk storage (cartridge disk or disk pack drive). Sequential or indexed sequential access by field name is provided.

Datapoint COBOL is an implementation of the ANSI-68 standard language with selected features from ANSI-74. It runs on any 5500 system. Compiled programs can be executed on an 1150 system, but compilation cannot be performed on an 1150. Specific inclusions are Level 1 Nucleus, Sequential Access, Random Access, and Segmentation; Level 2 Table, Sorting, and Library Facilities; and name qualification, full continuation for words and literals, complete figurative constants, arithmetic expressions, and extended file options from Level 2 Nucleus, Sequential Access, and Random Access. COBOL files are fully compatible with files generated and used by other Datapoint programming languages.

Assembly-language programming is available at all processor levels to support any configuration of main memory size and peripheral complement. Datapoint states that few of its users employ assembly-language programming.

APPLICATIONS PACKAGES: DATACCOUNTANT is a package that runs on a 16K Diskette 1100 under DOS. It provides accountants and bookkeepers with a client write-up function that includes a complete set of output reports tailored to each client's needs. All data for one client is contained on a single diskette. Each accounting period, a new diskette is created. Thus, the accountant can retain client data for any length of time and can rerun any period if necessary. A profile is prepared for each client that custom-tailors the data entry and reports to his special requirements.

FUNCTIONAL PACKAGES: This group of software facilities includes a general editing facility (GEDIT), a text editing program (SCRIBE), communications handling programs (DATAPOLL, UNITERM, and various emulators of remote batch terminals), and SORT/MERGE.

GEDIT is a generalized facility for modifying source code or data files. It is a separate program for cassette-oriented Datapoint processors and an integral facility of DOS.

SCRIBE is a text editing program used in conjunction with GEDIT in 8K, cassette-oriented Datapoint configurations or under DOS in diskette/disk configurations. It provides a series of commands to be used while typing text to specify the format of the output copy. Text can be typed free-form, using the CRT as the display medium, with carriage return, tabulation, margin setting, and other instructions imbedded in the text. Corrections are made on the fly, and the text is output to cassette, diskette, or disk. Playing the output back through SCRIBE results in the formatted printed output.

DATAPOLL is actually a group of free-standing or DOS packages designed for Datapoint-to-Datapoint communications. Utilizing an asynchronous adapter with internal 1200-bps modem, or a 4800-bps synchronous adapter, DATAPOLL provides unattended communications between a central Datapoint processor and a group of remote Datapoint processors. The central site can poll the remote stations by using the automatic dial feature of the adapter, thus implementing a network using the public telephone facilities. Asynchronous transmission is full duplex, after a fashion. Transmission one way is at 1200 bps, and the other way is at 150 bps (reverse channel). For communications applications where the direction of data transmission is principally in one direction, the utilization of the reverse channel for message acknowledgement (to request message retransmission or to give the go-ahead for the next message) eliminates modem turn-around time, one of the factors that usually slows data transmission. A reduced version of DATAPOLL is used in the remote processors; it provides unattended answering of poll calls and transmission of stored data. Automatic restart and program reload facilities minimize the effect of a power failure.

A variety of emulators of remote batch terminals is available. Specific terminals emulated include the IBM 2780, IBM 3780, IBM HASP/Multileaving Work Station, Control Data 200 User Terminal, and UNIVAC DCT 2000. Transmission speeds of up to 4800 bps are supported. Transmission is synchronous. In general, the common features and options of each terminal are emulated; e.g., bisynch protocol and transparent transmission for the 2780/3780 and BCD or ASCII code for the Control Data 200 UT. The emulation programs generally require a 12K configuration. Standard Datapoint data formats are accepted.

UNITERM is a generalized program for emulating a Teletype Model 33 or 35 teleprinter. It is intended to ease the problem of

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connecting a remote Datapoint processor to a larger computer via a communications line, since most computers include support for the Teletype devices. Transmission speeds of up to 1200 bps are supported by Datapoint. UNITRX is intended as a Teletype-style CRT emulator for operation at up to 1200 bps.

Other emulators are available to make the Datapoint processor look like an IBM 2740 or 2741 typewriter terminal.

The SORT/MERGE facility allows a file contained on any of the three disk-type devices to be sorted into ascending order based on 10-character keys (fields). The collation order can be modified if desired, and multiple levels of keys can be employed. In general, a new disk file is created by the sort; i.e., data is not rewritten over the source file. Multiple disk drives can be supported. A facility is also provided for stripping a file to produce multiple reports from the single sorted file.

UTILITIES: A number of utility programs are provided for performing diagnostic tests on a system and for performing data transcriptions from one type of medium to another.

COMPONENTS

PROCESSORS: The Diskette 1100, Cassette 1100, and 2200 processors are essentially identical. They are byte-oriented (8 bits/byte) minicomputers using an internal architecture built around two independent sets of seven 1-byte addressable registers and four 1-bit control flip-flops, plus a single 16-level pushdown stack for addresses and/or data items. The working set of registers and control flip-flops is selected by instruction. This permits rapid switching between foreground and background processing. Normally, the two modes are used for user program execution and for operating system and input/output operations. All data transfers between the processors and input/output devices utilize the arithmetic accumulator, which is one of the duplicated addressable registers.

Main memory is MOS semiconductor with a cycle time of 1.6 microseconds. Instruction execution requires two, three, or four memory cycles depending on the number of memory accesses required. The instruction set includes binary arithmetic (8-bit), logical, conditional and unconditional branch and subroutine call, compare, stack, mode, and I/O. An interrupt facility is provided on a timed basis. If enabled, an interrupt is generated every millisecond. This causes a branch to the address specified in memory location "0". The interrupt routine must check the status of various peripherals or machine conditions to determine appropriate action. There is no parity checking of internal transfers within the processor or between peripheral buffers and the processor. The magnetic tape drive and disk drive controllers check parity or other redundancy error control coding on transfers between the controller and the device.

The 5500 processor utilizes the same basic architecture as the 2200, but includes expanded memory and instruction set capabilities. Memory size is 64K bytes, with 16K reserved for system code. The 16K system portion is implemented as ROM/RAM and includes the functions provided by the bootstrap cassette loader in the 2200. The 1150 includes a 5500 processor with 24K-byte user memory and 4K-byte system ROM memory. The 5500 processor also includes provision for parity checking of internal memory transfers and external data transfers between the processor and peripheral devices.

A full interrupt structure is provided in the 1150 and 5500. Interrupts are generated for memory, input, and output parity failures; memory access violations; privileged instruction violations; at one-millisecond intervals (as in the 2200); by the execution of specific instructions such as System Call or Break Point; or by conditions such as depression of the Restart key or power up. Transfer of control through the interrupt system is accomplished through the pushdown stack. A memory protection technique is provided to simplify use of the system by multiple independent users. The expanded instruction set includes provisions for 16-bit binary arithmetic, handling strings of up to 256 bytes with one instruction, more flexible use of registers, address manipulation, and processor state save and restore.

CRT DISPLAY: An 11-inch (diagonal measurement) CRT with a viewing area 7 inches wide by 3.5 inches high is standard. The screen is arranged in 12 lines of 80 characters each, a total of 960 character positions. A character set of 94 ASCII characters, including upper and lower case alphabetics, numerics, and special symbols, is displayed in green against a dark background. Characters are formed by a 5-by-7 dot matrix. The cursor is a solid formed by the dot matrix and blinks repetitively.

All display functions, such as cursor positioning, erasing, scroll up, scroll down, and character display are entirely under the control of the stored program. The display unit includes a refresh memory of 960 cells (in effect, 35 bits per cell); the refresh rate is the same as the power line frequency. Data transfer is one-way. Displayed data contained in the refresh memory cannot be read into the processor; neither can the cursor position be determined from the display.

A Fast Display feature, standard on the Diskette 1100, 1150, and the 5500 and optional on the Cassette 1100 and the 2200, allows the data code/displayed character conversion to be defined by the user. This feature expands the character set to 128. To load the character generation memory, five 7-bit byte transfers are required to define the 35 positions of the 5-by-7 dot matrix. The character table is identified by position (i.e., 0 through 127). The translation between data code and table position is fixed. Thus, when a character is transferred to the display, whatever has been stored in that table position will be displayed. This feature is a convenient way to implement non-English alphabets, which is its most common use. The feature also implements a faster refresh memory, permitting data transfer between the refresh memory and the processor to proceed at processor speed (about 50,000 characters per second). Normal transfer rate is essentially the same as the refresh rate.

KEYBOARD: Includes a 41-key alphanumeric (typewriter-style) keygroup and an 11-key numeric (adding-machine-style) keygroup. The alphanumeric keygroup can produce any of 128 ASCII characters including upper- and lower-case alphabetics, numerics, control codes, and special characters. Five keys grouped to the right of the keyboard provide system control functions. Audible "clicks" and "beeps" for operator attention can be generated by programming.

The numeric keygroup can optionally be modified to produce a different set of 11 data codes. New keytops are available for identification. The keygroup can then be used as special function keys.

CASSETTE TAPE DRIVES: Two drives are included in the Cassette 1100, the 2200, and the 5500 as standard equipment. Additional drives cannot be added. The two drives are located in the top right-hand portion of the CRT/keyboard/processor cabinet. The cassette recorders each use a "Philips-type" cassette which contains 300 feet of 0.15-inch-wide magnetic tape. Data is recorded serially at 47 char/inch. The data transfer rate is 352.2 char/second. Read/write and rewind speeds are 7.5 and 90 inches/second, respectively. Maximum rewind time is 40 seconds. Start/stop time is 305 milliseconds. Inter-record gap is 2.2 inches. The cassette storage capacity is sufficient for 483 256-character records. Data can be read in the forward or reverse direction.

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DISKETTE DRIVES: One diskette drive controller and drive are standard in the Diskette 1100; up to three additional drives can be added. One controller and two drives are standard on the 1150; up to two additional drives can be added. The controller and up to four drives are optional for the 2200 and 5500. The controller and drives are either housed in a console or free-standing. The console is a combination desk and cabinet with a top surface large enough for the CRT/keyboard/processor and a generous work area, and includes space for one to four diskette drives. The console housing is standard on the Diskette 1100 and 1150. The diskettes are mounted "on edge." The recording method is compatible with the IBM 3740, but the standard layout as used in Datapoint software packages is not. However, a utility routine is available to add the index track to make Datapoint-recorded diskettes compatible with those of the IBM 3740.

Data is recorded in 128-byte sectors; there are 26 sectors per track and 77 tracks per surface. Only one surface is used. The total storage capacity of each diskette is 256,256 bytes. There is only one read/write head.

The diskette spins at 360 rpm, giving an average rotational delay (one-half revolution) of 83.3 milliseconds. The head positioning time is 10 milliseconds per track moved, plus 20 milliseconds settling time when the addressed track is reached. The data transfer rate is 31,250 bytes per second between the buffers and the diskettes. The controller contains four 256-byte buffers. Read/write operations are performed in units of two sectors (256 bytes). Each buffer is independent, and the four "pages" stored in the buffers need not be contiguous on the diskette. Each buffer is accessible by byte from the processor and can be utilized as if it were main memory; i.e., a register-to-memory instruction can be executed using the buffer as the memory.

CARTRIDGE DISK DRIVES: The drives are housed in a console and/or free-standing cabinets, each housing one or two drives. Up to four drives can be used in a Datapoint 2200 or 5500 system. Two disk drives are standard with a 5500 system.

Data is recorded on both surfaces of the single disk contained in the cartridge. There are 203 tracks per surface and 24 256-byte sectors per track. The total storage capacity is 2,494,464 bytes per cartridge. There are two read/write heads, one for each surface, permitting two data tracks to be accessed per position (12,288 bytes).

The disk spins at 1500 rpm, giving an average rotational delay (one-half revolution) of 20 milliseconds. Head positioning time is 15 milliseconds track-to-track, and the average positioning time is 70 milliseconds. The data transfer rate is 195,000 bytes per second between the buffers and the disk cartridges.

The controller contains 16 independent 256-byte buffers, each holding one data sector. The buffers can be treated as main memory.

DISK PACK DRIVES: The disk pack drives are housed in individual cabinets, with the controller in a separate cabinet.

Each disk pack contains a stack of 11 disks. Data is recorded on 20 of the surfaces in sectors of 256 bytes. There are 24 sectors per track and 203 tracks per surface. The total storage capacity per disk pack is 24,944,640 bytes. There are a total of 20 read/write heads contained in the positioning mechanism. The amount of data accessible at one position is 122,880 bytes.

The pack rotates at 2400 rpm, giving an average rotational delay (one-half revolution) of 12.5 milliseconds. The head positioning time is 35 milliseconds average and 60 milliseconds maximum.

The controller can accommodate up to eight drives, but only two drives are permitted for the 2200; the full complement of eight can be attached to a 5500 processor. The controller contains 16 independent 256-byte sectors or "pages" of data. Full access by byte is permitted, and the buffers act like a 4K extension to main memory.

MAGNETIC TAPE DRIVES: Several different models are available with similar mechanical performance but different recording formats. The formats are 7-track, 556/800 bpi; 9-track, 800 bpi; and 9-track, 1600 bpi. The 1600 bpi unit uses phase-encoded recording. All are compatible with the equivalent standard recording formats. Three models accommodate reels up to 8.5 inches in diameter (1200 feet); other models accommodate 10.5-inch reels (2400 feet). All models operate at a tape speed of 12.5 inches per second. The tape drives are housed in a console (8.5-inch reel models only) or in free-standing cabinets.

A controller is included with each drive; it contains a buffer of 1057 bytes or 2048 bytes (1600 bpi drives). The buffer size limits the record (block) size for industry-compatible recording. However, the 1600-bpi drives can be operated in essentially an incremental mode to permit records of any length to be recorded, although the inter-record gap then is non-standard. The buffer is fully accessible by byte from the processor and can be effectively used as main memory. The 1600-bpi drives can read data in the forward or reverse direction.

CARD READER: The card reader is a table-top unit that operates at 300 cards per minute, reading standard 80-column cards. A 12-bit binary image of each column read is transferred to the processor in two bytes. The reader includes a 64-character (32-column) buffer; transfers out of the buffer can be started before the buffer is filled, so that a full 80 columns can be read from a card. Input hopper and output stacker capacity is 550 cards each.

PRINTERS: Datapoint offers four types of printers for all its processors in a variety of models. All of the printers are buffered.

The Servo Printer, a Diablo HyType 1, prints at a nominal speed of 30 characters per second. Actual speed on highly formatted material can be substantially higher. Horizontal skipping can be performed at up to 30 inches per second, and vertical skipping at up to 24 lines per second. Horizontal pitch is variable in increments of 1/48 inch. The unit can accommodate friction-fed forms or pin-fed forms up to 14-7/8 inches wide. Printing width can be 132 positions at 10 characters per inch, or higher with a 12-pitch element or special spacing. The interchangeable rosette-shaped type wheel is available in several sizes and styles. The only vertical format control provided other than line spacing is top-of-form. The Servo Printer is available in a console model, which provides space for the Datapoint Processor, or in a free-standing cabinet.

The 9232 dual tractor matrix "Freedom printer" by Datapoint utilizes a 5 x 7 dot matrix to print a full 96 character set on a 132-character line using sprocket-fed paper. Up to six-part forms may be used on either of the dual tractor feeds. A bi-directional print technique is used. The rated speed is 80 characters per second. Line spacing is adjustable for 6 or 8 lines per inch. The unit features quick change top-of-form control on both tractors. The paper feed mechanisms are unique in that the two paper streams may be overlapped or separated. The 9232 has a built-in printer diagnostic in its internal processor. The print head assembly snaps in and out easily as a user-replaceable item.

Also available is a family of four belt printers. The 9291 operates at 120 characters per second (about 120 lpm), and the 9294 operates at 240 characters per second (about 240

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lpm). Both of these models accommodate forms from 3 to 12.85 inches wide and can print up to 120 columns; the character set includes 96 symbols including upper and lower case alphabetics. The 9212 operates between 120 and 240 lines per minute; the 9214, between 230 and 240 lines per minute nominally with a 96-character set; the exact speed depends on the number of characters printed per line. An option available for either of these two printers increases the maximum print speed to about 340 lines per minute by restricting printing to upper case alphabetics. The 9212 and 9214 can accommodate forms as narrow as 1.75 inches and can print up to 132 positions. All models described in this paragraph can use up to 6-part continuous forms.

The Line Printers operate at a nominal speed of 300 or 600 lines per minute. Models are available with 64-character or 96-character print sets and single or 12-channel vertical format control tape loops. All models accommodate up to 6-part, sprocketed, continuous forms. The print line can be up to 132 characters wide. All models are drum printers. Vertical spacing is operator-selectable at 6 or 8 lines per inch; horizontal pitch is 10 characters per inch. Vertical spacing for long skips is 20 (300-lpm model) or 25 (600-lpm model) inches per second.

In addition to the printers, interfaces are available for a user-supplied IBM Selectric I/O Typewriter and a Centronics printer.

PRICING

Datapoint equipment is available for purchase, on a one-, two-, three- or five-year, non-payout lease, or on a month-to-month rental agreement.

Information below is presented for one- and three-year leases as well as for purchase and maintenance. Maintenance costs have been included in the monthly equipment costs for your convenience. The maintenance figures quoted are for full-time (24 hours/day, 7 days/week) service within a Datapoint service area; rates for remote locations are subject to negotiation. Most standard software (see text) is included in the prices below; COBOL and DATACCOUNTANT are extra.

The two-year lease prices are approximately midway between the one- and three-year prices for all components. The month-to-month rental plan carries charges for equipment (excluding maintenance) that are about 60 percent (processors and diskette drives) to 90 percent (other peripherals) higher than the one-year lease prices.

All components are available for operation with a 115-volt or 230-volt power supply at no difference in cost.

Installation charges are:

Processor (Cassette 1100 or 2200):	$ 80
Processor (Diskette 1100):	110
Printers:	100 to 200
Diskette drive subsystem:	50
Cartridge disk drive:	120
Disk pack controller/drive:	250
Disk pack drive, additional:	100
Tape drive:	120 to 150
Card reader:	60
Single communications adapter:	15
Multi-port communications adapter	30

	Monthly Charge*			
Datapoint processors	1-Year Lease	3-Year Lease	Purchase	Monthly Maint.
Cassette 1100:				
4K bytes, two cassette drives	$ 225	$ 192	$ 6,400	$ 42
8K bytes, two cassette drives	232	215	6,834	42
Diskette 1100; 16K, one diskette drive	274	254	12,880	45
1150; 24K, two diskette drives	436	399	14,480	65
2200; 16K,two cassette drives**	435	367	13,297	75
Fast Display Option, factory-installed (standard on Diskette 1100, 1150, 5500)	11	9	375	—
Fast Display Option, field-installed	26	22	950	—
4000 Series DATASHARE configurations, with processor, dual disk drives, muitipoint communications adapter and software:				
2200; 16K, dual cartridge drives	813	655	20,629	153
2200; 16K, dual disk pack drives	1,511	1,281	42,119	288
5500; 48K, dual cartridge drives	1,169	983	33,888	185
5500; 48K, dual disk pack drives	1,876	1,581	53,607	320
Disk storage units				
Diskette Controller and Drive	123	111	3,800	28
Cartridge Disk Controller and 1 Drive	394	365	9,800	65
Cartridge Disk Controller and Dual Drive	612	555	13,600	76
Cartridge Disk Drive, dual additional	248	226	6,863	52
Disk Pack Controller and drive	711	635	19,872	130
Disk Pack Drive, additional	339	322	8,352	95
Printers				
Servo Printer, 30 cps	223	207	6,300	40
Datapoint 9232, 80 cps	141	128	3,950	30
Dual tractor	27	24	500	10
Interface for IBM Selectric; includes cable	34	29	830	10
Belt printers:				
9212; 132 columns, 120 lpm	325	300	8,640	65
9214; 132 columns, 240 lpm	410	380	11,880	80
9292; 120 columns, 120 cps	165	140	5,500	40
9294; 120 columns, 240 cps	220	185	7,300	55
Line printers:				
300 lpm, 64 char., 1-ch. VFU	470	424	12,600	120
300 lpm, 96-char., 1-ch. VFU	549	491	14,475	135
600 lpm, 64-char., 12-ch. VFU	635	575	16,380	180
600 lpm, 96 char., 12-ch. VFU	738	663	18,820	200
Other peripherals				
Card Reader, 300-cpm	159	144	5,000	35
Magnetic tape units:				
7-track, 556/800 bpi	295	264	8,500	50
9-track, 800-bpi	295	264	8,500	50
9-track, 1600 bpi	398	354	12,200	60
Communications Adapters				
Asynchronous, RS-232C interface	39	32	910	11
Asynchronous, integral modem, 450 bps	61	50	1,500	15
Asynchronous, integral modem, 1200 bps	61	50	1,500	15
Asynchronous, current loop interface	61	50	1,500	15
Synchronous, externally clocked	39	32	910	11
Synchronous, multi-function (MFCA)	78	71	1,911	25
Parallel, logic-level interface	35	29	750	11
Multiple Communications Adapter Housing	86	69	2,300	20
Multiple Port Communications Adapter	66	53	1,500	15

* Monthly charges include full-time equipment maintenance within a Datapoint service area.

**2200 systems with 4K, 8K, and 12K bytes are still available; contact Datapoint for prices.

Software	License	Monthly License	Monthly Maint.
COBOL	$2,500	$65	$20
DATACCOUNTANT	4,400	80***	20

***Plus one-time $1,950 license fee.■

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Decision Data 8001 and 8010 Data Recorders

MANAGEMENT SUMMARY

Decision Data, the world's largest independent supplier of 96-column punched card devices, has experienced financial woes during the past year, but it now appears that the crisis has been resolved. The problem was caused primarily by a sharp decline in orders for the 96-column card devices from Decision Data's largest OEM customer, Burroughs Corporation. The company has successfully obtained a revolving line of credit from its banks and is currently in a "stabilized" position. The prognosis is encouraging.

Decision Data entered the 80-column punched card equipment market in June 1973, four years after its inception in 1969. Its current family of 80-column products includes a data recorder, Model 8001; an interpreting data recorder, Model 8010; a data communications terminal, the CS-200 Model 4; a card reader, Model 8025; a reader/punch unit, Model 8035; and a printing reader/punch unit, Model 8045. These products share many of the same basic mechanisms and electronic circuits.

In May 1975, Decision Data introduced two significant new features for the 8001 and 8010 Data Recorders: an Accounting feature, (also available for the 96-column 9601, 9610, and 9660 Data Recorders), and a Card Conversion feature. Data verification can be minimized and the accuracy of data entry increased by the Accounting feature, which permits the user to create proof or hash totals and to perform crossfooting and batch balancing as work is transcribed. When combined with the optional Data Reporter (a serial printer), the Accounting feature can be used to create formatted reports with up

Decision Data's 80-column buffered keypunch/verifiers offer high operating speeds and a number of attractive options, including an accounting feature, a serial printer for hard-copy output, and a 96-to-80-column card conversion capability.

CHARACTERISTICS

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

MODELS: 8001 Data Recorder and 8010 Interpreting Data Recorder.

CARD OUTPUT: Standard 80-column cards punched in 80-column card code. The Punch, Verify Read, and Reproduce speeds are the same for both models. When performing card operations on only a few columns located anywhere on the cards, the punching and interpreting speeds approach 75 cpm. Rated speeds are as follows:

Device Function	Card Columns	Rated Speeds, cards/minute 8001 DR	8010 IDR
Punch	80	45	45
Verify Read	80	200	200
Reproduce	80	30	30
Reproduce and Print	80	–	25
Interpret	80	–	45

Primary and secondary input hoppers hold 600 and 400 cards, respectively. Two output stackers each hold 400 cards. Cards are loaded face-forward. Cards are fed front

This Decision Data 8010 Interpreting Data Recorder is shown with the optional 96-to-80-Column Card Converter (at left). The 8010's dual input hoppers can be seen at the far right, while the dual output stackers are clearly visible to the left of the keyboard.

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Decision Data 8001 and 8010 Data Recorders

to four levels of totals, yielding a potentially powerful small accounting system capability. The Card Conversion feature permits data punched into 96-column cards to be transcribed to 80-column cards without the aid of a computer. The feature includes a small, stand-alone, 96-column card reader (Model 9625) that cable-connects to the data recorder.

The Data Reporter, a serial matrix printer produced for Decision Data by Centronics, was originally introduced in the third quarter of 1974 for use with Decision Data's 96-column card data recorders. The option is now also available for use with the company's 80-column data recorders in two models which differ in print speed and print line length. The Data Reporter, combined with an 8001 or 8010 Data Recorder, can satisfy a host of off-line applications such as printing labels or parts lists, automatically listing data from cards, generating reports via the Accounting feature, etc. All formatting is specified by header cards, which define page and text length, horizontal and vertical spacing, and other parameters.

The 8000 Series data recorders are functionally the same as their 96-column 9600 Series counterparts, including card path arrangement and hopper and stacker capacity. Even the control panels of the related data recorders are quite similar.

The 8000 Series data recorders feature very high reading, punching, and printing speeds—by far the highest in the 80-column card industry. Cards are read at 200 cpm, while punching and printing speed ranges from 45 to 75 cpm (60 columns per second).

Other noteworthy features include: combined keypunch and verifier operation, buffered operation, four program levels (eight levels are optional), program revert, primary and secondary input hoppers, two output stackers, a visible card station, automatic blank card insertion during verification, an Interpret mode (Model 8010), Print Edit and Punch Suppress, check digit verification (optional), file reproduction and change, selectable zero or blank fill, interspersed gang punching (optional), production statistics (optional), and a 51-column card capacility (optional).

Decision Data began production deliveries of its 8001 and 8010 Data Recorders in November 1972. End-user sales and service are provided by the company through its sales and service facilities located in over 60 major cities throughout the U.S. and Canada.

USER REACTION

In Datapro's 1976 survey of key entry equipment users, 11 users reported on their experience with a total of 26 Decision Data 80-column keypunches and verifiers. Their ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	1	9	1	0	3.0
Ease of operation	4	7	0	0	3.4
Hardware reliability	0	6	4	0	2.6
Maintenance service:					
Promptness	0	7	3	0	2.7
Quality	1	6	3	0	2.8

*Weighted Average on a scale of 4.0 for Excellent.

card first (from the primary hopper) or rear card first (secondary hopper). Cards are stacked face-forward with printing at top; stacker overflow is provided. The card path is arranged in the following sequence: read, wait (visible), punch, and print (8010 only).

DEVICE CONTROL: Data and programs are stored in independent buffers. Buffer storage capacities are as follows:

	Data Storage	Program Storage
8001	240 char. (3 cards)	1,920 bits
8010	400 char. (5 cards)	2,080 bits

Provision is made for storing four or eight (optional) programs simultaneously, with manual switching among the programs. The program controls the format of the data by delimiting alphabetic, numeric and special fields and by initiating automatic field skipping, duplicating, right justification (selectable left zero or blank fill), and optional check-digit verification.

New programs are entered automatically from punched program cards on a one-program-per-card basis. Any one of four or eight (optional) stored programs can be manually selected, or all can be disabled to permit the operator to completely control the format of the recording. The operator can also select an alternate program and automatically return to the original program via the Program Revert function.

