

# DEC Datasystem D500, ST, and DM Series

## MANAGEMENT SUMMARY

DEC has again reconfigured and greatly expanded its "Datasystem 500 line." Therefore, this report actually covers three series or families of Datasystems built from a common base of hardware components. The three series are distinguished by the operating systems they employ. The D500 series of computer systems uses the CTS-500 operating system, a general-purpose multi-user system based on DEC's RSTS/E; the ST series uses TRAX, a new operating system oriented toward efficient transaction processing; and the DM series runs under RSX-11M, a real-time, event-driven system.

Within each series, the available models are distinguished by the central processors they employ. In the D500 series, for example, the D530 system employs the PDP-11/34A, the D560 uses the PDP-11/60, and the D750 is based on the powerful PDP-11/70. Each of these systems, in turn, is available in several packaged configurations that differ in main memory and in type and capacity of disk storage. The basic packaged configurations can be expanded through the addition of more main memory, additional disk storage units, and a variety of peripheral and communications equipment.

The DEC Datasystems are sold as enhanced, packaged configurations of standard DEC minicomputer equipment plus an operating system and appropriate program development aids such as language processors, debug tools, utilities, edit-programs, etc. These systems are designed primarily for sale either to sophisticated end

The Datasystem 500 family currently includes a broad array of packaged systems built around DEC's PDP-11/34A, 11/60, and 11/70 processors and one of three multi-user operating systems: CTS-500, TRAX, or RSX-11M. Upward-compatible with the Datasystem 320 and 350 series, the Datasystem 500's can support up to 4 million bytes of main memory, 64 terminals, and 1.5 billion bytes of disk storage.

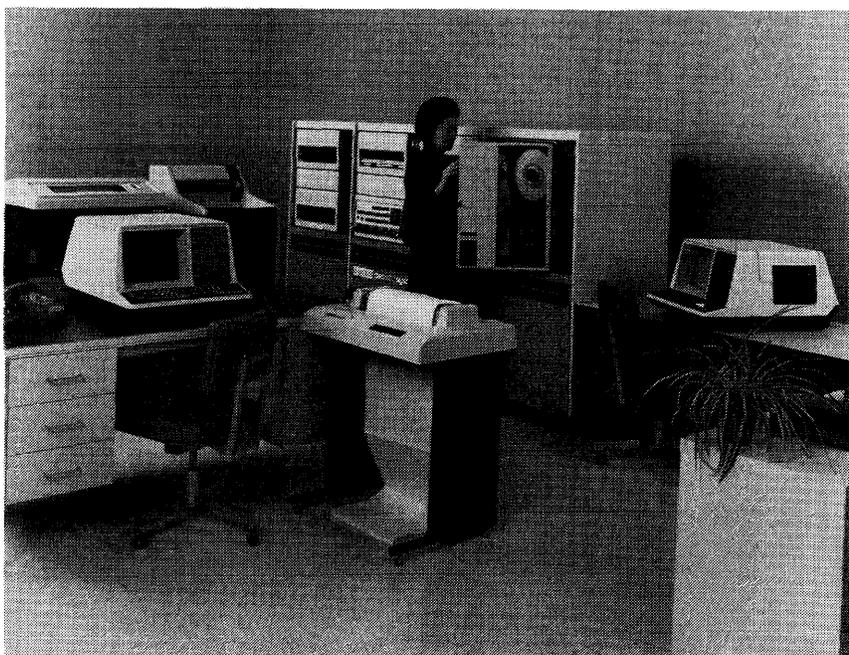
## CHARACTERISTICS

**MANUFACTURER:** Digital Equipment Corporation, Commercial Products Group, Continental Boulevard, Merrimack, New Hampshire 03054. Telephone (603) 884-5111.

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 200 sales and service offices in over 35 countries and has manufacturing facilities in Puerto Rico, Canada, Ireland, Scotland, Hong Kong, and Taiwan in addition to 17 facilities in the U.S. The company employs 38,000 persons worldwide and has installed more than 100,000 computer systems.

**VENDORS:** Manufacturer and OEM suppliers. Contact DEC's Commercial Products Group to find the OEM supplier in your locale.

