DEC Datasystem 310

MANAGEMENT SUMMARY

Since its introduction in January 1975, the Datasystem 310 has exhibited much the same rise to success as its generic type, the small business computer. This particular class of system was widely regarded as a curiosity until IBM introduced the System/32, a compact, low-cost system specifically targeted for small businesses, just eight days before DEC unveiled the Datasystem 310. During the two years following the introduction of these two systems, the industry has been flooded with small business computer systems, from major mini-computer makers and from OEM system builders who assemble both general and specialized packages of hardware and software for specialized markets.

At the time of its introduction, the Datasystem 310 shattered the $40,000 price barrier by offering a complete packaged business computer system at a purchase price of just $12,000. But the DS310 lacked the performance of the IBM System/32 primarily because the only mass storage available to it was floppy disk drives (up to four) whereas the IBM system also featured a fixed disk subsystem. The price tag on that basic DS310 configuration has now climbed to $14,095 (what hasn't?), but it still offers an excellent opportunity for even the smallest potential user to have a disk-based business computing system, complete with operating software and an easy-to-learn programming language.

More recently, DEC removed the last remaining substantial difference between the DS310 and the IBM S/32 by adding a hard disk subsystem. DEC now offers the RK05 series of cartridge disks with the DS310, making the ▷

The Datasystem 310, introduced as DEC's entry-level small business computer system, has been upgraded through the availability of RK05 cartridge disk drives. In addition to 1.34 million characters of floppy disk storage, the PDP-8/A-based system now features up to 12.8 million characters on cartridge disk.

CHARACTERISTICS

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

Digital Equipment Corporation (DEC) is the world's largest manufacturer of minicomputer systems. DEC's product lines include general-purpose computing systems, laboratory monitoring and control systems, process control systems, industrial control systems, editing and typesetting systems, and business computing systems. DEC maintains 125 sales and service offices in over 30 countries and has manufacturing facilities in Puerto Rico, Mexico, Canada, Ireland, Scotland, Hong Kong, and Taiwan in addition to six facilities in the U.S. The company employs 25,000 persons worldwide and has installed more than 65,000 computer systems.
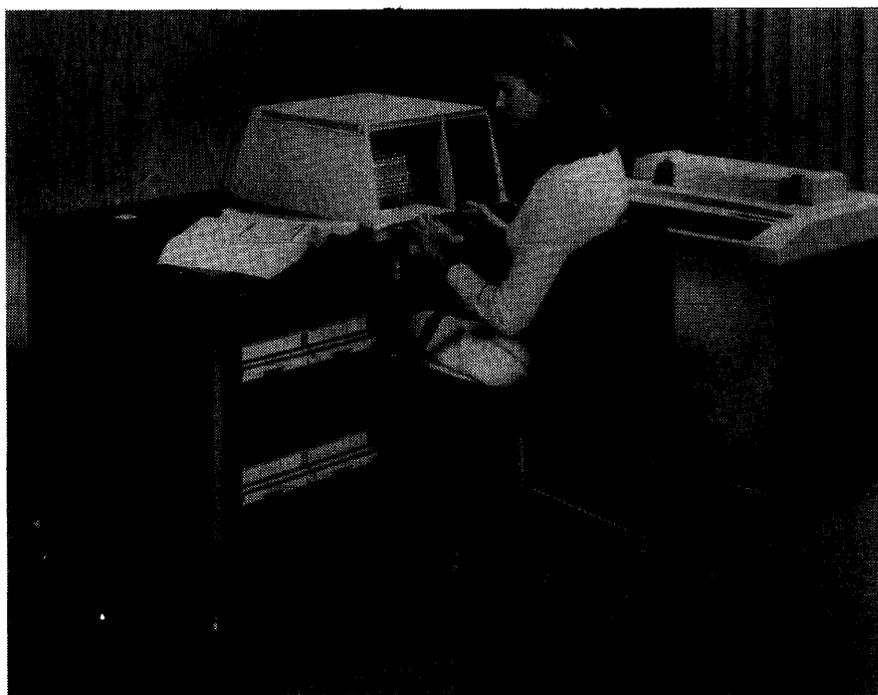
VENDORS: Manufacturer and OEM suppliers. Contact DEC's Business Products Group to find the OEM supplier in your locale.