Operating modes are: Program Load, Punch, Verify, and Reproduce. Additional functions provided only by the 8010 are: Interpret, Print, Verify Print, Print Edit, and Verify Print Edit.

The Program Load mode reads the program from an entered program card into the selected program memory. Program cards can be fed from primary or secondary hoppers, but are always stacked in the second stacker. Print Edit programs are loaded into a separate memory reserved for that application.

The Punch mode punches keyed data contained in memory into cards fed from either primary or secondary hoppers and delivers the punched cards to Stacker One.

The Verify mode compares keyed data column-for-column with the data read from a card. The card is fed from the primary hopper, its contents are read into memory, and the card is retained at the visible wait station until its contents have been verified. Corrections made during the Verify mode require reverification of each corrected field unless the reverification is performed manually as each column is corrected by backspacing and reverifying the corrected column. The whole card must be reverified if corrections were made without program control. A card that has been verified without corrections is notched and delivered to Stacker One, and the next card to be verified is fed. A card containing errors is delivered to Stacker Two un-notched; a blank card is automatically fed from the secondary hopper, punched with the corrected data notched, delivered to Stacker One, and the next card to be verified is fed.

The Reproduce mode feeds the card to be reproduced from the primary hopper, reads its contents into memory, and delivers the card to Stacker One. A card is then fed from the secondary hopper, punched with the contents of the previous card, and delivered to Stacker Two. As an alternative, all cards can be delivered to Stacker One. Editing functions operate on a column basis and include skipping and substituting a blank or a character from dup memory. Two card decks can be merged by programming a skip for each read column.

The Interpret mode (8010 only) feeds a card from the primary hopper, reads its contents into memory, prints the data on the card, and delivers it to Stacker One. Stacker One automatically overflows into Stacker Two.

Interpreting (8010 only) can be performed on the cards in either Punch, Verify, Reproduce or Interpret mode. Printing can be performed without punching in the Punch mode

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Decision Data 8001 and 8010 Data Recorders

As you can see, the users were generally well pleased with the overall performance and ease of operation of the 8001 and 8010, but several of the respondents felt there was room for improvement in the hardware reliability and the associated maintenance service. One user reported a few problems at first, but stated that they were satisfactorily resolved within an acceptable period of time.

Six of the Decision Data users responded to a survey question asking whether they were considering any change in their current data entry operations. Of these six, three reported that they planned to continue using the Decision Data units. The other three were considering a change to a more sophisticated operation using on-line terminals or key-to-disk devices. The three users who planned to continue using the 8001/8010 indicated a relatively high degree of satisfaction with the Decision Data units.□

on a column-by-column basis when operating with the program-controlled Punch Suppress feature. Only corrected cards need be printed in the Verify mode (though all cards can be printed if desired); only reproduced cards are printed in the Reproduce mode. When reproducing under program control with auto skip/dup enabled, fields programmed for skip are not printed; fields programmed for duplication are printed with the data to be duplicated.

Printing can be edited via a program in the print-edit memory. The print-edit program, which operates on a column-by-column basis, can erase specific character positions of the print memory and inhibit the transfer of data into those positions, allow the current contents of print memory to be retained but inhibit the transfer of data into those print memory positions, or print numeric columns with a minus overpunch as numbers, not letters.

The optional 1070 Data Recorder can print the data being keypunched, verified, reproduced, or interpreted simultaneously with these operations. Formatted reports can be printed from punched cards under the List Edit function, which provides page headings, page numbering, text length, and overflow capabilities. Card-based reports can be automatically edited to provide data compression, zero suppression, and the insertion of signs, dashes, periods, asterisks, and blanks.

Punch Suppress and Print Edit functions are independent operations that can be performed on the same card.

The optional Interspersed Master Card feature controls punching, verifying, and interpreting of interspersed master and detail cards (i.e., cards without an upper-left corner cut). Master or detail card operation is switch-selected and requires the use of two programs. This feature also controls interspersed gang punching.

The operator panel provides a two-digit column indicator to display the current location within the record. Status conditions such as operating mode, active program, error, and fault conditions are displayed in English, but are not visible until lighted.

The Production Statistics feature, an option, consists of three 6-digit counters located over the leftmost stacker. The counters present the total number of cards processed (resettable counter), total number of keystrokes x 10 in the Punch or Verify mode, and total errors (Verified Corrected).

The Accounting feature, also optional, consists of eight 16-digit accumulators that can be used to perform accounting functions. These functions, including add, subtract, crossfoot, store, carry-forward, and "read-out" of numeric information, can be performed under program control as cards are keypunched, verified, and interpreted. A file of cards can also be listed or tabulated as a separate operation to generate specific reports. This option is mutually exclusive with feature 1090, the 96-to-80-Column Card Converter option.

CARD CONVERSION: Feature 1090 provides 96- to 80-column off-line card conversion at speeds up to 75 cards/minute. The feature consists of a 96-column card reader (manufactured by Decision Data) which directly interfaces the 8001 or 8010 Data Recorder and provides hopper and stacker capacities of 600 cards each. The card image of each 96-column card is transferred as the card is read to the data recorder for punching (and printing with the 8010). This feature is mutually exclusive with the Accounting feature.

ERROR CONTROL: In the Punch mode, keying errors detected by the operator can be corrected by backspacing column-by-column and rekeying the correct character. Backspacing can be performed under manual or program control. Field Erase and Record Erase functions permit the operator to erase all data that has just been keyed into a field or record, respectively; duplicated data is not erased. Check digit verification for modulo 10 or 11 self-check numbers is optional.

KEYBOARD: The 54-key keypunch-style keyboard can produce any of 64 character codes, including 10 numerics, 26 alphabetics, and 28 special characters. The keyboard is similar to that of Decision Data's 9600 Series Data Recorders. The keyboard is designed for "n-key rollover," a design technique that permits character generation to occur only on the downstroke of a key, thereby permitting faster keying and reducing the likelihood of errors.

PRINTED OUTPUT: The Data Reporter, Feature 1070, is an impact matrix printer produced for Decision Data by Centronics and is available in two models. Model 2 (a Centronics 500) provides 132 print positions and prints 120 char/second (40 full lines/minute). Model 3 (a Centronics 306C) provides 80 or 132 print positions via switch selection and prints 100 (80 columns) or 165 (132 columns) char/second. Horizontal spacing is 10 char/inch at 80 columnns and 16.5 char/inch at 132 columns. Each character is formed by a 5-by-7 dot matrix. The adjustable tractor feed accommodates continuous, 5-part, sprocket-fed forms from 4 to 9½ inches wide in Model 3 and from 4 to 14⅞ inches wide in Model 2. Horizontal and vertical format control is performed under program control through punched control cards. The Data Reporter is mutually exclusive with the Mod 10 or 11 Self-Check Number feature.

PRICING: The 8001 Data Recorder and 8010 Interpreting Data Recorder are available on a 42-month lease or for purchase. Lease terms include maintenance and unlimited equipment usage. A separate maintenance contract is available for purchased units.

	Monthly Rental (1)	Purchase	Monthly Maint.
Data Recorders			
8001 (non-interpreting)	$141	$5,900	$40
8010 (interpreting)	167	6,800	50
Options			
Interspersed Gang Punching	11	480	1
Mod 10 Self-Check Number	14	700	1
Mod 11 Self-Check Number	19	900	1
Production Statistics	12	480	2
Eight Program Levels	11	480	1
51-Column Card	34	1,080	5
Reverse 10-Key Numeric Keyboard	8	480	3
Data Reporter (2):			
Model 2 (132 columns)	180	5,550	48
Model 3 (80/132 columns)	155	4,880	53
Accounting Feature (3)	20	700	4
96-to-80-Column Card Converter (4)	102	3,960	17

(1) For 42-month lease: includes maintenance.
(2) Mutually exclusive with Mod 10 or 11 Self Check Number.
(3) Mutually exclusive with 96-to-80-Column Card Converter.
(4) Mutually exclusive with Accounting Feature.■

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Tab Products Series 400 and 500 Punch-Verifiers and Interpreters

MANAGEMENT SUMMARY

Tab Products entered the punch-verifier and interpreter market in September 1972, when the company introduced its 400 Series. This original series was composed of the Model 405 Punch-Verifier and the Model 410 Punch-Verifier. The basic difference between these two models is that the 405 has five program levels and the 410 has ten. Production of these models ceased over a year ago, and the company has informed Datapro that returned and refurbished 400 Series units are currently offered, for purchase only, on an as-available basis.

The 400 Series was superseded by the current 500 Series family, which was introduced in February 1974. The major difference between the two series is that the newer 500 line has a 60 percent faster verification speed.

At the 1975 National Computer Conference, Tab introduced a new and considerably more sophisticated member of the 500 Series, the 501. The 501 Data Entry Microprocessor is a microprocessor-based, double-buffered, 80-column punch/verifier/interpreter/printer. Optional features offered with this unit include check digit, internal and visual production statistics, accumulation, computation, and a variety of interfaces for on-line card reading and punching. Volume shipments of the 501 began in May 1976, and over 400 units have been installed to date.

Tab markets the 501 as a multi-use machine. According to the company, installed 501's are currently functioning as stand-alone punch/verifiers, as well as on-line card readers and direct key entry devices on DEC PDP-8, PDP-11, and DECsystem-10, Hewlett Packard 2000, General Automation 1800, Burroughs B 6700, Wang 2200, and Basic Four computer systems. The company also states that the 501 has been interfaced to desk calcu-

The Tab Products family of buffered, 80-column keypunch-verifiers has recently been enhanced by the introduction of the Tab 501 Data Entry Microprocessor. In addition to the features of the Tab 400 and 510 Series stand-alone keypunches, the 501 offers a variety of enhancements, including the capability to interface with terminal devices, minicomputers, and computer mainframes.

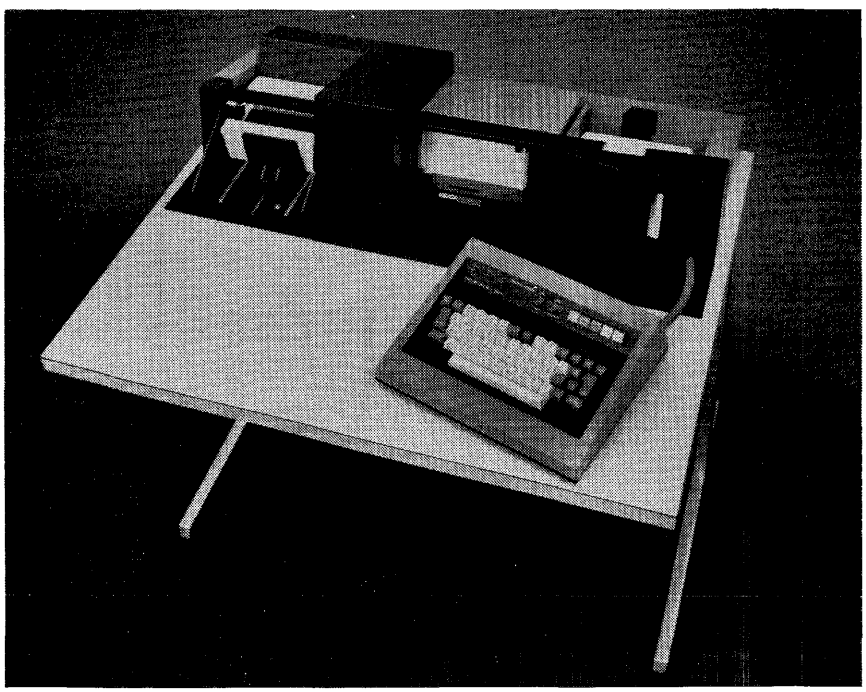
CHARACTERISTICS

MANUFACTURER: Tab Products Co., 2690 Hanover Street, Palo Alto, California 94304. Telephone (415) 493-5790.

400 SERIES MODELS: 405: Punch-Verifier, 5 program levels; 405-10: Punch-Verifier, 80 character constants; 405-20: Punch-Verifier, card printing and interpreting; 405-30: Punch-Verifier, 80 character constants, card printing and interpreting; 410: Punch-Verifier, 10 program levels; 410-10: Punch-Verifier, 80 character constants; 410-20: Punch-Verifier, card printing and interpreting; 410-30: Punch-Verifier, 80 character constants, card printing and interpreting.

500 SERIES MODELS: 501: Data Entry Microprocessor (fully buffered key entry and verifying), 8 program levels, 58 character constants; 510: Punch-Verifier, 10 program levels; 510-10: Punch-Verifier, 80 character constants; 510-20: Punch-Verifier, card printing and interpreting; 510-30: Punch-Verifier; 80-character constants, card printing and interpreting.

Left Zero and Blank Fill and Automatic Program Sequencing are standard features for all models of the 400 and 500 Series Punch-Verifiers. Options include Constant memory, available in 160- or 240-character capacities (a 220-character constant memory is available on all 501's),



Tab Products' buffered keypunch-verifiers use the same keyboard layout as the IBM 129 Card Punch and offer a number of worthwhile additional features.

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Tab Products Series 400 and 500
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lators. User interest is also developing in utilizing the 501 as a card punch via the bisynchronous communications capability of the unit.

Industry observers usually express pessimism when a new 80-column keypunch unit enters the market. However, the Tab 500 Series offers the user an opportunity to upgrade from a conventional off-line keypunch operation to direct key entry into a multitude of systems. This ability to upgrade is bound to enhance the attractiveness of the 501 to prospective buyers.

The basic Tab 400 or 510 Series keypunch is a buffered punch-verifier with 5 or 10 program levels. Since each program level is equivalent to the format control exerted by a drum card in a purely mechanical card punch unit, the basic Tab unit can format incoming data in five different ways instead of the two that are customary for a mechanical punch. A program card is punched in the usual way, but instead of mounting it on a drum, the program card is placed in the Input hopper and by the touch of a button the card contents are transferred into a semiconductor program buffer.

An important capability of the Tab punches is automatic sequencing of these programs—equivalent to program chaining in key-to-disk systems. Each program is assigned a number, and the desired program sequence is one of the program inputs. Hence, regardless of the order in which the programs are entered, the number sequence entered into the program buffer determines the order in which the program levels will be executed. Manual sequencing is also possible provided that a control on the keyboard is activated first.

Another important feature is insertion of constants. Constant data is that which is part of a specific format but cannot be duplicated from the previous format or card because it is not present. Either 80, 160, or 240 constants, according to the model, can be entered into memory from the keyboard and remain there until changed by the operator. Under program control, an appropriate constant is emitted into a field automatically, without the need for a keystroke.

All models perform left zero and blank fill as standard operations. Automatic duplication of columns and skipping of columns are also performed.

In addition to the program buffers, the Tab punch-verifier has a data input buffer and a data output buffer. The operator always keys data into the input buffer. Automatic operations are performed electronically by the machine. At any time prior to entering column 80, the operator can correct an error before it is punched into a card. Once column 80 is keyed, the data is immediately transferred to the output buffer, and a card is automatically punched.

While this card punching takes place, the operator proceeds to key the next record into the input buffer without any delay. Columns to be duplicated are obtained from the preceding record, which is still in the output buffer. In the rare case of realizing that an error had been made in column 80, the operator can automatically duplicate the first 79 columns from the output buffer contents and then correctly key column 80. Later,

Motor Pause, and Production Statistics, a visual display of operator statistics including number of keystrokes; cards punched, verified, or interpreted; and number of operator errors. The statistics are displayed via resettable counters that mount above the visible card station.

CARD OUTPUT: Standard 80-column cards are punched in standard card code. Input hopper capacity is 400 cards, Output stacker capacity is 500 cards, and Auxiliary hopper capacity is up to 25 cards. The input hopper capacity and the output stacker capacity for the 501 are 700 cards each.

Tab states that the electronic action of the punch enables a punching rate of 26 cards/minute and a verifying rate of 40 (400 Series) or 64 (500 Series) cards/minute. Interpreting is also accomplished at up to 30 cards/minute. A speed-up option for the 501 increases its punching speed to 42 to 74 cards/minute, its verifying speed to 70 cards/minute, and its interpreting speed to 53 cards/minute. The constant emitting feature raises throughput further by saving keystrokes. Stored program levels enable jobs requiring successively different formats to be handled in one pass without changes in job setup.

DEVICE CONTROL: The Tab Punch-Verifiers incorporate the following kinds of independent semiconductor memories: a program buffer, which can store 5 or 10 levels, depending on the model (the 501 can optionally store 28 levels); a data input buffer, which always receives data as it is keyed; a data output buffer, which receives the contents of the data input buffer as soon as column 80 is keyed; and a constant buffer, which stores 80, 160, or 240 characters entered from the keyboard. An 80-character buffer is standard with the exception of the 501, which has a 58- or 220-character constant memory and also incorporates a fully-buffered verifying procedure and a fully buffered keyboard.

Sequencing of the program levels can be either automatic or manual, as determined by the setting of a keyboard switch. The program controls the format of the entered data by defining alpha and numeric fields, by specifying automatic field skipping, duplicating, right justification (left zero fill within numeric fields and left blank fill within alpha fields), and by causing the insertion of constants at designated positions of the record. Automatic sequencing of programs is governed by the sequence number punched into the original program cards that are loaded into memory. A keyboard display informs the operator of the program number in effect. A "sequence repeat" switch enables the operator to repeat any program. Manual control can be exerted over constant emitting as well as over program sequencing if desired.

Modes of operation consist of Load Data/Program, Punch, and Verify. Certain models, as listed above, can also Interpret.

In the Load Program mode, programs read from the program card are entered into program memory, erasing any prior programs. The Load Data mode enters the data read from a master card into the data input buffer. Program and master cards are fed from the primary input hopper.

The data input buffer can be loaded by keying data, by inserting constant information from a master card, by emitting constants, by duplication, or by zero and blank fills. Prior to entering column 80, the operator can correct errors before a card is punched. The backspace key is used to go back one or more columns, the field repeat key is used to return to the start of the current or previous field, and the card repeat key is used to return to column 1. After the card is completed, the contents of the input buffer are automatically transferred to the output buffer and punching of a card commences. While punching proceeds, the operator keys the next record into the input buffer without any interruption. Columns can be duplicated from the previous record, which remains in the input buffer until it is displaced by the new record. In fact, if the operator became aware that the preceding card was in error, she could easily create a correct card by duplicating all the columns from the output buffer except those to be corrected.

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the preceding error card is removed from the deck. Each punched card can be viewed in the visible station.

Verification is carried out by first stacking previously punched cards into the Input hopper. The contents of the first card are automatically entered into a data buffer. The verifying operator keys the same information from the source document and a comparison is made, column by column, with the buffer image. Mismatches produce an error condition, and the operator must key a correction. When the buffer image has been corrected, a new card is automatically fed from the Auxiliary hopper and punched. The old card is passed into the Reject stacker, and the corrected card, with an identifying correction code punched into the leading edge, is sent to the Output stacker. Cards that need no correction are punched with an OK code.

The electronic keyboard has a feature called n-key rollover, which assures the proper sequence of keyed input even when two or more keys are depressed at almost the same time.

The punch-verifier-interpreter models can print while punching and can print correction cards when the unit is verifying. Prepunched cards can be interpreted at speeds of up to 53 cards/minute, depending on the number of columns to be interpreted. An ink roll, which can be readily removed, is employed instead of a conventional ribbon.

Another time-saving feature is automatic fast release. Cards having a limited number of columns to be punched or verified move through the unit at accelerated speeds without special programming.

The 501 Data Entry Microprocessor retains all the features of the Tab 400 and 510 Series stand-alone buffered keypunches and provides the following additional features:

- Up to 28 program levels (8 standard),
- Instant verification (fully buffered),
- Visual/internal production statistics,
- Accumulation,
- Check digit (modulus 10/11),
- Computation,
- Must enter, and
- Increased-speed option for the punch, punch/print, verify, and interpret modes.

The instant verification and must enter features are standard with the 501, while the other features listed above are optional.

The Tab 501 production statistics feature offers two methods of automatically gathering statistics: visual or internal. The visual production statistics feature has a small counter unit mounted on top of the punch-verifier. The three digital counters automatically provide a constant visual display of total keystrokes, total cards, and

In the Verify mode, the punched cards to be verified are placed in the primary input hopper. Their contents are read, one by one, into the data buffers. The operator rekeys the data from the source document and a mismatch between a keyed column and the corresponding column in the buffer produces an error condition. After corrections are keyed into the buffer, the operator is forced to reverify the entire field and a new card is automatically fed from the Auxiliary hopper and punched.

All printing models have the Interpret feature. Prepunched cards to be interpreted are placed in the primary input hopper and are automatically fed and interpreted.

A two-digit numerical column indicator located between the visible station and the Output stacker displays the next card column to be punched or verified. Status conditions such as interlock and error are displayed by indicator lamps on the status panel, and the operator mode is displayed at the keyboard.

ERROR CONTROL: Keying errors detected by the operator can be corrected by backspacing and rekeying the correct character.

PRINTER: Models that print can produce any of 64 characters. Standard character sets include A/N, CDC, ICL 1900, and ICL 2900.

KEYBOARD: A keypunch-style keyboard can produce any of 64 character codes: 10 numerics, 26 alphabetics, and 28 special characters. Various control keys initiate functions such as manual duplication and skipping, error correction, card ejection, right justification, etc. The keyboard layout is like that of an IBM 129 Card Punch.

PRICING: The Tab 400 Series units are now offered for purchase only, on an as-available basis. The Tab 500 Series equipment is available on a one-, two-, three-, four-, or five-year lease arrangement or for purchase. The five-year lease rates are about 10 to 15 percent lower than the one-year rates. A separate maintenance contract is available for purchased units. The rental prices below include maintenance.

		Monthly Rental*			
Model	Description	1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
405	Punch-Verifier: 5 program levels	—	—	$3,900	$25
405-10	Punch-Verifier: 80 character constants	—	—	4,500	30
405-20	Punch-Verifier: card printing and interpreting	—	—	4,950	35
405-30	Punch-Verifier, 80 character constants, card printing and interpreting	—	—	5,100	40
410	Punch-Verifier; 10 program levels	—	—	4,000	25
410-10	Punch-Verifier: 80 character constants	—	—	4,150	30
410-20	Punch-Verifier: card printing and interpreting	—	—	5,200	35
410-30	Punch-Verifier: 80 character constants, card printing and interpreting	—	—	5,350	40
501-00	Punch-Verifier: 8 program levels, 58 character constants	$186	$174	6,400	42
	Options				
	16 program levels, 220 character constants	10	10	250	NC
	28 program levels, 220 character constants	15	15	375	NC
	Speed-up option	NC	NC	NC	5
	Accumulate feature	4	4	87	1
	Check digit (Mod 10 or 11)	6	6	275	1
	RS-232 Serial Interface	—	91	1,100	15
510	Punch-Verifier: 10 program levels	137	132	4,840	25
510-10	Punch-Verifier: 10 program levels and 80 character constants	149	144	4,970	30

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Tab Products Series 400 and 500
Punch-Verifiers and Interpreters

total errors corrected (columns or cards corrected). These counters will automatically overflow, can be reset by the operator, can be stored (even when power is switched off), and give an exact count that requires no further calculation.

The internal production statistics option runs under program control and will punch out a card containing a count of total keystrokes, total cards, total columns corrected, and total cards corrected. The counters will automatically overflow, and are programmable for punchout or punchout and reset. The counts are separated and labeled on the punched statistics card.

The accumulate feature can be used for compiling totals or balances, crossfooting, and generating up to three independent progressive totals. The user can balance to a predetermined figure (zero balancing) or create a hash total for a batch of work. The feature provides three counters into which dollar amounts, quantities, totals, etc., may be added, subtracted, or stored for punchout. The amounts accumulated can be punched in the same card for which the keyed information was made or into a total or summary card.

The Tab 501 Data Entry Microprocessor can be interfaced to terminal devices, minicomputers, computer mainframes, OCR devices, plotters, and teletypewriters. The interface units are available from Tab Products and are pluggable components independent of the microprocessor. They can be serial or parallel, half- or full-duplex, synchronous or asynchronous.

The company provides its own maintenance from 21 service locations in the United States.

USER REACTION

In the 1976 Datapro survey of key entry equipment users, 10 users reported on their experience with a total of 44 Tab Products 400 and 500 Series units. This sample included 7 Model 405 units, 5 Model 501 units, and 27 Model 510 units. The users' ratings are summarized below.

	Excellent	Good	Fair	Poor	WA*
Overall performance	3	7	0	0	3.3
Ease of operation	3	7	0	0	3.3
Hardware reliability	1	6	3	0	2.8
Maintenance service:					
Promptness	2	7	1	0	3.1
Quality	1	5	4	0	2.7

*Weighted Average on a scale of 4.0 for Excellent.

These scores indicate a fairly high degree of user satisfaction with the Tab units, although there appears to be room for improvement in the hardware reliability and quality of maintenance service.

One Tab 510 user who also has a single IBM 29 keypunch indicated that he was very satisfied with the 510 and plans to upgrade his 29 keypunch to the Tab 501. It's not surprising that this user plans to acquire additional Tab keypunch units, because he rated his existing Tab unit excellent in every category. One respondent who has four Tab units reported a multitude of problems during the first three weeks of operation; however, he noted that since this initial period the units have been performing well. Neither of the two 400 Series users who responded to this survey made any mention of the "severe mechanical problems" that were reported in the 1975 edition of this report. Thus, it appears that Tab has totally resolved these problems by engineering changes.

The most popular data editing and validation features employed by these users were check digits and zero batch balancing.

Eight of the 10 respondents indicated that they had no plans for changing their current data entry operations, but two Tab 510 users were considering a change to key-to-disk systems. It is noteworthy that, in light of today's rapid trend toward more sopisticated data entry techniques (i.e., key-to-disk, on-line CRT's, and others), only 2 of these 10 Tab users were thinking of making a change. □

		Monthly Rental*			
Model	Description	1-Year Lease	2-Year Lease	Purchase	Monthly Maint.
510-20	Punch-Verifier: 10 program levels, 80 character constants, card printing and interpreting	167	162	5,810	35
510-30	Punch-Verifier: 10 program levels, 80 character constants, card printing and interpreting	179	174	5,940	40
	Options				
	Constant buffer				
	160 characters	2.50	2.50	115	0
	240 characters	5.00	5.00	230	0
	Production Statistics	10.00	10.00	490	1

*Includes maintenance. ■

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UNIVAC 1900 CADE Key/Disk System

MANAGEMENT SUMMARY

UNIVAC entered the key/disk arena in 1974 with the introduction of the 1900 CADE (Computer Assisted Data Entry) System. The company enhanced this system, which is manufactured by the Pertec Corporation, by offering a data communications capability in December 1975. Further enhancements, announced in July 1976, include more powerful software and an 8.8-megabyte disk unit. Originally, only a 2.2-megabyte disk was available. Delivery of the new software and the larger disk is planned for January 1977.

The recent software enhancement, known as FIT (File Inquiry Technique), improves the data entry capabilities and provides multiple access to large data files. Users will also be able to access related files from local keystations. An overall improvement in access time is made possible by generating disk files that have an associated retrieval key for each record. FIT requires a minimum of 16K bytes of storage, depending on the number of active keyboards, record sizes, and application packages.