**MODELS:** DEC currently offers the Datasystem 500 in 92 packaged versions.



Utilizing the PDP-11/34, 11/60, or 11/70 processor, the DEC Datasystem 500 family supports a maximum of 64 terminals, 2040K bytes of core memory, and up to 4 billion bytes of disk storage. The configuration shown includes a 176-megabyte disk drive, a VT52 terminal, a 300-lpm printer, a 1600-bpi magnetic tape transport, and a DECwriter hard-copy terminal.

**DEC Datasystem D500, ST, and DM Series**

**DATASYSTEM 500 MODEL AVAILABILITY SUMMARY**

Operating System Model Series	CTS-500*			TRAX		RSX-11M	
	D530	D560	D570	ST30	ST70	DM30	DM70
Processor	PDP-11/34A	PDP-11/60	PDP-11/70	PDP-11/34A	PDP-11/70	PDP-11/34A	PDP-11/70
Date announced	11/76	NA	2/75	5/78	5/78	NA	NA
Date of first delivery	4/77	NA	9/75	7/78	7/78	NA	NA
Purchase price of typical system	\$90,000	NA	\$170,000	\$180,000	\$240,000	\$80,000	\$120,000

\*CTS-500 is an adaptation of DEC's RSTS/E time-sharing system.

➤ users or to "systems houses." A primary characteristic of both of these marketplaces is the ability to develop their own applications software, thus reducing the amount of hand-holding support needed directly from DEC. The DEC Datasystems are not turnkey systems dedicated to specific problem solutions with pre-programmed applications. Rather, applications programs must either be developed directly by the end user or prepared for him by a systems house.

The basic marketing strategy for DEC's Datasystem line is to promote the systems as alternatives to centralized computer facilities in large or geographically dispersed companies that have remote sites with either localized time-sharing requirements, numerous small-to-medium-scale data bases, or medium-scale batch processing requirements. A Datasystem 500 can be considered a centralized computing facility on its own merit for medium-sized companies or for divisions of larger companies, while at the same time maintaining contact with other systems in a network.

The upper limits on Datasystem 500 equipment configurations are quite impressive. Both the D530 and D570 models can accommodate up to eight RP06 disk drives, for a maximum of 1.5 billion bytes of disk storage. If printing is your forte, you can add up to eight LP11-CA printers rated at 900 lpm each. Other configurable peripheral devices include the TE16 and TU45 reel-to-reel magnetic tape units, the CR11 punched card reader, and the VT52 or VT62 DECscope and LA36 DECwriter terminals. Data communications options come in the form of single-line and multi-line interfaces and an IBM 2780 or 3271 batch terminal emulator package.

The VT52 DECscope display terminal is an updated version of the VT50 offering a 1920-character screen and a numeric keypad that functions as a numeric entry device and can also be used with user software to provide a set of specialized functions.

The new VT62 alphanumeric display terminal was designed for use with the TRAX interactive transaction processing operating system. It displays forms for user data entry and includes reverse video, automatic cursor positioning, local error detection, and left and right justification capabilities.

➤ **DATE ANNOUNCED:** See Model Availability Summary above.

**DATE OF FIRST DELIVERY:** See Model Availability Summary.

**NUMBER INSTALLED TO DATE:** Not available.

**DATA FORMATS**

**BASIC UNIT:** 16-bit word plus two parity bits. The processors can also handle 8-bit bytes and are also capable of bit manipulation.

**FIXED-POINT OPERANDS:** 16-bit words or 8-bit bytes are used as operands in both single- and double-operand instructions. Bit manipulation is provided through Boolean AND/OR instructions.

**FLOATING-POINT OPERANDS:** The optional floating-point processor provides 17-digit precision in 64-bit mode or 8-digit precision in 32-bit mode.

**INSTRUCTIONS:** All instructions are not word in length (16 bits). There are no decimal instructions in any PDP-11 processor; however, under the three Datasystem 500 operating systems, decimal pseudo-instructions have been implemented. Addressing in all PDP-11's is by byte. For all D500 models, the maximum directly addressable memory is 64K bytes, through the use of 16-bit internal registers. The addition of Memory Management increases the system memory limit to 248K bytes in the 11/34A-based models, and to 4 million bytes in the 11/70-based models.

