All About Superminis

Superminis—those higher-powered, higher-priced computers that have evolved from the conventional 16-bit minicomputers—now represent the fastest-growing segment of the thriving minicomputer market. Now available from more than a dozen suppliers, the superminis feature a longer word length (usually 32 bits) that leads to increased throughput, more precise computations, and easier program development. Originally aimed at scientific "number-crunching" and real-time control applications, the superminis are gaining rapid acceptance in conventional data processing applications as well.

Market research figures provided by Data General Corporation predict that 32-bit systems will account for 15 percent of worldwide minicomputer revenues during 1983. However, MSRA, Inc., a market research firm located in New York, predicts that the supermini market will grow by approximately 56 percent each year until 1985.

Supermini vendors are expected to push their way into the commercial processing area, in particular, such areas that require a high degree of transaction processing. Certain analysts foresee the supermini commercial push growing by as much as 40 percent each year.

This report is designed to bring you, in concise comparison-chart form, an up-to-date compilation of the hardware and software characteristics of the superminis that are currently being marketed in the United States. You will also find some background information on the evolution and current status of the supermini market, detailed explanations of the chart entries, and guidance in selecting a supermini whose characteristics match the requirements of your applications.

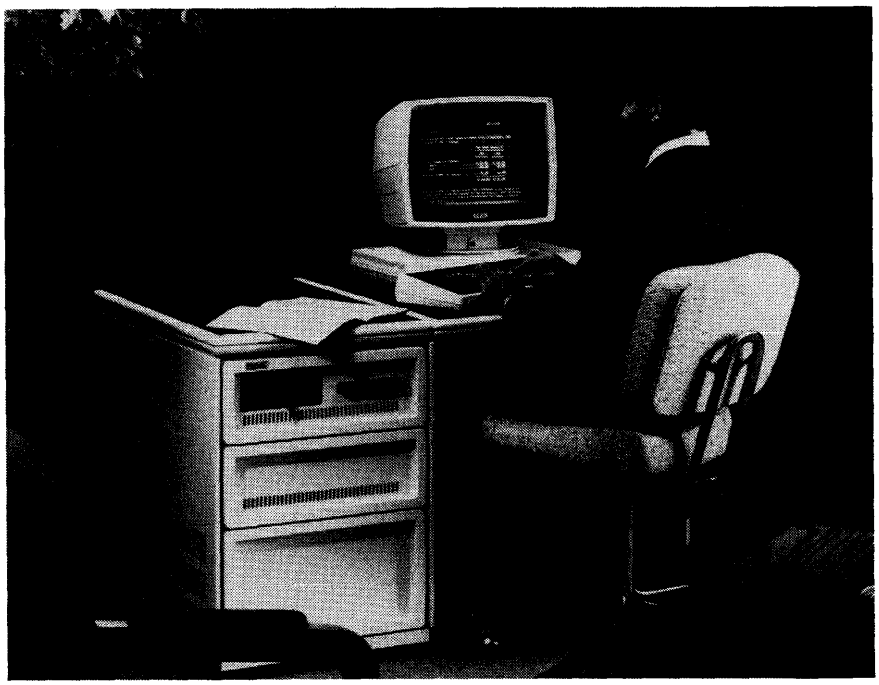
By means of detailed comparison charts, this report presents the salient characteristics of over 55 superminis from 19 vendors. The accompanying text explains the chart entries, describes the evolution and current status of the rapidly growing supermini market, and provides selection guidelines.

WHAT IS A SUPERMINI?

A supermini, for the purposes of this report, can generally be characterized as a computer that is distinguished by:

- A word length of more than 16 bits,
- A main storage capacity of one million bytes or more,
- An architecture that represents an extension of the architecture used in the vendor's smaller minicomputers,
- And a purchase price, for the basic CPU and minimum main storage, in the range of approximately $20,000 to $150,000.

The majority of the current superminis uses a 32-bit word length. A 32-bit word neatly holds four 8-bit bytes or two of the 16-bit words used in most of the smaller minicomputers. What's more, the 32-bit word length has been shown to yield an attractive balance between performance and cost in a broad range of applications. As a result, this word length has become so nearly universal among supermini designers that the terms "superminis" and "32-bit minicomputers" have become virtually synonymous.



The Prime 2250 from Prime Computer, Inc. offers up to 4 megabytes of main memory, 632 megabytes of disk storage, one or two 15MB ¼-inch cartridges and supports up to 32 terminals. The 2250 CPU, power supply, front panel and 1MB of memory is currently available for $48,900.

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In this report, for the sake of completeness, we have covered not only all of the known 32-bit superminis, but also the 24-bit and 48-bit computers produced by Harris Corporation—the one significant holdout against the 32-bit tide. We have also included the IBM-compatible 32-bit computer produced by Formation; although this computer has been designed specifically to execute the IBM System/370 instruction repertoire, its architecture, performance, and price place it in the same class as the other current superminis.

Conversely, to focus attention on the true superminis and avoid redundancy with other Datapro reports, we have deliberately *excluded* two categories of computers from this report: 1) the high-powered 16-bit minicomputers produced by companies such as Data General, DEC, Hewlett-Packard, and Modcomp; and 2) the 32-bit computers produced by established mainframe manufacturers such as IBM and Sperry Univac. Prospective buyers should note that there are sizeable overlaps in both performance and price between the superminis and some of the systems in these two excluded categories. As an example, the IBM 4331 Model Group 1, the smallest mainframe in the IBM 4300 Series, is dwarfed in performance and also exceeded in price by many of the current superminis. On the other hand, the most powerful members of Hewlett-Packard's 16-bit HP 3000 Series are in the same price/performance class as some of the superminis. As a result of these overlaps, computer buyers who want to be certain they are selecting the most suitable system for their needs must be increasingly painstaking and broad-minded.

SUPERMINI ADVANTAGES

The principal advantages of the superminis are a direct result of their extended word lengths. A longer word length generally leads to:

- *Increased addressability*—If an entire 16-bit word is used to specify a memory address, the maximum number of storage locations that can be directly addressed is only 2^{16} or 65,536. A 32-bit address, by contrast, can specify up to 2^{32} or *4.29 billion* distinct storage locations. Thus, the longer word length greatly increases a system's "logical address space" (i.e., the total amount of storage that can be directly addressed), permitting effective use of both the large physical main storage capacities and the virtual memory facilities that characterize most of the superminis. Virtual memory, in turn, can greatly facilitate the development of programs for execution on multiprogrammed computers by enabling each programmer to act as if he or she had a very large single-level storage space totally at his or her disposal.

- *Increased precision*—A single 32-bit word provides enough precision to satisfy the demands of most scientific and commercial computations, and most of the superminis are also capable of processing double-precision (64-bit) operands. Conversely, the common 16-bit minicomputer word length is too short to provide the required precision in many applications, necessitating the use of time-consuming multiple-word operations.

- *Increased instruction sets*—The longer word length typically makes more bits available for specifying the operation code of each instruction, as well as for specifying index registers, multiple accumulators, indirect addressing, and other parameters. Thus, the superminis can—and usually do—have larger and more powerful instruction repertoires than their 16-bit counterparts. As a result, a single supermini instruction can often do the work of several 16-bit instructions.

- *Increased performance*—A 32-bit supermini normally transfers twice as much information to or from main storage during each cycle as a 16-bit minicomputer, and this inherent performance advantage is further enhanced in many cases through the use of storage interleaving, cache memories, and other power-boosting features. The three previously discussed advantages (increased addressability, greater precision, and more powerful instruction sets) also lead directly to increased performance in most applications.

All of these impressive advantages of the superminis can be achieved only at the expense of increased hardware complexity, which inevitably leads to increased equipment costs. Thus, the superminis tend to have substantially higher price tags than most 16-bit minicomputers, and will prove to be cost-effective only in applications which impose clear-cut *requirements* for one or more of the supermini advantages discussed above. To put it another way, if a 16-bit minicomputer can handle the job, a supermini will usually prove to be an expensive luxury.

THE SUPERMINI MARKET

Credit for launching the supermini market can be claimed by two companies: Gould Inc., S.E.L. Computer Systems Division (formerly SYSTEMS Engineering Laboratories, Inc.) and Perkin-Elmer (formerly Interdata). Gould Inc. introduced the initial models of its 32 Series of 32-bit minicomputers in January 1975, while Perkin-Elmer announced the 8/32, its first true 32-bit processor, just two months later.

There was nothing new about 32-bit computers, of course. The IBM System/360 and System/370 computers are 32-bit machines, and Gould Inc. itself had marketed the 32-bit 8500 and 8600 computers in the late 1960s. But none of these systems could, by any stretch of the imagination, have been called minicomputers. On the other hand, companies such as Perkin-Elmer and Modular Computer Systems (Modcomp) had introduced earlier minicomputers that offered many of the characteristics of 32-bit machines but lacked a true 32-bit access path to main storage. Thus, the Gould Inc. 32 Series and the Perkin-Elmer 8/32 were the first commercially available computers that combined a true 32-bit processing capability with minicomputer-style architecture, compact physical size, and an attractively low price tag.

These two supermini pioneers have been steadily improving their product lines and doing a fairly brisk business ever since 1975. But the supermini market really began to take

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off when the undisputed king of minicomputers, Digital Equipment Corporation announced its first 32-bit computer in October 1977. DEC's VAX-11/780, described as an upward extension of its PDP-11 architecture, offers up to 12 million bytes of error-correcting MOS main storage, a virtual memory system with a 4 billion-byte logical address space and a full demandpaging facility, and a steadily growing complement of software. This impressive entry by the industry leader ensured the rapid growth of the supermini market.

The VAX-11/780 introduction was followed by the BTI 8000 in June 1978, by the Prime Series 50 family in January 1979, and by the Wang VS-100 in June 1979. Data General, which had long been assuring its users that it would enter the 32-bit computer market "when the time is right," took the wraps off its high-powered Eclipse MV/8000 in April 1980. Six months later, DEC added the VAX-11/750, which offers 60 percent of the VAX11/780's performance at less than 40 percent of its CPU price. And in December 1980, Honeywell unveiled its first superminis, the 32-bit DPS 6/92 and 6/96.

Since Honeywell's entry into the supermini market, some of the vendors mentioned above have added to their supermini lines, while others thrown their hats into the ring. Data General introduced the MV/6000 at the end of 1981, the MV/4000 at the end of 1982, and the newly announced MV/10000 which offers a maximum main memory of 16 megabytes. DEC has added the VAX-11/730 and VAX-11/782 to their line of superminis. Gould Inc., has added three new models to its 32 Series supermini line, the 32/6705, the 32/6750, and the 32/6780.

Some new faces in the supermini market include BBN Computer Corporation with two 20-bit systems, Convergent Technologies with its 32-bit Megaframe System, and Microdata Corporation's Sequel.

These and other product announcements have kept the supermini market in a state of rapid flux for the past few years, and the turbulence is likely to continue as new vendors enter the field and the existing suppliers keep adjusting their offerings to meet the demands of the marketplace.

The superminis are being marketed for—and finding widespread user acceptance in—a broad spectrum of applications. Data General, for example, says the applications for its superminis fall into three broad categories: scientific/technical, commercial, and combinations of the two. Scientific/technical uses typically require the handling of large programs and/or large volumes of data, in applications such as simulation, modeling, weather forecasting, telemetry, and seismic data reduction. Commercial applications include distributed processing networks, off-loading of applications from large batch-oriented data centers, and installations where large numbers of users must be supported simultaneously. In mixed technical/commercial environments, the superminis are used for a wide range of interactive applications, as well as for operations research functions that can help an organization improve its operations, allocate its resources, and sharpen its decisions.