The new features provided by FIT inlude: COBOL program access to batches and files, added COBOL language capabilities, new supervisor file management facilities, and a new operator mode for file inquiry and update. File inquiries can be run concurrently with data entry, allowing multiple operators to access and update shared files. In a move toward distributed processing on the 1900, FIT will allow user departments to access related files from local keystations.

The 1900 system supports up to 32 keystations and has a modular semiconductor memory expandable from 57K to 131K bytes in 8K increments. The system can also ▷

Recent software enhancements and larger disk units have improved the data entry capabilities of this shared-processor key/disk system and permitted multiple access by user departments to data files from the local keystations. The UNIVAC 1900 CADE system can support up to 32 keystations and can communicate with other 1900 systems, with UNIVAC 1100 Series and Series 90 computers, and with IBM 360/370 computers.

CHARACTERISTICS

SUPPLIER: Sperry Univac Division, Sperry Rand Corporation, P.O. Box 500, Blue Bell, Pennsylvania 19422. Telephone (215) 542-2011.

CONFIGURATION

KEYSTATION: Consists of a video display and an electronic keyboard. It is a compact, portable, desk-top unit of the same approximate size as an office typewriter. Any keystation can be converted into a supervisory station by entering a special password.

The keyboard can have any of three standard arrangements: standard keypunch, keypunch/adding machine, or typewriter with 10-key numeric overlay. Any combination of these keyboard styles can be mixed in a given system. The controlling format program can specify that the station be automatically shifted into an alphabetic, numeric, or lower case alphabetic shift, or the operator can shift the keyboard manually. When the keystation is in the lower case alphabetic shift, the video display presents each character as a true lower case letter. A cursor in block form appears in the space to be filled next. ◀

The 1900 CADE System supports up to 32 of the CRT keystations shown here. The display is arranged in 12 lines of 40 characters each, and the keyboard is available in standard keypunch, keypunch/adding machine, or typewriter arrangements. The control processor cabinet is shown in the left background.

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UNIVAC 1900 CADE Key/Disk System

handle up to four disk storage drives, providing a disk storage capacity of from 2.2 million to 35.2 million bytes. Up to four magnetic tape units (7- or 9-track), a 30-cps or 200-lpm printer, and a communications adapter can also be included.

The CADE system can support up to 32 CRT keystations, and the keyboard pattern can resemble an IBM 29 keypunch, a keypunch/adding machine combination, or a typewriter with 10-key numeric overlay. Keystations with different styles can be intermixed in a system. Each keyboard can execute three shifts—alphabetic, numeric, or lower case alphabetic. From the various keyboard styles, the user can fit one to the experience of the operator who will use it. For instance, an inexperienced operator with only a typing background would obviously be more comfortable with a typewriter-style keyboard. Because a keystation can be located up to 3,000 feet from the control processor, a station can be situated in a data source environment, away from the battery of other key operators, and a clerk can be assigned to that station. Extensive prompts permit rapid training of inexperienced operators.

The ability to transform any keystation into a supervisory console is also advantageous. If a remotely located clerk should need supervisory help, the supervisor can key in the proper password and then interrogate the system from that station without the need to walk back and forth. In addition, the system isn't knocked out when the supervisor's station goes down; a switch is made to another station and operations continue.

Each keystation features three different methods of formatting the screen. In the first method, field names and corresponding keyed data both appear in the body of the display. These field prompters assist in job training or in expediting an unfamiliar job. In the second method, field names are displayed one by one on the top line of the display, and each one remains until the operator is ready to key the next field; only data appears in the body of the display. In the third method, the keyed data does not build up on the screen, and instead only the last character keyed is shown on the top line.

Each format can consist of up to 32 levels, and each keystation has access to an unlimited number of formats stored on disk. Any or all of these control formats are available to as many keystations at the same time as desired. After the operator has finished keying a format level, another program can automatically succeed the previous one (format level chaining). This sequence of execution can be modified manually by the operator or by the onset of conditions specified in the format programs.

The main editing and validation procedures are as follows: alpha-only entry, numeric-only entry, must enter, must complete, boundary checking, range checking, ascendancy checking, sign checking, comparison logic (greater than, less than, equal to), check digit verification (modulo 7, 10, or 11, or user-specified), crossfooting, record subtotalling, and batch totalling and balancing. The conditions for comparison tests, such as those of range checking, are specified in the format program by means of COBOL verb statements and designations of the fields to be affected. By means of these elementary COBOL state-

The video display is composed of 12 lines of 40 characters each. The first two lines normally present job status information (job name, current field name, current record number, current character position in the record and in the field, current program level, and current status of automatic functions). System messages appear in the third line. Data keyed by the operator, with or without format headers, is exhibited in the remaining nine lines.

CONTROL PROCESSOR: This specially designed Pertec minicomputer has a 1.25-microsecond cycle time, a 16-bit word structure (plus 2 parity bits), a basic memory of 57,344 bytes, which can be expanded to 131,072 bytes in 8K-byte increments, 1 selector channel, and a real-time clock. All words are directly addressable.

MAGNETIC TAPE DRIVES: Six models, all intermixable, are available: 7 tracks, 556/800 bits/inch, at 18.75 or 37.5 inches/second forward speed; 9 tracks, 800 bits/inch, at 18.75 or 37.5 inches/second; and 9 tracks, 1600 bits/inch, at 18.75 or 37.5 inches/second. Operation of one tape drive in the system is standard, but a maximum of four is possible. Reel capacity is 600 feet or 2400 feet, depending on the model selected. These units are manufactured by Pertec.

DISK STORAGE: The standard Pertec magnetic disk drive employed in the system has a capacity of either 2.2 million bytes on a single removable platter; 4.4 million bytes on two platters, one removable and one fixed; or 8.8 million bytes on two platters, one removable and one fixed. Additional drives can be added to the system for a total of up to 35.2 million bytes of storage. The track-to-track head positioning time is 9 milliseconds, the average positioning time is 35 milliseconds, and the maximum is 60 milliseconds. The average rotational delay is 20 milliseconds.

PRINTERS: There are two printers available for use with the system, a 30-character/second incremental printer and a 200-line/minute matrix printer.

The incremental printer is from the UNIVAC DCT 500 terminal. It uses a helical print-wheel with single print-hammer actuator and ink roller to print 63 symbols and up to 132 columns per line. Horizontal pitch is 10 char/inch; vertical spacing is 6 lines/inch.

The incremental printer accommodates six-part continuous forms (or three-part carbonless forms) from 3-7/8 inches to 14-7/8 inches wide. Forms are fed at 30 lines/second; skipping speed is 12 inches or 72 lines per second. Black ink is standard; and red, green, or violet inks are available. Forms control, available as an option, features horizontal and vertical tabulation and accommodates forms of varying lengths.

The matrix printer is manufactured by Tally Corporation and has maximum print speed of 200 lines/minute. When printing lines containing lower case alphabetic characters that have descenders (i.e., g, j, p, q, y), however, the print speed is 165 lines/minute for those lines. This printer uses a 64- or 96-character set and prints up to 132 columns per line. Horizontal pitch is 10 char/inch and vertical spacing is selectable at 6 or 8 lines/inch.

The matrix printer accommodates up to six-part continuous forms from 4 to 14-7/8 inches wide. Forms are controlled by industry-standard 8-channel tape, and the paper advance speed is 4 inches/second.

COMMUNICATIONS

The communications adapter provides an RS-232/CCITT interface for synchronous data transmission in half-duplex mode at a speed of up to 9600 bps with the appropriate lines and modems. A 1900 CADE system can communicate with another 1900 system, with UNIVAC 1100 Series and Series 90 computer systems, or with IBM 360/370 systems. The user selects the line procedure to be used with the communications adapter.

Selection of the Uniscope 100 Display Terminal communications protocol allows the communications adapter to emulate the communications line procedures of the

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UNIVAC 1900 CADE Key/Disk System

ments, virtually any kind of conditional test that the user may require can be programmed into the system. COBOL statements can also be used to enter constants into registers and to mandate their insertion into records, either at the time of keying or at the time of writing to tape, according to specified conditions. Tables can be stored for look-up operations, and the allowable detail of the tables is limited only be the available processor and disk storage space. User effort can be negligible if simple tests are specified and more substantial if complex test routines are introduced; the system can perform tests and checks up to the degree of complexity that the user cares to install.

The data file in disk storage can be searched for a particular record number in a batch, for the next record in a batch carrying an error flag, for the next record having certain field contents specified by the operator, or for the next record within a particular program format having a specified field content. A record can be inserted or deleted from the batch in the Verify, Search/Modify, or Update mode. If you insert or delete a record, the system then renumbers the batch from this point forward; if duplications or calculations have been specified, the system automatically performs these operations with respect to the appropriate record.

The ability to perform all four arithmetic operations is an extremely valuable system property. If fast turnaround on certain types of documents is needed, such as invoices, purchase requisitions, trial balances, customer account statements, etc., the system can compute data for such forms and print formatted output from keyed data even as data for other jobs is being keyed.

Initially introduced without communications capability, the 1900 now offers a communications adapter as an integral feature. The adapter provides an RS-232/CCITT interface for synchronous data transmission in half-duplex mode at speeds up to 9600 bps. Selection features are available which enable the system to communicate with another 1900 system, with UNIVAC Series 90 or 1100 computer systems, or with an IBM 360/370 computer system.

USER REACTION

In Datapro's 1976 survey of key entry equipment users, responses were received from 10 users who reported on their experiences with 11 UNIVAC CADE systems. These 11 systems had a total of 109 keystations for an average of almost 10 keystations per system. The largest system had 17 keystations, while the smallest had only 6. Most of these users had installed 9-track, 800-bpi magnetic tape drives. Also, the majority of the users were employing most of the available data editing and validation features. These features included zero batch balancing, range checking and reformatting, table lookup, total and compare batch balancing, value checking, and prompting. These 10 users rated the CADE system as follows.

UNIVAC Uniscope 100. This enables the 1900 system to communicate with any of the UNIVAC computer systems in the 90, 9000, or 1100 Series. The emulation is for a polled environment, irrespective of whether communicating over a multipoint or point-to-point network. The system will handle a single data line. Some features of Uniscope 100 display terminal communications protocol are not supported under the 1900 system Uniscope 100 terminal emulation. These are: imbedded messages, asynchronous interfaces, terminal multiplexer interfaces, direct synchronous with clock interfaces, screen control, and report address.

The Binary Synchronous communications selection enables the communications adapter to emulate the IBM 2770 Data Communication System and the IBM 2780 and 3780 Data Transmission Terminals. This allows the 1900 system to communicate with another 1900 system and the following IBM systems/terminals:

- 360 under DOS with BTAM
- 360/370 under OS with BTAM, QTAM, or TCAM
- 360/370 under HASP, HASP II, or ASP
- System 3 with RPG II Telecommunications
- 2770
- 2780
- 3780

The 1900 system can receive or transmit data from any of the above systems/terminals, under control of the 1900 system supervisor.

Another selection provides for the emulation of IBM 2780 point-to-point communications procedures and also allows 1900-to-1900 system point-to-point communications. Data transmission can take place, dependent on lines and/or modems, at rates up to 9600 bps in either a dedicated or switched environment. IBM binary synchronous communication (BSC) conventions are observed and data transfer is performed in half-duplex mode using EBCDIC, ASCII, or 6-bit Transcode. EBCDIC may be used in transparency mode for sending any one of 256 characters. The following features are supported: trailing blank truncation, blank compression, horizontal tabling, multi-record formatting, EBCDIC transparency, multiple record transmission, extended inquiry retry, internal clock, and automatic answer/automatic hang-up. The IBM 2780 dual interface capability is not supported.

The communications adapter can operate at data rates ranging from 2000 bps to 9600 bps, depending on the lines and modems used. The lines can be either privately leased or dial-up lines and can use either 2- or 4-wire circuits.

The following table reflects the modems recommended for use with the 1900 system and their characteristics:

Modem	Speed (bps)	Line Type
Sperry UNIVAC 201	2400	Switched or private
Bell 201A	2000	Switched
Bell 201B	2400	Private 2- or 4-wire
Bell 201C	2400	Switched or private
Bell 208A	4800	Private 2- or 4-wire
Bell 208B	4800	Switched
Sperry UNIVAC DCM (type 8543)	2400, 3600, 4800, 7200, or 9600	Privately owned

Other equivalent modems to 9600 bps may be used assuming that unusual timing or interface constraints are not encountered.

SYSTEM OPERATION

Three display modes are available to the operator. In the *Formatted* mode, field names are written on the screen in their appropriate places within the record, and the operator keys data into the respective blanks. This mode is helpful in training novice operators or in expediting an unfamiliar job. In the *Unformatted* mode, a field name displayed on the first status line when the operator is ready to key the corresponding field; this name yields to the next one upon completion of the field. As the data is keyed, it is presented

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	Excellent	Good	Fair	Poor	WA*
Overall performance	6	3	1	0	3.5
Ease of operation	6	4	0	0	3.6
Hardware reliability	2	7	1	0	3.1
Maintenance service:					
Promptness	4	5	1	0	3.3
Quality	3	6	0	1	3.1
Software	2	6	2	0	3.0
Technical support	2	3	4	1	2.6

*Weighted Average on a scale of 4.0 for Excellent.

The CADE users' ratings made it clear that they were generally well pleased with their systems. Only 2 of the 10 users assigned any poor ratings. One, located in a small town in the southwest, rated the quality of maintenance poor. The other user, who was operating a single CADE processor with 12 keystations, gave a poor rating to the UNIVAC technical support but assigned ratings of good or excellent to all the other categories.

One user who had assigned fair ratings to the hardware reliability, promptness of maintenance service, and quality of maintenance in Datapro's 1975 key entry survey assigned good or excellent ratings to the same categories in the 1976 survey. This user had identified tape alignment problems as the reason for the initial low ratings, but he stated that these problems were resolved shortly before the 1975 survey. As evidenced by the high ratings he assigned in the latest survey, this user is now well satisfied with his CADE system and says the tape problems have been totally resolved.□

in the bottom nine lines in the usual way unless the format program orders that it not be displayed. Each data field is separated by a single space or by a field separator. In the *Blind* mode, only the last character keyed is displayed, and it appears on the top status line of the screen. Transition from this mode to either of the other two is easily accomplished from the keyboard.

Activity at the key entry installation is essentially like that of other key-to-disk systems. The supervisor maintains tight control over all system personnel and operations. She enters job and batch numbers, assigns the keystation operators, designs new program formats and enters them into the program library (or assigns the entry task to an operator), releases completed and reformatted batches on the disk file to tape, deletes outdated records or programs from the disk, requests system information and status messages, and causes printouts of various kinds of information. Operator statistics, which consist of the operator's identity, the time elapsed in keying a batch, the number of keystrokes, the keystrokes per hour, and the number of inserts, deletions, and corrections, represent a particularly useful system printout that the supervisor can specify. The operator and supervisor are assisted by nearly 100 prompts and nearly 100 messages describing system conditions.

The basic processor permits simultaneous operation of up to eight keystations, one of which can be controlling a disk-to-tape batch output operation. The expanded versions permit up to 32 keystations to be active simultaneously, together with write-to-tape and output-to-printer operations. In an emergency, such as when one of two system processors goes down, up to 62 keystations can be connected to the active processor.

Any keystation can be converted to a supervisory station by keying in a special password. Other passwords limit access to batches, records, or fields to authorized persons.

ERROR CONTROL: Parity generation and checking is performed on data transferred between the computer and disk and between disk and tape or other output devices. Odd parity is written on 9-track tape, and either odd or even parity on 7-track tape. Longitudinal and cyclic redundancy characters are created and written on disk and tape. A read-after-write check is performed on both tape and disk. Data written on a disk is read during the next revolution and compared with the original data in core; erroneous data is immediately rewritten. A read check is performed when reading from the disk. Validation and other errors cause electronic blocking of the keyboard and sounding of a tone. If desired, the operator can override errors and flag the record for later action.

OPERATING MODES

- Entry–Operator keys data from source documents under control of the format program; she can correct errors in any character position before releasing the record to the disk.
- Verify–An operator rekeys those fields specified for verification by the format program plus other fields that are either contributing to an out-of-balance condition or are designated by the system as containing invalid data.
- Search/Modify–Records stored in the data file can be searched and accessed by the operator according to a particular record number in a batch, by requesting the next record in a batch with an error flag, by calling for the next record having a specific data content entered by the operator, or by requesting the next record within a particular program level having a specific data content. Changes to the record can then be made in the normal way, as described for the Entry mode. Records can also be inserted or deleted from the batch; the batch is then renumbered from this point forward, and any specified duplication or calculation that affects subsequent records is automatically performed.
- Update–The operator can key additional data into each of the records of an existing batch; the display cursor is automatically positioned to the beginning of the field(s) designated for Update by the controlling format program. The purpose of this mode is to enable the operator to update files where most of the information remains constant. Essentially, the Update mode is a form of the Entry mode.
- Supervisor–This mode can be invoked only at a supervisory station for the purpose of supervisor/system conversation or for the performance of supervisory functions such as requesting system hard-copy printout, writing a completed batch to tape, deleting odd records from the data file, etc.
- Format Entry–The specifications for a format program and all automatic operations related to it are entered into the format program library by the operator from any keystation.
- File Inquiry–The FIT software adds COBOL indexed I/O (with minor variations), permitting multiple operators to share indexed files. Operations with indexed files can proceed simultaneously with regular data entry. All operations are under control of format programs prepared by the user. Although data in the indexed files can be accessed by format programs in the Enter, Verify, Update, and Search/Modify modes of operation, the new File Inquiry Update mode is recommended for use in inquiry-response applications and whenever data in indexed files is to be changed. This mode is a special case of the Enter mode in which certain functions, such as the record backspace key and replay, have been deleted. These functions are not applicable, or would have caused problems, when applied to indexed files. The data validation features of the Enter mode are retained to help assure that only error-free data is entered.

The format program can inhibit a particular field from being displayed and require the operator in the Entry mode to rekey that field for immediate verification. If the two field entries agree, the system permits the operator to continue. This entry/verification feature can save time when only one or a few fields in each record require

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verification. Another system feature is concurrent verification, which takes place when an operator keying in the Entry mode is almost immediately followed by a second operator keying the same material.

SYSTEM PROFILE

Since the basic 2.2-million-byte disk drive can be augmented with additional storage of up to 35.2 million bytes and the minicomputer memory can be expanded to 131,072 bytes, ample storage can be added to the CADE system for implementing any desired complement of features and storing any practical quantity of data records. Therefore, the file capacities appearing below represent a typical division of the basic 2.2-million-byte disk and should not be regarded as fixed.

- Record length–can be any length up to 999 characters; there can be 333 separate fields. If the record size is greater than can be displayed on a keystation CRT screen, the system automatically starts a new page when necessary, beginning with a reprinting of the last line of the previous page.
- Record blocking–records written to tape can be blocked up to 4096 characters.
- Record formats–for 999-character records or smaller, a 200-program library is representative of most application environments.
- Data record storage–25,000 80-character records or 18,000 120-character records are normal limits for the data record file.

Exact figures for the number of edit routines and system management programs that can be stored will not be stated, since additional storage capacity can be added as needed to accommodate new routines.

SOFTWARE

All of the conventional keypunch operations, such as skipping, duplication, left-zero fill, alpha-only entry, numeric-only entry, etc., are performed in conjunction with operator keying. In addition, the CADE system imposes such editing constraints as must enter, must skip, and must complete. Check digit verification using modulo 7, 10, 11 or any customer-specified check digit is also performed. Any violations detected by these procedures disable the keyboard, and the condition must be immediately corrected by the operator. Another useful feature is auxiliary duplication, which consists of emitting constants up to 999 characters long at positions within the record specified by the format program.

An advanced feature is "COBOL-procedure programming." Almost 40 COBOL and other procedural-language verbs are available, including Alarm, Call, Compute, Connect, Display, Dup, Field Backspace, Find, If, Move, and Tab. Use of the verbs Allow and Disallow can effect a broad range of character and field validity checking that is limited only by the available processor memory and disk space on the file. The user can also program arithmetic comparison conditions. For example, the operator must enter a certain field if the entry in a prior field exceeds a certain quantity. Or, the quantity entered within a certain field must fall within a specified range (range checking) if the quantity entered in a prior field is less than a certain quantity. Program statements are used to enter the limits of range checks, and to enter a set of table look-up values. If simple range-checking or table look-ups are to be performed, programming with the COBOL statements is not much different from the straightforward entry of parameters common to other systems.

The new FIT (File Inquiry Technique) software adds COBOL indexed I/O to the CADE system. Operations with these indexed files can occur concurrently with data entry. Multiple operators can share indexed files which are accessed by user-prepared format programs in the enter, verify, update, or search/modify modes of operation. The key characteristics of the FIT software can be summarized as follows:

- **Multiple operators can simultaneously share a common indexed file.**
- **Operators can access multiple indexed files in a single format program.**
- **Primary and alternate keys are supported for all indexed files.**
- **Alternate index keys are automatically updated, as required, in real time.**
- **When records are added to an indexed file, index keys are automatically added (in sorted order) to existing indices.**
- **Sharing of files is under program control. The following rules are available for sharing a file. The Input Only option limits a file to an inquiry-response function. No change in the data base is permitted. This is the primary method of sharing indexed files for regular data entry operations. The Output Only option limits an indexed file to a collection of records that could be used as an indexed transaction file. The Input/Output option is the real-time transaction capability. Records can be inserted, deleted, read, modified, and rewritten to the file. If multiple operators are sharing such a file, programmable record lock capabilities are provided to restrict access by other operators to a record which is being modified until the record is rewritten to file.**

The format program can also close and lock files so that a temporary file can be deleted to release memory and disk space used by that file while the job continues. It is also used to prevent undesired re-entry into a designated file as work progresses.

New verbs are added to the COBOL compiler to permit a full set of operator prompts to be displayed and retained on the CRT screen and to prohibit these prompt records from being written to disk.

An interesting property conferred by COBOL programming is the ability to alter format level sequencing in accordance with specified conditions. Hence, a particular sequence can be automatically instituted under one condition, and a different sequence can be implemented under another condition, all program-specified.

Extensive crossfooting within each record can be carried out. These totals can be added to those accumulated in previous records.

To implement batch balancing, a predetermined batch total is entered into the system. After the entire batch has been keyed, the aggregate of these entries must equal the predetermined entry. If an imbalance occurs, the batch is flagged to signify that it requires supervisory attention. The records of this batch need be verified only until correction of an error or errors produces a batch balance.

REGISTERS: The following allocation of registers is available to every batch stored in the system:

- Up to 99 character registers are available for storing characters or fields to facilitate their manipulation.
- Up to 99 auxiliary duplication registers are available for storing and emitting constants.
- Up to 99 balance registers are available for accumulating crossfooting totals and batch totals.
- Up to 99 arithmetic registers are available for COBOL arithmetic operations.

Any register can be displayed on the message line of a keystation CRT screen. Arithmetic registers, in conjunction with COBOL verbs specifying each of the four arithmetic operations, enable elementary data processing to be performed on entered data prior to its release to the output

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UNIVAC 1900 CADE Key/Disk System

tapes. If the user wishes, he can program various basic operations that are ordinarily performed by the mainframe.

REFORMATTING: In the standard form of the system, fields within a record can be rearranged before writing the record to tape. The records, which must all be of the same length, can be blocked up to a limit of 4096 characters. Constants can be emitted into appropriate field locations at this time as well as during the keying operations. Headers or accumulations can also be emitted into the reformatted record. If more complicated reformatting is desired, such as composing entirely new records by abstracting designated fields from stored records, appropriate COBOL statements can be entered into the system.

PRICING

The UNIVAC 1900 CADE system is available for rental on a one-year or five-year lease or for purchase. Monthly rental costs under a five-year lease are approximately 20 percent less than under a one-year lease. Maintenance contracts are available for either arrangement. Lease costs based on a one-year contract, purchase prices, and prime-shift maintenance charges are presented below. The monthly rental costs below include prime-shift maintenance.