Twelve address modes are provided with each operand address, consisting of three bits to specify address mode and three bits to specify the register used to calculate the address. The eight direct and indirect addressing modes consist of "Register" (operand in register), "Register Deferred" (operand address in register), "Auto Increment/Decrement Indirect" (self-incrementing/decrementing register which contains or points to an address in memory), "Indexed," and "Indexed Deferred." The four program counter addressing modes for handling location-independent code or unstructured data are: immediate, absolute, relative, and relative deferred.

**INTERNAL CODE:** ASCII.

**MAIN STORAGE**

**STORAGE TYPE:** Dynamic MOS for 11/34A-based systems; ECC MOS for 11/60-based systems; ECC MOS and/or core for 11/70-based systems.

**CYCLE TIME:** 700 nanoseconds per 2-byte word for 11/34A-based systems; 1200 nanoseconds per word for 11/60 or 11/70-based systems. (See "CACHE MEMORY" below.) ➤

## DEC Datasystem D500, ST, and DM Series

### PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION AND SPEED	MANUFACTURER
MAGNETIC TAPE	(8 maximum)	
TE16	Industry-compatible transport; 45-ips; 9-track; 800/1600 bpi; 72,000 bytes/sec. maximum transfer rate; 12-inch reel	DEC
TU45	Industry-compatible transport; 75-ips; 9-track; up to 800/1600 bpi; 120,000 bytes/sec. maximum transfer rate; 12-inch reel	DEC
TS03	Transport; 12.5-ips, 9-track, 800 bpi, 10,000 bytes/sec. maximum transfer rate; 7-inch reel	Kennedy
TE10	Transport; 45-ips, 7-track; 200, 556, or 800 bpi; 9,000, 25,000, or 36,000 bytes/sec.; 10.5-inch reel	DEC
PRINTERS	(8 maximum)	
LA35	132 positions, 96 characters; 7 x 7 matrix; 30 cps	DEC
LA180	132 positions, 96 characters; 7 x 7 matrix; 180 cps	DEC
LP11-WA	132 positions, 96 characters; drum; 240 lpm	Dataproducts
LP11-CA	132 positions, 96 characters; drum; 900 lpm	Dataproducts
LP11-VA	132 positions, 64 characters; drum; 300 lpm	Dataproducts
CARD UNIT	(8 maximum)	
CR11	Card reader, 80-column; 300 cpm	Documation
TERMINALS	(32 maximum on PDP-11/34, 63 maximum on PDP-11/70)	
VT52	DECscope CRT/keyboard; 1920 characters, 80 characters by 24 lines, numeric keypad, direct cursor addressing, 64-character set; 9600 bps	DEC
VT62	TRAX Display Terminal; 1920 characters, 24 lines by 80 characters, typewriter-style keyboard; designed for use in TRAX interactive transaction processing system	DEC
LA36	DECwriter II, printer/keyboard, 132 positions, 96 characters, 7 x 7 dot matrix; 300 bps asynchronous, 30 cps print speed, 50 cps positioning speed	DEC

▷ The LA36 DECwriter provides hard-copy printing at 30 cps, using a 7-by-7 dot matrix printer. The LA36 features the full 96-character ASCII set and a paper adjustment that allows up to 5 carbon copies.

Users can intermix LA36, VT52, and VT62 terminals, since each terminal transmits an identifying code that enables the software to adapt to its specified characteristics.

A detailed description of the entire DEC PDP-11 family, which forms the hardware basis for all of the Datasystem 500's, is contained in Report M11-384-301.

The Commercial Transaction System (CTS-500), the key software element of the D500 systems, is a general-purpose multi-language operating system designed for business applications requiring large numbers of terminals with concurrent program development, interactive and batch processing, and transaction processing. CTS-500 also offers data management services (RMS-11) to meet specific requirements of on-line access to data stored for interactive data processing applications, allowing indexed random, indexed sequential, and relative access file structures. DECFORM is a group of utility programs designed for screen formatting, data entry, and file review operations, and is compatible with the CTS-300 version used on the Datasystem 320 and 350 models.