An important trend in the supermini field is the rapidly increasing emphasis on the use of these systems for business data processing. Although more superminis are currently being used for scientific/technical work than for business applications, the business segment is growing faster and offers a far greater growth potential for the future. Recognizing this, the supermini vendors are hastening to provide the appropriate software tools to turn their systems into efficient business data processors. Prime Computer already boasts a relatively strong complement of business-oriented software. And, of course, the IBM-compatible Formation supermini can utilize the full spectrum of software that has been written for the IBM System/370 computers.

THE COMPARISON CHARTS

The key functional characteristics of over 55 commercially available superminis from 19 manufacturers are presented in the accompanying comparison charts. Most of the information in the charts was supplied and/or verified by the manufacturers during the months of January and February 1983; their cooperation with the Datapro Research staff in the preparation of these charts is greatly appreciated.

Regular Datapro users will probably notice that the supermini comparison charts represent a "compatible superset" of Datapro's minicomputer comparison charts; that is, the supermini charts contain all of the entries found in the minicomputer charts plus 11 additional entries which describe the expanded addressing, processing, input/output, and software facilities of the superminis. These additional entries are as follows:

- Storage interleaving
- Maximum data rate (to/from main storage)
- Virtual memory
- Logical address space
- Maximum program size
- Page size
- Number of instructions
- 16/32-bit compatibility
- Cache memory
- Other I/O channels or ports
- Data base management system

All of the comparison chart entries are explained in the following paragraphs, together with discussions of their significance to prospective buyers and some guidelines for selecting the most appropriate superminis for specific applications.

Word Length

Probably the single most important distinguishing characteristic of a computer 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

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general, the longer the word length, the greater the efficiency and accuracy of a computer's internal operations—and the higher its price tag. Nearly all of the superminis currently on the market have a 32-bit word length. This size neatly accommodates four 8-bit bytes or two of the 16-bit words used in most of the smaller minicomputers, and yields an attractive balance between economy and performance in many applications. Indeed, the 32-bit word length is the most frequently used criterion for distinguishing between the superminis and their smaller relatives. The entries also indicate the presence of additional bits used for parity checking or error correction purposes (e.g., the entry "32 + 5" indicates that each word location in main storage consists of 32 data bits and 5 error correction bits).

Number of Workstations Supported

A very important consideration for many users who are considering the acquisition of a computer is the number of workstations it can support. Workstations, in this case, can mean most any type of device which can input and/or receive data from the computer. When the computer is used in a business environment, for example, the workstation would normally be a CRT display terminal or teletypewriter, but in a manufacturing or distribution environment, the workstation could be a sensor or transmission unit that simply transmits signals back to the computer for processing.

Main Storage

The *storage type* generally falls into one of two basic categories, magnetic core or semiconductor memory. Most of the superminis employ MOS (metal-oxide semiconductor) memory because of its compactness, reliability, and low price. However, bipolar semiconductor 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* for a storage device is a 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 computer'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 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 onehalf the cycle time; semiconductor memories do not display a similar relationship.

The *Min./Max. capacity, bytes* entry shows the minimum and maximum amount of main storage available for each computer, expressed in thousands (K) or millions (M) of bytes. (Remember, each 32-bit word is capable of holding four 8-bit bytes. Most vendors now express storage capacities in terms of bytes rather than words.)

Storage interleaving is a feature that improves the performance of a computer system by permitting overlapped accesses to two or more independently operating banks of main storage. Four-way interleaving, for example, can effectively quadruple the maximum rate at which data can be transferred between a central processor and its associated main storage.

Maximum data rate, bytes/sec., sometimes called the "memory bandwidth," is the maximum rate at which data can be transferred in to or out of main storage, expressed in thousands (K) or millions (M) of bytes per second.

Virtual memory is a facility that simplifies programming by providing a large addressable space on a high-speed disk or drum storage unit that appears to the user as real main storage, and from which instructions and data are transferred into real main storage locations as required. Specialized hardware and/or software is required to perform the translations between virtual and real storage addresses, and to perform the necessary transfers of instructions and data between auxiliary (disk or drum) storage and main storage.

The *logical address space, bytes* is the total amount of storage that can be directly addressed. It is usually limited by the capacity of the system's real main storage, or, in the case of systems with virtual memory facilities, by the number of address bits in each machine-language instruction. For example, a 32-bit address can specify up to 2^{32} or 4.29 billion distinct storage locations.

The *maximum program size, bytes* (i.e., the maximum length of any one program) may be the same as the logical address space, or it may be a smaller figure because of limitations imposed by storage protection and management schemes or other factors.

The *page size, bytes* entry expresses the size of the fixed-length blocks of instructions and/or data which are transferred between auxiliary (disk or drum) storage and main storage in systems which utilize the popular "paging" approach to virtual memory management. (An alternative approach is the transfer of logical "segments" of varying length.)

Parity checking is a standard feature of some computers and an extra-cost option for others. In some systems, a more powerful technique called "error correction" is used in place of, or in addition to, parity checking. 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;

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the technique permits detection of most, though not all, read and write errors.

Error correction is a more powerful memory-checking technique that involves appending five or more check bits to each word of memory. The check bits, called a Hamming code, and special algorithms allow a system to detect and correct single-bit errors, and also to detect a fair proportion of the multiple-bit errors that occur.

Storage protection is a feature that prevents unauthorized writing in and/or reading from 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. Some of the superminis feature elaborate storage protection schemes that divide the total logical address space into hierarchical segments or "rings" with varying degrees of protection against unauthorized access.

Central Processor

Although there are many variations in their internal architecture, the majority of currently available superminis are parallel, binary processors with a fixed word length of 32 bits.

The *number of directly addressable bytes* of main storage is one of the principal distinguishing features between the superminis and the smaller minicomputers. The short word lengths used in most minicomputers 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.

The 32-bit word length used in most of today's superminis effectively removes this limitation. If just 16 of the 32 bits in each instruction word are used to hold the address field, up to 2^{16} or 65,536 distinct memory locations can be addressed. If a full 32-bit word is used to hold the address field, up to 2^{32} or 4.29 billion distinct locations (most of which would necessarily be in virtual memory rather than in real main storage) can be directly addressed.

The *number of instructions* entry provides an indication of the power of a computer's instruction set. Systems with large, powerful instruction sets tend to require fewer instructions to perform a given task, thereby saving both storage space and execution time. Some instructions, such as floating-point arithmetic instructions, may be extra-cost options.

The *16/32-bit compatibility* entry indicates the extent of program compatibility between a supermini and the same vendor's 16-bit minicomputers (if any). "Direct" indicates that the vendor claims that the supermini's instruction set is a "compatible superset" of the instruction set used in the vendor's 16-bit computers, so that all programs written for the 16-bit computers can be executed without modification on the supermini. "Via mode bit" indicates that the supermini can be switched from its native operational mode into a "compatibility mode" in which it can execute some—but perhaps not all—programs written for the vendor's 16-bit computers.

A *cache memory* is a high-speed storage unit that can significantly increase the performance of a computer by serving as a fast-access buffer between main storage and the central processor and/or input/output subsystem. The entry indicates the capacity of the cache memory unit, if any.

Control storage provides an indication of the microprogrammability of a computer. Microprogrammability is a trait that enables the vendor and/or the user to tailor a computer's internal processing capabilities to suit his or her 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, while in others, they are accessible only to the vendor. Microprogrammability can greatly increase the flexibility of a computer, 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 control storage.

Although it is undeniably dangerous to make inferences about a computer's overall performance capability on the basis of instruction execution times, our charts show the basic *add time, microseconds* to give a first-level indication of fixed-point arithmetic speeds. In general, the indicated add times are the times required to retrieve a one-word operand from main storage and add it to another operand already contained in an accumulator, with no indexing or indirect addressing. Comparisons based on add times can easily be misleading, however, because of differences in word lengths and instruction repertoires.

Hardware multiply/divide facilities are standard in most superminis. In cases where no hardware facilities are present, multiplication and division must be performed by means of programmed subroutines at a significant reduction in execution speeds.

Hardware floating-point facilities are also included in the standard instruction repertoires of most of the currently available superminis, and are optional in others. Where no hardware facilities are present, floating-point arithmetic

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must be performed by means of time-consuming 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. Many of the superminis have special instructions that permit 8-bit segments of a word to be processed efficiently as individual bytes or byte strings.

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

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

Input/Output Control

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

Other I/O channels or ports describes the I/O control facilities, if any, that are provided in addition to one or more DMA channels. Some superminis offer multiplexer channels, which enable multiple peripheral devices to transfer data to or from main storage simultaneously, while others include special high-speed channels designed to accommodate high-performance disk or tape subsystems.

Maximum I/O rate, bytes/sec. sometimes called the "I/O bandwidth," is a measure of each computer's potential ability to transfer data to and from peripheral devices or other external sources via all of the available I/O channels, buses, and/or ports. It should be noted that in practical applications, I/O data rates approaching the indicated maximum rates can usually be handled only in short bursts, if at all.

The *number of external interrupt levels* provides a reasonable indication of the power of a computer'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. Some computers offer additional external interrupt levels as extra-cost options, and in these cases our charts show the available range, from minimum to maximum.

Communications

Maximum number of lines indicates how many data communications lines can be handled by a particular system. The types of lines are specified in the next two entries.

Synchronous and *asynchronous* have entries of standard, optional, or no, indicating their availability, and also a notation as to the speed of each line in bits per second (bps). Most entries will be of the type "to 9600 bps," indicating one or more transmission speeds up to a maximum of 9600 bps.

Protocols supported indicates which of the common data communications protocols, if any, are supported through the availability of appropriate hardware and software facilities.

Network architectures supported indicates which of the standardized data communications network architectures, if any, are supported through the availability of appropriate hardware and software facilities.

RJE terminals emulated indicates which of the popular remote job entry terminals, if any, the system can be equipped to emulate. Programs that emulate the functions of the IBM 2780, 3780, and HASP terminals, for example, are available for many of the current superminis.

IBM 3270 emulation indicates whether the system can be equipped to emulate the functions of the widely used IBM 3270 display terminals.

Peripheral Equipment

The comparison charts summarize the standard peripheral devices that are available for use with each computer.

Floppy disk (diskette) drives indicates whether this type of low-cost storage is available, and the minimum and maximum on-line capacities that are offered.

Disk pack/cartridge drives signifies whether one, or the other, or both of these types of auxiliary storage 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 drive or the total capacity of two or

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more (typically, four to eight) drives that can be connected to the system.

Magnetic tape cassettes/cartridges indicates the availability and recording densities in bits per inch (bpi) of I/O devices that accommodate low-cost magnetic tape cassettes or cartridges.

Magnetic tape, ½-inch indicates the availability and transfer rate in thousands of bytes per second (KBS) of tape drives that accommodate industry-standard ½-inch wide magnetic tape.

Serial printers (character-at-a-time) can provide excellent-quality hard-copy reports for far less money than the line-at-a-time printers usually used with large computers. However, for users who require faster printing capabilities, *line printers* are also available for use with most superminis. Serial printers generally range in speeds 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).

Data communications interface describes the computer's capabilities, if any, to send and receive data over a common-carrier communications link. The 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 supported 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 or her 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, or both. A macro assembler is another software tool to aid the programmer and make his job a little easier. Macro routines can be called by the programmer and copied right into his/her 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.