MODEL: Datasystem 310.

DATE ANNOUNCED: January 1975.

DATE OF FIRST DELIVERY: May 1975.

NUMBER INSTALLED TO DATE: Not available.

This typical entry-level Datasystem 310 configuration includes 16K words of core memory, four floppy disk drives, and a 180-cps DEC-printer in addition to the basic DS310 system. This configuration is priced at $23,275, and the monthly maintenance charge is $195. System storage capacity can be expanded by adding up to four RK05 cartridge disk drives for a total on-line capacity of 12.8 million 6-bit characters. An IBM 2780 Emulation package, consisting of a synchronous controller and 2780 Emulator software, permits the system to function as a remote job entry terminal to an IBM host system.

DEC Datasystem 310

▷ system more directly competitive with the System/32. One significant difference is that DEC's disk drives employ interchangeable cartridges whereas the System/32 uses a nonremovable disk. Another major difference between the two product lines is IBM's Industry Application Programs (IAP's), currently 15 in number and growing steadily. The IAP's mark the most significant strategy difference between DEC and IBM. While Digital provides the DIBOL language for application program development, IBM supplies separately priced packages that include all coding, documentation, and training material required to get a user installation up and running. System/32 users can also develop their own application programs, but the programming language provided is RPG II, which, although simpler to use, is generally not as effective as DIBOL. In addition, System/32 users must cope with IBM's not-so-simple Operation Control Language when developing their own programming. It should also be noted that the System/32 RPG II compiler is separately priced.

The basic Datasystem 310 configuration includes a PDP-8/A CPU with 8,192 words of 1.5-microsecond core memory and bootstrap loader; a dual floppy disk drive subsystem, with each drive capable of storing up to 335,000 six-bit characters; a 1920-character CRT display/keyboard; and a desk. Also included in the $14,095 purchase price is a license for the COS 310 operating system and the DIBOL compiler. Memory can be expanded to 32K words, and floppy disk storage can be increased to a maximum of four drives (two dual drive units), for a total of 1.34 million characters on-line.

Up to four RK05 cartridge disk drives can also be added, providing an extra 12.8 million characters of storage. The first disk drive and controller cost $8,800 and include a cabinet capable of mounting one additional drive.

Three types of printers are also offered as options with the DS310. The 30-cps LA35 DECwriter II Printer is essentially the popular DECwriter II without a keyboard. Another DEC-manufactured printer, the LA180, is six times as fast as the LA35 but costs less than $1,000 more. And for those who expect to generate large volumes of reports, the 300-lpm Dataproducts 2230 line printer can also be added to the system.

The Datasystem 310 can be employed as a remote entry terminal to a host system through the IBM 2780 Emulation package. This package includes a synchronous line controller and the necessary software to communicate with other DEC Datasystems (310's, 320's, 350's, or 500's), DECsystem 10's or DECsystem 20's, or any IBM 360/370 computer system. The communications software package provides automatic answering, automatic retransmission of data in error, and double buffering of disk and line printer files. The data transmission rate is currently limited to 4800 bps, but this is expected to be raised to 9600 bps in the future.

The entire Datasystem 310, including the cartridge disk drives and line printers, plugs into standard three-prong wall sockets. No special flooring is required, and any normal office environment is suitable for the system.

DEC sells the DS310 to end users and OEM's alike. The company makes the units available to volume purchasers ▷

▶ DATA FORMATS

BASIC UNIT: The PDP-8/A uses 12-bit words; programmers, however, see only 6-bit modified ASCII for numeric or alphanumeric data.

FIXED-POINT OPERANDS: The PDP-8/A uses 12-bit binary words; programmers, however, see the system as having fixed-point decimal capability only, with precision of 15 digits, due to the standard software.

FLOATING-POINT OPERANDS: None provided.