In addition, CTS-500 provides concurrent batch processing with on-line transaction processing, on-line program

▶ **CAPACITY:** 128K to 256K bytes for 11/34-based systems; 192K to 256K bytes for 11/60-based systems; 256K to 2,040K bytes for 11/70-based systems. The upper 8K bytes of memory are reserved for I/O functions and registers on all models.

**CHECKING:** A parity bit is standard with each byte.

**STORAGE PROTECTION:** None, unless the memory map is considered. The process of mapping automatically protects storage.

**RESERVED STORAGE:** The uppermost 8K bytes are reserved for I/O registers.

**CACHE MEMORY:** A 240-nanosecond bipolar cache memory is provided with the PDP-11/60 and 11/70 CPU's under the CTS-500 operating system. This 2048-byte memory effectively reduces the main memory cycle time to less than 400 nanoseconds.

#### CENTRAL PROCESSORS

See text and processor characteristics charts in Report M11-384-301 for details on the PDP-11/34A, and 11/60, and 11/70 processors.

**REGISTERS:** D500 systems have eight user-accessible 16-bit registers (six general-purpose, one stack pointer, and one program counter). The general-purpose registers can be used as index registers, hardware stack pointers, accumulators, or autoincrement/autodecrement registers.

**INDIRECT ADDRESSING:** Single level is standard in all models.

**INSTRUCTIONS:** PDP-11 instructions are 16 bits long. If program counter addressing is employed, then an additional ▶

## DEC Datasystem D500, ST, and DM Series

▷ development, file maintenance utilities, and “Big Block Send and Receive,” which allows 256 words (512 bytes) of data to be transmitted from one program to another. The idea here is to allow specific routines to be shared by other programs. For example, no matter how many jobs are running, the user may need only one disk accessing routine and one screen formatting routine. The other user programs can send data to those routines and receive responses, thus eliminating the need for every job to have its own disk accessing software. A better term might be “software resource sharing.”

RSX-11M, the operating system used in the DM30 and DM70 systems, is a real-time, event-driven, disk-based system. It can be generated as either a mapped or unmapped system. Memory is divided into partitions in which tasks can be loaded under either user or system control. Task checkpointing allows tasks to be displaced to enable a higher priority non-resident task to execute. RSX-11M requires a minimum of 64K bytes of main memory and one hard disk, plus one other disk (which can be a floppy) or a tape unit as a backup device.

The RSX-11M file system provides space allocation and file structures for all block-structured devices. Features include sequential, random, and relative file organizations, and file protection.

TRAX, the software on which the ST30 and ST70 systems are based, was introduced in May 1978 as “the industry’s most comprehensive minicomputer-based system for interactive transaction processing.” The system is designed to manage the collection, organization, storage, and retrieval of business transaction information for financial institutions, insurance companies, government agencies, and other commercial and industrial users. TRAX uses the new VT62 display terminals, and four of these terminals are included in every packaged TRAX configuration. TRAX can support up to 16 applications terminals on an 11/34A-based system and up to 64 on an 11/70-based system. The TRAX record management services support sequential, relative, and multi-key indexed file organizations.

As for programming languages, DEC offers BASIC-PLUS II, COBOL, and a Macro Assembler for use under all three of the Datasystem operating systems; FORTRAN IV and RPG II for use under CTS-500 or RSX-11M; and APL and DIBOL for use under CTS-500 only. DEC’s version of RPG II is said to be “99 percent compatible” with IBM’s System/3 Model 10 RPG at the source level. In addition, DEC’s RPG II offers some additional features, such as the support of terminals as I/O devices.

Communications software products include IBM HASP, 3780, and 3271 emulators and the extensive DECnet communications network software.

For data base users, DEC offers DBMS-11, a data base management software system based on Cullinane Corporation’s IDMS. This makes two powerful data base ▷

▶ 16 bits are added to the instruction length. All Datasystem 500 processors have the same basic instruction set, with the larger processors having larger sets. Instruction formats are numerous, varying from one PDP-11 model to another. Common formats throughout the PDP-11 line occur in instructions of the single operand group, the double operand group, branch group, subroutine return, and condition code operators group. Operation codes vary from 4 bits to 16 bits in length.