	Monthly Rental*	Purchase	Monthly Maint.
1900 CADE Processor (includes 57K-byte memory, controllers for up to 4 disk drives and 4 tape drives, and space for two 7-inch tape drives and one disk drive or one 7-inch tape drive and two disk drives)	$606	$25,200	$81
Storage expansion—8K-byte module (first module)	138	6,096	11
Storage expansion—each succeeding 8K-byte module	96	4,080	11
Power Supply Expansion (required for memory over 65K)	42	1,824	4
Drive/Single Disk (2.2M-byte cartridge)	270	10,176	58
Drive/Double Disk (2.2M-byte cartridge and 2.2M-byte fixed disk)	400	15,024	87
Drive/Double Disk (4.4M-byte cartridge and 4.4M-byte fixed disk):			
First drive	487	19,200	87
Second drive	377	13,920	87
Third drive	345	12,960	75
Fourth drive	315	12,000	65
Disk Control Expansion (provides second disk controller for dual access to two or more drives)	63	2,784	5
18.75 ips tape drives; 7-inch reels (fit into Processor or Tape/Disk Cabinet):			
7-track, 556/800 bpi, NRZI	135	5,088	29
9-track, 800 bpi, NRZI	135	5,088	29
9-track, 1600 bpi, PE	179	6,624	41
37.5 ips tape drives; 10.5-inch reels (free-standing):			
7-track, 556/800 bpi, NRZI	222	8,400	47
9-track, 800 bpi, NRZI	222	8,400	47
9-track, 1600 bpi, PE	259	9,936	52
NRZI Formatter**	53	2,304	5
Phase Formatter (for PE drives)**	106	4,560	11
Tape/Disk Cabinet (houses two 7-inch tape drives and two disk drives, or four 7-inch tape drives)	106	4,560	11
Keystation (any keyboard style)	76	3,168	10
Table—one drawer	5	240	—
Table—two drawers	7	336	—
Character Printer (30 cps)	109	4,080	24
Line Printer (200 lpm)	397	14,976	85
Communications Adapter	70	2,640	15

*Includes prime-shift maintenance.
**One Formatter is required for a group of NRZI and PE tape drives.■

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A Buyer's Guide to Data Base Management Systems	70E-010-61	5	5/76
A Buyer's Guide to Data Management Systems	70E-010-62	4	11/76
A Buyer's Guide to Data Communications Monitors	70E-010-63	5	3/76
ASI-ST, Applications Software Incorporated	70E-051-01	2	5/75
PI SORT, Applied Data Research, Inc.	70E-052-01	1	5/75
The LIBRARIAN, Applied Data Research, Inc.	70E-052-02	2	12/76
AUTOFLOW II, Applied Data Research, Inc.	70E-052-03	4	5/75
ROSCOE, Applied Data Research, Inc.	70E-052-04	1	9/75
MetaCOBOL, Applied Data Research, Inc.	70E-052-07	2	9/76
Extracto, Aquila BST	70E-058-01	2	11/76
DRS, A.R.A.P.	70E-059-01	2	10/76
A.S.A.P. Payroll/Personnel System, Argonaut Information Systems	70E-060-01	1	11/76
Project Control/70, Atlantic Software, Inc.	70E-064-01	1	9/75
Query5, Azrex, Inc.	70E-085-01	1	5/75
Total System Analyzer (TSA), Boole and Babbage, Inc.	70E-098-01	1	8/76
Configuration Utilization Evaluator (CUE), Boole and Babbage, Inc.	70E-098-02	1	8/76
CAS/CPA, Boole & Babbage, Inc.	70E-098-03	1	8/76
CONTROL/IMS, Boole & Babbage, Inc.	70E-098-04	2	10/76
DMS-II, Burroughs Corporation	70E-112-01	2	12/75
CROSSTABS, Cambridge Computer Associates, Inc.	70E-123-01	1	9/75
UTILITY-CODER/360, Cambridge Computer Associates, Inc.	70E-123-03	2	5/75
Optimizer II, Capex Corporation	70E-124-01	1	10/75
COTUNE, Capex Corporation	70E-124-02	1	10/75
Autotab II, Capex Corporation	70E-124-04	1	5/75
DUCS-VI, C F S, Inc.	70E-129-01	1	1/76
TOTAL, Cincom Systems, Inc.	70E-132-01	2	3/76
Environ/1, Cincom Systems, Inc.	70E-132-02	2	3/76
3705 Performance Packages, Comm-Pro Associates	70E-158-01	1	2/76
SYMBUG, Computer Associates	70E-165-01	1	9/76
CA-SORT II, Computer Associates	70E-165-02	1	8/76
Model 204, Computer Corporation of America	70E-174-01	3	12/75
DATACOM/DC, Computer Information Management Co.	70E-180-01	1	2/76
DATACOM/DB, Computer Information Management Co.	70E-180-02	2	4/76
SCERT/76, Comten, Inc.	70E-242-01	1	5/76
AMIGOS, Comten, Inc.	70E-242-02	1	5/76
ALERT, Comten, Inc.	70E-242-03	1	8/76
IDMS, Cullinane Corporation	70E-272-02	2	3/76
CULPRIT, Cullinane Corporation	70E-272-03	1	12/76
JASPER, Datachron Corporation	70E-334-01	1	9/75
Data-Man, Data-Man Ltd.	70E-339-01	1	12/76
1130/SORT, DNA Systems, Inc.	70E-396-01	1	9/76
Quantitative Computer Management (QCM), Duquesne Systems, Inc.	70E-398-01	1	6/76
DYL-250 and DYL-260, Dylakor Computer Systems, Inc.	70E-400-01	1	4/75
Data Base Directory, Eastern Air Lines, Inc.	70E-402-01	2	6/75
FORESIGHT, Foresight Systems Inc.	70E-440-01	1	12/75
GBASWIFT, GBA International	70E-444-01	1	2/76
TLMS, Gulf Oil Computer Sciences, Inc.	70E-462-02	1	8/76
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SLICK, NCI, Inc.	70E-659-03	1	8/76
TUMS, NCI, Inc.	70E-659-04	1	10/75
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PANVALET, Pansophic Systems, Inc.	70E-677-01	2	12/75
EASYTRIEVE, Pansophic Systems, Inc.	70E-677-02	1	12/75
PAN*DA, Pansophic Systems, Inc.	70E-677-04	1	3/76
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Intercomm, Programming Methods Company	70E-694-01	2	2/76
Minicomm, Programming Methods Company	70E-694-02	1	1/76
Betacomm, Programming Methods Company	70E-694-03	1	2/76
Score, Programming Methods Company	70E-694-04	1	1/76
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EPAT, Software Design, Inc.	70E-760-02	1	10/76
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User Ratings of Proprietary Software

More Users, More Packages, and More Winners

Datapro is pleased to present the fourth annual *User Ratings of Proprietary Software* report. It's the biggest one yet. We again went to our subscribers and asked them to rate the software packages utilized in their own installations by assigning ratings to seven distinct categories describing the effectiveness of each package and of the vendor supplied-support in the form of documentation, training, and on-site support. In addition, we gathered from these users financial information regarding their past, current, and future budgets for software acquisition.

Again, as in 1975, we asked the users to include ratings on all types of software, whether it be "free" (or bundled) or obtained from computer vendors or software suppliers at a definite cost. Thus, for many well-known packages and systems, this report should help to answer the familiar question: is a free package a bargain?

In the 1976 survey, we received more user responses and more ratings on more different packages than ever before in the history of this survey. What's more, we are happy to announce that there are more winners of the coveted Datapro Software Honor Roll award than ever before. This year 38 packages from 27 different vendors achieved Honor Roll status. We interpret this as a sign that vendors are not only offering better software products, but that they are striving to improve their existing products to better meet their customers' needs. After all, it is not Datapro that selects the products to the Honor Roll; you, the users, through your ratings, have placed them there.

Who We Surveyed and What We Asked

The 1976 survey of proprietary software users was again undertaken cooperatively. As in 1975, Datapro Research Corporation and *Datamation*, the industry's leading monthly magazine, planned and implemented this large-scale joint effort to assess users' experience with proprietary software, and a condensed presentation of the results is scheduled for publication in the December issue of *Datamation*.

Survey forms were mailed to 30,000 specially qualified subscribers to *Datamation*, the cream of the magazine's circulation list; that is, the persons to whom the survey forms were sent tended to be data processing managers or company presidents.

The survey form itself was of Datapro's traditional design, with a few amendments by *Datamation*. The forms were mailed first class and were printed on the reverse side of an introductory letter signed by John L. Kirkley, *Datamation's* editor. Completed forms were returned to *Datamation*, where they were consecutively numbered by machine. Then the returned survey forms were forwarded to Datapro, where all the processing and statistical work was performed.

This report contains the results of Datapro's fourth annual survey of proprietary software users, conducted in cooperation with *Datamation*. You'll find extensive tables showing how thousands of users rated 250 individual packages, plus financial insights and the 1976 Software Honor Roll. The results can assist you in evaluating proprietary software for your installation and getting more for your software dollar.

We'll tell you more about the processing later. At this time, we'd like to briefly describe the survey form.

The form contained 20 questions. The first 4 were general, the next 15 applied to specific software packages, and the remaining question was a place where the user could add any additional comments.

Question 1 was: Do you use proprietary software supplied by an independent vendor? Question 2 asked: Do you presently use separately priced software from your mainframe manufacturer? Thus, depending on the answers received, it was possible for us to determine whether the user, regardless of whether or not he actually supplied any ratings, (a) was not using proprietary software, (b) was using a computer vendor's charged-for software, or (c) was using independently vended software. Additionally, a pair of "no" responses coupled with a rating indicated a fourth possibility: that the user was using and rating a free package from his equipment vendor.

Question 3 was a general budgetary question in three parts. Users were asked to inform us as to how much they spent, are presently spending, and plan to spend on software packages in 1975, 1976, and 1977. The financial figures thus obtained are presented later in this report.

Question 4 asked: What packages or types of packages do you plan to evaluate during the next 12 months? It proved impossible to report these responses in print, due to time and space constraints, but information of this type will ultimately become available to Datapro subscribers through our telephone consulting service.

The 16 remaining questions could be answered for any number of software packages. The form contained space for ratings of three packages, but users were in- ▷

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User Ratings of Proprietary Software

vited to copy the form as many times as necessary in order to report on more than three packages. Many respondents did just that.

Questions 5 and 6, respectively, asked for the name of the package and of the package's vendor. Question 7 asked for the month and year when the user began using the package. Question 8 asked the user to identify the make and model of his computer system, and question 9 asked for the identity of his operating system. Question 10 queried: How much main storage is used by the package?

Question 11 asked: What is the approximate price of each package? Responses to this question, unfortunately, were impossible to process and present in meaningful fashion because it was often impossible to determine whether the indicated price was a rental, lease, license, or purchase price--let alone whether the price stated included maintenance, training, source code, etc., and whether it was a discounted price, a multiple-installation price, a beta test site price, etc. Question 12, which asked for the annual maintenance charge, was answered by too few respondents to be presented as statistically valid.

Question 13 was the all important and by now famous Datapro User Ratings question. In seven parts, it asked users to rate each package as either Excellent, Good, Fair or Poor with respect to: Overall Satisfaction, Job Throughput or Program Efficiency, Ease of Installation, Ease of Use, Documentation, Vendor's Technical Support, and Training, if applicable. It was on the basis of the "weighted averages" calculated from these responses that the charts concluding this report were compiled and the 1976 Datapro Software Honor Roll winners determined.

Question 14 was another traditional Datapro rating question: Did the package perform as advertised immediately, eventually, or never? The responses were charted.

Question 15 was: Did the package require modification by the vendor, by the user, or not at all? The answers were also charted in this report. Question 16, a follow-up question, asked the users to record the approximate costs of these modifications. Limited space prevents our presentation of the responses, but our telephone consultants can respond to specific inquiries.

Question 17 asked the users to check off particular advantages of each package. This format allowed us to group responses that would otherwise have been impossible to present neatly in the charts. Users could check off: Flexible, Inexpensive, Saves system resources, or Saves human resources.

Question 18 allowed us to report on points of specific user dissatisfaction, if any, with each package. Check-off choices included: Inflexible, Complex, Costly, Slow, Uses excessive resources, Lacks key capabilities, and Compatibility problems.

Question 19 asked whether the user acquired the package, expects to acquire it, or rejected it after testing it. It seems reasonable to assume that people who decide to acquire a package will be biased in its favor. To help offset this effect, we gave equal weight to ratings submitted by prospective users who reported that they rejected a package after subjecting it to thorough testing.

Question 20 allowed the user to make any additional comments regarding the package. Many users availed themselves of this opportunity, and their comments made interesting reading. They will aid us greatly in the preparation of future reports on specific packages and in providing telephone consulting services to our subscribers.

About the Overall Response

A total of 5202 users, or 17.4 percent of the addresses, returned forms. This total can be further broken down as follows: (1) 2,128 users provided one or more package ratings and general budget information; (b) 375 users provided one or more package ratings but no general budget information; (c) 507 users provided general budget information but no package ratings; (d) 2,086 users responded to indicate that they use no proprietary software and did not provide any general budget figures; and (c) 106 returns were ruled invalid because they contained no user identification (we had to be sure that the source of information was legitimately a user) or were supplied by software vendors or competitors of vendors. Also ruled invalid were unreadable forms and undecipherable or ambiguous forms (e.g., a form on which a user states that he uses a general ledger package, but doesn't identify the vendor or his system).

Expressed in percentages, the breakdown of the 5,202 returns was as follows:

Category	Percent
Gave ratings and budgets	40.9
Gave ratings only	7.2
Gave budgets only	9.7
Gave neither	40.1
Invalid returns	2.1

A total of 2503 users (groups a and b above) supplied ratings of software packages. A high proportion of the users who rated packages, by the way, rated more than one. And that point is important in the statistical information following: a distinction is made between a *response* and a *rating*. A *response* is a returned form, or

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in some cases a returned form with an attached sheaf of copies; a *rating* is a set of information supplied by one user about a particular package.

The total number of ratings was 3,659. This total includes all the figures given in the comparison charts for the 250 packages rated by three or more users. In addition, there were 1,196 packages rated by only one or two users, but these packages are not mentioned in this report because of space limitations and because we believe the sample sizes are too small to serve as reliable guides to overall user satisfaction with these products.

What We Learned About Software Expenditures

A total of 2,635 survey respondents (50.7 percent) gave some budgetary figures for their 1975 and 1976 software package expenditures and/or their anticipated software package budgets for 1977. This total is comprised of 2,128 users who gave both ratings and budgets and 507 users who gave no package ratings but did supply some budget figures. Not all gave software budget figures for all three years, however.

From last year's survey, where we gathered the corresponding information for the years 1974, 1975, and 1976, we observed that the rate of increase in the budgetary figures was approximately 20 percent per year. Based on this year's survey, the rate of increase in dollars being spent on the acquisition of "outside" software has jumped four percent, on the average, to 24 percent per year. The following table shows the number of user responses reporting budgetary figures, the sum of the dollars being spent or projected, and the average expenditure per installation for each of the three years in question.

	1975	1976	1977
No. of responses	1,546	1,914	1,741
Sum	$22,510,752	$34,997,441	$38,986,419
Average	$14,561	$18,285	$22,393

These figures make it clear that the proprietary software industry is a healthy one and that its products are finding steadily increasing user acceptance.

The survey results also provide a general indication of where the proposed expenditures will be spent. In Question 4 of the survey form, we asked the users to indicate what packages, or types of packages, they anticipate evaluating during the next 12 months. Although it turned out to be virtually impossible to quantify the packages mentioned in these responses, we noted that numerous respondents indicated they would be looking at data base management systems and telecommunications monitors. Many users also mentioned the old standbys: payroll, personnel, and general accounting packages. System support packages, such as hardware and software performance measurement packages, were also mentioned. Thus, it can truthfully be said that users have widely diversified software needs and will continue to evaluate and acquire a broad range of packages. Prospective software purchasers shuld benefit by carefully reviewing this year's user ratings of software to get a better picture of what users of various types of packages have to say about the products that they have acquired and installed in their installations.

Make It or Buy It?

There was a day, not very long ago, when the idea of purchasing software, especially from anyone but your mainframe vendor, was risky at best. There were hundreds of packages available, but the products and their vendors were unproven. For a while, software vendors seemed to be dying off as quickly as new ones were born to replace them. A potential buyer of software had to wonder whether the vendor would even be around next month to support the product. Technical support and documentation were often sketchy and in some cases were nonexistent.

For all of these reasons, when a user did decide to go to the outside for a software package, he often selected software available from his mainframe manufacturer instead of better, more efficient, and lower-cost systems offered by the independents. At lease the user had some level of assurance that the company would be around to honor the contract.

But those days are gone. The software business is, today, a legitimate and thriving one in its own right. The purchase or leasing of proprietary software is gaining an increasing percentage of EDP budgets every year. Some of the more successful software houses claim to have tripled or even quadrupled their sales in the past few years. Most predict that this trend will continue.

Meanwhile, users are becoming more and more aware of the economic and other advantages of obtaining proprietary software. The risk now is minimal, and is usually offset by a risk of equal proportion that confronts a company developing a system in-house. At least when you purchase a proprietary software package, the cost and (hopefully) the installation time are fixed. And that's certainly more than can be said for in-house development efforts.

The "not invented here" syndrome, which plagued the software industry for so long, is dying. Granted, it is not dying quickly or easily, but it is showing a progressively fainter heartbeat. Users are increasingly aware that the use of proprietary software, when compared to the cost and uncertainty of in-house development, has a legitimate place in almost every EDP installation.

Before You Buy

But just because the software industry as a whole has come into its own, it doesn't follow that every package is clean, cost-effective, well supported, or adaptable to

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every installation. Even packages from highly reputable vendors may be lacking in some respects.

Before putting your money on the line for separately priced software, you deserve to know—and should demand to know—how that software is performing in other user installations. DATAPRO 70 is placing steadily increasing emphasis on the User Reaction section of each software package report because we believe that the comments and evaluations of people who are actually using each system are invaluable to others considering its use. In addition, we feel that this report, containing directly comparable ratings by actual users of 250 software packages from 103 sources, can help to guide potential software buyers toward packages of proven reliability.

Reasons for Using Proprietary Software

There are many reasons why a user may wish to obtain a proprietary software package. The main ones are:

- Avoidance of an in-house effort,
- Standardization,
- Improvements in the speed or efficiency of program execution,
- Improvements in the control, speed, or ease of system operation, and
- The resultant cost savings from any or all of the above.

Avoiding an in-house effort is often one of the best reasons for acquiring a package. But it may also be the most difficult one to rationalize within your own company. First, you have to convince management that the money and/or the time that will be spent for the package is less than the amount that would be required for in-house development. This is often difficult to prove, especially since time and cost estimates for system development nearly always tend to be overly optimistic.

Secondly, you must confront the fact that avoiding an in-house effort may mean avoiding the hiring of additional programmers, and, in some cases, actually reducing the size of your existing programming staff. Needless to say, this isn't going to go over well with your programming staff, and perhaps not with your programming manager either. It's no wonder that programmers often refer to proprietary software as "outhouse" efforts.

Then, after you've gotten over that hurdle, you must convince management and programmers alike not to be taken in by the "not invented here" syndrome. So many people still believe that nothing from outside can possibly be as good as something they develop themselves. And, in some cases, they may have half a point. General-purpose systems software can frequently be installed without any modification required to make it fit the installation. But this is usually not true in the case of applications software, as you can readily see in the charts at the end of this report.

Overall, the respondents to this year's survey provided 3,503 responses to the question about whether the packages required modification (Question 15). Although 2,195 (63 percent of these responses) replied "none," 658 (19 percent) said "yes, by the vendor" and 806 (23 percent) answered "yes, by the user." In numerous cases both the vendor and the user made modifications, which explains why the percentage figures total more than 100.

It should also be borne in mind by prospective users of proprietary applications packages that vendors, especially vendors of packages used on low-budget systems, often either cannot afford to support or modify packages installed outside a small geographic region, or may even be vending packages with the explicit understanding that modifications are not a part of their standard deal.

Thus, the buyer of applications software (and often systems software, too) must keep in mind that frequently he will have to allocate some time, manpower, and other resources to the installation of a proprietary software package. This must be considered in making the decision of whether or not to buy.

Standardization is often a good reason for a user—especially a user with multiple computer systems at various sites—to purchase proprietary applications software. This can guarantee that a particular application, such as accounts receivable, will be processed the same way regardless of location. Additionally, standardization at one or more computer sites can be achieved through the use of proprietary systems or operations software, such as library systems, documentation aids, languages, shorthands, and some accounting and reporting systems. Proper standardization can improve communication among personnel and systems, enable data to be transferred among systems, and permit simplified, standardized maintenance of programs.

Proprietary software used to improve the execution speed of a common application must save the user at least as many dollars worth of computer time as it costs to be worthwhile. Prime examples of packages designed to do this are sorts, utilities, data manipulators, report writers and generators, language optimizers, and data base management systems.

Some proprietary software packages are designed to speed or ease the way in which a system is operated. By their nature, they may also serve to standardize system operations. Additionally, there are packages designed to improve the control management has over

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computer operations. The various operating system enhancements, accounting packages, library systems, documents, some reporters, and even some sorts and utilities fall into the group providing services in all of these areas. Cost justification for many of these packages, like that for standardizing packages, can be difficult to assess. Often, a trial is the only way to judge. Can a shift be eliminated when the package is used? Are costly operator errors being reduced? Is the number of production job reruns going down? Are deadlines being met when they weren't before? Do you need an evaluation of whether the deadlines themselves are reasonable? (There are packages for that, too.)

What We Learned About User Satisfaction

The basic information collected from the survey is presented in the charts that fill the last eight pages of this report. In reviewing these charts, we urge you to give careful consideration to the number of user ratings received for each package. In general, the larger the sample size, the more confident you can be that the tabulated information represents a reliable indication of overall user experience with the package.

We anticipate that this year's charts will be more meaningful and helpful than ever. The total of 250 packages rated by three or more users, this year's minimum for inclusion in the tabulated results, is nearly 20 percent larger than in 1975.

Using the Charts

The charts, with their accompanying legends, largely speak for themselves. But a few comments are in order. In the user ratings of the seven categories, it often occurs that the total number of responses we receive in a given category is less than the stated number of users rating the package. This happens when a user has chosen not to rate a given category. The weighted average is calculated by using the number of users rating each individual category, and not the total number rating the package in general.

Also, the number of responses that show up in the "Require Modification?" column may exceed the total number of users rating the package. This happens when both the user and the vendor have made modifications to the package in one or more cases.

The weighted averages for all packages were computed in a manner similar to most college grading systems: excellent is weighted as 4, good as 3, fair as 2, and poor as 1. Then, the tallied number of each response is multiplied by the corresponding weight, and an average is taken by dividing the sum of the products by the number of responses totaled.

About Weighted Averages

Weighted averages have a purpose, and that purpose is scoring or ranking. It's achieved by assigning each of the possible ratings an appropriate amount of "weight." But consider this: Two packages with 15 users reporting on each could both earn a weighted average of 3.0 in Overall Satisfaction, but one could have 15 "good" ratings in the category while the other could have 5 ratings each in the "excellent," "good," and "fair" categories. Our point is that in the first case, all users said "good" in this category, but in the second case some users, one-third of them in fact, called their Overall Satisfaction only "fair." Yet, in the second case, another one-third of the users called the package "excellent" in the same category. If the two packages compete, which is better?

Usually, that's where additional research (performed as required for our subscribers by Datapro's telephone consultants) comes in. It can sometimes be learned whether a user had special reasons for assigning some "poor" ratings. Was his installation the first for the package on his machine type, or the first use with a different operating system? Were his file structures vastly different? Were new devices used for the first time, such as communications gear or double-density disks? These and a host of other points of information can only be garnered by follow-up checks with the users who gave the ratings. Fortunately, we've kept this in mind, and have maintained an audit trail that will enable the Datapro telephone consultants to assist our subscribers.

Trends in User Satisfaction

In an effort to determine whether user satisfaction with proprietary software is increasing or decreasing, we compared the *overall weighted average user ratings* earned by all the packages rated in this year's survey with the same figures from last year's survey. Here are the results:

Category	1975	1976	Difference
Overall satisfaction	3.3	3.3	0
Throughput/efficiency	3.1	3.1	0
Ease of installation	3.1	3.1	0
Ease of use	3.2	3.2	0
Documentation	3.0	2.9	-0.1
Vendor technical support	2.9	2.9	0
Training	2.8	2.8	0

As you can see, there was remarkably little change in the overall consensus of user opinion. The slight downward drift in the Documentation rating is probably too small to be of any real significance. As in 1975, software users exhibit a fairly high level of Overall Satisfaction with the products they are using, but tend to be somewhat critical of the associated Training, Vendor Technical Support, and Documentation.

The 1976 Honor Roll

In 1973 we introduced the Datapro Software Honor Roll. The criterion for making this list was an Overall Satisfaction rating of 3.5 or better with at least three users reporting. In 1974, we stiffened the basic require-

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ments. In addition to having an Overall Satisfaction rating of 3.5 or better, the package had to receive no rating lower than 2.8 in each of four other categories: Throughput/Efficiency, Ease of Installation, Documentation, and Vendor's Technical Support. Additionally, ratings from at least six users were required in 1974.

The Honor Roll requirements for 1975 were even more demanding, because an additional rating category, Ease of Use, was added. The Honor Roll packages had to earn a rating of at least 2.8 in this new category as well. In addition to this explicit new requirement for honors, an implicit factor may have tended to winnow down the Honor Roll candidates: in 1975, for the first time, those who had tried and rejected a package were permitted to enter their ratings of it.

In 1976 we have continued to use the same Honor Roll criteria, except that we asked users who rated a package after rejecting it to do so only if they had thoroughly tested the product.

This year no fewer than 38 packages from 27 vendors qualified for the Datapro Software Honor Roll, a 52 percent increase over the 25 packages that qualified in 1975. Since the total number of user ratings received this year was nearly the same as in the 1975 survey and the overall level of user satisfaction was about the same, the only reasonable conclusion seems to be that the number of truly high-quality software packages in widespread use has increased dramatically during the past year. Clearly, this is good news for prospective software buyers.

Seven of the 1976 Honor Roll packages have earned a place among software's elite by achieving Honor Roll status for the fourth consecutive year. In the list that follows, these packages are denoted by three asterisks. Five packages have earned that distinction for the third consecutive year, and they are denoted by two asterisks. Seven were named to the Honor Roll for the second consecutive year, and they are denoted by a single asterisk. The four packages denoted by a pound sign (#) earned Honorable Mention in 1975. Additionally, the names of the vendors with more than one package on the Honor Roll this year are printed in italics in the following list.

And now, here it is—the 1976 Datapro Software Honor Roll:

ALLTAX***—Management Information Service

ASAP*—*Universal Software, Inc.*

CA-SORT II—Computer Associates, Inc.

CYTOS#—*DNA Systems, Inc.*

DFAST—*Oxford Software Corporation*

DIOPEN#—*IBM Corporation*

DISKPLAY#—Boole & Babbage, Inc.

Disk Utility System***—*Westinghouse Electric Corp.*

DYL-250***—*Dylakor Software Systems, Inc.*

DYL-260—*Dylakor Software Systems, Inc.*

EASYTRIEVE—*Pansophic Systems, Inc.*

EPAT***—*Software Design Inc.*

Fast/Dump/Restore**—Innovation Data Processing, Inc.

FMAINT#—*Software Design Inc.*

1130/FORTRAN*—*DNA Systems, Inc.*

GRASP***—*Software Design Inc.*

IDMS—Cullinane Corporation

IMAGE—Hewlett-Packard Co.

IMSL Subroutine Libraries*—IMSL, Inc.

The LIBRARIAN***—*Applied Data Research, Inc.*

LOOK—*Applied Data Research, Inc.*

Minicom—Informatics, Inc.

Optimizer II**—Capex Corporation

PANVALET***—*Pansophic Systems, Inc.*

RELO-PLUS*—*Universal Software, Inc.*

RPG II(for 360/370)**—*IBM Corporation*

SAS—SAS Institute, Inc.

SLICK—NCI, Inc.

Software 1040—SAB, Inc.

1130/SORT*—*DNA Systems, Inc.*

SPSS—SPSS, Inc.

SYNCSORT**—Whitlow Computer Systems, Inc.

Teleprocessing Interface System (WESTI)*—*Westinghouse Electric Corp.*

TFAST—*Oxford Software Corporation*

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TLMS—Gulf Computer Sciences, Inc.

TOTAL—Cincom Systems, Inc.

UCC 1**—University Computing Co.

WATFIV*—University of Waterloo

*Honor Roll package for the second year.

**Honor Roll package for the third year.

***Honor Roll package for the fourth year.

#Honorable Mention package in 1975.

Special recognition should go to the nine vendors that placed two or more packages on the 1976 Datapro Software Honor Roll. Software Design Inc. is the proud supplier of three of the Honor Roll packages: EPAT, GRASP, and FMAINT (now incorporated into a new package called FLEET). DNA Systems, Inc. also placed three packages on the Honor Roll: CYTOS, 1130/FORTRAN, and 1130/SORT. Companies with two packages on the list include Applied Data Research, Dylakor Software Systems, IBM, Oxford Software, Pansophic Systems, Universal Software, and Westinghouse Electric.

The makeup of the 1976 Software Honor Roll deserves a few comments. Nineteen of the 25 packages on last year's Honor Roll earned the same distinction again this year. The 1976 Honor Roll is again dominated by "systems" packages (as distinguished from packages for specific applications), with 33 of the 38 packages falling into the systems category. And, as in 1975, most of the Honor Roll packages are relatively simple products with straightforward functions.

There has, however, been a significant breakthrough in the composition of the 1976 Honor Roll. Last year, despite the strong industry emphasis on data base management systems, not a single DBMS was able to satisfy the Honor Roll criteria (although several came very close), and we considered adjusting the Honor Roll standards to give the more complex, multi-function software products as much of a chance at making the list as the small, simple packages. This year, things are different. Three data base management systems—Cincom's TOTAL, Cullinane's IDMS, and Hewlett-Packard's IMAGE—all earned places on the Honor Roll, and Burroughs' DMS-II achieved Honorable Mention. Thus, it appears that user satisfaction with data base management systems is increasing, and that it is entirely reasonable to judge these complex products by the same standards as the simpler packages.