INSTRUCTIONS: One-word single-address machine instructions, as is common to the PDP-8 line. But since the only programming language available to users is DIBOL, users see the instruction format in terms of the DIBOL syntax, and the repertoire in terms of the DIBOL command list.

INTERNAL CODE: Binary, as in the PDP-8 line. But users make no reference to machine code; they see alphanumeric data in DIBOL data structure, coded in 6-bit modified ASCII.

MAIN STORAGE

TYPE: Magnetic core.

CYCLE TIME: 1.4 microseconds.

CAPACITY: 8K to 32K 12-bit words, in 8K increments (K = 1,024). DEC also refers to capacities in "bytes" or characters. A DECbyte is *six bits;* hence, the capacities could be quoted as 16K to 64K six-bit bytes in 16K increments.

CHECKING: None.

STORAGE PROTECTION: None in hardware, but via operating system software. The basic COS 310 residency requirement is 4K words, and the operating system manages the memory resource for a single user.

RESERVED STORAGE: 4K words of memory for COS 310. The "system" diskette also has a reserved section for COS 310 and system utility programs.

CENTRAL PROCESSOR

The CPU is a PDP-8/A minicomputer, a slower, one-board version of the DEC PDP-8/E. See Report M11-384-101 for more details on the CPU.

CONTROL STORAGE: None is accessible to users.

REGISTERS: The PDP-8-style "autoindex" registers are used by COS 310 and are not accessible to programmers. The CPU has the normal complement of PDP-8 registers for the operating system to use: 12-bit accumulator, general-purpose register, program counter, memory address register, memory buffer register, 3-bit operation code register, and 1-bit link carry register for arithmetic overflow. None of these registers is accessible to DIBOL programmers. (The switch register has been eliminated, since there is no operator's console.)

ADDRESSING: All PDP-8's have four addressing modes: direct (128 locations); indirect (one-level); indirect-indexed, using the auto-index registers in memory; and program-relative.

INSTRUCTION REPERTOIRE: The CPU has the basic PDP-8 instruction set: 6 memory reference instructions, 4 interrupt control system instructions, 3 flag processing instructions, and 41 "operate" instructions for logical control. But only DIBOL is available to programmers. DIBOL has field manipulation instructions and add, subtract, multiply, divide, numeric content check, numeric field formatting, truncation, and rounding available in any combination in a single DIBOL statement. DIBOL also provides the system's I/O instructions, logical functions, and branching. ▶

DEC Datasystem 310

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	MANUFACTURER
PRINTERS		
LA35	DECwriter II; 132 positions, 96 ASCII characters, variable forms width, switch-selectable speeds, 10, 15, or 30 cps	DEC
LA180	DECprinter; 132 positions, 96 ASCII characters, variable forms width, top-of-form control; 180 cps	DEC
LE8	Line Printer; drum, 132 positions, 64 ASCII characters, top-of-form control; 300 lpm	Dataproducts
TERMINALS		
VT52	DECscope; 80 characters by 24 lines, 64-character ASCII keyboard, full-duplex operation, direct cursor addressing, 19-key numeric keypad, switch-selectable data rates; 75 to 9600 bps	DEC

▷ at quantity-discount prices. Even more substantial discounts are available to OEM buyers, and about 100 of these are committed to making tailored and/or turnkey DS310-based business applications systems available to customers at negotiated prices.

USER REACTION

Datapro contacted eight Datasystem 310 users in December 1976 through both telephone interviews and mailed questionaires. These eight users collectively accounted for more than 50 systems, and two of them reported plans to acquire many more. The user population was evenly divided between end users, each with a single system, and OEM system builders, who add specialized software packages and resell the equipment in turnkey systems. Coincidentally, two of the OEM's also qualified as end users, since they were also using DS310's for their own internal accounting functions.

The end-user population included a distributor, a dentist, machine shop, and a leading wood products firm with regional offices in nearly every state. This large firm is assembling a network of terminal systems based on the IBM 2780 emulation capabilities of the 310. Eventually this network will involve over 150 systems.