**INSTRUCTION TIMINGS:** All times are machine timings for full-word, fixed-point operands, in *microseconds*.

Instruction	D530 Models	D570 Models
Load/Store	2.3	0.95/1.4
Add/Subtract	N/A	0.40
Multiply/Divide	8.8/12.5	3.4/7.9
Branch/No Branch	2.2/1.76	0.4/0.7

**INTERRUPTS:** Four-level automatic priority interrupt system, plus seven additional software-supported levels of interrupts for all models. Each of the interrupt levels can attach multiple, independently prioritized peripheral devices.

**PHYSICAL SPECIFICATIONS:** All Datasystem 500’s are 50 inches high and 30 inches deep. The 11/34A-based systems are 22 inches wide and weigh 330 pounds, the 11/60 systems are 27.5 or 46.5 inches wide; and the 11/70-based systems are 44 inches wide and weigh 660 pounds. All systems require 115 VAC, 60 Hz (or 230 VAC, 50 Hz) power with a voltage tolerance of ±10 percent. The operating temperature range for all Datasystem 500’s is 65 to 75 degrees Fahrenheit.

### INPUT/OUTPUT CONTROL

**UNIBUS:** All Datasystem 500’s have a single, common data path Unibus that treats all components or modules of a system as equal-level devices for data access/transfers, including the processor, memory modules, and peripherals. The priority of any device connected to the busses is determined by its physical position, and the processor is normally attached so that it has the highest priority.

There is no logical limit to the number of device attachments that can be made to the Unibus, with bus access and control handled by the interrupt system. The maximum Unibus data transfer rate is 2.5 million words/second, and it always operates in a master/slave manner.

**32-BIT BUS:** In addition to a standard Unibus, a special expanded-capability bus has been added to the PDP-11/70 (the base of the D570 systems). This bus is not accessible to normal programming needs such as loading registers, etc., but only to DMA transfers between cache memory and mass storage peripherals. Only special high-speed controllers interface this special bus, which handles four eight-bit bytes per transfer.

### CONFIGURATION RULES

There is only one physical limit upon D500 system configuration—the length of the Unibus—and that limit is such that any system approaching the maximum length would contain more equipment that is found in even the largest business systems or could be driven by existing programming. However, the size of the systems is limited by the number of components offered in the various packages, by terminal response times, and by throughput considerations.

System expansion is accomplished through BA11-F expansion boxes which contain space for up to nine mounting panels called system units, plus a power supply. There are ▶

## DEC Datasystem D500, ST, and DM Series

▷ management systems available for PDP-11 systems, since Cincom Systems has developed a version of its popular TOTAL system for use on PDP-11's. DEC chose to go with the Cullinane system because it conforms to CODASYL recommendations. DBMS-11 is available with the RSX-11M operating system.

A substantial library of user-generated, but not DEC-supported, software is available from two groups within DEC. DECUS, the DEC USERS Society, offers a catalog of software packages that includes languages, editors, numerical functions, utilities, display routines, and various other types of applications software. Also, the Educational Products Group publishes the Index and Description of Educational Application Software (IDEAS), which lists software packages developed by users specifically for educational purposes. Some of the programs listed in the IDEAS catalog are from the DECUS catalog. Users can obtain copies of these programs on various media for a nominal charge by contacting either of these organizations.

Although DEC sells most of its products on a purchase basis, leasing arrangements are available either through DEC's joint venture with U.S. Leasing Corp. or through TEC Leasing Corp. of New York. Lease rates vary with the prime interest rate, the buyer's volume of business with DEC, and the value of the equipment being leased. DEC software is not sold; rather, it is licensed. Users purchase licenses and distribution rights separately.

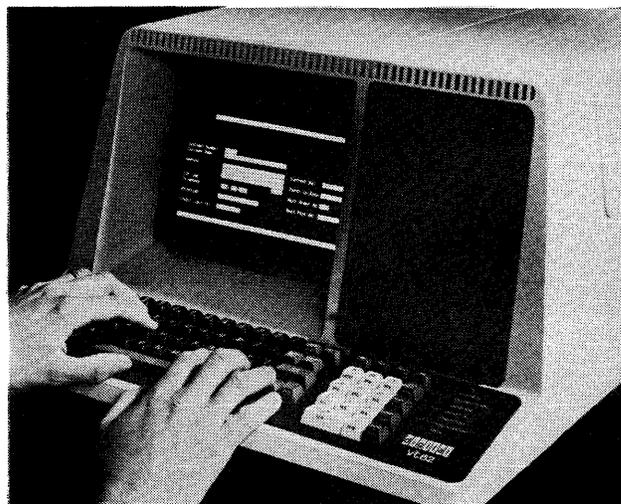
Hardware and software maintenance are offered through several levels of optional service. Hardware maintenance options vary from several off-site plans to on-call service and guaranteed four-hour service. Software maintenance is offered through several levels of optional service ranging from a periodic software newsletter to automatic updates of software and manuals via a subscription service.