As in previous years, we asked the users to rate the Training, if any, that accompanies each software package. However, since formal user training is neither offered nor required for many of the simpler packages, *the ratings of Training were not included in the Honor Roll criteria.* Still, it's interesting to note that 28 of the 38 Honor Roll packages would remain on the 1976 Honor Roll if a rating of 2.8 or better in Training were required.

We are happy that so many of the products that appeared on previous Honor Rolls and Honorable Mention lists have again been so honored by their users. We must impress upon our readers that it is not Datapro that decides who makes the honors lists, but rather the users of the various software products. The awards are based directly upon the users' experience as reported to us, and the significant increase in the number of Honor Roll packages seems to indicate that they are happier with the overall software offerings on the market today than ever before. Let's hope that this trend continues.

Honorable Mention

To acknowledge the apparent excellence of software packages that met the Honor Roll rating criteria (3.5 or better in Overall Satisfaction and 2.8 or better in every other category, with Training excluded), but which received ratings from only three to five users instead of the required six or more, we have compiled a list of packages which deserve Honorable Mention. Remember, the criteria for Honorable Mention are just as tough as those for the Honor Roll, except for the smaller sample size. Sixteen packages (out of a total of 250) from 15 vendors earned Honorable Mention.

The following list identifies the vendor and briefly states the purpose of each Honorable Mention package:

ADPAC II—Applied Data Systems (business-oriented higher-level language and compiler with a report program generator feature)

Autotab II—Capex Corporation (a financial modeling, reporting, and analysis language designed for non-programmer use)

CIMS—BMS Computer Inc. (job accounting and system performance monitors for IBM DOS, OS, or their VS counterpart systems)

COBOL—Burroughs Corporation (standard Burroughs compiler for most B Series computers)

COBOL—NCR Corporation (NCR ANS COBOL processor for most Century and Criterion Computers)

DMS-II—Burroughs Corporation (a generalized data base management system designed to operate on most larger B series computers)

DOS/MVT—Software Pursuits, Inc. (replacement for IBM's DOS operating system; supports a 12 partition environment)

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DOSSIER—Computer Concepts, Inc. (IBM DOS or DOS/VS program library file descriptor system for core-image and/or relocatable libraries)

DUCS VI—CFS, Inc. (display unit control system that contains an access method providing support for 2260's and remote or local 3270's)

F-LE-E—Goal Systems (replacement linkage editor for IBM S/370 DOS/VS systems)

GBASWIFT—GBA International (generalized telecommunications monitor for IBM S/360 or 370 DOS or DOS/VS systems)

Installment Loan System—Florida Software Services, Inc. (a flexible installment loan system designed to run on IBM, Burroughs, NCR, and Honeywell systems)

MAC-PAC-3—Arthur Andersen & Co. (manufacturing planning and control system designed for use on the IBM System/3)

PROCON—Nichols & Co. (project planning and control system for use on IBM 360/370, Burroughs, Honeywell, and DECsystem-10 computers)

TERMINAL—Parallel Data Systems, Inc. (data communications magnetic tape formatting program for use with IBM 360/370 systems)

XBASE—DNA Systems, Inc. (extended data base support for disk access on IBM 1130 and compatible systems).

Some Shopping Advice

By reading the charts that follow and making judicious comparisons, the prospective software buyer can determine, with a considerable degree of confidence, the principal strengths and weaknesses of 250 popular software packages as judged by their users. What's more, in the many cases where two or more products from a given vendor are rated here, the prospective user can learn quite a bit about the vendor, too.

If you're shopping for a particular type of software package, you can maximize the value of the information in this article by grouping the user ratings of all the relevant packages into a "sublist" that facilitates direct comparisons. As an example of this straightforward comparison technique, we've listed the ratings of all the popular data base management systems in the accompanying table. In addition to the three DBMS products that made the Honor Roll (IDMS, IMAGE, and TOTAL), you can see that several others were highly regarded in one or more of the rating categories and might well be even more suitable for use in certain installations. Computer Information Management's Datacom DB, for example, received the highest user rating of any DBMS in the important Throughput/Efficiency category but failed to satisfy the Honor Roll criteria primarily because of a sub-par rating in Documentation. Conversely, IBM's GIS, DL/1, and IMS were the three DBMS products rated lowest in Overall Satisfaction by their users.

HOW USERS RATE THE POPULAR DATA BASE MANAGEMENT SYSTEMS

Package & Vendor	No. of users reporting	Weighted Average User Ratings*						
		Overall satisfaction	Throughput/Efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training
ADABAS, Software AG	4	3.3	3.3	3.3	3.5	2.0	2.8	2.5
Datacom DB, CIM	8	3.3	3.4	3.0	3.4	2.3	3.4	3.1
DBOMP, IBM	48	3.0	2.6	2.4	2.7	2.5	2.7	2.4
DL/1, IBM	29	2.6	2.4	2.3	2.4	2.4	2.5	2.6
DMS-II, Burroughs	5	3.8	4.0	3.6	3.6	2.8	3.0	3.2
GIS, IBM	7	2.4	2.1	2.1	3.0	2.7	2.6	2.3
IDMS, Cullinane	17	3.8	3.3	3.4	3.6	3.0	3.6	3.5
IMAGE, Hewlett-Packard	11	3.6	3.3	3.7	3.2	2.8	2.9	2.7
IMS, IBM	33	2.9	2.4	2.2	2.5	2.8	2.8	2.9
INQUIRE, Infodata	6	3.2	2.2	2.7	3.0	2.5	2.8	2.6
Model 204, C.C.A.	3	3.7	3.3	3.3	3.3	2.7	3.3	2.7
SYSTEM 2000, MRI Systems	21	3.0	2.3	2.9	3.5	2.4	2.7	2.1
TOTAL, Cincom Systems	113	3.5	3.1	3.4	3.4	2.8	3.0	2.8

*All weighted averages are based on a scale of 4.0 for Excellent.

While it can be very helpful to know what current users think about the strengths and weaknesses of a software package, the key question is always how well the package can satisfy your own particular requirements. And Datapro brings you three important tools to help you answer that question. First, the user ratings charts that follow should aid you in pinpointing the packages that are meeting the test of user satisfaction. Second, the list of Vendor Addresses below will make it easy for you to go directly to the source to obtain additional information. Third, *DATAPRO 70* and/or the *DATAPRO DIRECTORY OF SOFTWARE* contain detailed information about the capabilities and features of most of the packages listed here; please refer to the Index for specific references. We hope you'll use all of these tools, and that they'll help you to get a better return on your future software expenditures.

We'll See You Next Year

We want to thank all the proprietary software users who responded to the 1976 survey. To the best of our knowledge, no software user survey of this magnitude has ever been undertaken by any other organization. Vendors, users, and Datapro will all benefit from the statistics shown in this report. And it wouldn't have been possible without you.

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We look forward to receiving your input again next year. In fact, if you've had direct experience that confirms, augments, or contradicts any of the user ratings in this report, we'd be delighted to hear from you at any time. Just write or phone us at your convenience.

Vendor Addresses

For your convenience in obtaining additional information about the software packages rated in the charts that follow, the full names, addresses, and telephone numbers of the 103 companies that supply them are listed below.

Aeronautical Research Associates of Princeton, Inc. (A.R.A.P.), 50 Washington Rd., P.O. Box 2229, Princeton, NJ 08540; (609) 452-2950.

American Valuation Consultants, Inc., One North Broadway, Des Plaines, IL 60016; (312) 297-6100.

Applications Software, Inc., 21515 Hawthorne Blvd., Torrance, CA 90503; (213) 542-4381.

Applied Data Research, Inc., Route 206 Center CN-8, Princeton, NJ 08540; (609) 921-8550.

Applied Data Systems (aka ADPAC Corp)., 120 Howard St., San Francisco, CA 94105; (415) 981-2710.

Aquila BST (1974) Ltd., P.O. Box 10, Stock Exchange Tower, Montreal, Quebec, Canada H4Z 1A4; (514) 866-5841.

Arthur Andersen & Co., 69 West Washington Street, Chicago, IL; 60602 (312) 346-6262.

Atlantic Software Inc., Lafayette Building, Suite 910, Fifth & Chestnut Sts., Philadelphia, PA 19106; (215) 922-7500.

The Automated Quill, Inc., 3501 South Corona St., Suite 5, Englewood, CO 80110; (303) 761-2722.

Azrex, Inc., 3 Mountain Rd., Burlington, MA 01803; (617) 272-8750

BMS Computer, Inc., P.O. Box 3086, Walnut Creek, CA 94598; (415) 938-2620.

Boole & Babbage, Inc., 850 Stewart Drive, Sunnyvale, CA 94086; (408) 735-9550.

Burroughs Corp., Burroughs Place, Detroit, MI 48232; (313) 972-7000.

Business EDP Services, Inc., P.O. Box 5445, Tallahassee, FL 32301; (904) 222-8849.

California Computer Products, Inc., (Cal-Comp), 2411 West La Palma Ave., Anaheim, CA 92801; (714) 821-2011.

Capex Corp., 2613 North Third St., Phoenix, AZ 85004; (602) 264-7241.

Certified Software Products, 3140 Harbor Lane North, Minneapolis, MN 55441; (612) 559-5952.

CFS, Inc., P.O. Box 662, Brookline, MA 02147; (617) 731-3474.

Cincom Systems, Inc., 2300 Montana Ave., Cincinnati, OH 45211; (513) 662-2300.

Citicorp (Citibank, N.A.), 399 Park Ave., 28th Floor, New York, NY 10022; (212) 559-3256.

Computer Associates, Inc., 655 Madison Ave., New York, NY 10021; (212) 355-3333.

Computer Concepts, Inc., 6443 S.W. Beaverton Highway, Portland OR 97221; (503) 297-4721.

Computer Corp. of America, 575 Technology Square, Cambridge, MA 02139; (617) 491-3670.

Computer Information Management Co., (CIM), 325 Oak Plaza Building, 3707 Rawlins St., Dallas, TX 75219; (214) 526-4280.

The Computer Software Co., 6517 Everglades Drive, Richmond, VA 23225; (804) 276-9200.

Comtech (U.S.A.), Inc., Commercial Ave., Suite 207, Palisades Park, NJ 07650; (201) 224-0206.

Comten, Inc., 3 Choke Cherry Rd., Rockville, MD 20851; (301) 948-8000.

Cornell University, Dept. of Computer Sciences, Upson Hall, Ithaca, NY 14853 (607) 256-2369.

Cullinane Corp., 20 William St., Wellesley, MA 02181; (617) 237-6601.

Datachron Corp., 174 Fifth Ave., New York, NY 10010; (212) 675-5333.

Data General Corp., Route 9, Southboro, MA 01772; (617) 485-9100.

Dearborn Computer Leasing Co., 4849 North Scott St., Schiller Park, IL 60176; (312) 671-4410.

Digital Equipment Corp. (DEC), 146 Main Street, Maynard, MA 01754; (617) 897-5111.

DNA Systems, Inc., 1258 South Washington, P.O. Box 1424, Saginaw, MI 48605; (517) 793-0185.

Donovan Data Systems, Inc., 666 Fifth Ave., New York, NY 10019; (212) 586-0055.

Dylakor Software Systems, Inc., 16255 Ventura Blvd., Encino, CA 91436; (213) 995-0151.

Financial Technology, Inc., 612 N. Michigan Ave., Room 716, Chicago, IL 60611; (312) 751-2600.

Florida Software Services, Inc., P.O. Box 2269, Orlando, FL 32802; (305) 831-3001.

Foresight Systems, Inc., 1901 Avenue of the Stars, Suite 585, Century City, Los Angeles, CA 90067; (213) 277-2722.

GBA International, 2247 Union St., San Francisco, CA 94123; (415) 563-8880.

General Automation, Inc., 1055 South East St., Anaheim, CA 92805; (714) 778-4800.

General Computer Services, Inc., P.O. Box 5148 N.E., Huntsville, AL 35805; (205) 539-9492.

Goal Systems, P.O. Box 24067, Columbus, OH 43224; (614) 882-3867.

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Gulf Computer Sciences, Inc., 1775 St. James Place, Houston, TX 77056; (713) 627-9320.

Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, CA 94304; (415) 493-1501.

Honeywell Information Systems, Inc., 200 Smith St., Waltham, MA 02154; (617) 890-8400.

IBM Corporation, General Systems Division, P.O. Box 2150, Atlanta, GA 30301; (404) 256-7000.

IBM Corporation, Data Processing Division, 1133 Westchester Ave., White Plains, NY 10604; (914) 696-1900.

Infodata Systems, Inc., 5205 Leesburg Pike, Falls Church, VA 22041; (703) 578-3430.

Infonational, Inc., P.O. Box 82477, San Diego, CA 92138; (714) 560-7070.

Informatics, Inc., 21031 Ventura Blvd., Woodland Hills, CA 91364; (213) 887-9040.

Innovation Data Processing, Inc., 970 Clifton Avenue, Clifton, NJ 07013; (201) 777-1940.

International Mathematical & Statistical Libraries, Inc. (IMSL), 7500 Bellaire Blvd., Sixth Floor, Houston, TX 77036; (713) 772-1927.

International Systems, Inc., 150 Allendale Road, King of Prussia, PA 19406; (215) 265-1550.

Jason Data Services, 1871 Johive Rd., Sebastopol, CA 95472; (707) 823-2293.

Johnson Systems, Inc., 8400 Westpark Drive, McLean, VA 22101; (703) 893-8700.

Management and Computer Services, Inc., (MACS), 790 Valley Forge Plaza, P.O. Box 826, Valley Forge, PA 19482; (215) 265-2910.

Management Information Service (MIS), 3445 Peachtree Rd., N.E., Atlanta, GA 30326; (404) 262-2376.

Management Science America (MSA), 3445 Peachtree Rd., N.E., Atlanta, GA 30326; (404) 262-2376.

Maxima Systems Group, P.O. Box 1166, Alameda, CA 94501; (415) 522-6030.

McCormack & Dodge Corp., 381 Elliot Street, Newton, MA 02164; (617) 964-6610.

McDonnell Douglas Automation (MCAUTO) Co., P.O. Box 516, St. Louis, MO 63166; (314) 232-8035.

MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 265-7553.

MRI Systems Corp., 12675 Research Blvd., Austin, TX 78759; (512) 258-5171.

NCI, Inc., 6075 Roswell Road, NE, Atlanta, GA 30328; (404) 252-9474.

NCR Corporation, South Main & K Streets, Dayton OH 45479; (513) 449-2000.

Network Data Processing Corp., 321 Third Street, S.E., Cedar Rapids, IA 52407; (319) 365-8691.

Nichols & Co., 1888 Century Park East, Los Angeles, CA 90067; (213) 556-2757.

Northwestern University, SPSS Project, Vogelback Computing Center, 2129 Sheridan Road, Evanston, IL 60201; (312) 492-3682.

On-Line Software International, Continental Plaza, 411 Hackensack Ave., Hackensack, NJ 07601; (201) 489-0400.

Oxford Software Corporation, 158 Linwood Plaza, Fort Lee, NJ 07024; (201) 944-0083.

Pace Applied Technology, Inc., 2990 Telestar Court, Falls Church, VA 22042; (703) 573-9131.

Pansophic Systems, Inc., 709 Enterprise Drive, Oak Brook, IL 60521; (312) 986-6000.

Parallel Data Systems, Inc., 381 Park Avenue South, New York, NY 10016; (212) 573-9270.

Personnel Data Systems, Inc., Whitemarsh Plaza, Conshohocken, PA 19428; (215) 828-4294.

Program Products, Inc., 95 Chestnut Ridge Road, Montvale, NJ 07645; (201) 391-9800.

Project Software & Development, Inc., 14 Story Street, Cambridge, MA 02138; (617) 868-6921.

SAB, Inc., 405 Park Avenue, Room 202, New York, NY 10022; (212) 421-5380.

SAS Institute, Inc., P.O. Box 10066, Raleigh, NC 27605; (919) 834-4381.

Software AG of North America, Inc., 11800 Sunrise Valley Drive, Reston, VA 22091; (703) 860-5050.

Software Design Inc. (SDI), 880 Mitten Road, Burlingame, CA 94010; (415) 697-3660.

Software International Corp., 2 Elm Square, Andover, MA 01810; (617) 475-5040.

Software Pursuits, Inc., 1052 Anza Drive, Pacifica, CA 94049; (415) 355-8600.

SPSS, Inc., 111 E. Wacker Drive, Chicago, IL 60601; (312) 861-0933.

St. Joseph's Bank & Trust Co., 202 S. Michigan Street, South Bend, IN 46601; (219) 237-5259.

Stockholder Systems, Inc., 5590 Old National Highway, College Park, GA 30349; (404) 768-2979.

Synergetics Corp., One DeAngelo Drive, Bedford, MA 01730; (617) 275-0250.

System Integrators, Inc., 1820 Tribute Road, Sacramento CA 95815; (916) 929-9481.

System Support Software, Inc., 28 E. Rahn Road, Dayton, OH 45429; (513) 435-9514.

Systonetics, Inc., 600 N. Euclid Street, Suite 70, Anaheim, CA 92801; (714) 778-1600.

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077; (503) 638-3411.

Time Share Corp., 3 Lebanon Street, Hanover, NH 03755; (603) 643-3640.

Turnkey Systems, Inc., 111 East Avenue, Norwalk, CT 06851; (203) 853-2884.

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Univac Division, Sperry Rand, Corp., P.O. Box 500, Blue Bell, PA 19422; (215) 542-4011.

Universal Software, Inc., 136 White Street, Danbury, CT 06810; (203) 792-5100.

University Computing Co. (UCC), 8303 Elmbrook Street, Dallas, TX 75247; (214) 688-7100.

University of California at Los Angeles (UCLA), Department of Biomathematics, Room AV 111, Los Angeles, CA 90024; (213) 825-5800.

University of Waterloo, Supervisor of Technical Products and Program Distribution, Distribution Computing Centre, Math and Computer Building, Waterloo, Ontario, Canada N2L 3G1; (519) 885-1211 Extension 3268.

Value Computing Inc., 300 VCI Building, West Marlton Pike, Cherry Hill, NJ 08002; (609) 429-4200.

Versatec, Inc., 2805 Bowers Ave., Santa Clara, CA 95051; (408) 988-2800.

Wang Laboratories, Inc., One Industrial Ave., Lowell, MA 01851; (617) 851-4111.

Western Electric Co., Inc., Guilford Center, P.O. Box 25000, Greensboro, NC 27420; (919) 697-2000.

Westinghouse Electric Corp., 2040 Ardmore Blvd., Pittsburgh, PA 15221; (412) 256-5583.

Whitlow Computer Systems, Inc., 560 Sylvan Ave., Englewood Cliffs, NJ 07632; (201) 568-9700.□

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		Overall satisfaction	Throughput/efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training	Flexible	Inflexible	Saves system resources	Saves human resources	Inexpensive	Costly	Complex	Slow	Uses excessive resources	Lacks key capabilities	Compatibility problems	Immediately	Eventually	Never	No	Yes, by vendor	Yes, by user
Aeronautical Research Associates of Princeton, Inc. (A.R.A.P.)																									
DRS	4	2.8	2.3	2.8	2.7	2.3	3.5	3.8	3	1	0	1	0	0	1	1	1	0	0	3	1	0	2	2	0
American Valuation Consultants, Inc.																									
Bit-Facs	7	2.7	3.0	2.7	2.7	2.7	3.0	2.4	4	2	1	5	1	1	3	0	0	1	1	2	5	0	1	2	5
Applications Software, Inc.																									
ASI-ST	7	3.0	3.1	3.3	2.7	3.0	2.6	3.3	4	0	1	7	0	0	1	0	1	1	0	5	2	0	6	0	1
Applied Data Research, Inc.																									
AUTOFLOW II	18	3.1	3.0	3.1	3.2	2.9	2.9	3.0	4	4	3	18	1	3	1	3	2	1	0	16	2	0	13	2	1
LIBRARIAN	119	3.7	3.5	3.5	3.5	3.3	3.1	3.1	56	32	51	92	4	4	3	2	5	2	4	105	10	2	99	8	9
LOOK	6	3.5	3.2	3.5	3.3	3.3	3.2	4.0	2	1	4	1	0	0	0	0	0	0	2	4	2	0	4	1	1
MetaCOBOL	8	2.9	2.9	2.9	2.8	2.5	2.9	2.3	2	1	3	7	0	0	2	0	1	1	0	4	2	2	3	4	1
PI-SORT II	3	3.3	3.0	3.5	3.0	3.5	2.0	—	1	1	3	0	0	0	0	0	0	0	0	3	0	0	2	0	0
ROSCOE	15	3.2	3.2	2.8	3.4	2.8	2.5	2.5	6	1	5	14	1	3	0	0	2	3	2	9	5	1	8	4	4
Applied Data Systems																									
ADPAC II	4	3.8	3.8	3.5	3.5	3.3	3.3	2.3	2	0	2	3	0	0	1	0	0	0	1	3	1	0	4	0	0
Aquila BST(1974)Ltd.																									
Extracto	3	3.3	3.0	3.0	3.3	2.3	2.3	3.0	2	1	0	3	0	0	0	1	1	0	0	3	0	0	1	2	0
Arthur Andersen & Co.																									
Lexicon	3	3.0	2.7	2.7	2.7	3.0	3.0	3.3	2	1	0	3	0	0	2	0	1	0	0	2	1	0	3	0	0
MAC-PAC-3	3	3.7	3.3	3.3	3.7	3.7	3.0	3.0	0	0	0	1	1	0	1	0	0	0	0	2	1	0	0	3	3
Atlantic Software Inc.																									
PC/70	10	3.0	2.7	2.8	2.8	2.3	3.0	2.6	4	2	0	4	2	1	1	0	4	1	0	3	6	1	2	5	5
The Automated Quill, Inc.																									
MINI-MIZ	3	3.0	3.0	2.7	3.0	2.3	2.7	4.0	2	2	0	3	0	0	0	0	0	0	0	1	1	0	0	2	1
Azrex, Inc.																									
QUERY 5	3	3.0	2.0	2.7	3.3	3.0	2.7	2.5	1	1	0	3	0	0	0	2	1	0	0	2	1	0	1	2	1
BMS Computer Inc.																									
CIMS	3	3.7	3.0	3.3	3.0	3.3	4.0	—	1	2	1	2	0	0	0	0	0	0	0	3	0	0	3	0	0
Boole & Babbage, Inc.																									
CAS/CPA	3	3.0	3.0	2.7	3.0	2.3	3.3	3.0	2	0	0	0	0	0	0	0	0	0	1	1	2	0	0	3	0
CUE	11	3.3	3.4	3.4	3.3	2.6	2.9	3.3	1	0	7	6	1	2	0	0	2	0	1	9	1	0	9	1	0
DISKPLAY	6	3.7	3.5	3.7	3.7	3.2	2.8	2.0	1	3	1	4	0	0	0	0	0	0	0	4	2	0	4	2	0
Burroughs Corp.																									
Accounts Payable	5	3.0	2.8	2.8	2.8	2.2	2.0	2.0	2	2	0	2	1	0	0	0	0	2	2	2	2	1	0	2	4
BHAS	6	2.8	2.8	3.0	4.0	2.8	3.0	2.8	4	0	2	4	0	0	1	1	0	0	0	2	3	1	0	0	5
COBOL	3	3.7	3.3	3.7	3.7	3.0	3.0	3.0	0	1	0	1	0	0	0	0	0	0	0	2	1	0	3	0	0
DMS-II	5	3.8	4.0	3.6	3.6	2.8	3.0	3.2	5	0	4	5	0	0	0	0	0	0	2	4	0	0	5	0	0
FORTE	23	3.3	3.0	2.8	3.2	2.6	2.3	2.2	15	7	6	18	3	1	7	1	6	2	3	16	7	0	15	5	3
General Ledger	7	2.9	2.9	2.9	2.9	2.1	1.6	2.0	2	4	0	1	3	1	0	2	1	2	0	2	4	1	0	3	7
NDL	23	3.4	3.2	3.3	3.4	2.3	2.5	2.5	16	7	7	15	0	0	1	0	3	1	2	21	1	1	15	5	4
Payroll	13	2.7	2.5	2.5	2.5	2.4	2.2	2.1	4	4	0	5	3	0	3	4	0	5	1	4	7	1	3	2	10
PCS	5	3.2	3.6	2.8	3.2	2.0	2.6	2.8	3	0	3	5	0	1	2	0	0	0	0	2	3	0	1	0	4
Reporter	13	2.5	3.1	3.2	3.4	2.5	2.3	2.5	9	5	5	13	2	0	0	1	2	5	1	10	3	0	9	1	3
THRIFT	3	2.7	3.3	2.0	3.0	2.0	1.3	2.7	2	0	0	1	0	0	1	0	1	2	0	1	2	0	0	1	3