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.

Entries in this section of the charts may include widely used high-level programming languages such as *Cobol,* (Common Business Oriented Language), *RPG* (Report Program Generator), *Fortran* (Formula Translator), *Basic* (Beginners All-purpose Symbolic Instruction Code), *Algol* (Algorithmic Language), *APL, PL/1* or *Pascal;* or proprietary languages that are available from a vendor for use on a particular system. 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 such functions 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; "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. The operating systems for many of the current superminis are capable of supporting two, three, or all four of the above modes of operation simultaneously.

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A *data base management system* (DBMS) is a software facility designed to manage and maintain data in a nonredundant structure so that the data will be conveniently available for processing by multiple applications. The DBMS organizes data elements in some predefined structure and keeps track of the relationships among the data elements, thereby facilitating information retrieval and report generation. The availability of an effective DBMS can greatly simplify the applications programming task and increase the overall value of a data processing system.

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 need two or more computers, it is 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 computer 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 January 1983.

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.

SUPERMINI MANUFACTURERS

Listed below, for your convenience in obtaining additional information, are the full names, addresses, and telephone numbers of the 19 vendors whose products are listed in the specification charts that follow.

Accelerated Data Systems, 1183 Bordeaux, Suite 18, Sunnyvale, CA 94086. Telephone (408) 744-0264.

Apollo Computer, Inc., 15 Elizabeth Dr., Chelmsford, MA 01824. Telephone (617) 256-7858.

BBN Computer Corporation, 3 Moulton Street, Cambridge, MA 02238. Telephone (617) 491-1850.

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

Charles River Data Systems, Inc., 4 Tech Circle, Natick, MA 01760. Telephone (617) 655-1800.

Computer Designed Sytems, Inc., 10911 Olson Memorial Highway, Minneapolis, MN 55441. Telephone (612) 545-2855.

Convergent Technologies, 2500 Augustine Drive, Santa Clara, CA 95051. Telephone (408) 727-8830.

Data General Corporation, 4400 Computer Drive, Westboro, MA 01581. Telephone (617) 366-8911.

Digital Equipment Corporation (DEC), 129 Parker Street, Maynard, MA 01754. Telephone (617) 897-5111.

Formation, 823 East Gate Drive, Mt. Laurel, NJ 08054. Telephone (609) 234-5020.

Gould Inc., S.E.L. Computer Systems Division, (formerly SYSTEMS Enginering Laboratories, Inc.), 6901 West Sunrise Boulevard, Fort Lauderdale, FL 33313. Telephone (305) 587-2900.

Harris Corporation, Computer Systems Division, 2101 West Cypress Creek Road, Fort Lauderdale, FL 33309. Telephone (305) 974-1700.

Honeywell Information Systems, Inc., Three Newton Executive Park Drive, Newton Lower Falls, MA 02162. Telephone (617) 671-6000.

Microdata Corporation, 17481 Red Hill Avenue, P.O. Box 19501, Irvine, CA 92713. Telephone (714) 540-6730.

NCR Corporation, 1700 South Patterson Boulevard, Dayton, OH 45479. Telephone (513) 445-5000.

Perkin-Elmer, Computer Operation, Computer Systems Division, 106 Apple Street, Tinton Falls, NJ 07724. Telephone (201) 870-4500.

Prime Computer, Inc., Prime Park, Natick, MA 01760. Telephone (617) 655-8000.

Stratus Computer, Inc., 17-19 Strathmore Road, Natick, MA 01760. Telephone (617) 653-1466.

SYSTEMS Engineering Labortories, Inc. (see Gould Inc., S.E.L. Computer Systems Division).

Wang Laboratories, Inc., One Industrial Avenue, Lowell, MA 01851. Telephone (617) 459-5000.□

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MANUFACTURER AND MODEL	Accelerated Data Systems Infinity System 300	Accelerated Data-Systems Infinity System 400	Apollo Computer, Inc. Apollo Computer DN420, DN600	BBN Computer Corporation C/60	BBN Computer Corporation C/70
WORD LENGTH, BITS	32/24/16	32/24/16	32	20	20
NO. WORKSTATIONS SUPPORTED	32	32	200	16	64
MAIN STORAGE					
Storage type	MOS	MOS	MOS (64K RAMs)	MOS	MOS
Cycle/access time, microseconds	90 ns	90 ns	100 ns	.135/.405	.135/.405
Min./Max. capacity, bytes	128K/33M	128K/33M	512K/3.5M	25K/1MB	50K/1MB
Storage interleaving	Std.; 4-way	Std.; 4-way	No	No	No
Maximum data rate, bytes/sec.	22M	22M	2M	2MB	2MB
Virtual memory	No	No	Std.; 16M	Standard	Standard
Logical address space, bytes	16M (24-bit)	16M (24-bit)	Std.; 16M	1MB	1MB
Maximum program size, bytes	16M	16M	16M	1MB	1MB
Page size, bytes	16M (Direct Add.)	16M (Direct Add.)	1024	8KB	8KB
Parity checking	NA	NA	NA	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	16M	16M	16M	1M	2M
No. of instructions	Over 100	Over 100	65	40	40
16/32-bit compatibility	Direct	Direct	—	—	—
Cache memory	Standard	Standard	Opt.; 4K bytes	—	—
Control storage	2K PROM	2K PROM	NA	PROM/RAM	PROM/RAM
Add time, microseconds	90 ns	90 ns	0.4	1.33	1
Hardware multiply/divide	Standard	Standard	Optional	Standard	Standard
Hardware floating point	Standard	Standard	Optional	Optional	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Standard	Standard	No	No	No
Real-time clock or timer	Optional	Optional	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Opt.; 22MB/sec.	Opt.; 22MB/sec.	Standard	No	No
Other I/O channels or ports	Std.; to 256 ports	Std.; to 256 ports	See Comments	—	—
Maximum I/O rate, bytes/sec.	6MB/sec. (PIO)	6MB/sec. (PIO)	1.5M	4.5M bytes/sec.	4.5M bytes/sec.
No. of external interrupt levels	256	256	8	16	16
COMMUNICATIONS					
Maximum number of lines	256	256	3	18	66
Synchronous	Optional	Optional	—	Std.; 56K bps	Std.; 56K
Asynchronous	Std.; (32) 19.2K bps	Std.; (32) 19.2K bps	Standard	Std.; 19.2K bps	Std.; 19.2K bps
Protocols supported	IBM 2780/3780	IBM 2780/3780	Async ASCII, X-25, HASP, 3270	HDLC	HDLC
Network architecture supported	Infinity Network	Infinity Network	APOLLO Ring	ARPANET	ARPANET
RJE terminals emulated	IBM 2780/3780	IBM 2780/3780	IBM HASP	No	No
IBM 3270 emulation	No	No	Yes	No	No
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Optional	Optional	Opt.; 1M bytes	No	No
Disk pack/cartridge drives	Std.; 32-96MB	Std.; 32-96MB	Pack; (2) 300M bytes	Opt.; (2) 600MB	Opt.; (4) 1200MB
Drum/fixed-head disk storage	No	No	Opt.; 33-66, 158MB Winchester	Opt.; (2) 128MB	Opt.; (4) 248MB
Magnetic tape cassettes/cartridges	No	No	—	Std.; TU58	Std.; TU58
Magnetic tape, ½-inch	Std.; 800 bpi, 20MB	Std.; 800 bpi, 20MB	Opt.; 1600 bpi	Yes; 20MB/tape	Yes; 20MB/tape
Serial printer	Opt.; 100-200 cps	Opt.; 100-200 cps	Opt.; 60 cps	Optional	Optional
Line printer	Opt.; 600 cps	Opt.; 600 cps	Std.; 300-600 lpm	Opt.; 600 1pm	Opt.; 600 lpm
Data communications interface	Std.; to 19.2K bps	Std.; to 19.2K bps	RS-232-C; 19.2K bps	Opt.; 100,000 bps	Otp.; 100,000 bps
CRT	Opt.; (32) 1920 ch.	Opt.; (32) 1920 ch.	Standard	Opt.; any 16	Opt.; any 64
Other supported peripheral units	Modems	Modems	Dual-mode printers, multi-font CRT	—	—
SOFTWARE					
Assembler	Yes	Yes	—	No	No
Compilers	Fortran, Basic, Cobol	Fortran, Basic, Cobol	Fortran 77, Pascal, C, com. code gen.	Cobol, Basic, F77, Dibol	Cobol, Basic, F77, Dibol
Operating system	MIPS time-sharing, batch, real-time	MIPS time-sharing, batch, real-time	Network Operating System	Time-shared, UNIX	Time-shared, UNIX
Data base management system	Optional	Optional	Yes; D3M	Optional	Optional
Language implemented in firmware	Partially	Partially	No	Partially	Partially
Operating system implemented in firmware	Partially	Partially	No	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	Contact vendor	Contact vendor	28,900 (512KB)	Contact vendor	Contact vendor
Monthly maint. of basic configuration above for on-site contract, $	Contact vendor	Contact vendor	290	—	—
Discounts available	Up to 40 percent	Up to 40 percent	Yes	Qty., Educational	Qty., Educational
Price of memory increment, $	11,800 (1MB)	11,800 (1MB)	9,000 (1MB)		
Date of first delivery	NA	NA	March 1981	1981	1980
Number installed to date	NA	NA	500 (approx.)	—	—
COMMENTS	"Team Computer" arch., plus hardware mul./div., sing.- and dbl.-prec. (32/64-bit) floating pt.	"Team Computer" with floating point and Acceleration Proc. to boost avg. execution rate	Other I/O controls: 1 block multiplexer channel, 1 multibus controller		