Probably the greatest strength of the Datasystem 500 family is its growth potential. With DIBOL-11 as the common language among all Datasystems, including the smaller D322, and with COBOL, FORTRAN IV, RPG, and BASIC-PLUS II compilers, DEC isn't giving its users a reason for switching to a competitor because of software limitations. And with a top end of 4 million bytes of core memory, 1.5 billion bytes of disk, and 64 terminals, there should be little justification for switching because of insufficient hardware capabilities.

#### USER REACTION

Datapro contacted six Datasystem 500 users. These users had a total of 14 systems installed, and had been using them for an average of 22 months. The largest system in our survey consisted of a PDP-11/70 processor with 256K bytes of core memory, 176 million bytes of disk storage, 10 interactive terminals, one tape drive, and a printer.

Applications included time-sharing services, software development, accounting, production control, sales analysis, and inventory control. All of the systems were being used ▷



*The new forms-oriented VT62 display terminal for DEC's TRAX system includes reverse video display, automatic cursor positioning, error detection features, and special message displays. PDP-11/70 TRAX systems can support up to 64 VT62 terminals.*

▶ two types of system units available, one for CPU's, memories, etc., and one for peripheral controllers. Systems are configured by interconnecting the system units to form the necessary number of slots needed for the components. Each system unit contains 20 slots into which modules are inserted, some requiring up to six slots.

Each expansion box contains space for nine system units, but each cabinet has space for only one expansion box. All D500 models are supplied with sufficient cabinets, mounting chassis, power supplies, and Bus Repeaters to enable the maximum configuration to be implemented without difficulty.

In 11/70-based systems, optional 32-bit high-speed I/O controllers (limited to four per system) can be used with the RK05 (fixed-head swapping disk) and 1600 bpi (fast) magnetic tape units.

**SIMULTANEOUS OPERATIONS:** Overlapped instruction execution and memory access are provided. The 11/60 and 11/70-based models, with their cache memory system, do not require interleaving for greater effective speed. Instead of accessing alternate memories, they transfer three extra bytes into cache memory each time a location is read from main memory. DMA I/O operations are concurrent with processing and with one another.

#### MASS STORAGE

**RX11 FLOPPY DISK:** The RX11 is a flexible disk drive with a capacity of 256,256 bytes per drive. Up to two drives per controller can be configured. Average access time is 357 milliseconds; rotational speed is 360 rpm, yielding an average rotational delay of 83 milliseconds. A track-to-track move takes at least 10 milliseconds. The surface of the diskette is divided into 77 tracks, each with 26 sectors. The RX11 floppy disk drive is manufactured by DEC.

**RL01 5.2-MEGABYTE CARTRIDGE DISK DRIVE:** This is a top-loading drive employing a removable cartridge. Features provided in the RL01 include an embedded servo, allowing control information to be dispersed on each data track for data integrity. Disk rotational speed is 2400 rpm, and average rotational delay is 12.5 milliseconds. Average head positioning time is 55 milliseconds. Data transfer rate is 512K bytes per second. The drive is manufactured by DEC. ▶

## DEC Datasystem D500, ST, and DM Series

▷ for multi-terminal, interactive processing, and the four OEM users were also developing software.

The ratings assigned by these users are shown in the following table.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	1	0	0	3.8
Reliability of mainframe	5	1	0	0	3.8
Reliability of peripherals	4	2	0	0	3.7
Maintenance service:					
Responsiveness	3	3	0	0	3.5
Effectiveness	2	4	0	0	3.3
Technical support	3	1	2	0	3.2
Manufacturer's software:					
Operating system	4	2	0	0	3.7
Compilers and assemblers	2	3	0	0	3.4
Ease of programming	3	3	0	0	3.5
Ease of conversion	2	3	0	0	3.4
Overall satisfaction	4	2	0	0	3.7

\*Weighted Average on a scale of 4.0 for Excellent.