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Business EDP Services, Inc.																									
CHAMP	4	3.5	3.3	3.5	3.3	2.5	3.5	2.7	2	0	4	0	0	0	1	1	0	0	0	3	1	0	1	3	0
PRO	3	3.3	3.7	3.7	3.0	3.0	3.3	2.3	2	0	1	3	0	0	0	0	0	1	0	3	0	0	3	0	0
California Computer Products																									
CalComp Plot Libs.	6	3.7	3.3	3.4	3.7	3.2	2.5	2.7	2	2	2	5	0	0	0	2	0	1	0	3	2	0	2	1	2
Capex Corporation																									
Autotab II	3	3.7	3.3	3.5	4.0	3.5	3.5	2.5	2	3	1	3	0	0	0	0	0	0	0	3	0	0	3	0	0
COTUNE II	4	3.3	3.0	3.0	3.0	3.0	3.0	3.0	1	1	2	2	0	0	0	1	0	0	1	4	0	0	2	1	0
Optimizer II	17	3.6	3.4	3.6	3.6	2.9	3.3	2.8	3	3	16	4	0	3	0	1	0	1	2	14	2	0	15	1	0
PLAN IV	3	3.3	3.0	3.0	3.3	3.3	3.0	—	1	1	0	3	0	0	0	1	0	0	0	3	0	0	2	1	0
Certified Software Products																									
General Ledger	3	2.0	2.0	2.7	1.7	1.3	2.0	2.0	1	2	0	1	0	0	0	2	0	0	0	1	2	0	1	1	2
C F S, Inc.																									
DOCS	3	3.3	3.5	3.0	3.7	2.3	3.0	—	0	1	3	1	0	0	0	0	0	0	1	2	0	1	2	1	0
DUCS VI	3	3.7	3.7	3.0	3.3	3.0	3.7	2.0	1	3	1	1	0	0	0	0	0	0	0	2	1	0	2	0	1
Cincom Systems, Inc.																									
Environ/1	18	3.1	3.1	3.2	3.1	2.3	2.5	2.5	9	2	7	13	2	3	3	4	0	5	2	9	5	4	11	4	4
TOTAL	113	3.5	3.1	3.4	3.4	2.8	3.0	2.8	78	13	42	79	5	23	3	15	8	18	4	76	27	4	91	13	4
Citicorp (Citibank, N.A.)																									
PROBE	4	3.5	2.0	3.3	3.8	3.3	3.0	3.3	3	1	0	3	0	0	0	3	0	0	0	1	3	0	0	4	1
Computer Associates, Inc.																									
CA-SORT II	18	3.8	3.8	3.8	3.7	3.2	3.3	3.3	11	6	15	3	0	1	0	0	0	1	1	16	2	0	17	0	0
Computer Concepts, Inc.																									
DOSSIER	4	3.8	3.3	4.0	3.5	3.3	3.3	3.0	0	2	0	4	1	0	0	0	0	0	0	3	1	0	3	1	0
Computer Corp. of America																									
Model 204	3	3.7	3.3	3.3	3.3	2.7	3.3	2.7	3	1	0	3	0	0	1	0	2	0	0	2	1	0	1	2	1
Computer Information Management Company (CIM)																									
Datacom DB/DC	8	3.3	3.4	3.0	3.4	2.3	3.4	3.1	5	2	5	6	0	0	0	0	0	1	0	4	3	0	3	4	1
The Computer Software Co.																									
EDOS	32	3.2	3.2	2.9	3.2	2.9	3.1	2.8	15	9	24	11	0	1	3	2	2	2	1	23	6	3	21	6	5
Comtech (U.S.A.), Inc.																									
PAYMASTER	5	2.4	2.4	2.4	2.8	2.2	1.8	2.0	4	0	0	2	1	0	3	0	0	1	0	1	2	2	1	3	3
Comten, Inc.																									
AMIGOS	3	3.0	3.0	3.0	2.7	3.0	2.7	3.0	1	0	2	1	0	0	1	0	0	0	2	1	2	0	2	1	0
Cornell Univ.																									
PL/C	3	3.3	3.3	3.3	3.7	3.0	3.0	—	1	0	2	1	0	0	0	0	0	1	0	3	0	0	1	0	1
Cullinane Corp.																									
CULPRIT	7	3.6	2.7	3.9	3.3	2.6	3.1	2.9	5	1	2	7	0	1	1	1	0	0	2	6	1	0	4	3	0
IDMS	17	3.8	3.3	3.4	3.6	3.0	3.6	3.5	14	2	7	15	0	1	2	1	0	0	1	14	3	0	11	5	0
Datachron Corp.																									
JASPER	4	3.0	3.5	2.5	2.8	2.0	2.8	3.5	3	0	1	2	0	0	2	0	0	1	0	2	2	0	1	3	0
LIBRA	4	3.5	3.5	4.0	3.8	2.3	3.0	—	1	1	4	1	0	0	0	0	0	0	0	4	0	0	4	0	0

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Data General Corp.																									
RDOS	9	2.8	2.7	2.9	3.0	2.3	1.9	2.0	5	1	1	2	2	1	2	2	3	2	3	4	3	2	4	2	4
RTOS	3	2.3	2.3	2.0	2.0	1.3	1.3	2.0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	0	1	1
Dearborn Computer Leasing Co.																									
DOS/RS	6	3.7	3.7	3.0	3.7	2.7	3.2	2.7	2	3	6	5	0	0	0	0	0	0	0	4	2	0	2	3	2
Digital Equipment Corp. (DEC)																									
APL	4	3.0	2.3	2.7	3.0	2.3	2.0	2.5	1	1	0	2	0	0	1	0	1	3	2	3	1	0	1	1	2
BASIC	4	3.3	2.8	3.8	3.8	3.0	2.5	2.0	2	1	0	2	0	0	0	1	0	1	0	2	1	0	4	0	0
COBOL	3	2.0	1.7	2.7	2.7	2.7	2.0	2.0	0	1	1	2	1	1	1	1	1	1	1	3	0	0	3	0	0
COS-300	3	3.7	3.7	3.7	3.7	2.3	2.0	3.5	0	0	0	2	1	0	0	0	0	0	2	3	0	0	2	1	0
DOS	7	3.2	2.5	2.8	2.7	2.7	2.4	3.0	1	0	1	2	0	1	0	2	0	0	0	3	4	0	5	2	1
FORTRAN	18	3.1	3.1	2.9	3.0	2.5	1.9	2.4	10	4	6	5	3	3	5	4	2	3	4	9	6	2	9	5	5
MUMPS	3	2.0	2.0	1.3	3.3	2.7	2.0	3.0	1	0	0	2	1	1	1	2	2	2	2	0	2	1	0	1	2
OS/8	17	3.6	3.2	3.4	3.5	3.0	2.4	3.0	14	9	5	9	1	0	1	1	1	2	1	12	4	0	8	5	6
RSTS/E	22	3.4	3.0	3.3	3.5	2.6	2.2	2.6	18	4	5	9	0	1	2	3	1	5	4	19	2	1	15	1	6
RSX-11	29	3.0	2.8	2.7	2.9	2.1	2.0	2.5	17	8	9	10	1	3	8	3	5	5	2	10	17	2	9	10	14
RT-11	19	3.1	3.2	3.4	3.0	2.4	2.0	2.9	11	9	4	6	2	1	0	3	1	5	3	11	4	2	10	2	7
RTS-8	3	3.0	2.7	2.0	2.0	2.0	2.0	2.3	2	1	0	0	1	0	1	0	0	1	0	1	2	0	1	1	2
Sort	8	3.1	3.8	3.0	3.6	2.4	2.1	1.8	4	2	6	4	1	0	0	2	2	2	0	6	2	0	6	1	1
DNA Systems, Inc.																									
CYTOS	8	3.8	3.5	3.6	3.6	3.0	3.6	3.0	7	1	5	6	0	2	1	2	0	1	1	7	0	0	7	0	0
TSO	10	3.5	3.7	3.4	3.3	2.5	3.3	2.4	6	3	8	5	1	1	2	0	1	2	2	8	2	0	5	5	2
XBASE	4	3.8	3.5	3.7	3.2	3.5	3.2	3.0	3	2	3	1	0	0	0	1	0	0	0	4	0	0	4	0	0
1130/FORTRAN	22	3.7	3.3	3.4	3.6	3.0	3.2	3.0	9	9	6	15	0	0	2	2	1	2	4	19	1	0	13	5	3
1130/Sort	10	3.9	3.8	3.7	3.4	3.0	3.2	3.0	10	5	7	7	0	0	0	0	0	0	0	9	0	0	10	0	0
Donovan Data Systems, Inc.																									
DISKTAB	3	3.0	2.7	3.7	2.0	2.0	2.7	2.5	3	0	0	1	0	2	1	1	0	0	3	3	0	0	3	0	0
Dylakor Computer Systems, Inc.																									
DYL-250	19	3.5	3.2	3.7	3.3	3.2	3.3	2.6	15	14	7	16	0	0	1	0	1	3	0	17	1	0	16	0	2
DYL-260	55	3.8	3.6	3.8	3.3	3.1	3.2	2.9	47	43	22	50	2	0	5	1	1	1	2	52	2	1	50	1	1
Financial Technology, Inc.																									
General Ledger	3	2.5	3.0	3.0	2.5	2.5	2.5	2.0	2	2	2	1	0	0	0	0	0	0	0	2	0	0	0	0	1
Florida Software Services, Inc.																									
Installment Loan	4	3.5	2.8	3.3	3.0	3.8	3.0	2.0	4	2	0	2	0	0	1	1	1	0	0	2	1	0	2	0	2
Mortgage Loan	5	2.8	2.8	2.5	2.5	3.3	3.0	1.5	2	0	0	2	1	1	0	0	1	1	0	2	2	0	0	2	3
Payroll	6	3.0	3.0	2.5	2.5	2.7	3.4	2.3	3	4	1	2	0	0	0	0	0	1	0	4	2	0	1	0	5
Foresight Systems, Inc.																									
FORESIGHT	4	3.0	2.0	3.0	3.5	2.3	3.0	2.8	1	1	0	1	2	0	0	0	1	0	0	4	0	0	3	1	0
GBA International																									
GBASWIFT	3	3.7	3.3	4.0	3.7	3.0	3.0	3.0	2	1	3	3	0	0	0	0	0	2	0	2	1	0	2	1	0
General Automation, Inc.																									
DBOS	3	2.3	2.0	2.7	3.3	2.0	2.0	4.0	1	1	1	0	0	0	1	1	0	0	0	1	1	0	1	0	1
RTOS	4	3.0	3.3	3.5	3.8	3.0	3.0	2.7	3	1	2	2	0	0	1	1	0	0	1	2	2	0	2	1	1
General Computer Services																									
Personal Trust	4	3.0	2.8	2.8	2.8	2.5	3.0	3.7	0	2	0	3	1	0	1	2	2	1	1	2	1	0	1	3	1
Goal Systems																									
F-LE-E	3	4.0	4.0	4.0	4.0	4.0	4.0	—	2	3	2	1	0	0	0	0	0	0	0	3	0	0	3	0	0

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		Overall satisfaction	Throughput/efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training	Flexible	Inflexible	Saves system resources	Saves human resources	Inexpensive	Costly	Complex	Slow	Uses excessive resources	Lacks key capabilities	Compatibility problems	Immediately	Eventually	Never	No	Yes, by vendor	Yes, by user
Gulf Computer Sciences, Inc.																									
TLMS	7	3.7	3.6	3.3	3.3	3.5	3.8	3.5	5	2	3	7	0	0	1	0	0	0	1	6	1	0	4	1	3
Hewlett-Packard Co.																									
DOS	3	3.0	3.0	3.3	2.3	2.3	2.0	2.0	0	3	1	0	1	0	0	1	1	3	0	1	2	0	1	0	2
IMAGE	11	3.6	3.3	3.7	3.2	2.8	2.9	2.7	6	3	1	7	2	0	0	1	0	3	1	11	0	0	10	1	0
RTE-II	7	2.6	2.6	2.3	2.7	2.9	2.6	2.4	3	0	0	3	1	0	3	0	0	2	1	3	2	2	4	2	1
Honeywell Information Systems																									
Accounts Payable	7	2.9	2.6	3.1	2.6	2.9	2.9	3.0	2	5	0	4	0	0	1	3	0	0	0	6	1	0	0	1	7
Accounts Receivable	3	2.0	1.7	2.7	2.3	2.3	3.0	—	0	1	0	0	0	0	1	1	1	0	0	1	1	1	0	2	3
IMS	12	2.8	2.7	2.2	2.8	2.9	2.2	2.8	10	6	0	7	1	0	2	3	4	1	1	3	9	0	4	2	8
Payroll	10	2.9	2.5	2.8	2.8	2.6	2.6	1.5	4	5	2	5	2	0	3	4	1	2	2	2	7	1	0	5	8
SCRIBE	3	2.7	2.0	2.0	2.7	2.0	3.3	1.7	2	0	0	2	0	0	1	1	0	0	1	0	3	0	0	3	1
IBM Corporation																									
Accounts Payable (S/3)	23	2.8	2.5	2.7	2.8	2.7	2.2	1.9	6	13	1	13	2	0	5	4	3	6	2	8	13	0	0	1	23
Accounts Receivable (S/3)	11	2.6	2.5	2.2	2.6	2.6	1.9	1.4	1	4	2	7	2	0	6	3	1	2	1	0	8	0	0	1	11
Auto Report (S/3)	3	3.3	3.0	3.3	3.3	3.0	2.5	2.0	0	0	0	3	0	0	1	0	0	0	0	2	1	0	3	0	0
BACIS	4	2.5	2.3	1.8	2.5	2.5	3.0	2.3	2	1	0	3	1	2	3	3	2	0	1	0	4	0	0	2	4
BASIC (360/370)	4	2.0	2.5	1.5	2.0	2.5	1.5	1.5	1	0	0	1	0	1	0	0	0	1	0	1	1	1	1	1	0
BOMP	51	3.3	2.8	2.8	3.1	3.4	2.8	2.4	26	18	11	35	3	4	18	8	3	4	7	25	24	0	1	2	49
Budgetary Accounting (S/3)	3	2.7	2.7	2.0	3.3	2.0	2.0	3.0	1	1	0	1	0	0	1	0	0	0	0	1	2	0	0	0	3
CFO-II	5	3.4	2.8	2.4	3.2	3.2	2.5	2.3	3	3	1	5	0	0	2	0	1	0	1	3	2	0	1	0	4
CICS	161	2.9	2.7	2.3	2.6	2.6	2.8	2.7	87	14	29	82	8	46	76	25	73	10	9	57	94	7	80	43	43
COBOL (360/370)	116	3.3	3.0	3.2	3.3	3.4	2.9	3.1	27	16	28	40	2	11	3	17	8	5	10	94	18	2	80	30	2
COBOL (S/3)	6	3.0	3.0	3.3	3.3	3.0	3.2	3.3	0	0	1	0	1	1	0	1	0	2	0	5	0	0	5	1	0
COBOL (1130)	23	3.1	2.9	2.8	3.0	2.6	2.4	2.0	2	7	2	9	0	2	0	3	0	6	7	12	9	1	8	9	4
Coursewriter III	3	2.3	2.5	2.3	3.0	2.0	2.7	3.0	0	0	0	1	0	0	2	0	2	1	0	0	3	0	2	1	0
DBOMP	48	3.0	2.6	2.4	2.7	2.5	2.7	2.4	11	18	11	24	14	2	18	17	7	6	2	24	23	0	25	5	17
DIOPEN	48	3.6	3.4	3.4	3.6	3.3	3.4	3.0	1	4	3	4	0	1	0	0	0	0	0	9	0	0	7	2	0
DITTO	36	3.3	3.1	3.4	3.5	3.4	2.8	2.7	26	17	15	24	3	0	1	1	0	7	0	32	2	0	29	3	3
DL/1	29	2.6	2.4	2.3	2.4	2.4	2.5	2.6	10	2	7	9	1	7	13	7	19	1	5	6	19	1	15	8	6
EPIC—Budgetary/Financial	3	2.0	1.3	2.0	2.0	2.7	2.3	2.0	1	1	0	0	1	0	2	2	1	1	1	0	3	0	0	1	4
EPIC—FAST	4	1.5	2.0	1.5	1.5	1.8	2.3	2.0	1	0	0	0	1	0	4	2	2	1	1	1	1	2	1	3	2
EPIC—SOCRATES	20	3.2	2.6	2.4	2.9	2.5	2.5	2.2	10	3	0	15	4	1	8	10	4	0	1	8	12	0	7	7	6
Fixed Assets (S/3)	7	3.4	3.0	3.3	3.4	2.7	2.8	2.7	1	5	1	6	1	0	1	0	0	2	0	5	2	0	1	1	5
FORTRAN (360/370)	13	3.0	2.9	3.0	3.2	2.9	3.0	4.0	4	4	2	2	0	1	1	1	1	2	2	9	3	0	8	4	1
FORTRAN (S/3)	3	3.3	3.3	3.7	3.7	2.7	2.3	1.0	2	0	0	2	0	2	0	0	0	1	0	1	2	0	2	0	1
FORTRAN (S/7)	3	2.3	2.7	2.7	2.3	2.0	2.0	2.5	1	0	0	1	0	1	0	1	2	1	2	0	3	0	0	3	1
General Ledger (S/3)	14	3.1	2.6	2.8	3.0	2.9	2.1	2.0	4	11	2	5	1	1	0	3	1	3	0	8	6	0	1	0	13
GIS	7	2.4	2.1	2.1	3.0	2.7	2.6	2.3	4	1	1	7	1	1	2	3	2	2	0	1	5	0	4	0	2
GPSS	3	3.0	2.7	3.0	3.0	2.7	2.0	2.3	2	0	0	1	0	0	0	0	0	0	0	2	1	0	3	0	0
HCS/Accounting	11	2.5	2.2	1.9	2.5	2.0	2.2	1.9	4	3	1	9	1	2	8	3	2	2	1	3	6	1	0	2	11
IMS	33	2.9	2.4	2.2	2.5	2.8	2.8	2.9	29	0	4	12	0	15	23	7	13	1	2	8	23	1	21	10	3
IPICS	21	3.1	2.8	2.5	2.8	2.2	2.9	2.1	5	13	2	13	2	2	4	1	1	0	3	5	12	0	0	2	20
IRP (Inventory Req. Proc.)	13	2.0	2.4	2.9	2.6	2.7	2.5	2.8	6	5	3	6	2	2	7	2	1	2	2	4	7	1	0	1	12
JAS/3	5	3.0	3.2	2.8	2.8	1.6	2.0	4.0	3	3	1	3	0	1	0	1	0	1	1	2	3	0	3	0	2
MRP (Material Req. Plan)	7	3.0	2.7	2.4	2.7	2.2	2.8	2.6	0	0	0	6	1	1	3	2	1	0	0	5	1	0	0	0	5
MTCS	24	3.2	3.0	2.9	3.0	2.4	2.9	2.7	9	12	6	14	2	0	2	1	1	1	1	14	8	1	16	3	4
Municipal Budget Accounting	3	2.3	2.3	2.0	2.7	3.3	1.7	1.0	1	0	0	2	0	1	0	0	0	1	0	0	3	0	0	0	3
Payroll (S/3)	32	2.8	2.6	2.5	2.8	2.6	2.4	2.1	13	12	3	11	2	3	8	9	2	3	2	13	16	2	0	7	30
PL1/ Optimizer	28	3.2	2.9	2.9	3.3	2.8	2.6	2.5	11	2	7	12	0	4	5	4	5	1	1	18	9	1	19	8	0
PMS	3	3.0	3.0	2.0	2.0	2.3	2.7	2.0	3	2	1	2	0	0	2	1	1	0	0	0	3	0	2	1	0
POWER	7	3.0	3.3	3.0	3.3	2.8	3.3	3.0	3	7	3	3	2	0	0	1	2	0	1	2	3	0	3	1	3
PROJACS	3	3.0	3.0	2.7	3.0	2.7	2.7	2.0	1	0	0	2	0	0	0	0	0	0	0	3	0	0	1	2	0
QUERY	5	2.8	2.8	2.8	3.0	2.3	2.0	2.0	2	3	1	3	0	0	0	1	1	0	0	2	2	0	0	1	3
RPG II (S/3)	59	3.4	3.1	3.6	3.4	3.3	3.2	3.2	21	21	10	24	2	8	1	12	1	3	2	55	3	0	51	6	3
RPG II (360/370)	66	3.5	3.3	3.5	3.5	3.5	2.9	3.1	18	18	17	36	3	3	2	4	4	6	4	63	2	1	57	3	5

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IBM (continued)																									
Sort/Merge (360/370)	105	3.2	3.0	3.4	3.4	3.1	3.1	3.0	28	32	18	22	4	6	3	12	12	2	2	92	7	1	84	8	4
Sort (S/3)	48	3.4	3.3	3.6	3.3	3.3	3.2	2.8	21	16	3	17	1	3	4	11	2	3	1	45	3	0	46	2	0
Source Pgm. Maintenance	7	3.3	3.1	3.0	3.4	2.6	2.7	2.5	3	2	2	6	1	1	0	0	1	0	0	4	2	0	5	1	1
STAT/BASIC	4	2.5	2.5	2.8	2.3	2.3	1.5	—	1	2	0	3	2	0	0	1	0	1	1	2	2	0	2	0	2
TSO	6	3.5	3.0	3.0	3.3	3.0	2.6	3.0	2	0	1	5	1	2	2	1	1	0	2	5	0	0	2	2	2
Utilities (S/3)	23	3.3	3.0	3.5	3.1	3.1	3.2	3.1	9	6	4	7	2	3	1	3	2	2	0	22	0	1	19	4	0
Video/370	7	2.7	2.4	1.9	2.8	2.6	3.1	2.9	3	2	2	6	2	0	3	3	4	0	1	2	4	1	3	3	0
Infodata Systems, Inc.																									
INQUIRE	6	3.2	2.2	2.7	3.0	2.5	2.8	2.6	5	0	0	6	0	2	2	2	2	0	2	2	4	0	4	1	2
Infonational, Inc.																									
Accounts Payable	12	3.0	2.3	2.5	2.9	2.7	2.9	2.3	6	4	1	8	2	3	1	4	1	1	0	2	9	0	2	6	5
General Ledger	7	3.0	2.3	3.1	3.1	2.3	2.4	2.7	6	0	1	5	0	0	3	6	2	1	0	3	4	0	0	5	5
Informatics, Inc.																									
ACCOUNTING IV	5	2.8	2.8	2.0	2.5	3.0	2.0	1.7	3	0	0	3	0	0	2	1	1	0	0	1	3	0	2	3	2
ELIMIN8	4	3.5	3.5	3.0	3.5	2.5	3.0	3.0	2	1	4	1	0	0	0	0	1	0	2	3	1	0	2	2	0
Intercomm	13	2.6	2.8	2.1	2.4	2.0	2.0	2.4	7	0	2	6	3	2	7	0	3	1	2	2	8	2	3	7	5
Life-Comm III	4	2.0	1.7	1.7	2.3	2.3	2.0	2.0	2	0	0	2	0	0	1	1	0	0	0	0	3	0	0	3	4
MARK IV	57	3.3	2.9	3.4	3.3	3.2	3.2	3.3	36	5	12	51	2	16	8	7	17	7	1	36	13	4	43	10	4
Minicomm	7	3.6	3.4	3.4	3.9	3.0	3.3	2.9	3	5	3	5	1	0	1	0	0	0	0	7	0	0	1	6	2
Score	6	3.2	3.3	3.3	3.2	3.0	3.0	2.8	5	2	2	5	0	0	1	0	1	2	0	5	0	1	3	3	0
Stock & Bond Systems	3	2.3	2.7	2.7	3.0	2.7	2.0	2.3	2	1	0	1	0	0	0	2	0	0	0	1	1	0	2	0	1
Innovation Data Processing																									
Fast/Dump/Restore	27	3.8	3.8	3.8	3.8	3.1	3.2	3.2	11	7	25	8	0	1	0	0	0	0	1	24	3	0	21	2	2
FATS	3	3.3	3.0	4.0	4.0	3.3	4.0	—	1	0	2	2	0	1	0	0	0	1	0	3	0	0	3	0	0
International Mathematical & Statistical Libraries, Inc.																									
IMSL Libraries	18	3.5	3.2	3.4	3.2	3.6	3.5	2.5	9	7	4	14	0	1	2	0	0	1	0	16	2	0	11	5	1
International Systems, Inc.																									
PAC II	5	3.0	3.6	3.2	3.0	2.8	3.6	3.6	1	1	1	4	0	0	1	1	1	1	1	1	4	0	2	2	2
Jason Data Services																									
SPRINT	28	3.3	3.5	3.4	3.4	2.8	2.8	2.4	12	21	23	9	2	0	0	1	1	4	0	23	3	1	24	1	0
Johnson Systems, Inc.																									
Job Accounting (DOS)	17	3.1	2.8	2.9	2.8	2.6	2.4	1.9	10	4	2	6	3	0	2	6	2	4	2	11	4	1	11	3	3
Job Accounting (OS)	12	2.9	2.4	3.4	2.8	2.8	2.5	2.2	5	3	1	9	4	1	2	5	3	2	0	8	3	0	8	2	0
Management and Computer Services, Inc. (MACS)																									
DATAMACS	4	2.0	2.8	2.8	2.0	2.5	2.8	2.0	1	0	1	1	2	1	2	0	0	2	0	2	2	0	2	1	0
Management Information Service																									
ALLTAX	32	3.6	3.3	3.4	3.3	3.4	3.4	3.0	14	12	8	29	1	0	3	0	2	2	2	27	5	0	21	1	8
Management Science America																									
FICS	7	3.0	2.3	2.5	3.0	3.3	3.2	2.8	6	0	0	3	0	2	4	3	1	1	2	3	2	0	4	1	3
MSA Accounts Payable	4	1.8	1.8	2.0	2.0	1.8	1.5	1.3	0	2	0	2	3	0	3	2	2	1	1	1	1	2	0	1	4
MSA Fixed Assets	3	3.0	2.7	2.3	3.0	3.3	3.0	3.0	1	1	1	1	1	0	1	1	0	0	3	0	2	1	0	1	3
MSA General Ledger	16	2.7	2.2	2.2	2.5	2.8	2.2	2.3	6	1	4	9	0	8	12	4	7	2	5	3	8	3	9	4	5
MSA Payroll	41	2.9	2.4	2.4	2.7	3.3	2.8	2.8	26	4	2	22	2	4	16	11	10	2	4	18	20	2	8	11	27