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MANUFACTURER AND MODEL	BTI 8000	Charles River Data Systems Universe System Model 15/17	Charles River Data Systems Universe System Model 80/82	Charles River Data Systems Universe System PB07/CP68	Charles River Data Systems Universe 68 68/05
WORD LENGTH, BITS	32	32	32	32	32
NO. WORKSTATIONS SUPPORTED	200	10	34	10	64
MAIN STORAGE					
Storage type	Semiconductor	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	0.67	0.5	0.5	0.5	400
Min./Max. capacity, bytes	256K/16M	256K/2M	256K/6M	256K/2M	256K/3MB
Storage interleaving	—	No	No	No	Optional
Maximum data rate, bytes/sec.	60M	10M	10M	10M	20M
Virtual memory	Standard	No	No	No	No
Logical address space, bytes	512K	16M	16M	16M	16M
Maximum program size, bytes	—	16M	16M	16M	3M
Page size, bytes	4096	NA	NA	NA	4KB
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	No	Optional	Optional	Optional	Optional
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	—	16M	16M	16M	4M
No. of instructions	174	—	—	—	56
16/32-bit compatibility	—	Direct	Direct	Direct	Direct
Cache memory	—	No	No	No	Standard
Control storage	PROM	NA	NA	NA	RDM
Add time, microseconds	3.5	0.5	0.5	0.5	320 NS
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Standard	No	No	No	Optional
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Standard	No	No	No	No
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	4 to 32	Standard	Standard	Standard	Standard
Other I/O channels or ports	—	Selector channel	Selector channel	Selector channel	Yes
Maximum I/O rate, bytes/sec.	10M	20M	20M	20M	8.4M
No. of external interrupt levels	—	7 int., 5 DMA	7 int., 5 DMA	7 int., 5 DMA	7
COMMUNICATIONS					
Maximum number of lines	200	10	34	34	64
Synchronous	No	Optional	Optional	Optional	Opt.; 9600 bps
Asynchronous	Std.; to 19,200 bps	Std.; to 9600 bps	Std.; to 9600 bps	Std.; to 9600 bps	Std.; 19.2K bps
Protocols supported	Async	—	—	—	NA
Network architecture supported	No	—	—	—	CRDS/NET
RJE terminals emulated	No	—	—	—	NA
IBM 3270 emulation	No	—	—	—	No
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	Std.; 1.2M bytes	Std.; 512K bytes	Optional	Std.; 1MB
Disk pack/cartridge drives	Pack; 67MB to 254MB	Std.; (1) 16M bytes (formatted)	Std.; (1) 80M bytes (formatted)	Optional	Optional
Drum/fixed-head disk storage	No	—	—	—	—
Magnetic tape cassettes/cartridges	No	Optional	Optional	Optional	No
Magnetic tape, ½-inch	200KBS (9-trk.)	—	—	—	Optional
Serial printer	No	Optional	Optional	Optional	Optional
Line printer	300, 600, 900 lpm	Optional	Optional	Optional	Optional
Data communications interface	19.2K bps; Async	—	—	—	Optional
CRT	Std.; 24 x 80 char.	Opt.; 1920 char.	Opt.; 1920 char.	Opt.; 1920 char.	Optional
Other supported peripheral units	None	—	—	—	Std. 10MB fixed Winch. disk
SOFTWARE					
Assembler	—	Yes	Yes	Yes	Standard
Compilers	Basic, Fortran, Cobol, Pascal	Fortran, Pascal, Basic, C	Fortran, Pascal, Basic, C	Fortran, Pascal, Basic, C	Cobol, Basic, Fortran, Pascal, C
Operating system	Time-sharing, batch	Real-time, multi-tasking (UNOS*)	Real-time, multi-tasking (UNOS*)	UNOS, real-time, multi-tasking	Real-time, multi-tasking, multi-user
Data base management system	—	Opt.; UNOS DBMS	Opt. UNOS DBMS	Optional	Opt.; NDBMS
Language implemented in firmware	No	No	No	No	No
Operating system implemented in firmware	Partially	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	57,000	19,200 (256KB)	38,500 (256KB)	9,600 (256KB)	11,900 inc. disk
Monthly maint. of basic configuration above for on-site contract, $	827	NA	NA	NA	NA
Discounts available	Quantity	Quantity	Quantity	Quantity	Quantity, Educ.
Price of memory increment, $	16,000 (512K bytes)	5,450 (512KB)	5,450 (512KB)	1,825 (128KB)	5,500 (1MB)
Date of first delivery	April 1981	January 1982	September 1981	January 1982	February 1983
Number installed to date	NA	NA	NA	NA	NA
COMMENTS	Packaged system for interactive and multi-stream batch workload	*UNOS is a UNIX-Rev. 7-compat. OS; inc. 2 ser. ports, 1 pr. port, one 16MB Win. dr., 1.2M flpy.	*UNOS is a UNIX-Rev. 7-compat. OS; inc. 2 ser. ports, 1 prnt. port, 80MB dk., 512KB fpy. disk	Includes 2 serial ports and 1 printer port	All units inc.: 4KB Cache, 256KN RAM, Sel. chan. intrfac., flop. disk, back-up med., I/O proc.

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MANUFACTURER AND MODEL	Charles River Data Systems Universe 68 68/37	Charles River Data Systems Universe 68 68/47	Charles River Data Systems Universe 68 68/80	Computer Designed Systems Adviser IV/900	Convergent Technologies Megaframe
WORD LENGTH, BITS	32	32	32	32 + 4	32
NO. WORKSTATIONS SUPPORTED	64	64	64	128	128
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	400	400	400	0.35, 0.68/0.03	350
Min./Max. capacity, bytes	256K/5MB	256K/5MB	256K/3MB	32K/8M	1M/24MB
Storage interleaving	Optional	Optional	Optional	Std.; 4-way	No
Maximum data rate, bytes/sec.	20M	20M	20M	Variable	11M bytes
Virtual memory	No	No	No	Standard	Standard
Logical address space, bytes	16M	16M	16M	Variable	240 bytes
Maximum program size, bytes	5M	5M	13M	256K	4M bytes
Page size, bytes	4KB	4KB	4KB	256K	4K bytes
Parity checking	Standard	Standard	Standard	Optional	Standard
Error correction	Optional	Optional	Optional	Optional	Standard
Storage protection	Standard	Standard	Standard	Optional	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	4M	4M	4M	256K	4MB
No. of instructions	56	56	56	144	—
16/32-bit compatibility	Direct	Direct	Direct	Optional	Yes
Cache memory	Standard	Standard	Standard	Up to 4M	No
Control storage	RDM	RDM	RDM	ROM; 16K x 56 bits	No
Add time, microseconds	320	320NS	320 NS	0.4	—
Hardware multiply/divide	Standard	Standard	Standard	Standard	Yes
Hardware floating point	Optional	Optional	Optional	Optional	No
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	No	No	Optional	—
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Other I/O channels or ports	Yes	Yes	Yes	Opt. 128 ports for peripherals	160
Maximum I/O rate, bytes/sec.	8.4M	8.4M	8.4M	2.91M	11M bytes/sec.
No. of external interrupt levels	7	7	7	—	64
COMMUNICATIONS					
Maximum number of lines	64	64	64	128	160
Synchronous	Opt.; 9600 bps	Opt.; 9600 bps	Opt.; 9600 bps	Opt.; 9600 bps	Standard
Asynchronous	Std.; 19.2K bps	Std.; 19.2K bps	Std.; 19.2K bps	Opt.; 9600 bps	Standard
Protocols supported	NA	NA	NA	2780/3780, SNA/SDLC	—
Network architecture supported	CRDS/NET	CRDS/NET	CRDS/NET	SNA (opt.)	—
RJE terminals emulated	NA	NA	NA	2780/3780	—
IBM 3270 emulation	No	No	No	Optional	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Std.; 1MB	Opt.; 1MB	Opt.; 1MB	No	No
Disk pack/cartridge drives	Optional	Std.; 10MB	Std.; 13MB	Both; 4800M bytes	Std.; (23) SOMB
Drum/fixed-head disk storage	—	—	—	No	—
Magnetic tape cassettes/cartridges	No	No	No	No	Std.; 5MB cart.
Magnetic tape, ½-inch	Optional	Optional	Optional	120 KBS	Yes
Serial printer	Optional	Optional	Optional	200 cps	Standard
Line printer	Optional	Optional	Optional	300-1200 lpm	Standard
Data communications interface	Optional	Optional	Optional	To 9600 bps	Standard
CRT	Optional	Optional	Optional	80 x 24 char.	Standard
Other supported peripheral units	Std. 32MB fixed Winch. disk	Std. 32MB fixed Winch. disk	Std. 67MB fixed Winch. disk	A/D-D/A conv., plotters, graphics	—
SOFTWARE					
Assembler	Standard	Standard	Standard	Macro assembler	Standard
Compilers	Cobol, Basic, Fortran, Pascal, C	Cobol, Basic, Fortran, Pascal, C	Cobol, Basic, Fortran, Pascal, C	Pascal, Cobol, Basic, Fortran	Cobol, Basic, Pascal, Fortran
Operating system	Real-time, multi-tasking, multi-user	Real-time, multi-tasking, multi-user	Real-time, multi-tasking, multi-user	Batch, real-time, multi-task, interac.	Mult. OS, UNIX and CTOS; r-tm, m-tsk
Data base management system	Opt.; NDBMS	Opt.; NDBMS	Opt.; NDBMS	Yes (DBMS)	Std.; CT-DRMS
Language implemented in firmware	No	No	No	Partially	No
Operating system implemented in firmware	No	No	No	Partially	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	18,300 inc. disk	22,100 inc. disk	38,500 inc. disk	100,000 (64K bytes)	17,000
Monthly maint. of basic configuration above for on-site contract, $	NA	NA	NA	5,400	Contact vendor
Discounts available	Quantity, Educ.	Quantity, Educ.	Quantity Educ.	Quantity	OEM
Price of memory increment, $	5,500 (1MB)	5,500 (1MB)	5,500 (1MB)	18,000 (64K bytes)	4,500 (1MB)
Date of first delivery	July 1982	July 1982	October 1981	November 1978	3rd qtr. 1983
Number installed to date	NA	NA	NA	NA	—
COMMENTS	See 68/05 Comments	See 68/05 Comments	See 68/05 Comments	Single source responsibility, turn-key interactive, direct processing system	

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MANUFACTURER AND MODEL	Data General Eclipse MV/4000	Data General Eclipse MV/6000	Data General Eclipse MV/8000	Data General Eclipse MV/10000	Digital Equipment VAX-11/730
WORD LENGTH, BITS	32	32 + 7	32 + 7	32	32
NO. WORKSTATIONS SUPPORTED	64	96	128	192	24
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	200 ns	220 NS	220 NS	140 NS	400 NS/810 NS
Min./Max. capacity, bytes	1M/8MB	1M/4MB	1M/2MB	1M/16MB	1M/5MB
Storage interleaving	Standard	Std.; 4-way	Std.; 4-way	Standard	—
Maximum data rate, bytes/sec.	—	—	36.4M	—	—
Virtual memory	Standard	Standard	Standard	Standard	Standard
Logical address space, bytes	4000M	4000M	4000M	4000M	4000M
Maximum program size, bytes	512M	512M	512M	512M	2000M
Page size, bytes	2048K	2048K	2048K	2048K	512
Parity checking	No	No	No	No	No
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	Std.; 8 hierarchical rings	Standard; 8 hier archical rings	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	4000M	4000M	4000M	4000M	4000M
No. of instructions	—	467	467	—	244
16/32-bit compatibility	Direct	Direct	Direct	Direct	Via mode bit
Cache memory	None	16K bytes	16K bytes	16K bytes	—
Control storage	Optional	—	—	Optional	16K 24-bit microwds
Add time, microseconds	—	—	0.66	—	—
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Standard	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Standard	Standard	Standard	Standard	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Std.; Unibus
Other I/O channels or ports	High-speed burst multiplexer	High-speed burst multiplexer	High-speed burst multiplexer	Dual ports	Opt.; Massbus
Maximum I/O rate, bytes/sec.	—	18.2M	18.2M	—	—
No. of external interrupt levels	—	16	16	—	—
COMMUNICATIONS					
Maximum number of lines	—	64	128	192	—
Synchronous	Up to 56,000 bps	Up to 56,000 bps	Up to 56,000 bps	Up to 56,000 bps	Up to 1M bps
Asynchronous	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps
Protocols supported	BSC, X.25, SNA/ SDLC	BSC, X.25, SNA/ SDLC	BSC, X.25, SNA/SDLC	BSC, X.25, SNA/ SDLC	DDCMP, X.25
Network architecture supported	Xodiac, X.25, SNA	Xodiac, X.25, SNA	X.25, SNA, Xodiac	Xodiac, SNA, X.25	DNA, X.25
RJE terminals emulated	2780/3780, HASP	2780/3780, HASP	2780/3780, HASP	2780/3780, HASP	—
IBM 3270 emulation	Yes	Yes	Yes	Yes	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	315K-2.5M bytes	315K-2.5M bytes	315K-2.5M bytes	315K-2.5M bytes	—
Disk pack/cartridge drives	Pack & cartridge	Pack & cartridge; 10-2510M bytes	Pack & cartridge; 10-6648M bytes	Pack & cartridge	Pack & cartridge
Drum/fixed-head disk storage	Fixed-head	Fixed-head; 1-20M bytes	Fixed-head; 1-48M bytes	Fixed head	No
Magnetic tape cassettes/cartridges	No	No	No	No	—
Magnetic tape, ½-inch	42-468 KBS	42-468 KBS	42-468 KBS	42-468 KBS	36-200 KBS
Serial printer	10-180 cps	10-180 cps	10-180 cps	10-180 cps	30-180 cps
Line printer	240-900 lpm	240-900 lpm	240-900 lpm	240-900 lpm	210-1200 lpm
Data communications interface	Up to 56,000 bps	Up to 56,000 bps	56,000 bps (max.)	56,000 bps	—
CRT	135 char. x 24 lines	135 char. x 24 lines	135 char. x 24 lines	135 char. x 24 lines	80 char. X.24 lines
Other supported peripheral units	A/D & D/A subsystems	A/D & D/A subsystems	Card readers, plotter, A/D & D/A subsystems	—	—
SOFTWARE					
Assembler	Assembler, macro assembler	Assembler, macro assembler	Macro assembler; 16-bit assembler	Assembler, macro assembler	Macro assembler
Compilers	Cob., Bas., PL/1, C, Fort., Pasc., APL	Cob., Bas., RPG II, PL/1, APL, C	Fort., Bas., Pl/1, RPG II, APL, Cob., C	Cob., Bas., PL/1, C, Fort., Pasc., APL,	Fort., Bas., DSM, Cob., Coral, Pasc.,
Operating system	Real-time, multi-task, multi-prog.	Batch, multi-task., real-time, m-prog.	Time-sharing, multiple-batch, on-line	Real-time, multi-task., multi-prog.	Time-sharing, batch, on-line
Data base management system	DBMS	DBMS	DBMS	DBMS	—
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, frt. panel, and minimum memory in chassis, $	56,300 (1MB)	87,000 (1MB)	179,500 (1MB)	211,000 (2MB)	48,900
Monthly maint. of basic configuration above for on-site contract, $	368	395	873	Contact vendor	342
Discounts available	Various types	Various types	Various types	Various types	Yes
Price of memory increment, $	9,000 (1MB)	9,000 (1MB)	9,000 (1MB)	9,000 (1MB)	9,000 (1MB)
Date of first delivery	December 1982	1981	October 1980	March 1983	May 1982
Number installed to date	NA	NA	NA	NA	Over 2,000
COMMENTS		Uses a compatible superset of the 16-bit Eclipse instruction set	Uses a compatible superset of the 16-bit Eclipse instruction set	Inc. address gen. and a two-brd. fltg. pt. unit which increase concur. op. w/in. cen. proc.	