As the ratings indicate, these users were well pleased with their Datasystem 500's. Two of the users rated their systems excellent in all respects. One, an OEM, felt that the reason for his company's success was the quality of DEC's hardware, software, and support services. Another user said he got more support from IBM—but that DEC's *lack* of support allowed him more freedom to develop his own systems.

Two users rated DEC's technical support as only fair. Neither was pleased with either the DEC-supported application programs or those available from DECUS, the DEC users' group.

With an overall satisfaction rating of 3.7, it is obvious that there were not many complaints. The DEC Datasystems seem to combine reliability with workable software, and this is what users want most. The Datasystem family appears capable of supporting the needs of most time-sharing users. With the hardware expansion potential and choices of programming languages it offers, the Datasystem product line is a formidable opponent for competitive systems. □

▶ **RK05 CARTRIDGE DISK DRIVES:** There are two versions currently available, the RK05J and the RK05F. The RK05J is a removable cartridge disk drive with a capacity of 2.4 million bytes of data, while the RK05F is a fixed-disk unit offering 4.8 million bytes. Each RK05F is counted as two disk drives when configuring systems.

The D534, DM30J, and DP30J systems are offered with a choice of either two RK05J drives (4.8 million bytes total), or one RK05J and one RK05F (7.2 million bytes total). The system can support a maximum of eight logical drives (19.2 million bytes). The drive types can be intermixed, but there must be at least one removable disk in the system.

Data is recorded on both sides of a single disk contained in an IBM 2315-style, front-loading cartridge. There are either 203 (RK05J) or 406 (RK05F) tracks where data is recorded in 12 sectors of 512 bytes each. Head movement time is 10 milliseconds for a single-track move, 85 milliseconds for a 200-track move, and 50 milliseconds average. The rotational

delay averages 20 milliseconds. Data transfer rate is 180K bytes per second. The subsystem is manufactured by DEC.

**RK06 CARTRIDGE DISK DRIVE:** Up to eight of these removable disk drives can be attached to an RK611 controller. Data is recorded on two disks contained in an IBM 5440-style top-loading cartridge. There are 200 tracks per inch, with 22 sectors per track and 512 bytes per sector. Each drive has a capacity of 14 million bytes, with subsystem expansion capabilities ranging to a maximum to 112 million bytes for eight drives. Average head positioning time is 38 milliseconds, and average rotational delay is 12.5 milliseconds, for an average access time of 50.5 milliseconds. Data transfer rate is 538,000 bytes per second. The subsystem is manufactured by DEC.

**RK07 28-MEGABYTE CARTRIDGE DISK DRIVE:** This drive is functionally identical to the RK06, but its formatted capacity is 28 megabytes. The RK07 drives and related subsystems are manufactured by DEC.

**RM02/RM03 67-MEGABYTE DISK PACK DRIVE:** This drive, like other disk pack drives offered by DEC for the PDP-11, employs a technology similar to that of the IBM 3330 through the use of a track-following servo system. In this system, one disk surface of each pack is dedicated to servo control and tracking information. The pack contains five platters, with the top and bottom platters employed for protection. Data is recorded on five surfaces. The drives rotate at 2400 rpm (RM02) or 3600 rpm (RM03), resulting in average rotational delays of 12.5 milliseconds (RM02) or 8.3 milliseconds (RM03). Average head positioning time is 30 milliseconds, and data transfer rate is 806K (RM02) or 1200K (RM03) bytes per second. The drives are manufactured by DEC.

**RP06 176-MEGABYTE DISK PACK DRIVE:** Up to 8 of these drives can be attached to an RJP06 controller. The RP06 uses IBM 3336 Model 11-type disk packs, recording data on 19 of 20 surfaces. There are 815 tracks per surface, 22 sectors per track, and 512 bytes per sector, for a capacity of 176 million bytes per pack. A maximum configuration of eight drives yields 1.408 billion bytes of storage. Average head positioning time is 28 milliseconds, and average rotational delay is 8.3 milliseconds, for an average access time of 36.3 milliseconds. Data transfer rate is 806,000 bytes per second. The RP06 is manufactured by DEC.