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Maxima Systems Group																									
MAXI-LIBE	7	3.6	3.6	3.4	3.7	2.7	3.0	2.7	6	5	4	7	0	0	1	0	0	0	0	4	3	0	5	1	0
McCormack & Dodge Corp.																									
Accounts Payable	11	3.0	2.7	2.8	2.7	3.3	3.0	2.7	7	6	0	3	1	0	0	2	1	1	0	8	3	0	1	6	8
Fixed Assets Accounting	18	3.2	2.8	2.8	2.8	3.1	2.8	2.2	10	6	3	12	1	1	2	3	1	1	1	7	10	0	0	8	12
McDonnell Douglas Automation Co.																									
ICES	3	3.0	2.7	2.0	3.0	2.7	3.0	2.5	3	0	1	3	0	1	2	1	1	0	1	1	2	0	1	2	1
MITS																									
BASIC	4	3.3	3.3	2.8	3.3	2.3	3.0	3.0	1	3	0	1	1	0	0	1	0	1	0	3	1	0	2	1	1
MRI Systems Corp.																									
System 2000	21	3.0	2.3	2.9	3.5	2.4	2.7	2.1	15	0	3	13	1	6	5	8	9	1	2	8	6	4	11	7	3
NCI, Inc.																									
SLICK	18	3.5	3.6	3.3	3.5	2.9	3.1	2.6	11	17	13	10	1	0	0	1	1	1	1	14	3	1	16	2	0
Work Ten	3	2.0	2.0	2.7	1.7	2.0	1.7	1.0	0	0	0	3	0	0	1	1	1	0	0	1	0	2	1	1	1
NCR Corporation																									
Accounts Payable	13	2.8	2.7	2.8	2.8	3.0	2.9	3.0	3	9	2	8	3	0	5	3	2	2	1	9	4	0	2	2	9
Accounts Receivable	10	3.2	2.8	3.0	2.9	3.6	2.4	2.9	3	8	2	6	1	0	3	2	2	0	0	9	1	0	3	1	6
BOMP	4	3.0	3.0	2.5	2.8	2.5	2.3	2.0	1	4	1	3	1	0	1	1	0	1	1	1	3	0	2	0	2
Budget Accounting	3	2.0	1.7	1.7	1.7	2.3	2.3	1.7	1	2	0	1	1	0	1	2	0	1	0	0	2	1	1	0	2
CIF	6	3.3	2.7	2.8	3.3	2.7	2.3	2.2	2	5	2	3	0	0	2	2	0	0	1	4	2	0	2	0	4
COBOL	3	3.7	4.0	4.0	4.0	3.7	3.7	3.0	0	1	3	1	0	0	0	0	0	0	0	3	0	0	3	0	0
FOCIS	3	4.0	3.7	3.7	3.7	3.0	2.0	2.3	1	3	2	2	0	0	0	0	0	0	0	3	0	0	3	0	0
General Ledger	17	3.2	3.1	3.2	3.4	2.9	2.6	2.5	9	14	4	8	1	0	2	4	1	1	1	13	4	0	7	2	8
Order Billing	3	3.0	2.0	2.3	3.0	3.3	2.3	2.0	0	1	0	3	0	0	1	1	1	1	1	2	1	0	0	0	3
Payroll	36	3.1	2.8	3.0	3.0	2.9	2.5	2.6	15	30	7	19	6	0	5	9	3	6	3	22	9	4	6	8	26
PNA	3	3.0	3.0	2.3	2.3	2.0	2.0	2.0	0	3	2	2	1	0	1	0	0	1	0	2	1	0	3	0	0
SCHOLARS	3	3.3	3.0	2.3	2.7	2.7	2.7	2.0	2	0	1	1	0	1	2	1	0	0	0	1	2	0	1	1	1
SPIRIT	4	2.3	2.5	1.8	2.7	2.7	2.3	2.0	1	2	0	1	2	0	2	0	0	2	1	1	2	1	0	2	2
Utility Billing	3	3.0	2.7	2.7	3.7	2.3	2.3	3.5	2	1	0	1	1	0	1	1	0	1	1	2	1	0	0	2	2
Network Data Processing Corp.																									
LILA	8	3.0	2.0	2.1	2.5	2.5	2.4	2.4	4	1	3	6	2	1	1	5	1	0	1	4	4	0	0	5	5
Nichols & Co.																									
PROCON	4	3.5	3.0	3.3	3.0	2.8	2.8	3.0	2	1	0	1	0	1	0	0	0	1	0	3	1	0	2	2	0
Northwestern Univ.																									
SPSS	7	3.1	3.1	3.1	2.9	3.3	3.0	3.0	5	3	1	5	0	0	0	1	1	0	0	7	0	0	5	2	0
On-Line Software International																									
STOP	3	3.0	2.5	3.7	3.5	3.0	3.5	—	0	0	2	2	0	0	0	0	0	2	0	2	1	0	2	1	0
Oxford Software Corp.																									
DFAST	21	3.7	3.6	3.6	3.6	2.9	2.9	2.9	14	7	18	15	0	1	0	1	0	0	0	17	2	1	15	4	0
Save-Restore	9	3.4	3.9	3.3	3.1	2.9	2.6	3.0	6	3	7	4	0	0	0	0	0	0	2	3	6	0	6	2	0
TFAST	8	3.5	3.8	3.4	3.6	2.8	2.8	2.3	5	4	7	7	0	0	0	0	0	1	1	5	3	0	5	3	0
Pace Applied Technology, Inc.																									
KOMAND	3	3.0	3.0	2.3	2.7	2.7	2.3	2.0	1	0	0	1	0	0	1	0	0	0	0	2	1	0	2	1	0

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User Ratings of Proprietary Software

Vendor and Package Name	No. of User Ratings Received	Weighted Average User Ratings							Advantages Cited by Users				Disadvantages Cited by Users							Perform as Advertised?			Require Modification?		
		Overall satisfaction	Throughput/efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training	Flexible	Inflexible	Saves system resources	Saves human resources	Inexpensive	Costly	Complex	Slow	Uses excessive resources	Lacks key capabilities	Compatibility problems	Immediately	Eventually	Never	No	Yes, by vendor	Yes, by user
Pansophic Systems, Inc.																									
EASYTRIEVE	60	3.6	3.4	3.6	3.6	3.1	3.1	2.6	36	22	25	55	0	4	3	2	4	2	1	48	10	0	49	5	0
PAN*DA	4	3.3	3.3	3.8	3.5	3.0	3.5	4.0	3	3	4	3	0	0	0	0	0	0	0	3	1	0	4	0	0
PANVALET	172	3.7	3.5	3.5	3.5	3.3	3.2	2.9	109	52	97	135	0	5	6	2	5	7	6	158	10	0	137	11	13
Parallel Data Systems, Inc.																									
TERMINAL	3	3.7	3.7	3.7	3.7	3.0	3.3	3.0	2	2	3	3	0	0	0	0	0	0	0	3	0	0	2	1	0
Personnel Data Systems, Inc.																									
PASS	3	2.3	2.3	2.7	2.7	2.3	2.3	2.7	1	1	1	1	1	2	0	1	1	0	0	1	1	1	0	3	1
Program Products, Inc.																									
Data Analyzer	11	3.1	3.0	2.8	3.0	2.8	2.9	2.9	6	3	2	9	1	1	3	3	2	1	1	8	3	0	8	1	1
Project Software Development, Inc.																									
PROJECT/2	3	2.7	2.7	3.7	2.7	3.0	2.3	2.3	3	0	0	3	0	2	2	1	0	0	1	1	2	0	3	0	0
SAB, Inc.																									
Software 1040	6	3.5	2.8	3.5	3.2	3.3	3.3	3.3	2	0	2	6	2	0	2	1	0	0	0	4	2	0	3	3	0
SAS Institute, Inc.																									
SAS	6	3.7	3.0	3.5	3.5	3.2	3.2	1.0	5	3	0	6	0	0	1	0	0	2	0	5	1	0	4	1	0
Software AG of North America																									
ADABAS	4	3.3	3.3	3.3	3.5	2.0	2.8	2.5	3	0	0	1	0	3	0	0	0	0	0	4	0	0	4	0	0
Software Design Inc.																									
EPAT	42	3.5	3.4	3.3	3.3	3.2	3.0	2.9	15	7	23	33	3	8	1	1	0	1	1	33	8	1	31	6	2
FMAINT	8	3.6	3.9	3.6	3.9	3.5	3.0	3.7	4	2	8	3	0	0	0	0	0	0	1	6	2	0	6	1	0
GRASP	81	3.5	3.5	3.6	3.5	3.1	3.2	3.1	41	10	70	38	5	40	0	0	1	5	6	69	8	2	67	11	2
Software International Corp.																									
Accounts Payable	8	3.0	3.2	3.0	2.8	2.6	2.8	2.8	6	1	1	3	1	1	1	0	0	1	1	3	2	1	2	4	2
Accounts Receivable	4	3.0	3.0	2.5	2.8	3.0	3.0	2.8	0	0	0	3	1	0	1	0	0	0	2	1	1	0	0	2	2
General Ledger	19	2.7	2.4	2.5	2.6	2.4	2.7	2.2	12	1	2	11	2	4	6	5	7	3	3	6	7	4	3	10	7
Software Pursuits, Inc.																									
DOS/MVT	4	4.0	4.0	3.7	3.8	3.3	4.0	3.3	3	2	4	4	0	1	0	0	0	0	1	3	0	0	1	2	0
SPSS, Inc.																									
SPSS	24	3.5	3.4	3.4	3.5	3.7	3.1	2.7	12	12	2	20	0	1	1	0	4	2	1	19	4	0	18	4	0
St. Joseph's Bank & Trust Co.																									
Trust System	4	3.0	3.0	3.5	3.3	3.5	3.0	3.0	1	1	0	3	0	0	1	1	0	0	0	2	2	0	3	0	1
Stockholder Systems, Inc.																									
PEP	5	2.8	2.6	2.6	2.8	2.8	3.0	2.8	4	0	0	2	0	0	1	1	1	0	0	3	2	0	4	0	1
Synergetics Corp.																									
PRO-TEST	3	3.0	3.3	3.0	3.3	2.7	3.0	3.5	3	0	0	2	0	1	0	0	0	0	0	2	1	0	2	0	0
System Integrators, Inc.																									
T2P2	3	3.3	3.0	2.7	3.0	1.0	2.0	1.5	3	0	0	2	0	0	2	0	0	0	1	2	1	0	0	1	2

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User Ratings of Proprietary Software

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		Overall satisfaction	Throughput/efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training	Flexible	Inflexible	Saves system resources	Saves human resources	Inexpensive	Costly	Complex	Slow	Uses excessive resources	Lacks key capabilities	Compatibility problems	Immediately	Eventually	Never	No	Yes, by vendor	Yes, by user
System Support Software, Inc.																									
QUIKJOB	27	3.4	3.3	3.7	3.4	3.0	3.1	2.8	21	18	7	23	3	2	0	1	3	4	0	23	3	0	24	1	2
Systonetics, Inc.																									
EZPERT	3	3.3	2.7	2.0	3.0	2.7	3.3	3.3	2	0	0	3	1	1	1	1	0	0	0	1	1	0	0	2	0
Tektronix, Inc.																									
Plot-10	7	2.8	2.7	2.7	3.0	2.5	3.0	2.0	3	2	1	2	0	1	2	1	2	1	2	0	4	0	1	2	5
Time Share Corp.																									
GIS	4	3.3	3.3	3.0	3.3	3.5	3.5	3.3	2	1	0	4	0	2	0	0	1	1	0	3	1	0	1	1	2
Turnkey Systems, Inc.																									
TASK/MASTER	19	3.3	3.2	2.8	3.3	2.5	2.7	2.7	11	1	8	14	0	2	4	0	3	2	2	6	11	2	7	8	6
Univac Division, Sperry Rand Corp.																									
UNIS/90	3	3.0	3.0	3.0	3.5	2.3	3.3	3.5	2	2	1	2	0	0	1	0	0	0	0	1	0	0	0	0	2
Universal Software, Inc.																									
ASAP	47	3.5	3.6	3.4	3.4	2.9	3.0	3.0	17	20	42	18	2	1	2	0	0	2	5	34	10	0	31	11	3
RELO-PLUS	6	3.7	3.8	3.5	4.0	3.3	3.2	3.3	3	3	6	3	0	0	0	0	0	0	0	5	0	0	5	0	0
OPTIMUS	5	3.2	3.2	4.0	4.0	3.4	3.6	3.3	2	2	3	1	0	0	0	0	0	0	0	4	1	0	4	1	0
University Computing Co.																									
FCS	9	3.0	2.6	2.3	2.7	2.3	2.7	2.8	6	1	2	6	0	1	4	1	5	0	2	3	6	0	2	4	5
UCC 1 (TMS)	15	3.5	3.4	3.0	3.4	2.9	3.0	3.0	5	2	10	11	0	1	5	0	0	0	1	12	2	0	9	2	5
UCC 2 (DUO)	15	3.4	2.9	3.0	2.9	2.7	3.0	3.0	3	2	4	11	1	3	3	1	2	2	2	11	4	0	8	5	2
UCC 10	8	3.3	2.9	2.5	3.0	2.6	2.7	2.0	5	1	0	8	0	1	2	1	1	1	1	5	3	0	3	1	4
University of California at Los Angeles (UCLA)																									
BMD	8	3.4	2.7	3.3	3.0	3.6	2.6	2.7	5	5	2	5	0	0	1	2	2	0	1	5	2	0	6	0	1
University of Waterloo																									
WATFIV	11	3.8	3.7	3.4	3.7	3.3	3.1	3.8	3	6	9	8	0	0	0	0	0	0	0	9	1	0	7	0	3
Value Computing Inc.																									
Comput-A-Charge	7	3.1	3.1	3.1	3.0	2.6	2.9	2.3	4	0	1	5	1	0	2	1	0	0	1	3	4	0	4	2	1
VALU-LIB	7	3.0	2.6	2.7	2.9	2.9	3.0	3.0	3	0	2	5	1	0	1	1	1	0	0	5	2	0	1	5	1
Versatec, Inc.																									
Versaplot	4	2.5	2.3	2.3	2.5	2.3	2.3	2.0	1	0	0	3	1	0	2	2	1	1	2	1	3	0	1	0	3
Wang Laboratories, Inc.																									
Payroll Systems	8	3.1	2.5	2.6	2.9	3.4	3.3	3.1	6	2	2	7	0	1	1	2	2	1	0	4	4	0	2	1	5
Western Electric Co., Inc.																									
UNIX	5	4.0	4.0	3.4	3.6	2.6	2.0	1.0	5	2	5	4	0	2	1	0	0	0	1	5	0	0	0	0	5
Westinghouse Electric Co.																									
Disk Utility System	117	3.8	3.9	3.8	3.7	3.5	3.3	3.2	75	68	108	58	3	1	0	0	0	0	6	112	2	0	110	2	3
Job Accounting	5	3.2	3.4	2.8	3.2	2.8	2.8	3.0	0	3	1	3	0	0	0	0	0	0	0	4	1	0	3	0	2
Teleprocessing Interface System (WESTI)	29	3.7	3.6	3.6	3.6	3.1	3.2	2.8	17	23	20	22	1	0	1	1	0	2	1	25	3	0	24	1	2
Whitlow Computer Systems, Inc.																									
Syncsort	46	3.7	3.8	3.1	3.7	3.2	3.4	2.6	18	11	44	15	0	2	1	0	0	0	2	37	8	0	35	9	2

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HOW USERS RATE THE POPULAR DATA BASE MANAGEMENT SYSTEMS

Package & Vendor	Weighted Average User Ratings*							
	No. of users reporting	Overall satisfaction	Throughput/Efficiency	Ease of installation	Ease of use	Documentation	Vendor technical support	Training
ADABAS Software AG	4	3.3	3.3	3.3	3.5	2.0	2.8	2.5
Datacom DB, CIM	8	3.3	3.4	3.0	3.4	2.3	3.4	3.1
DBOMP, IBM	48	3.0	2.6	2.4	2.7	2.5	2.7	2.4
DL/1, IBM	29	2.6	2.4	2.3	2.4	2.4	2.5	2.6
DMS-II, Burroughs	5	3.8	4.0	3.6	3.6	2.8	3.0	3.2
GIS, IBM	7	2.4	2.1	2.1	3.0	2.7	2.6	2.3
IDMS, Cullinane	17	3.8	3.3	3.4	3.6	3.0	3.6	3.5
IMAGE, Hewlett-Packard	11	3.6	3.3	3.7	3.2	2.8	2.9	2.7
IMS, IBM	33	2.9	2.4	2.2	2.5	2.8	2.8	2.9
INQUIRE, Infodata	6	3.2	2.2	2.7	3.0	2.5	2.8	2.6
Model 204, C.C.A.	3	3.7	3.3	3.3	3.3	2.7	3.3	2.7
SYSTEM 2000, MRI Systems	21	3.0	2.3	2.9	3.5	2.4	2.7	2.1
TOTAL, Cincom Systems	113	3.5	3.1	3.4	3.4	2.8	3.0	2.8

*All weighted averages are based on a scale of 4.0 for Excellent.

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The LIBRARIAN
Applied Data Research, Inc.

MANAGEMENT SUMMARY

The primary function of The LIBRARIAN is to provide IBM System/360 and 370 users under DOS, OS, or their VS counterparts with a facility for source-program maintenance and retrieval.

To service the needs of those installations operating in a real-time environment, The LIBRARIAN/On-Line (LIB/OL) version was recently introduced. This version offers several optional on-line facilities such as the ability to operate with CICS, TASK/MASTER, and other teleprocessing monitors. In addition, The LIBRARIAN interfaces with TSO, VM/CMS, and ROSCOE, ADR's own conversational programming system.

Another recently introduced version is The LIBRARIAN/VS (LIB/VS) system, which is designed for operation in OS/VS and DOS/VS environments. It contains unique facilities to optimize and enhance performance under VS. These include re-enterability, an optimized working set, and single-segment construction.

All versions of the system produce audit-trail documentation of individual programs as well as the entire source library containing the programs. After initial installation, programmers use LIBRARIAN control cards or statements to access source programs for updates and compilations.

The LIBRARIAN also eliminates cumbersome card decks, provides increased security for program maintenance and storage, and reduces the programmer time required for program modification. It also provides a means for the user to generate improved and/or less expansive audit-trail documentation and saves on disk storage space requirements.

The LIBRARIAN approaches the audit-trail documentation problem by providing several types of standard documentation for each program and library of programs. These are produced automatically as a by-product of typical updates and program modifications, rather than as a separate effort, however slight, by the programmer. The audit trails provide a historical record of individual programs, reflecting the successes or failures of all LIBRARIAN operations as well as providing helpful data for the programmers to assist them in using the system.

Reduction of programmer effort required for modification is a significant justification for the use of The LIBRARIAN. An important point to consider is that each individual programmer retains control over his own programs through the use of control cards, rather than instructions to the computer operator. Once created, the deck can be run with other programmers' update decks in a single batch. The elimination of a series of individual runs will save considerable computer time. All the facilities mentioned here are available with the LIB/OL version and can be invoked from teleprocessing monitor terminals.

The LIBRARIAN, a Datapro Software Honor Roll package for four consecutive years, provides source-program maintenance and retrieval for IBM System/360 and 370 users under DOS, OS, their VS counterparts, and VM/CMS. The system allows COBOL, FORTRAN, PL/1, and Assembly language modules to be intermixed in a single user library.

CHARACTERISTICS

SUPPLIER: Applied Data Research, Inc., Route 206 Center, CN-8, Princeton, New Jersey 08540. Telephone (609) 924-9100.

Sales and support for the program are handled from the Princeton Headquarters of Applied Data Research. Other ADR offices are located in principal cities throughout the United States. Overseas offices and representatives of ADR are located in Canada, throughout Europe, England, Australia, Mexico, the Philippines, Japan and other Asian countries, and South America.

BASIC FUNCTION: The LIBRARIAN maintains and controls source libraries on tape and/or disk for installations using an IBM System/360 or 370 under DOS, OS, or VS. The LIBRARIAN documents all update runs and records the date when each card of an existing program was last modified. It also includes the facility to interface with TSO, VM/CMS, and ADR's ROSCOE, as well as allowing all features to be executed under CICS and other teleprocessing monitors. A feature of the program is that it will maintain a library containing any combination of programs (in any language) and/or data, so long as it was originally supplied in 80-c olumn card image format.

OPERATION: The user of The LIBRARIAN system will instruct his programmers to use the 12 LIBRARIAN control cards in order to modify or retrieve any source program. Each programmer will produce his own card input to achieve his particular purposes—e.g., to modify or document a program, or to produce a workstream involving a compilation and perhaps a program execution. His card deck can then be batched with others and run against the library.

In order to modify a program already in the tape or disk library, the programmer uses INSert, DELete, or REPlace control cards. The required parameters specify the sequence number of the statement after which the insert is to be made, or the sequence number of the first and last statements to be replaced or deleted. Optionally, updates can be made based on data card sequence numbers (when they are present) rather than using the explicit LIBRARIAN commands.

Three commands permit character string operations, within individual card images. The LIBRARIAN can search a module or group of cards within a module for the occurrence of a particular string and replace that string with another (EDIT) or list the occurrences (SCAN). The FILL command causes a specified string to be forced into particular card columns (used primarily to insert or modify program ID FIELDS).

In addition to actually modifying his program, the programmer can also document the modification as he desires. Documentation consists of either listing the program or punching it out. Under The LIBRARIAN system, the programmer must specify his output requirements only if they differ from the standard documentation produced for each run. For example, if a typical run produces a listing of any

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The LIBRARIAN
Applied Data Research, Inc.

Besides the obvious aid The LIBRARIAN provides in program development, program maintenance is simplified by the audit-trail provision. History cards are listed along with the program listing showing reasons for specific program changes and their corresponding dates. These are automatically placed as history comments next to affected program statements by The LIBRARIAN.

In attempting to determine possible savings from using The LIBRARIAN, an installation should estimate the frequency of source program updates and compilations. Typically, they will be run once or twice a day, but this figure may vary for different installations.

Elimination of source program card decks is another advantage for several reasons: reduced storage requirements, fewer accidents such as dropping or tearing cards, and reduced machine time otherwise wasted in reading cards. In some situations, however, the ability to change a single card in a particular deck directly is desirable, or the machine time saved by eliminating decks is negligible.

Additionally, The LIBRARIAN can generate savings in file space by significantly compressing, by as much as an 80 into 25 ratio (80 into 50 is more typical), any card images, be they source programs or data. Besides this, The LIBRARIAN, using disk master files and its special direct-access techniques, can maintain disk file space effectively and can permanently eliminate one hated procedure, the file REORG.

The key elements in determining the potential value of reducing or eliminating the use of card libraries are the amount of time which can be saved and the need to reduce accidental mishaps in card handling. Again, this depends on local factors and individual circumstances. The important characteristic of The LIBRARIAN is that it offers an alternative to current practices, thereby providing the opportunity to investigate and improve current performance.

USER REACTION

In the 1976 Datapro survey of proprietary software users, The LIBRARIAN joined only six other products in achieving the distinct honor of being elected to the Datapro Software Honor Roll for the fourth consecutive year. There were 119 responses to our survey questionnaire from users of The LIBRARIAN. Here are their ratings:

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	86	27	5	1	3.7
Throughput/efficiency	66	43	6	0	3.5
Ease of installation	71	39	3	4	3.5
Ease of use	64	46	5	1	3.5
Documentation	49	54	11	1	3.3
Vendor technical support	41	46	19	6	3.1
Training	32	40	17	3	3.0

*Weighted Average on a scale of 4.0 for Excellent.

As might be expected from a package of this sort, the major advantage was reported to be the savings in

modified program but does not punch programs out unless a special request is submitted, a programmer will receive a listing automatically without using any control cards. He can additionally request a punch-out or suppress the listing simply by entering a SEL (select) control card. This card initiates the run and identifies the program module to be selected by The LIBRARIAN.

A Utility feature is included that gives the user much of the flexibility in rearranging card images that he had when working directly with the cards. Groups of cards can be moved around in the same module, transferred to a new master file, set up as a separate module, placed into card-image data sets on disk or tape, and punched, printed, or displayed on an on-line terminal.

Optionally, users can employ the COBOL Syntax Checker to examine modules when added and during subsequent changes. The syntax checker handles all levels of IBM COBOL, including ANSI, and checks for correct sentence structure, punctuation, reserved words, picture clauses, etc., but not for validity of data or for procedure references. The user can specify that compilation for the particular module be suppressed if any syntax errors are found. By flagging errors at update time, unsuccessful compilations can often be avoided.

The LIBRARIAN contains automatic safeguards against making changes to the wrong program. The main protective feature is the password facility. As each program is placed on the file, a unique four-character "password" is assigned to it. A user can require that the proper password, as well as the program name, be specified before any updates will be applied.

The password facility is basically a protection against keypunch errors, rather than against any security breaches. ADR feels that the module names used by programmers are so alike that clerical errors frequently occur. The password technique will prevent a single keypunch error from causing serious damage to the wrong program module. Additional security is provided by a cryptically encoded software lock.

Another security feature that can be optionally used by the programmer is the VERS feature, which offers protection against using an outdated listing. The programmer supplies the date (or date and time) of the listing he's using and The LIBRARIAN will automatically compare this information to the date (and, if necessary, time) when the module was last updated. If the two do not agree, the programmer is assumed to be updating an outdated module, and updating for that module is bypassed.

A debugging facility copies existing modules and assigns the copied module a new name. This temporary module can be used for testing and debugging purposes, while the original module simultaneously is maintained as a production version. Once the copied version has been thoroughly tested, it can be renamed to replace the original version. Alternatively, a temporary change can be made to the production module.

If a user has tape master files, Cycle Control is an optional facility which relieves programmers of the burden of cycling the tapes. A Cycle Control File is set up on disk storage for each source library. When The LIBRARIAN is called to do an update, all tape mounting instructions are printed out automatically by the program. The Cycle Control feature also checks to ensure that its instructions have been followed properly when tape master files are used. This prevents the operator from mounting the incorrect tape and applying updates to the wrong file. In addition, a specific number of tapes are allocated for each library concerned and assigned appropriate sequence numbers.

Default JCL parameters are stored for effortless standard operating procedures with both tape and disk master files. The LIBRARIAN uses these optional parameters to automatically generate error-free JCL at the user's direction.

In creating a job stream, the latest version of each required program in the library is merged as instructed by the programmer's control cards and passed, together with additional control cards and data, into the operating system. Compile-only or compile/link/go operations can be initiated as necessary.

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human resources. There were 92 responses noting this advantage. Flexibility was cited as an advantage in 56 responses, and savings in system resources in 51.

There were very few user responses reflecting any major disadvantages of the system. Five users noted excessive resource utilization, and there were four indications of inflexibility, costliness, and compatibility problems. The scarcity of reported disadvantages, together with the many positive statements on advantages, provide further justification for The LIBRARIAN's perennial presence on the Datapro Software Honor Roll.

It is significant that 105 users stated that the product performed as advertised "immediately," while only 10 indicated that there was some delay in the product reaching the advertised performance level. This was complemented by the fact that 99 users indicated that no modifications to the system were required, while 8 said the vendor made some modifications and 9 noted that user modifications were implemented.

The average use time reported by these 119 users was 28 months. Of the 119 respondents, 86 were IBM System/370 users and the remainder were using System/360 computers. Their operating systems ranged from DOS through the various versions of OS/VS, and the hardware configurations in use ranged from 360/30's and 370/115's through 370/168's.

Only four users indicated that any modification costs were incurred, and the average of these costs was $3,525. The modifications were primarily for specialized hardware/software interfaces that were needed to support "unusual" configurations. These same four respondents rated the package highly.

As one user pointed out (and we feel that this sums up the feelings of most of the respondents), "It is a sound investment." We should also note, however, that three respondents mentioned that the tape-handling capabilities of the system were not all they could have expected, but said that the system "was well worth getting."

With the advent of the new LIB/OL and LIB/VS versions, ADR now offers a version of The LIBRARIAN to suit almost any configurational need. Considering the popularity of the product, along with the high ratings submitted by its current users, it's clear that anyone interested in an effective source library maintenance system should take the time to evaluate what The LIBRARIAN has to offer. □

Card images are compressed when entered on The LIBRARIAN master file. Compression is achieved by eliminating contiguous blanks, by eliminating the program ID field of each card (optional), and by taking advantage of certain characteristics of each language. Maximum compression is typically achieved with higher-level languages, such as FORTRAN and COBOL, rather than with Assembly language code. ADR estimates that, typically, one source card will occupy only about 25 bytes, including the control codes necessary for expansion to the full form.

Master file setup or adding to the master file requires preparing a card, tape, or input deck for each program to be placed on the master file (if none exists), determining the number of individual libraries to be established, and running an initialization pass. In addition, all programmers and operators are provided with introductory training in the use of the system. A standard for using and filing the program documentation produced during the runs also should be established.

GROUP PROCESSING OPTION: A feature recently added to the list of The LIBRARIAN functions is called the Group Processing Option (GPO). This feature enables the user to access a group of modules that have common attributes. After determining which attributes are to be used for grouping the modules, the programmer substitutes the appropriate GPO keyword parameter(s) for the module name in a single — DLM — SEL, or —COPY card. The LIBRARIAN scans the master file, creates a LIBRARIAN command with the name of each module that satisfies the specified criteria, and produces a listing of these commands. Additionally, index listings of selected groups of modules can be requested.

Through the use of GPO, it is possible to compile, list, copy, delete, edit, and produce index listings for a group of modules.