The systems surveyed had an average installed life of about eight months. The typical configuration we encountered included four floppy disk drives and the LA180 printer. The average memory size was about 16K words, but the systems ranged from the minimum 8K words to the maximum 32K words. Only two users reported having the RK05 cartridge disk drives, but three others said they were considering upgrading to these. Only one system included a 300-lpm line printer, and that was not supplied by DEC. Although the CRT display now supplied with the Datasystem 310 is DEC's 1920-character VT52, all of those queried had the 960-character VT50.

The results of the user survey are tabulated below. The categories of applications programs and ease of conversion have been omitted since DEC offers no applications software with the Datasystem 310 and none of the survey systems had replaced other equipment. ▷

▶ INSTRUCTION TIMINGS: Timings are given in *microseconds* for both CPU (machine-level) instructions and DIBOL operations on 15-digit operands.

	CPU	DIBOL
Load/store	1.4	100 average
Add/subtract	2.8	1,000
Multiply/divide	NA	2,000
Compare & branch	1.4	25-100*

* For 15 characters. The time can vary widely, since DIBOL permits the operation on fields 1 to 4096 characters in length.

INTERRUPTS: A single-line interrupt structure is provided. Software polls the interrupting device for its identification. Interrupts are handled by COS 310, and the programmer is not concerned with them.

PHYSICAL SPECIFICATIONS: Except for optional printers, the entire Datasystem 310 fits within a desk measuring 30 inches high, 48 inches wide, and 30 inches deep, and weighing 400 pounds. No special environment is required; the system works in the normal office environment. The desk is mounted on casters, and the system plugs into a standard wall socket (single-phase, 3-wire grounded duplex, 110-120 volts AC, 60 Hertz). Power consumption is 1,000 watts. The optional printers vary in size and weight, are not caster-mounted, and obtain power from the desk unit. The printers connect to the Datasystem 310 via short cables.

Power consumption, heat dissipation, and weights for various elements of the Datasystems are as follows:

Unit	Power Consumption, Watts	Heat Dissipation, BTU/hr.	Weight, Pounds
DS310	1000	3400	400
RK05	160	2400	110
Dual RK05 (in cabinet)	220	4800	550
LA36	300	1000	102
VT52	110	1000	44
RX8 (dual)	110	500	60

INPUT/OUTPUT CONTROL

I/O CHANNELS: Six cycle-stealing channels on the Omnibus are used by the basic Datasystem 310. Six more are available for expansion. The channels operate at rates in accordance with the I/O device speeds.

SIMULTANEOUS OPERATIONS: Full peripheral overlap is provided by the hardware and COS 310. The keyboard and serial printers are buffered; diskette access is overlapped with serial or line printer output; and COS 310 includes a standard line printer spooler. ▶

DEC Datasystem 310

A minimal Datasystem 310, consisting of a PDP-8/A CPU with 8K words of core memory, a dual floppy disk drive subsystem, and a 1920-character CRT display/keyboard, is shown in the standard desk enclosure. The system purchase price of $14,095 also includes the COS 310 operating system, DEC's DIBOL business-oriented language, and system installation. Monthly maintenance charge for this configuration is $99.

▷

	Excellent	Good	Fair	Poor	WA*
Ease of operation	7	1	0	0	3.9
Reliability of mainframe	7	1	0	0	3.9
Reliability of peripherals	2	6	0	0	3.3
Responsiveness of maintenance service	2	5	1	0	3.1
Effectiveness of maintenance service	4	4	0	0	3.5
Technical support	3	1	2	0	3.2
Operating system	6	2	0	0	3.8
Compilers and assemblers	6	2	0	0	3.8
Ease of programming	5	3	0	0	3.6
Overall satisfaction	5	3	0	0	3.6

*Weighted average on a scale of 4.0 for Excellent.

It is evident from the results that users are well satisfied with the DS310. Peripheral reliability was rated slightly lower than most other categories due to early problems with DEC's floppy disk subsystems. All the users agreed, however, that these problems had been rectified by DEC. Likewise, the ratings for responsiveness of maintenance service and technical support suffered somewhat due to problems encountered during the early life of the systems.