All About Superminis

MANUFACTURER AND MODEL	Digital Equipment VAX-11/750	Digital Equipment VAX-11/780, 11/782	Formation 4000 Information System	Gould, Inc. S.E.L. 32/27	Gould, Inc. S.E.L. 32/77
WORD LENGTH, BITS	32 + 8	32 + 8	32	32	32
NO. WORKSTATIONS SUPPORTED	80	112	96	96	96
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	0.64/0.32	0.600/0.290	1.2/0.8	0.6/0.36	0.6/0.36
Min./Max. capacity, bytes	1M/8MB	1M/12M	256K/8M	256K/16MB	256K/16MB
Storage interleaving	—	2-way (optional)	No	Optional	Standard
Maximum data rate, bytes/sec.	5M	13.3M	5M	26.67MB	26.67MB
Virtual memory	Standard	Standard	Standard	NA	NA
Logical address space, bytes	4000M	4000M	16M	16MB	16MB
Maximum program size, bytes	2000M	2000M	16M	2MB	2MB
Page size, bytes	512	512	OS dependent	2KW blocks	8KW blocks
Parity checking	No	No	Standard	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard; 4 hierarchical modes	Standard; 4 hierarchical modes	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	4000M	4000M	16M	16M	16M
No. of instructions	244	244	IBM/370 inst. set	176	189
16/32-bit compatibility	Via mode bit	Via mode bit	—	NA	NA
Cache memory	4K bytes	8K bytes	No	NA	NA
Control storage	10K	12K	WCS 8K x 64 bits	PROM/ROM	PROM/ROM
Add time, microseconds	0.92	0.4	1.4	1.65	—
Hardware multiply/divide	Standard	Standard	No	Standard	Standard
Hardware floating point	Standard	Standard	No	Optional	Optional
Hardware byte manipulation	Standard	Standard	No	No	No
Battery backup	Optional	Optional	No	Optional	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Std. (Unibus)	1 to 4 Unibuses	Standard	Standard	Standard
Other I/O channels or ports	Up to 3 optional Massbus adapters	Up to 4 optional Massbus adapters	IBM-compatible Byte Mux	I/O processor, FMS, HSD, MPCI, Z-card	HSD, Async, Sync
Maximum I/O rate, bytes/sec.	5.0M	13.3M	5M	26.67MB	26.67MB
No. of external interrupt levels	32	32	256	16-112	16-112
COMMUNICATIONS					
Maximum number of lines	80	112	100	64 Async, Sync	64 Async, Sync
Synchronous	Up to 1Mbps	Up to 1M bps	Opt.; 19.2K bps	Opt.; to 9600 bps	Opt.; to 9600 bps
Asynchronous	Up to 9600 bps	Up to 9600 bps	Opt.; up to 9600 bps	Std.; 19.2K bps	Std.; 9600 bps
Protocols supported	DDCMP, X.25	DDCMP, X.25	Async, Bisync, SDLC	Bisync, HDLC	Bisync, HDLC
Network architecture supported	DNA, X.25	DNA, X.25	IBM SNA, Ethernet	—	—
RJE terminals emulated	—	—	2780/3780, HASP	HASP	HASP
IBM 3270 emulation	—	—	Yes	—	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	—	1 in console std.	Opt.; 2M-4M bytes	Opt.; 1.6M bytes	No
Disk pack/cartridge drives	Pack & cartridge; 14-2400M bytes	Pack & cartridge; 14-2400M bytes	—	Both; 80M-300MB	Both; 80M-300MB
Drum/fixed-head disk storage	No	No	Fixed; 70M-5080M bytes	Fixed; 80-675M bytes/dr.	Fixed-head; 80-675MB/dr.
Magnetic tape cassettes/cartridges	One in console (std.)	No	No	No	No
Magnetic tape, ½-inch	36-200 KBS	36-200 KBS	72-200 KBS	—	(4) 45/75/125 ips
Serial printer	30-180 cps	30-180 cps	180 cps	340 cps	340 cps
Line printer	210-1200 lpm	210-1200 lpm	300-1000 lpm	300-1000 lpm	300-900 lpm
Data communications interface	Up to 1M bps	Up to 56K bps	To 19.2K bps	3.2M bytes	40K bps
CRT	80 char. x 24 lines	80 char. x 24 lines	80 x 24 char.	1920 characters	1920 characters
Other supported peripheral units	Card readers, A/D & D/A subsystems, graphics	Card readers	Card reader	Graphics, AID, RTP	A/D, D/A, RTF, graphics
SOFTWARE					
Assembler	Macro assembler (BLISS-32)	Macro assembler (BLISS-32)	IBM/370-compatible	Assembler, macro assembler	Assembler, macro assembler
Compilers	Fortran, Basic, DSM, Cobol, Coral, Pasc.	Fortran, Basic, Cobol, Coral	IBM/370-compatible	Basic, Fortran, Cobol, ADA, C	Fortran, Cobol, Basic, Pascal
Operating system	Time-sharing, batch, on-line	Time-sharing, batch, on-line	DOS/VSE, OS/VS1, VM/370, OS/MVS	UNIX, real-time MPX, inter. multi-batch	Real-time, interactive, multi-batch
Data base management system	—	16-bit only; DBMS-11	Optional (TMS)	Opt.; Total, Seed	Opt.; Total, Seed
Language implemented in firmware	No	No	No	Fortran RTL (part.)	Fortran RTL (part.)
Operating system implemented in firmware	No	No	ECPS: VM/370	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	84,900	219,100 (11/780) 395,000 (11/782)	50,300 (256K bytes)	33,000 (512KB)	49,080 (256KB)
Monthly maint. of basic configuration above for on-site contract, $	NA	955/2,126	162	245	350
Discounts available	Yes	Yes	Quantity	—	—
Price of memory increment, $	9,000 (1MB)	13,000 (2MB)	10,000 (1MB)	23,000 (2MB)	29,000 (1MB)
Date of first delivery	November 1980	February 1978	August 1980	March 1980	October 1978
Number installed to date	Over 2,000	2000+	50	255	925
COMMENTS	Uses gate array technology; 488 logic gates per chip	High-performance floating-point accelerator is optional	IBM/370 software-compatible with Full Failsoft architecture remote opt.		