SPACESAVER: One of the numerous options available to users of The LIBRARIAN is the SpaceSaver option. This feature is designed to produce management reports aimed at helping to achieve improved utilization of disk storage space. Due to the limited OS facilities for disk space utilization control, OS installations typically have substantial amounts of unused, inaccessible disk space. SpaceSaver can go further to help users make use of this space than the existing IBM utilities. This option is available only with the OS version of The LIBRARIAN.

SpaceSaver can: 1) report the amount of space allotted versus the amount actually used, 2) call attention to "stray" data sets (i.e., data sets created but never used again), 3) determine the number of directory blocks used, and 4) report data set usage by user and volume. It can provide management with information that can help avoid a disk storage shortage crisis and help to optimize the use of disk storage resources. It can produce two disk analysis reports. It can also allow users to establish naming conventions for data sets, and its reports can be helpful even when conventions haven't been established in the past.

CROSS-PROGRAM AUDITOR: A new option available with The LIBRARIAN (and also available with ADR's AUTOFLOW II product) is called the Cross-Program Auditor (CPA). This facility is an efficient investigator of application systems, particularly when they are written in COBOL. CPA can analyze any number of programs in terms of their functional interaction. The results of its analysis are presented in a concise, problem-oriented format.

CPA utilizes the computer's resources to automatically gather, reduce, and organize any desired set of system information. The kinds of information valuable to system maintenance might include how individual programs interact, what factors are common among them, and where the differences might exist. The input for CPA may come from a LIBRARIAN tape or disk master file, from any data set in OS, from a source library in DOS, or from a card reader.

LIB/VS: The LIBRARIAN/VS version of the system offers users all the same facilities and options available with The LIBRARIAN, but takes advantage of the features of the virtual environment. The LIB/VS system incorporates re-entrant coding, an optimized working set, and single-segment construction. These features result in reduced loading and paging overhead, reduced CPU and I/O time, and improved overall system throughput in a VS system.

LIB/OL: Another version of the system is The LIBRARIAN/On-line (LIB/OL). LIB/OL, like LIB/VS, offers the user all the existing facilities of the basic system. In addition, the user has the ability to invoke the system via CICS, TASK/MASTER, or other telecommunications monitoring systems. Source programs stored in the master file can be updated under the control of commands entered at the terminal. With LIB/OL-BX, updating is performed by a remotely scheduled batch execution of The LIBRARIAN. With LIB/OL-IX, an immediate execution of The LIBRARIAN is performed during the programmer's terminal session, and the results of the update can be immediately verified.

The LIB/OL facilities enable the programmer to display all or portions of the program on the screen, browsing in a forward or backward direction. A split-screen design lets the programmer view source statements displayed on the lower

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portion of the screen while entering update commands in the upper screen area.

To extend LIB/OL's flexibility, a generalized RJE capability has been added to the system. Jobs that can be prepared on cards and entered into a conversational batch environment can be prepared and submitted to the operating system (OS or DOS) from the teleprocessing monitor terminal. Provisions are included for line-by-line entry of the job stream in scratchpad storage for subsequent consolidation, and for submitting verified jobs to either DOS or OS for servicing. The RJE facility is useful not only for program development and maintenance purposes, but also for production scheduling and routine system housekeeping.

Under DOS, LIB/OL-IX users can view, print, or delete job output. To facilitate viewing of job output wider than 80 positions, horizontal screen shifting is supported. Additionally, the contents of DOS reader, print, and punch queues and a list of all jobs active in the system can be displayed.

TSO INTERFACE: The LIBRARIAN/TSO interface consists of four command processors, or promptors, which are functionally similar to the prompters for language translators offered as program products by IBM. These prompters, called LIBGET, LIBSAVE, LIBLIST, and LIBINDEX, are designed for maximum user convenience. All command operands are either optional or have defaults.

The LIBGET command reads a source module from the master file and places it in a sequential data set. The LIBSAVE command invokes the LIBRARIAN program in a foreground region and transfers a TSO sequential data set to a master file. The LIBLIST command permits browsing of a module at a TSO terminal, and the LIBINDEX command creates a sequential data set containing an index listing of all modules for which the terminal user is responsible. The HELP facility is available to provide additional information at the terminal.

VM/CMS INTERFACE: In a VM/CMS environment, CMS facilities are used to both prepare and maintain source programs while The LIBRARIAN provides a permanent, secure storage capability. There are two command processors—one to retrieve source programs, the other to produce index summaries—incorporated into CMS. The LIBFETCH command is entered at a CMS terminal and effects the retrieve function. The user enters or is prompted for relevant information and is subsequently notified of all error conditions. A successfully retrieved module becomes a CMS file suitable for editing.

As in the TSO option, LIBINDEX is the command processor for listing and/or displaying programmer-responsible modules. The index in this case is written as a CMS file and displayed at the terminal under CMS command control.

REPORTS: The reporting function of the system generates documentation at many different levels for use by all levels of management. There are reports dealing with file management (updating, adding, deleting, editing, etc.), lists of activities carried out against the files, verification lists, historical file information, statistical information, and records of all actions taken by programmers while maintaining their programs.

HARDWARE/SOFTWARE REQUIREMENTS: The LIBRARIAN operates under DOS, OS, or their VS counterparts on any IBM System/360 or 370 computer except the System/360 Model 20 and Model 44.

Two tape drives are required to handle tape library files. A 2311, 2314, 3330, 3340, or 3350 disk drive can be used for disk files. A tape-oriented LIBRARIAN installation needs a disk to accommodate the Cycle Control feature if desired.

Main memory requirements depend on the operating system, the features implemented, and the type of library master files used. Approximate requirements are: DOS tape—24K bytes; DOS disk—30K bytes; OS tape—50K bytes; OS disk—40K bytes. An additional 12K bytes are required if the COBOL Syntax Checker is used. These main memory requirements do not include operating system residency requirements.

PRICING: The LIBRARIAN is available on a monthly license or permanent license basis at the following prices:

	Single Payment	3 Annual Payments	36 Monthly Payments	Monthly License
DOS Version	$4,900	$1,875	$175	$275
OS Version	5,800	2,225	210	325
TSO Interface	2,000	765	70	110
SpaceSaver Option	1,200	460	45	65
VM/CMS Interface	2,000	765	70	110
CPA	3,700	1,420	135	200
LIB/OL-BX	1,700	650	60	100
LIB/OL-IX	3,500	1,340	125	200

On a monthly license basis, maintenance, training, and installation are included in the license cost. For the permanent license, one year of maintenance is included. Thereafter, the annual maintenance fees are:

DOS LIBRARIAN	$735
OS LIBRARIAN	870
TSO Interface	300
SpaceSaver Option	180
VM/CMS Interface	300
CPA-DOS	415
CPA-OS	495
LIB/OL-BX	265
LIB/OL-IX	525
LIB/VS-DOS	735
LIB/VS-OS	870

INITIAL DELIVERY: October 1969 (DOS and OS LIBRARIAN); February 1976—LIB/OL; August 1976—LIB/VS.

CURRENT USERS: Over 3,000 installations as of August 1976.■

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Data-Man
Data-Man, Ltd.

MANAGEMENT SUMMARY

Data-Man is a general-purpose software system that provides file management and report retrieval facilities. It is a Canadian product that is currently in use in 40 Canadian installations, on IBM systems ranging from a 64K-byte 360/30 to several 370/168's. It is currently enjoying use in individual installations as well as in large data centers. There are an additional 24 installations in England, the United States, and Australia.

Report requests in Data-Man are unusually free in form, and the average request can be coded in half a day, by typical non-EDP-oriented users after only two days training. With requests thus generated, the average number of tests to a successful run is reputed to average about 2.3. Importantly, input can come from multiple files.

The package is in continuous development. The current release, Version 5.2, was delivered in January 1976 and offers VSAM support and the ability to read and write up to 32 files at any point in a Data-Man procedure, as well as a user exit facility that allows a call-return from Data-Man to any user-written subroutine and automatic return to the next Data-Man statement. Data-Man has other strengths. Its users rate it as one of the most cost-effective systems of its type, and it has won out over strong competitors in quite a few situations. It is said by many to be the least expensive package of its type. Moreover, it can be rented as well as purchased, and a free trial is available.

The four basic parts of Data-Man are File Definition, Retrieval-Reporting, Table Creation/Maintenance, and File Maintenance.

File description is a necessary part of any software of Data-Man's type, but this one has a few new wrinkles. To save time, only those fields required for specific reports need be defined to the Data-Man system. Based on this input, data can subsequently be extracted conditionally.

To retrieve and report, Data-Man reads the input file or files, creates an internal select output file, sorts that intermediate file by report number and sequence within report, and then transfers control to a report generator that prints the requested reports. All this is done automatically.

Data-Man provides access to tables of numeric factors or alphabetic descriptions designed by the user through specification statements. Table data is entered via cards, and the resulting internal table file can be used automatically in table lookup procedures during reporting and/or maintenance.

Data-Man is a powerful, flexible file management and report retrieval package that offers ease of use and multiple-file input to IBM System/360 and 370 users without regard to operating system considerations.

CHARACTERISTICS

SUPPLIER: Data-Man Ltd., 1160 IBM Building, Calgary, Alberta, Canada. Telephone (403) 266-6358. Sales and support are provided in Eastern Canada; New York; Melbourne, Australia; and London, England. Sales and support for Data-Man in the United States are provided by Oxford Software Corporation, 158 Lynwood Plaza, Fort Lee, New Jersey. Telephone (201) 944-0083.

BASIC FUNCTION: File management and report retrieval for IBM System/360 and 370 configurations under any operating system. Data-Man can be used by non-programmers for the production of requested reports and by others for file management that includes creation and/or updating of files.

OPERATION: There are three steps in preparing a report from a data base using Data-Man: (1) define the data base, (2) code the report specifications, and (3) execute the reports.

In defining the data base, specifications provide the name assigned to the data base, physical characteristics of the files within the data base, names assigned to data elements within the files, provision of the attributes (field length, etc.) of the data elements, and file fields that are to be used by the system to coordinate reading of multiple records and input files.

Coding the report specification involves providing the name of the data base to be used, the conditions for selecting the report data, the report sort sequence, heading information, and the print format for the report's detail and total lines. The coding form is quite simple, having only line numbers, a directive column, a name column, and a parameter column.

For processing a report request, specifications give the data base to be accessed for execution of the report, the identification of the report(s) that are to be executed, and run-time information such as the date and other parameters.

The Data-Man system consists of several processing components that, in general, can be run independently or in conjunction with other components. The translator converts the user's source-language statements into a form that can be used by other phases of the system. Its output is a printed source listing with error messages and an internal program library or control file that contains the compiled version of the source-language procedures used by all other components.

The table creation component of Data-Man reads the user's table data cards and creates or updates the table library. The file tables are maintained in proper sequence, and can be used by all other system components.

The retrieval component is responsible for retrieving data from the user's data base that is required for report printing. Up to three coordinated files can be used as input, and any number of reports can be produced in one pass of the input file(s). The

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Data-Man
Data-Man, Ltd.

The file maintenance facility within Data-Man is used in much the same way as the reporting facility. It reads a master file and a transaction file to create a new master file and an audit file. The facilities offered range from simple maintenance using a few statements through complicated maintenance and updates.

Data-Man provides all these features: (1) ability to process existing files; (2) complete conditional logic, e.g., if, else, go to, etc.; (3) coordinated reading of up to three files for a report; (4) ability to read and/or write up to 32 subfiles; (5) complete calculation facilities, including Boolean commands; (6) creation of any number of reports in one pass of the files; (7) overlay structures, work fields, and conditional field definition; (8) table lookup facilities for single- or multiple-column tables; (9) user exit facilities; and (10) reports with automatic formatting, headings, subheadings, details, and totals, with any number of lines and unrestricted calculations, conditional logic, and editing.

USER REACTION

In the 1976 Datapro survey of proprietary software users, only one respondent rated Data-Man, so we contacted eight additional users of the product from a list supplied to us by the vendor. The combined ratings of all nine users appear in the following table.

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	4	5	0	0	3.4
Throughput/efficiency	2	4	1	1	2.9
Ease of installation	5	4	0	0	3.6
Ease of use	4	5	0	0	3.4
Documentation	0	5	1	3	2.2
Vendor technical support	3	4	0	1	3.1
Training	1	4	0	1	2.8

*Weighted Average on a scale of 4.0 for Excellent.

It is obvious from their ratings that the users had a high opinion of the Data-Man system's overall capabilities. However, they were strongly critical of the product's documentation. Some of the users expressed a desire for the vendor to take steps to improve both the documentation and the training. One user remarked that the training he received was good, but the course was too short. He recommended that multiple sessions be given so that all the information could be adequately presented.

Without exception, the users noted that Data-Man was a good report generation package, but that it lacked certain key features to make it a good file management system. All the respondents appeared pleased with the type and variety of reports that can be generated by the Data-Man and the ease of generation. As one user said, "It's simple to use for most straightforward applications." Another user noted that "a new application can be running quickly and easily." Reduced programming and testing costs were cited by some, as well as the ability to serve the end-user departments quickly with meaningful and accurate information.

A criticism voiced by one user was that Data-Man used excessive system resources, with extremely high CPU utilization, which caused him to doubt the ability of the product to handle recurring production runs. Even so, this user rated the package well above average in all areas except documentation.

Only two users indicated that any modifications were required to install the system, and there was no cost involved in either case. The average usage time reported by the nine respondents was 60 months, with the shortest installation time being 18 months and the longest six years.

In summary, Data-Man is flexible and easy to use, and we recommend that you take the time to evaluate what it may be able to do for your installation.□

process is invoked via control cards. Report items are selected, the table library is used to bring in the required tables, and the program library is used by this phase.

The sort component reads the output file of the retrieval component and arranges output into the demanded sequence before passing control to the report component. The report component handles the report generation, using report specifications from the program library and tables from the table library. It ensures that printing continues until all reports are completed.

Additionally, external subroutines written in any language can be called.

PERFORMANCE: Data-Man is said by its users to perform as advertised, especially in report creation based on data retrieval. This is its most popular usage, but the system also wins endorsements for its other functions. Please refer to the "User Reaction" section of this report. About 80 percent of the Data-Man jobs in operation are routine repetitive tasks.

HARDWARE/SOFTWARE REQUIREMENTS: IBM System/360 or 370 under DOS, OS/MFT, OS/MVT, or their virtual storage counterparts. The system is release-independent to these operating systems and is transparent to OS and DOS. Minimum core requirements are 34K bytes for DOS and 44K bytes for OS.

PRICING: Monthly rental is $450 per month plus an installation fee of $400. The system can be purchased outright for $11,000 to $15,000. Use of Data-Man can also be obtained through a data center for a surcharge rate; contact the vendor for further information.

INITIAL DELIVERY: The initial version was delivered late in 1969. Enhancements have since arrived about twice yearly, and the current Version 5.2 was first installed in January 1976.

CURRENT USERS: As of August 1976, there were 64 copies of Data-Man in use at 61 locations: 40 copies in Canada, 17 in England, 5 in the United States, and 2 in Australia.■

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SYNCSORT III-and-a-half
Whitlow Computer Systems, Inc.

MANAGEMENT SUMMARY

SYNCSORT III-and-a-half is the latest in a series of sorting products released by Whitlow Computer Systems for the IBM System/360 and 370 computers. While retaining JCL and Sort Control Card compatibility with the IBM sorting products, SYNCSORT releases over the past five years have introduced many innovations in sorting technology. These innovations have resulted in both improved sorting performance and solutions to operational problems which have plagued the computer industry.

One example is the set of disk space features, first announced in 1973, which support Secondary Allocation (without inclusion in JCL), Release of Excess Disk Space, and the use of Non-Contiguous Disk Space. This combination virtually eliminated the "sort capacity exceeded" problem, returned over-allocated disk space for use by other jobs, and allowed the sorting jobs to begin sooner. Without alteration of any JCL, certain jobs sorted with SYNCSORT were enabled to execute in one-tenth the disk space normally allocated by users, freeing the other nine-tenths for other functions. Studies conducted by the vendor indicte that users had frequently been over-allocating by as much as 1000 percent.

In addition to enhancements in the internal sorting techniques that have yielded further performance improvements, two new features, reportedly unique in the sorting field, have been incorporated into the current release of SYNCSORT III-and-a-half to provide a convenient solution to two other critical data processing problems.

The first is the need for software such as the sort routines to coexist efficiently with "on-line" systems without materially impacting the response times of these systems. SYNCSORT provides this capability through the "PARM-EXIT" facility. This new feature is essentially a Sort Control System which carefully determines the best executing environment at the time of initiation and may alter its predefined mode of execution automatically according to the guidelines set by each installation. In this way, the sort will be able to acquire, without manual intervention, the maximum resources available to it at those times when the on-line systems are either not operational or marginal in demand, while at critical demand periods the sort will be able to limit its execution to comply with the user's needs.

The second feature, called "COBOL-WRITTEN EXITS," is designed both to improve the performance of COBOL-invoked sorts and to facilitate the interface between the COBOL program and the sort.

SYNCSORT III-and-a-half, a Datapro Software Honor Roll package for three consecutive years, is a disk and tape sorting product for IBM System/360 and 370 computers. It is compatible with the IBM sorting products and is guaranteed to outperform all competitive sorts in either OS or OS/VS environments. A DOS and DOS/VS version is scheduled for release early in 1977.

CHARACTERISTICS

SUPPLIER: Whitlow Computer Systems, Inc., 560 Sylvan Avenue, Englewood Cliffs, New Jersey 07632. Telephone (201) 568-9700. Whitlow also has agents in Brussels, Dusseldorf, Geneva, The Hague, London, Milan, Paris, Stockholm, Australia, and Brazil.

BASIC FUNCTION: Disk and tape sorting program for IBM System/360 and 370 computers. SYNCSORT III-and-a-half is believed to be the fastest available sort for either OS or OS/VS environments and is designed to cost-justify itself from both an operational and a performance standpoint. It is a compatible replacement for the IBM sorting products.

OPERATION: Although SYNCSORT III-and-a-half employs a new internal high-performance sorting technique, it retains all of the distinctive features and properties of previous SYNCSORT packages and adds a number of additional features for both OS and OS/VS.

The package can reportedly be installed within 15 minutes, with no SYSGEN required. It has the same user exits and links as the IBM sorts. It is release-independent for OS/MFT, MVT, PCP, and all OS/VS systems; user interviews verify its successful use under MFT, MVT, VS1, and VS2 (SVS and MVS).

SYNCORT III-and-a-half's new high performance applies equally to all record types: fixed, variable, and spanned. It supports all IBM 2311, 2314, 3330, 3340, and 3350 and equivalent disk drives and all IBM and equivalent tape drives as input, output, and working storage. In addition, it can operate in a mixed random-access environment, supporting combinations of 2311, 2314, 3330 Mod 1, 3330 Mod 11, 3340, and 3350 disk drives during a single sort step. SYNCSORT III-and-a-half also provides COBOL and PL/1 sort verb compatibility.

Furthermore, SYNCSORT III-and-a-half contains the following sorting features:

- **PARM-EXIT—a Sort Control System that dynamically determines the best executing mode for the sort.**
- **COBOL-WRITTEN-EXIT—a new facility for COBOL programmers that allows sort exits to be written in COBOL. This enables the modularization of COBOL routines and improves the performance of COBOL-invoked sorts.**
- **SYNCSIM—a program that can predict the resources utilized for a given sort run.**
- **HISTOGRM—a program that analyzes the characteristics of variable-length files.**

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SYNCSORT III-and-a-half
Whitlow Computer Systems, Inc.

In a business environment, executing sorts through COBOL procedures frequently results in degraded sort performance, since the sort is dependent on the invoking program for its I/O. This has a tendency to limit the ability of the sort to efficiently utilize and coordinate the I/O activity. In addition, the core space being occupied by the invoking program is not available to the sort even when the invoking program is not fully utilizing all of the space.

The capability to process data both before and/or after it has been sorted is not limited to invoking procedures. Normal Exit processing permits this capability, but the exits must be written in Assembly language, which may limit some COBOL programmers.

SYNCSORT addresses both of these problems by providing the capability to write the Exit programs in COBOL. Instead of the COBOL program invoking the sort after its own input, the sort will invoke the COBOL-WRITTEN EXIT. In this manner, SYNCSORT has the ability to manage both its core and I/O facilities more efficiently, thereby improving performance relative to the COBOL-invoked procedure.

According to the vendor, two additional benefits are derived from this approach. The first is that programmer productivity can be increased due to the fact that the exit routines become simpler to upgrade and maintain because they are written in COBOL. The second is that, through modularization of the input and output portions of the sort operation through their own exits, it is now possible for the programmer to change the requirements of either input or output without having to rewrite the entire system.

SYNCSORT supports FORTRAN and PL/1 exits in the same manner as it does COBOL.

SYNCSORT III-and-a-half is currently operational on System/360 and 370 computers under OS and OS/VS. Whitlow states that a DOS and DOS/VS version is scheduled for release in the first quarter of 1977.

Whitlow Computer Systems employs a systematized approach to both the marketing and support of its SYNCSORT products. A six-step sorting survey is offered to prospective users, beginning with a one-and-a-half hour technical presentation at the prospect's location. Second, Whitlow performs an analysis of the prospect's sorting load through a special SMF analysis program. Based on the user's SMF data, it shows the relative importance of sorting in his environment and classifies both the resources used and the type and size of the sorts being executed. It reports on such items as mode (invoked vs. JCL), I/O device mix, use of exits, work device type, distribution of sortworks assigned versus number of spindles used, record length distribution, block sizes, number of steps, etc. Third, based on the data obtained in step two, a test outline is described to reflect the specific requirements of the

- **VSAM support.**
- **EQUAL option for Sort and Merge.**
- **All standard exits including E32, E61, and Special Exit E14.**
- **All Control Fields and ALTSEQ.**
- **VIO data sets.**
- **Direct communication with invoked sorts through the ALTPARM.**
- **Selectable optimization modes—system performance can be optimized in terms of maximum multiprogramming throughput (M), minimized channel time (I), minimized EXCP's (E), or least elapsed time in a dedicated environment (D).**
- **Support of secondary allocation without inclusion in JCL—avoids "sort capacity exceeded" problems when sort space is underallocated.**
- **Release of excess disk space without inclusion in JCL—automatically returns overallocated disk space.**
- **Use of noncontiguous disk space—sorting functions can begin sooner.**
- **Reduced initial disk space requirement—can sort up to 100 percent more records.**
- **In-core and turn-around sort.**
- **Page-fix option—VS only.**
- **EXCP-VR option—VS only.**
- **Record sizes up to 32K bytes in length.**
- **Compare Option (CLC or CPD)—use of the CPD option will detect erroneously specified data descriptions.**
- **Bias detection and utilization.**
- **"Debug" capability.**
- **Expanded message options.**
- **Separate core size options for JCL and invoked sorts.**
- **ABEND or Return Code 16.**
- **Merge (JCL and invoked).**
- **Variable-length record key check.**
- **Alternate dynamic device selection.**
- **Re-entrant code.**

PERFORMANCE: Datapro has in its possession several copies of benchmarks from installed systems, and all show significant performance gains over the IBM sorts. However, since SYNCSORT-III-and-a-half's performance can only be measured against selective objectives (usually user-defined), and since sort characteristics and system configurations can vary greatly, the best performance indicator is an on-site demonstration, performed by the vendor as described in the Management Summary.

HARDWARE/SOFTWARE REQUIREMENTS: SYNCSORT III-and-a-half can handle both disk and tape sorts on any IBM computer system operating under OS or

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SYNCSORT III-and-a-half
Whitlow Computer Systems, Inc.

prospect's sorting environment. Fourth, an on-site demonstration is performed, and fifth, Whitlow tabulates the results and presents them to the prospect. The sixth step is a 30-day trial period. The result of this approach is a clear assessment of the value of SYNCSORT III-and-a-half in the user's environment. There is no charge for this service.

Whitlow guarantees that SYNCSORT III-and-a-half will outperform all competitive sorts. In most OS and OS/VS installations, the performance and operational features of SYNCSORT III-and-a-half should enable the package to cost-justify itself many times over. What's more, since SYNCSORT III-and-a-half uses significantly fewer system resources than most competitive sorts, the performance of other jobs which are executed simultaneously with sorting should also improve.

USER REACTION

For the third consecutive year, SYNCSORT has earned a place on the Datapro Software Honor Roll. In the 1976 survey of proprietary software users, there were 46 responses that contained ratings of the SYNCSORT product. The results were as follows:

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	34	12	0	0	3.7
Throughput/efficiency	34	10	0	0	3.8
Ease of installation	22	20	1	0	3.5
Ease of use	34	11	1	0	3.7
Documentation	15	23	6	0	3.2
Vendor technical support	20	20	2	0	3.4
Training	7	12	6	0	3.0

*Weighted Average on a scale of 4.0 for Excellent.

It's easy to see that the users of SYNCSORT appreciate the capabilities of the product. When asked to indicate the major advantages of the product, 44 users said that it saves system resources, 18 cited its flexibility, 11 noted its low cost, and 15 indicated that it saves human resources.

Only two users stated that the product was costly, and two others said that they had encountered compatibility problems when installing the system. One of these was an SVS user, and he remarked that many ZAP's were needed to install the system, and that "implementation was complex."

On the other hand, the majority of the users had only praise for the product. One user was quoted as saying, "It's a super package. I wish that all software would be like it." Another summed up his feelings toward the product with the single word, "Terrific!"

SYNCSORT appears to be a software product that, in most cases, can be installed with little or no modification. This is attested to by the fact that 35 users noted that it was installed with no modification, while 8 said that some vendor-supplied modifications were required.

The only areas of weakness were that some users seemed to feel that the documentation could be improved and that the training could be "beefed up." One user said that "the documentation does not contain good examples of call routines." However, 38 of the 46 users rated the documentation good or excellent.

The SYNCSORT product was obviously rated by users with a fair amount of experience, inasmuch as the average use time they reported was 15.2 months. Of the reporting users, 24 were using SYNCSORT under OS/VS operating systems, and the remainder under the MFT and MVT versions of OS. According to the vendor, many of the OS users are converting to VS systems and are converting SYNCSORT to these environments as well. Whitlow also noted that most of its recent installations have been for OS/VS users.

Judging from the ratings and testimonials given by the survey respondents, it's clear that anyone in the market for a fast, efficient, and flexible sort product for use on an IBM System/360 or 370 would do well to examine what Whitlow Computer Systems has to offer. With the trial period and the benchmarking work offered by the vendor at no cost to the user, there is much to be gained with very little effort.□

OS/VS. According to the vendor, a DOS and DOS/VS version is scheduled for release in the first quarter of 1977.

PRICING: SYNCSORT, complete with its ancillary programs, is available on a one-year or three-year license. The single-computer one-year price is $3,000, and the three-year price is $6,200. Additional licenses cost $2,700 for one year and $5,500 for three years. All prices include maintenance, updates, and new releases.

INITIAL DELIVERY: SYNCSORT I—January 1972; SYNCSORT II—January 1973; SYNCSORT III—September 1974; SYNCSORT III-and-a-half—February 1975.

CURRENT USERS: More than 1,000 copies of SYNCSORT are currently installed in the U.S. and Canada, and there are 250 users in Europe. The vendor claims an acceptance rate of about 90 percent among prospects who test the package.■

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