On the positive side, both the COS 310 operating system and the DIBOL compiler were highly rated. Datapro made it a point to ask whether the end users had attempted to develop programs of their own. All but one had successfully written at least one application program and felt that, with practice, they could develop more. □

► **CONFIGURATION RULES**

DS310 systems are packaged. Minimum configuration is CPU with 8K words of core memory, CRT, two diskettes, and keyboard; maximum system is CPU with 32K words. CRT, four diskettes, keyboard, one printer, IBM 2780 emulation, and up to four RK05 cartridge disks for a total capacity of 6.4 million words or 12.8 million characters (DECbytes.)

The basic Datasystem has six Omnibus slots available for system expansion. Slot requirements for various expansion options are provided with the component descriptions in the Equipment Prices section of this report.

MASS STORAGE

For the Datasystem 310 line, DEC offers standard cartridge disk and floppy disk subsystems.

RX8 FLOPPY DISK: The RX8 is a flexible disk drive with a capacity of 512K 8-bit words per drive. Up to two drives per controller and 8 controllers per processor can be configured. Average head-movement time is 370 milliseconds. A track-to-track move takes at least 10 milliseconds. Rotational speed is 360 rpm, yielding an average rotational delay of 83 milliseconds. Data transfer rate is 5K 12-bit words per second. The surface of the diskette is divided into 77 tracks, each with 26 sectors. The RX8 floppy disk drive is manufactured by DEC. The floppy disks are standard (IBM-compatible) and are available from many sources.

RK8-J CARTRIDGE DISK SUBSYSTEM: Includes an RK05J cartridge disk drive with one removable IBM 5440-type cartridge and a controller for up to eight drives. The RK05J drive records data at 256 words per sector, 16 sectors per track, and 203 tracks per surface. Formatted capacity is 1.6 million 12-bit words. Average rotational delay is 20 milliseconds, and average head-positioning time is 50 milliseconds. Data transfer rate is 120K words per second. The RK05J cartridge disk drive can be intermixed with the RK05F double-density drive on the same controller. The RK05J disk drive is manufactured by DEC.

RK05F CARTRIDGE DISK DRIVE: A double-density version of the RK05J cartridge disk drive having 406 tracks per surface. It uses a nonremovable cartridge and has a capacity of 3.3 million words. The RK05F drive can be intermixed with the RK05J drives on the same controller. To the operating software, one RK05F appears as two logical RK05J's. The RK05F disk drive is manufactured by DEC.

In addition to the disk products offered by DEC, more than 15 manufacturers currently supply DEC-compatible disk ►

DEC Datasystem 310

▶ drives. These units are either DEC-equivalent units or IBM 2315, 5440, or 3470 equivalents. A detailed summary of these products is presented in Report M13-100-201, *Minicomputer Disk Storage,* and Report M13-100-251, *Minicomputer Floppy Disk Storage.*

INPUT/OUTPUT UNITS

See Peripherals/Terminals table on the second page of this report. Also, several independent manufacturers offer direct-replacement magnetic tape drives for the PDP-8 series computers: these units are summarized in Reports M13-100-301, *Minicomputer Reel-to-Reel Magnetic Tape Units,* and M13-100-351, *Minicomputer Cassette/Cartridge Magnetic Tape Units.* Similarly, a number of vendors manufacture direct-replacement line printers for the PDP-8 series, as outlined in Report M13-100-401, *Minicomputer Printers.*

COMMUNICATIONS CONTROL

The Datasystem 310 can handle one communications line, with the speed of synchronous data transmission set by the modem used: 2000, 2400, or 4800 bits per second. The transmission code used is EBCDIC, and the line protocol is IBM 2780-compatible binary synchronous (BSC), full duplex. Leased or switched lines can be used, both with auto-answer. No switched control is available. The languages supported are DIBOL for program development and IBM 2780 remote job entry conventions. Another Datasystem 310, a Datasystem 320, 350, or 500, or an IBM System/360 or 370 computer can be interfaced. An IBM 2780 emulator software package is supported. Communications error control consists of a block check character with automatic retransmission upon detection of an error.