All About Superminis

MANUFACTURER AND MODEL	Gould, Inc. S.E.L. 32/2750	Gould, Inc. S.E.L. 32/6705	Gould, Inc. S.E.L. 32/6750	Gould, Inc. S.E.L. 32/6780	Gould, Inc. S.E.L. 32/7780
WORD LENGTH, BITS	32	32	32	32	32
NO. WORKSTATIONS SUPPORTED	96	96	96	96	96
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	0.6/0.36	0.3/0.6	0.3/0.6	0.3/0.6	0.6/0.3
Min./Max. capacity, bytes	512K/16M	1M/16MB	1M/16MB	2M/16MB	1M/16MB
Storage interleaving	Optional	Optional	Optional	Optional	Standard
Maximum data rate, bytes/sec.	26.67MB	26.67MB	26.67MB	26.67MB	26.67MB
Virtual memory	NA	NA	NA	NA	NA
Logical address space, bytes	16MB	8MB	16MB	16MB	16MB
Maximum program size, bytes	2MB	8MB	16MB	16MB	2MB
Page size, bytes	2KW blocks	2KW blocks	2KW blocks	2KW blocks	8KW blocks
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	16M	8M	16M	16M	16M
No. of instructions	176	214	214	214	189
16/32-bit compatibility	NA	NA	NA	NA	NA
Cache memory	NA	Std.; 32K	Std.; 32K	Std.; 64K	NA
Control storage	PROM/ROM	PROM/RAM 4KW	PROM, RAM 4KW	PROM/RAM	PROM/ROM
Add time, microseconds	1.65	—	—	—	—
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Optional	Optional	Optional
Hardware byte manipulation	No	No	No	No	No
Battery backup	Optional	Optional	Optional	Optional	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Other I/O channels or ports	I/O processor, FMS, HSD	HSD, Async, Sync	HSD, Async, Sync	HSD, Async, Sync	HSD, Async, Sync
Maximum I/O rate, bytes/sec.	26.67MB	26.67MB	26.67MB	26.67MB	26.67MB
No. of external interrupt levels	16-112	16-112	16-112	16-112	16-112
COMMUNICATIONS					
Maximum number of lines	64 Async, Sync	64 Async, Sync	64 Async, Sync	64 Async, Sync	64 Async, Sync
Synchronous	Opt.; to 9600 bps	Opt.; 9600 bps	Opt.; 9600 bps	Opt.; 9600 bps	Opt.; 9600 bps
Asynchronous	Std.; 19.2K bps	Std.; 9600 bps	Std.; 9600 bps	Std.; 9600 bps	Std.; 9600 bps
Protocols supported	Bisync, HDLC	Bisync, HDLS	Bisync, HDLS	Bisync, HDLS	Bisync, HDLS
Network architecture supported	—	—	—	—	—
RJE terminals emulated	HASP	HASP	HASP	HASP	HASP
IBM 3270 emulation	—	—	—	—	—
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Opt.; 1.6M bytes	Opt.; 1.6M bytes	Opt.; 1.6M bytes	Opt.; 1.6M bytes	No
Disk pack/cartridge drives	Both; 80M-300MB	Both; 80-300MB	Both; 80M-300MB	Both; 80-300M bytes/dr.	Both; 80-300M bytes/dr.
Drum/fixed-head disk storage	Fixed; 80-675M bytes/dr.	Fixed; 80-675M bytes/dr.	Fixed; 80-675M bytes/dr.	Fixed; 80-675M bytes/dr.	Fixed; 80-675M bytes/dr.
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	(4) 45/75 ips	(4) 45/75/125 ips	(4) 45/75/125 ips	(4) 45/75/125 ips	(4) 45/75/125 ips
Serial printer	340 cps	340 cps	340 cps	340 cps	340 cps
Line printer	300-900 lpm	300-900 lpm	300-900 lpm	300-900 lpm	300-900 lpm
Data communications interface	3.2M bps	40K bps	40K bps	40K bps	40K bps
CRT	1920 characters	1920 characters	1920 characters	1920 characters	1920 characters
Other supported peripheral units	Graphics, A/D, RTP	Graphics, RTP, A/D	Graphics, RTP, A/D	Graphics, RTP, A/D	Graphics, RTP, A/D
SOFTWARE					
Assembler	Assembler, macro assembler	Assembler, macro assembler	Assembler, macro assembler	Assembler, macro assembler	Assembler, macro assembler
Compilers	Basic, Cobol, Fortran, ADC, A	Basic, Cobol, Fortran, ADA, C	Basic, Cobol, Fortran, ADA, C	Basic, Cobol, Fortran, Pascal	Fortran, Cobol, Basic, Pascal
Operating system	Unix, real-tm., MPX, inter., multi-batch	Unix, real-time, MPX inter. multi-batch	Unix, real-time, MPX inter. multi-batch	Real-time, interactive multi-batch	Real-time, interactive, multi-batch
Data base management system	Opt.; Total, Seed	Opt.; Total, Seed	Opt.; Total, Seed	Opt.; Total, Seed	Opt.; Total, Seed
Language implemented in firmware	Fortran RTL (part.)	Fortran RTL (part.)	Fortran RTL (part.)	Fortran RTL (part.)	Fortran RTL (part.)
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	42,000 (512KB)	120,000 (1MB)	NA	170,000 (2MB)	84,000 (1MB)
Monthly maint. of basic configuration above for on-site contract, $	275	NA	NA	NA	690
Discounts available	—	—	—	—	—
Price of memory increment, $	23,000 (2MB)	23,000 (2MB)	23,000 (2MB)	23,000 (2MB)	29,000 (1MB)
Date of first delivery	March 1980	March 1983	March 1983	March 1983	April 1981
Number installed to date	110	—	—	—	820
COMMENTS					Dual-stream processing with IPU

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MANUFACTURER AND MODEL	Gould, Inc. S.E.L. 32/8705	Gould, Inc. S.E.L. 32/8750	Gould, Inc. S.E.L. 32/8780	Harris 80	Harris 100
WORD LENGTH, BITS	32	32	32	24	24
NO. WORKSTATIONS SUPPORTED	96	96	96	32	32
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	0.3/0.6	0.3/0.6	0.3/0.6	0.40/0.29	0.40/0.29
Min./Max. capacity, bytes	2M/8MB	2M/16MB	2M/16MB	192K/768K	192K/768K
Storage interleaving	Standard	Standard	Standard	Opt.; 4-way	Opt.; 4-way
Maximum data rate, bytes/sec.	26.67MB	26.67MB	26.67MB	19.0M	19.0M
Virtual memory	NA	NA	NA	Standard	Standard
Logical address space, bytes	8MB	16MB	16MB	6M	6M
Maximum program size, bytes	2MB	2MB	2MB	768K	768K
Page size, bytes	2KW blocks	2KW blocks	2KW blocks	3072	3072
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	8M	16M	16M	96K	96K
No. of instructions	206	206	207	241	241
16/32-bit compatibility	NA	NA	NA	NA	NA
Cache memory	Std.; 32K/64KB	Std.; 32K/64KB	Std.; 64K/128K	No	No
Control storage	RAM	RAM	RAM	No	No
Add time, microseconds	0.075	0.075	0.075	0.3	0.3
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Integral	Integral	Integral	Optional	Optional
Hardware byte manipulation	No	No	No	Standard	Standard
Battery backup	Optional	Optional	Optional	No	Optional
Real-time clock or timer	Standard	Standard	Standard	Optional	Optional
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Optional	Optional
Other I/O channels or ports	HSD, IOP, EMS	HSD, IOP, FMS	HSD, IOP, FMS	Up to 24 logical I/O channels	Up to 24 logical I/O channels
Maximum I/O rate, bytes/sec.	26.67MB	26.67MB	26.67MB	19.0M	19.0M
No. of external interrupt levels	16-112	16-112	16-112	8-24	8-24
COMMUNICATIONS					
Maximum number of lines	64 Async, Sync	64 Async, Sync	64 Async, Sync	32	32
Synchronous	Opt.; 9600 bps	Opt.; 9600 bps	Opt.; 9600 bps	Opt.; 56K bps	Opt.; 56K bps
Asynchronous	Std.; 19.2K bps	Std.; 19.2K bps	Std.; 9600 bps	Opt.; 19.2K bps	Opt.; 19.2K bps
Protocols supported	Bisync, HDLC	Bisync, HDLC	Bisync, HDLS	Async, Bisync	Async, Bisync
Network architecture supported	—	—	—	None	None
RJE terminals emulated	HASP	HASP	HASP	See Comments	See Comments
IBM 3270 emulation	—	—	—	Yes	Yes
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	Std.; 1.6M bytes	Std.; 1-6M bytes	Opt.; 1.6M bytes	No	No
Disk pack/cartridge drives	Both; 80-300M bytes/dr.	Both; 80-300M bytes/dr.	Both; 80-300M bytes/dr.	Opt.; 40-300MB	Opt.; 40-300MB
Drum/fixed-head disk storage	Fixed; 80-675M bytes/dr.	Fixed; 80-675M bytes/dr.	Fixed; 80-675M bytes/dr.	Std.; 80MB, opt.; 160-675MB	Opt.; 80, 160, 675MB bytes
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	(4) 45/75/125 ips	(4) 45/75/125 ips	(4) 45/75/125 ips	6250 bpi, 75 ips	6250 bpi, 75 ips
Serial printer	340 cps	340 cps	340 cps	Opt.; 165 cps	165 cps
Line printer	300-900 lpm	300-900 lpm	300-900 lpm	Opt.; 240-1200 lpm	240-1200 lpm
Data communications interface	40K bps	40K bps	40K bps	56K bps	56K bps
CRT	1920 characters	1920 characters	1920 characters	1920 characters	1920 characters
Other supported peripheral units	Graphics, RTP, A/D	Graphics, RTP, A/D	Graphics, RTP, A/D	Printer/plotter	Printer/plotter
SOFTWARE					
Assembler	Assembler, macro assembler	Assembler, macro assembler	Assembler, macro assembler	Macro assembler	Macro assembler
Compilers	Basic, Cobol, Fortran, ADA, C	Basic, Cobol, Fortran, ADA, C	Basic, Cobol, Fortran, Pascal	Fort., Bas., Cob., APL, Pas., RPG II,	Fort., Bas., Cob., APL, Pas., RPG II
Operating system	Unix, real-time, MPX, int., mul.-bth.	Unix, real-time, MPX, int., mul.-bth.	Real-time, interactive, multi-batch	Batch, multi-task., real-time, multi-us.	Batch, multi-task., real-time, multi-us.
Data base management system	Opt.; Total, Seed	Opt.; Total, Seed	Opt.; Total, Seed	TOTAL	TOTAL
Language implemented in firmware	—	—	—	No	No
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	199,900 (2MB)	235,000 (2MB)	330,000	44,950	55,000
Monthly maint. of basic configuration above for on-site contract, $	1,514	1,794	2,494	Contact vendor	Contact vendor
Discounts available	—	—	—	Yes	Yes
Price of memory increment, $	23,000 (2MB)	23,000 (2MB)	23,000 (2MB)	Contact vendor	Contact vendor
Date of first delivery	October 1981	June 1982	June 1982	1981	1977
Number installed to date	25	80	20	NA	NA
COMMENTS				RJE terminals emulated: 2780/3780, HASP, VT-200, and U-1004	See Harris 80 Comments