SOFTWARE

The Datasystem 310 is intended to function as a stand-alone system that permits entry-level users to generate applications programs through the DEC-developed DIBOL language (Digital Business-Oriented Language).

OPERATING SYSTEM: The Datasystem 310 operating system is *COS 310,* a modified version (not a proper subset) of COS 300 for DEC's larger Datasystems. COS 310 functions to make the PDP-8/A appear as a "black box," control I/O operations, and handle the operator interface. It supports DIBOL. The operating system requires about 4K words of memory and resides, with numerous utility programs, on about one-third of a diskette.

COS 310 supports named I/O devices in the packaged systems. It supports batch and interactive processing as well as interactive program development. It manages direct access to diskette data through user file directories. It provides direct printing or spooling for an optional line printer, cursor control for the CRT, and a buffer for the keyboard. It allows programs to be chained. COS 310 supports multiple-volume data files on diskette. The operating system also contains fixed-point decimal arithmetic routines.

The COS 310 MONITOR is split into a core-resident and a diskette-resident segment; it includes interactive job control and editor functions, and maintains a directory of all programs stored within the system. The EDITOR is an interactive, line-oriented program that also accepts input from the keyboard and accepts and stores batch-mode commands or control files for SORT, BUILD, or other programs. The COS 310 MONITOR and one or two key utilities occupy about one-fifth of a diskette. The remaining diskette space is available for compilation, etc.

LANGUAGE: *COS 310 DIBOL* is composed of data definition and procedure sections. It resides on a diskette and runs on a minimum Datasystem 310. It will support up to 28K words of user storage, which is the maximum storage in a Datasystem 310. Source code can be input from the console or from diskette, via job control statements. DEC quotes compile times for complex programs in the range of 10 to 20 seconds.

DIBOL object code, in executable form, resides on the system diskette and can be stored by name in the user's pro-

gram library. DIBOL provides decimal arithmetic precision to 15 places, using one 6-bit "DECbyte" of memory to express each decimal digit. Further, the language offers program debugging from the console CRT, logical data files, program chaining, and an internal subroutine facility. Simple DIBOL commands are expressed in English statements, and can be classified according to type and function as follows:

Compiler commands—statement type defined.

Control commands—program execution sequence.

Data manipulation—calculations and data movement in main memory.

Data specification—size, type and position of data.

Debug facility—program step trace.

File control—data file open and close.

I/O control—data movement into and from memory.

DIBOL supports a six-bit ASCII character subset, and features data manipulation capabilities such as subscripting, array handling, rounding, truncating, and record overlaying. CALLs can be nested. There are useful utilities for DIBOL supported by COS 310.

DEC has recently announced the availability of DIBOL to the entire Datasystem line, including the PDP-11-based Datasystem 320's, 350's, and 500's. The version that is used with these other Datasystems is DIBOL-11, which is not truly compatible with COS 310 DIBOL. Hence, some reprogramming will be required in the event a user upgrades to a larger Datasystem.

UTILITIES: With the COS-310 SORT/Merge routine, the user can specify one to eight subfields in the sort key. The SORT utility also has a file merge capability. The system's editor is interactive, allowing various types of input. The BUILD utility creates data files from a data entry terminal. An UPDATE routine maintains master files.

DDT (DIBOL Debugging Technique) is an optional run-time DIBOL debugging feature. It lets the programmer stop execution at a given statement to examine variables, using their DIBOL labels. It is interactive.

DAFT (Dump and Fix Technique) is a selective file maintenance/dumping utility written in DIBOL. It searches a data file on a specified key, makes minor changes to a data file, prints or displays records or parts of records, searches for a specified record, skips or backspaces a requested number of records, and places a specified number of copies of a record on an output file.

CREF (Cross Reference) provides an alphabetical listing of symbols used in a DIBOL program, and also gives the program line numbers.

PATCH is used to update programs. It contains a check sum feature to verify the validity of the changes.

PRINT is an output utility for the optional printer. Written in DIBOL, it provides page counts, page headings, and field headings, and its data positioning commands are defaulted. It accumulates field totals, generates breaks at specified levels, and optionally ejects pages with summaries at breaks. Some computational routines are supported. PRINT is actually an output-oriented language that translates report parameters into a DIBOL program. If the DIBOL program is not exactly what the user wanted, he can modify it.

COMMUNICATIONS SOFTWARE: COS 310 supports an optional IBM 2780 Remote Data Communications emulator package.

PRICING

POLICY: Datasystem 310's are available for purchase only; maintenance is separately priced. End-user discounts are provided for volume purchases, as summarized below. ▶

DEC Datasystem 310

Number of Systems	Discount, percent
2-4	2
5-9	5
10-19	8

OEM volume discounts range from a minimum of 15 percent for a single system to 35 percent for quantities greater than 100. Hardware installation and software are included in the price.

EQUIPMENT: Datasystem 310's are sold as packaged systems. The basic configuration includes a PDP-8/A CPU with 8K words of core memory, dual floppy disk drive subsystem, VT52 CRT display/keyboard, desk, COS 310 operating system, DIBOL compiler, and system utilities. Purchase price for the basic package is $14,095, with monthly maintenance priced at $99. A Datasystem 310 with a 300-lpm line printer and 12.8-million-word cartridge disk subsystem in a separate cabinet is priced at $34,130; monthly maintenance changes are $220.■

EQUIPMENT PRICES

	Purchase Price	Monthly Maint.
SYSTEMS		

All Datasystem 310's include a PDP-8/A CPU with 1.5-microsecond core memory and bootstrap loader, RX8 dual floppy disk subsystem, VT52 CRT display/keyboard, desk, COS 310 operating system, DIBOL compiler, and utilities.

		Purchase Price	Monthly Maint.
DS310-EA	With 8K words of memory; provides 6 expansion slots	$14,095	$99
DS310-WA	With 16K words of memory; provides 6 extension slots	15,095	109
MEMORY			
MM8-AA	8K words of core memory; requires 2 slots	1,500	10
MM8-AB	16K core words of memory; requires 2 slots	2,500	15
MASS STORAGE			
DS3RX-BA	Dual Floppy Disk Drive and Controller; 1 dual drive per controller, maximum 2 per system, requires 1 slot	4,095	33
DS3RK-EA	Cartridge Disk Drive and Controller; 1.6 million words, four RK05J or two RK05F drives maximum, requires 3 slots	8,800	49
RK05J-AA	Cartridge Disk Drive for DS3RK-EA above; 1.6 million words, maximum 4 per system	5,100	39
RK05F-AA	Cartridge Disk Drive for DS3RK-EA above; 3.2 million words, maximum 2 per system, includes cartridge	6,500	54
RK05K-08	Disk Cartridge for RK05J-AA or RK05F-AA	99	—
PRINTERS			
DS3D5-BA	LA35 DECwriter II Printer and Controller; 64-character set, 30 cps, requires 1 slot	2,690	36
LA8-PA	LA180 Printer and Controller; 96-character set, 180 cps, requires 1 slot	3,585	53
LE8-VA	Printer and Controller; 64-character set, 300 lpm, requires 1 slot	11,235	72
COMMUNICATIONS			
DS3CB-AY	2780 Communications Package; includes DP8 synchronous interface, 2780 Emulator license and software installation. Requires 3 slots	4,300	16
DS3CB-DZ	2780 Communications Package; includes DP8 synchronous interface and 2780 Emulator license. Requires 3 slots	2,800	16
CABINETS AND HARDWARE			
H967-HK	Cabinet; 50-inch, for third and fourth RK05 disk drives, includes power control	935	—
SOFTWARE			
IBM 2780 Emulator (with installation)		700	—
IBM 2780 Emulator (without installation)		200	—