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MANUFACTURER AND MODEL	Harris 300	Harris 500	Harris 800	Honeywell DPS 6/92	Honeywell DPS 6/94
WORD LENGTH, BITS	48	48	48	32	32
NO. WORKSTATIONS SUPPORTED	48	64	128	64	112
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	0.40/0.29	0.40/0.29	0.40/0.29	0.55 cycle	0.55 cycle
Min./Max. capacity, bytes	768K/3027K	768K/3072K	768K/12MB	1024K/4096K	1M/6M
Storage interleaving	Opt.; 4-way	Opt.; 4-way	Opt.; 4-way	Standard	Standard
Maximum data rate, bytes/sec.	19.0M	19M	19M	13M	13M
Virtual memory	Standard	Standard	Standard; 48MB	No	No
Logical address space, bytes	12M	12M	12M	16M	16M
Maximum program size, bytes	3M	3M	3M K	—	—
Page size, bytes	3072	3072	3072	—	—
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	3072K	3072K	3072K	16M	16M
No. of instructions	241	241	254	237	237
16/32-bit compatibility	NA	NA	—	Direct	Direct
Cache memory	No	6K	6K	8K bytes	8K bytes
Control storage	No	No	No	PROM; 2K x 96 bits	PROM; 2K x 96 bits
Add time, microseconds	0.3	0.3	NA	0.4	0.4
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Standard	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	No	Optional	Optional	Optional	Optional
Real-time clock or timer	Optional	Optional	Optional	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Optional	Optional	Optional	Standard	Standard
Other I/O channels or ports	Up to 24 logical I/O channels	Up to 24 logical I/O channels	Up to 31 logical I/O channels	Sync, Async, broad-band, HDLC, SDLC	Sync, Async, broad-band, HDLC, SDLC
Maximum I/O rate, bytes/sec.	19.0M	19.0M	To 19M bps	13M	13M
No. of external interrupt levels	16-48	16-48	16-72	64	64
COMMUNICATIONS					
Maximum number of lines	48	64	128	64	112
Synchronous	Opt.; 56K bps	Opt.; 56K bps	Opt.; 56K bps	Up to 72,000 bps	Up to 72,000 bps
Asynchronous	Opt.; 19.2K bps	Opt.; 19.2K bps	Opt.; 19.2K bps	Up to 9600 bps	Up to 19,200 bps
Protocols supported	Async, Bisync	Async, Bisync	Async, Bisync	VIP,BSC,HDLC,SDLC, HASP, 2780/3780	VIP,BSC,HDLC,SDLC, HASP 2780/3780
Network architecture supported	None	None	None	DSA, SNA	DSA, SNA
RJE terminals emulated	See Comments	See Comments	See Comments	2780/3780, HASP	2780/3780, HASP
IBM 3270 emulation	Yes	Yes	Yes	Yes	Yes
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	No	512K to 650KB	512K to 650KB
Disk pack/cartridge drives	Opt.; 40-300MB	Opt.; 40-300MB	Opt.; 40-300MB	Pack & cartridge; 67 to 2048MB	Pack & cartridge; 67 to 3072MB
Drum/fixed-head disk storage	Std.; 80MB bytes, opt.; 160-675MB	Opt.; 80, 160, 675M bytes	Opt.; 80, 160, 675M bytes	No	No
Magnetic tape cassettes/cartridges	No	No	No	No	No
Magnetic tape, ½-inch	6250 bpi, 75 ips	6250 bpi, 75 ips	6250 bpi, 75 ips	800-6250 bpi	800-6250 bpi
Serial printer	165 cps	165 cps	165 cps	120-160 cps	100-160 cps
Line printer	240-1200 lpm	240-1200 lpm	240-1200 lpm	300-1200 lpm	300-900 lpm
Data communications interface	56K bps	56K bps	56K bps	72,000 bps (max.)	72,000 bps (max.)
CRT	1920 characters	1920 characters	1920 characters	80 char. x 24 lines	80 char. x 24 lines
Other supported peripheral units	Printer/plotter	Printer/plotter	Printer/plotter	Crd. rd., doc. hdl., factory ter., letter quality prtr.	Card rdr., doc. hd., fac. ter., letter-qualilty printer
SOFTWARE					
Assembler	Macro assembler	Macro assembler	Macro assembler	Macro assembler	Macro assembler
Compilers	Fort., Bas., Cob., APL, Pas., RPG II	Fort., Bas., Cob., APL, Pas., RPG II,	Fort., Bas., Cob., APL, Pas., RPG II	Cobol, Fortran, Basic, RPG, Pascal	Cobol, Fortran, Basic, RPG, Pascal
Operating system	Batch, multi-task., real-time, multi-us.	Batch, real-time, multi-user, -task.	Batch, real-time, multi-user, task.	Time-sharing, on-line, batch	Time-sharing, on-line, batch
Data base management system	TOTAL	TOTAL	TOTAL	I-D-S/II, TOTAL	I-D-S/II, TOTAL
Language implemented in firmware	No	No	No	Partially	Partially
Operating system implemented in firmware	No	No	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	74,950	106,600 (768KB)	192,400	110,000 (1024KB)	35,000 for upgrade from equiv. DPS 6/76
Monthly maint. of basic configuration above for on-site contract, $	Contact vendor	Contact vendor	Contact vendor	10,430 (annual)	14,430 (annual)
Discounts available	Yes	Yes	Yes	Yes	Yes
Price of memory increment, $	Contact vendor	Contact vendor	Contact vendor	12,000 (1024KB)	12,000 (1MB)
Date of first delivery	1981	1979	1980	4th quarter 1981	4th quarter 1981
Number installed to date	NA	NA	NA	NA	NA
COMMENTS	See Harris 80 Comments	RJE terminals emulated 2780/3780, HASP, UT-200, and U-1004	RJE terminals emulated 2780/3780, HASP, UT-200, and U-1004	Fully compatible with 16-bit members of DPS 6 line (see minicomputer charts)	This md. is for fld. upgd. from DPS 6/76 and below. New orders would be for DPS 6/96, w/differing max. mem. capa.

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MANUFACTURER AND MODEL	Honeywell DPS 6/96	Microdata Sequel	NCR I-9050	Perkin-Elmer Model 3200MPS	Perkin-Elmer 3210
WORD LENGTH, BITS	32	32	32	32	32
NO. WORKSTATIONS SUPPORTED	112	127	20*	128	32
MAIN STORAGE					
Storage type	MOS	MOS	MOS (LSI)	MOS	MOS
Cycle/access time, microseconds	0.55 cycle	600 ns	.35	500 ns	0.4
Min./Max. capacity, bytes	1024K/16M	1M/2MB	1M/4MB	2M/16MB	512K/4M
Storage interleaving	Standard	No	1/2 way	Up to 4-way	None
Maximum data rate, bytes/sec.	13M	6.67MB	16M	64MB	1M
Virtual memory	No	Standard	Standard	No	None
Logical address space, bytes	16M	4MB	NA	16M	4M
Maximum program size, bytes	—	32K	NA	16M	4M
Page size, bytes	—	512	—	—	—
Parity checking	Standard	Standard	Standard	No	No
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	No	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	16M	—	4M	16MB	4M
No. of instructions	237	—	—	206 std.; 52 opt.	206 std.; 52 opt.
16/32-bit compatibility	Direct	32 bit	Direct	Direct	Direct
Cache memory	8K bytes	No	—	Std.; 8KB	None
Control storage	PROM; 2K x 96 bits	ROM; 64KB	RAM	ROM	ROM; 2K x 32 bits
Add time, microseconds	0.4	2.5	—	NA	NA
Hardware multiply/divide	Standard	No	Standard	Standard	Standard
Hardware floating point	Standard	No	Standard	Standard	Optional
Hardware byte manipulation	Standard	Standard	—	Standard	Standard
Battery backup	Optional	Standard	Optional	Standard	Standard
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	32-channel DMA	8-channel DMA
Other I/O channels or ports	Sync, Async, broadband, HDLC, SDLC	—	Sync, Async, multiplexer	Multiplexer bus	Multiplexer bus
Maximum I/O rate, bytes/sec.	13M	6.67MB	2M	40M	8M
No. of external interrupt levels	64	None	8	1024	1024
COMMUNICATIONS					
Maximum number of lines	112	127	20	63	63
Synchronous	Up to 72,000 bps	—	Std.; to 19.2K bps	Up to 2M bps	Up to 2M bps
Asynchronous	Up to 9600 bps	Std.; 9600 bps	Std.; to 19.2K bps	Up to 9600 bps	Up to 9600 bps
Protocols supported	VIP, BSC, S/HDLC, HASP, 2780/3780	2780/3780	Async, Bisync	SDLC, HDLC, ADCCP, BSC	SDLC, HDLC, ADCCP, BSC
Network architecture supported	DSA, SNA	None	—	PENnet (PE X.25)	PENnet (PE X.25)
RJE terminals emulated	2780/3780, HASP	—	2780/3780	2780/3780, HASP	2780/3780, HASP
IBM 3270 emulation	Yes	No	Yes	Yes	Yes (BSC & SNA)
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	512K to 650KB	None	Yes	No	No
Disk pack/cartridge drives	Pack & cartridge; 67 to 3072M bytes	Winchester; 28MB/1GB	Fixed & removable; 27M-3280MB	Pack & cartridge; 10-600M bytes	Pack & cartridge; 10-600M bytes
Drum/fixed-head disk storage	No	No	No	Drum; 80MB	No
Magnetic tape cassettes/cartridges	No	No	Std.; 800/1600 bpi	Cassette; 1KBS	Cassette; 1KBS
Magnetic tape, ½-inch	800/1600/6250 bpi	Streaming	Opt.; 50/160/320	Up to 6250 bpi	36-781KBPS
Serial printer	120-160 cps	165 cps	No	Up to 180 cps	30-180 cps
Line printer	300-1200 lpm	150-1200 lpm	Std.; 70-1440 lpm	Up to 600 lpm	300-600 lpm
Data communications interface	72,000 bps (max.)	—	Std.; to 19.2K bps	—	—
CRT	80 char. x 24 lines	Std.; 80 x 24 char.	Std.; 1920 char.	80 char. x 24 lines	80 char. x 24 lines
Other supported peripheral units	Crd rdr., doc. hdl., fac. term., letter-quality printer	—	Card readers	Card readers, D/A, A/D, array proc. through sys. dev.	Card readers, A/D and D/A
SOFTWARE					
Assembler	Macro assembler	Yes	NCRL	Macro assembler	Assembler, macro assembler
Compilers	Cobol, Fortran, Basic, RPG, Pascal	English, Databasic	Basic, Cobol, RPG, Fortran, NEAT 3	Cobol, Basic, RPG, Fortran, Pascal	Basic, Cobol, RPG II, Fortran, Pascal
Operating system	Time-sharing, on-line, batch	Interactive, multi-tasking	Real-time, multi-programming, inter.	Real-time, batch, multi-task., timesh.	Batch, real-time, time-shar., m-task.
Data base management system	I-D-S/II, TOTAL	Standard	Yes, DBS/ITX	DMS/32; Rel. PLUS	DMS/32; Rel. PLUS
Language implemented in firmware	Partially	Partially	No	No	No
Operating system implemented in firmware	No	Partially	No	No	No
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	130,000 (1024KB)	160,000	52,100 (1024KB)	185,000 (2MB)	See Comments
Monthly maint. of basic configuration above for on-site contract, $	10,890 (annual)	1,000	3,600 (annual)	1,422	480
Discounts available	Yes	—	Yes	Quantity, dol. vol.	Quantity, dol. vol.
Price of memory increment, $	12,000 (1024KB)	13,700 (512K)	12,000 (1024KB)	9,000 (1MB) 16,000 (2MB)	9,000 (1MB) 16,000 (2MB)
Date of first delivery	4th quarter 1981	December 1981	June 1981	—	September 1981
Number installed to date	NA	200	NA	NA	NA
COMMENTS	Fully compatible with 16-bit members of DPS 6 line		*More workstations can be supported via com. multiplexer; intergrated with front end 256 lines	Allows up to 9 aux. proc. units to be plugged into "central" unit, for "plug-in" perf.	Minimum system with 512KB memory & 32MB disk storage is available for 42,000

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MANUFACTURER AND MODEL	Perkin-Elmer 3230	Perkin-Elmer 3250	Prime 250-II	Prime 550-II	Prime 750
WORD LENGTH, BITS	32	32	32	32	32
NO. WORKSTATIONS SUPPORTED	64	128	32	64	96
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	0.4	0.4	1 ms./4 bytes	1 ms./4 bytes	1 ms./8 bytes
Min./Max. capacity, bytes	512K/16M	2M/16M	512K/1MB	512K/4MB	512K/8MB
Storage interleaving	None	Up to 4-way	Std.; 2-way	Std., 2-way	Std.; 2-way
Maximum data rate, bytes/sec.	20M	64M	2.5M	2.5M	8M
Virtual memory	None	None	Standard	Standard	Standard
Logical address space, bytes	16M	16M	512M	512M	512M
Maximum program size, bytes	16M	16M	32M	32M	32M
Page size, bytes	—	—	2K	2K	2K
Parity checking	No	No	Standard	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Standard	Standard	Standard, 3 hierarchical rings	Std., 3 hierarchical rings	Std.; 3 hierarchical rings
CENTRAL PROCESSOR					
No. of directly addressable bytes	16M	16M	64K	64K	64K
No. of instructions	206 std.; 52 opt.	206 std.; 52 opt.	500+	500+	500+
16/32-bit compatibility	Direct	Direct	Direct	Direct	Direct
Cache memory	Std.; 1K bytes	Std.; 8K bytes	Standard; 2KB	Standard; 8KB	Std.; 16KB
Control storage	ROM; 2K x 32 bits	ROM; 2K x 32 bits	PROM; 32KB	PROM; 32KB	PROM; 40KB
Add time, microseconds	NA	NA	0.58	0.48	0.24
Hardware multiply/divide	Standard	Standard	Standard	Standard	Standard
Hardware floating point	Optional	Optional	Standard	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Standard	Standard	Optional	Optional	Optional
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	8-channel DMA	32-channel DMA	Standard	Standard	Standard
Other I/O channels or ports	Multiplexer bus	Multiplexer bus	Optional controllers	Optional controllers	Optional controllers
Maximum I/O rate, bytes/sec.	8M	40M	2.5M	2.5M	8M
No. of external interrupt levels	1024	1024	64	64	64
COMMUNICATIONS					
Maximum number of lines	63	63	Async (32); Sync (8)	Async (64); Sync (8)	Async (96); Sync (8)
Synchronous	Up to 2M bps	Up to 2M bps	Std.; to 56K bps	Std.; to 56K bps	Std.; to 56K bps
Asynchronous	Up to 9600 bps	Up to 9600 bps	Std.; to 19.2K bps	Std.; to 19.2K bps	Std.; to 19.2K bps
Protocols supported	SDLC, HDLC, ADCCP, BSC	SDLC, HDLC, ADCCP, BSC	See Comments	See Comments	See Comments
Network architecture supported	PENnet (PE X.25)	PENnet (PE X.25)	PrimeNET, X.25	PrimeNET, X.25	PrimeNET, X.25
RJE terminals emulated	2780/3780, HASP	2780/3780, HASP	2780/3780, HASP	HASP, 2780/3780	HASP, 2780/3780
IBM 3270 emulation	Yes (BSC & SNA)	Yes (BSC & SNA)	Yes	Yes	Yes
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	No	No	512K-2M bytes	512K-2M bytes	512K-2M bytes
Disk pack/cartridge drives	Pack & cartridge; 10-600M bytes	Pack & cartridge; 10-600M bytes	Both; 32-5400M bytes	Both; 32-5400M bytes	Both, 32-5400M bytes
Drum/fixed-head disk storage	No	No	No	No	No
Magnetic tape cassettes/cartridges	Cassette; 1KBS	Cassette; 1KBS	No	No	No
Magnetic tape, ½-inch	36-781KBS	36-781KBS	800/6250 bpi	800/6250 bpi	800/6250 bpi
Serial printer	30-180 cps	30-180 cps	Std.; 55 cps-300 lpm	Std.; 55 cps-300 lpm	Std.; 55 cps-300 lpm
Line printer	300-600 lpm	300-600 lpm	1000 lpm	1000 lpm	1000 lpm
Data communications interface	—	—	Std.; to 56K bps	Std.; to 56K bps	Std.; to 56K bps
CRT	80 char. x 24 lines	80 char. x 24 lines	Std.; 1920 char.	Std.; 1920 char.	Std.; 1920 char.
Other supported peripheral units	Card readers, A/D and D/A	Card readers, A/D and D/A	PT, card reader, printer/plotter, letter-qual. printer	PT, card reader, printer/plotter, letter-qual. printer	PT, card reader, printer/plotter, letter-qual. printer
SOFTWARE					
Assembler	Assembler, macro assembler	Assembler, macro assembler	Macro & micro assemblers	Macro & micro assemblers	Macro & micro assemblers
Compilers	Basic, Cobol, RPG II, Fortran, Pascal	Basic, Cobol, RPG II, Fortran, Pascal	Bas., Cob., Fort., PL/1, RPG II, PL/G,	Bas., Cob., Fort., PL/1, RPG II, PL/G,	Bas., Cob., Fort., PL/1, RPG II, PL/G,
Operating system	Batch, real-time, time-shar., m-task.	Batch, real-time, time-shar., m-task.	Multi-user, virtual memory	Multi-user, virtual memory	Multi-user, virtual memory
Data base management system	DMS/32; Rel. PLUS	DMS/32; Rel. PLUS	DBMS, Cod., Query	DBMS, Cod., Query	DBMS, Cod., Query
Language implemented in firmware	No	No	Partially	Partially	Partially
Operating system implemented in firmware	No	No	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	64,150 (512KB)	150,000 (2MB)	48,500 (512K bytes)	89,000 (512KB)	154,000 (1MB)
Monthly maint. of basic configuration above for on-site contract, $	430	882	Contact vendor	Contact vendor	Contact vendor
Discounts available	Quantity, dol. vol.	Quantity, dol. vol.	Volume	Volume	Volume
Price of memory increment, $	9,000 (1MB) 16,000 (2MB)	9,000 (1MB) 16,000 (2MB)	Contact vendor	Contact vendor	Contact vendor
Date of first delivery	March 1981	January 1982	February 1981	February 1981	1979
Number installed to date	NA	NA	600	560	1000
COMMENTS			Prot. supp. include most IBM, Univac, Honeywell, and ICL; Prime/SNA also supported	Prot. supp. include most IBM, Univac, Honeywell, and ICL; Prime/SNA also supported	Prot. supp. include most IBM, Unviac, Honeywell, and ICL; Prime/SNA also supported

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MANUFACTURER AND MODEL	Prime 850	Prime 2250	Stratus Computer STRATUS/32	Wang VS 90	Wang VS 100
WORD LENGTH, BITS	32	32	32 + 6	32	32
NO. WORKSTATIONS SUPPORTED	128	32	64 (2048/sys.)	48	128
MAIN STORAGE					
Storage type	MOS	MOS	MOS	MOS	MOS
Cycle/access time, microseconds	1 ms./8 bytes	230 ns	0.375/0.125	.48	.48
Min./Max. capacity, bytes	2M/8MB	512KB/4MB	2M-16M	1M/4MB	1M/8MB
Storage interleaving	Std.; 2-way	Standard	Std.; 4-way	No	No
Maximum data rate, bytes/sec.	8M	—	16M	16.6M	16.6M
Virtual memory	Standard	Standard	Standard	Standard	Standard
Logical address space, bytes	512M	512M	16M	8M	8M
Maximum program size, bytes	32M	32M	12M	1M	1M
Page size, bytes	2K	2K	4096	2048	2048
Parity checking	Standard	Standard	Standard	Standard	Standard
Error correction	Standard	Standard	Standard	Standard	Standard
Storage protection	Std.; 3 hierarchical rings	Std.; hier. multi-ring protection	Standard	Standard	Standard
CENTRAL PROCESSOR					
No. of directly addressable bytes	64K	64K	8M	4MB; 1M word	8MB; 2M words
No. of instructions	500+	550+	1000+	180	180
16/32-bit compatibility	Direct	Direct	NA	Direct	Direct
Cache memory	Std.; 32KB	Standard; 2KB	Memory prefetch	No	Yes; 32K bytes
Control storage	PROM; 96KB	PROM	ROM; 32K bytes	8K bits	8K bits
Add time, microseconds	0.24	—	0.75	—	—
Hardware multiply/divide	Standard	Standard	No	Std.; multiply	Std.; multiply
Hardware floating point	Standard	Standard	No	Standard	Standard
Hardware byte manipulation	Standard	Standard	Standard	Standard	Standard
Battery backup	Optional	Optional	Standard	No	No
Real-time clock or timer	Standard	Standard	Standard	Standard	Standard
INPUT/OUTPUT CONTROL					
Direct memory access channel	Standard	Standard	Standard	Standard	Standard
Other I/O channels or ports	Optional controllers	Optional	29	—	—
Maximum I/O rate, bytes/sec.	8M	—	16M	16.6M	16.6M
No. of external interrupt levels	64	64	3	5	5
COMMUNICATIONS					
Maximum number of lines	Async (128);Sync (8)	Async (8); Sync (1)	Async(64);Sync(32)*	Appl. dependent	App. dependent
Synchronous	Std.; to 56K bps	Standard	Opt.; to 56K bps	Opt.;up to 64K bytes	Opt.;up to 64K bytes
Asynchronous	Std.; to 19.2K bps	Standard	Std.; to 19.2K bps	Opt.; 9600 bps	Opt.; 9600 bps
Protocols supported	See Comments	See Comments	Bisync, Stratalink	2780/3780, SDLC, HDLC, MSVI	2780/3780, SDLC, HDLC
Network architecture supported	PrimeNET, X.25	PrimeNET, X.25,	X.25, StrataNet	SNA, WANGNET	SNA, WANGNET
RJE terminals emulated	HASP, 2780/3780	HASP, 2780/3780	2780/3780, HASP	2780/3780, 3777	2780/3780, 3777
IBM 3270 emulation	Yes	Yes	Yes	Yes; 3271/4 also	Yes; 3271/4 also
PERIPHERAL EQUIPMENT					
Floppy disk (diskette) drives	512K-2M bytes	512K-2M bytes	No	Opt.; (48) 1.2MB	Opt.; (128) 1.2MB
Disk pack/cartridge drives	Both; 32-5400M bytes	—	30-4600M bytes/processor	Opt.; (8) 640MB	Opt.; (8) 640MB
Drum/fixed-head disk storage	No	—	No	Opt.; fixed 288MB	Opt.; fixed 288MB
Magnetic tape cassettes/cartridges	No	15MB	No	—	—
Magnetic tape, ½-inch	800/6250 bpi	—	160K, streaming	—	—
Serial printer	Std.; 55 cps-300 lpm	Standard	55 cps	Opt.; 35, 120 cps	Opt.; 35, 120 cps
Line printer	1000 lpm	—	300, 600, 900 lpm	Opt.; 1100 lpm	Opt.; 1100 lpm
Data communications interface	Std.; to 56K bps	Standard	Opt.; to 70K bps	Std,; 9.6K bytes	Std.; 9.6K bytes
CRT	Std.; 1920 char.	Std.; 1920 char.	Std.; 25 x 80 char.	1920 characters	1920 characters
Other supported peripheral units	PT, card reader, printer/plotter, letter-qual. printer	Combined disk and tape controller	Stratalink	Laser printer	Laser printer
SOFTWARE					
Assembler	Macro & micro assemblers	Macro assembler	Yes	Assembler and macro assembler	Assembler and macro assembler
Compilers	Bas., Cob., Fort., PL/1, RPG II, PL/G,	Bas., Cob., Fort., PL/1, RPG II, Pas.	Cob., PL/1, Bas., Pascal, Fort.-77	PL/1, Cobol, Basic, Fortran	PL/1, Cobol, Basic, Fortran
Operating system	Multi-user, virtual memory	Multi-user, virtual memory	Virt., multi-prog., real-time, batch	Interactive, multi-user	Interactive, multi-user
Data base management system	DBMS, Cod., Query	DBMS, Cod., Query	Optional	Opt.; TOTAL	Opt.; TOTAL
Language implemented in firmware	Partially	Partially	No	Partially	Partially
Operating system implemented in firmware	Partially	Partially	Partially	Partially	Partially
PRICING & AVAILABILITY					
Price of CPU, power supply, frt. panel, and minimum memory in chassis, $	295,000 (2MB)	48,900 (1MB)	123,350 (see comments)	73,000 (1MB)	75,000 (512KB)
Monthly maint. of basic configuration above for on-site contract, $	Contact vendor	Contact vendor	589	450	638
Discounts available	Volume	Volume	Dollar volume	Quantity	Quantity
Price of memory increment, $	Contact vendor	Contact vendor	10,000 (1MB)	16,000 (1MB)	16,000 (1MB)
Date of first delivery	September 1981	1982	1981	April 1982	December 1980
Number installed to date	60	NA	NA	—	—
COMMENTS	Prot. supp. include most IBM, Univac, Honeywell, and ICL; Prime/SNA also supported	Prot. supp. include most IBM, Univac, Honeywell and ICL; Prime/SNA also supported	*per proc.; inc. 2 CPUs, 2 disk cont., 2 comm. cont., 2MB mem., two 30MB dsk., CRT, tp., etc.		