### INPUT/OUTPUT UNITS

Please refer to the Peripherals/Terminals table on page M11-385-403.

### COMMUNICATIONS CONTROL

Communications options are available to provide an interface to DEC and non-DEC computers. Both single- and multiple-line interfaces are offered for local and remote communications. Utilizing both synchronous and asynchronous connections, these interfaces provide services such as:

- Programmable speeds and formats.
- 20-mA and EIA modem control.
- Dial-up characteristics.
- Program-selectable features (such as full- or half-duplex operation).
- Speeds up to 9600 bits/second.

Remote data communication with other computer systems can be done on a D500 through emulator options such as an IBM 2780 or 3271 emulator. Operating concurrently with the execution of user programs, the 2780 hardware/software packages permits on-site processing and RJE compatibility with an IBM 2780 Model 1 Data Transmission Terminal. Other features include: ▶

## DEC Datasystem D500, ST, and DM Series

- ▶ ● Automatic answering of incoming calls.
- Interactive mode for direct control of files by a system operator.
- Data transmission rates up to 4800 bits/second.

DECNET is a hardware and software programming tool which allows interconnection of other Digital computer systems in a network and provides the ability to communicate with other mainframes using industry-compatible protocols. Networks under DECNET usually fall into one of three categories:

- Communications networks to move data from one location to another.
- Distributed computing networks to coordinate the activities of several independent systems.
- Resource-sharing networks.

## SOFTWARE

**OPERATING SYSTEMS:** Operating systems for the Data-system 500 Series include: 1) the CTS-500 general-purpose time-sharing system; 2) the RSX-11M real-time multi-programming system; 3) TRAX, an interactive transaction processing system. The following discussion of these operating systems is augmented by the Operating Systems Comparison Table which appears on page M11-385-408.

*CTS-500 (Commercial Transaction System-500):* The four versions of the CTS-500 operating system combine the Resource-Sharing Timesharing System/Extended (RSTS/E) time-sharing operating system with combinations of the COBOL, BASIC, or DIBOL language processors, single- or multiple-key data management systems, and DEC's SORT-11. CTS-500 is a time-sharing system designed to accommodate large numbers of interactive users. The interactive language is BASIC-PLUS II, an enriched version of the popular BASIC language, or DEC's business language, DIBOL-11. RPG II and FORTRAN IV are also available. CTS-500 requires a PDP-11/34A, 11/60, or 11/70 with hardware memory management for memory expansion and protection. A wide range of communications interfaces is supported to allow mixes of local and remote terminals with varying characteristics. For a normal job mix, up to 24 concurrent users can be supported on a PDP-11/34A based system, while up to 63 can be supported on an 11/70-based system.

CTS-500 supports a wide range of peripherals, including up to eight line printers, punched card equipment, punched tape equipment, all types of mass storage devices, communications interfaces, and IBM 2741-compatible terminals.

CTS-500 supplies a comprehensive file system. User files may be random or sequential, numeric or alphanumeric. Files can be created, updated, extended, and deleted interactively from a user terminal or under program control. Files can be protected from access on an individual, group, or universal basis; can be accessed by many terminal users simultaneously; and can be updated on-line.

RMS-11K is a file management system that runs under CTS-500, RSX-11M, or TRAX on a PDP-11/34A, 11/60, or 11/70. RMS-11K is a multi-key indexed sequential (ISAM) file management system that supports the ANSI-74 COBOL Level 2 Indexed I/O Module specification. The system permits both fixed- and variable-length records and provides RSTS/E users with sequential, relative, and indexed file organization. This allows sequential, random, dynamic, or direct physical access to data records. Combinations of the above modes can also be invoked. Other significant features of RMS-11K are multi-level privacy control and both generic and approximate key searches in multi-keyed indexed processing. The system manager can, for each user, specify the programmer and project number, the password, the maximum logged-out disk space, and the maximum number of files.

DMS-500 is the single-key access method included in the CTS-500 packages. It provides data management file services for organizing and processing information stored in sequential, indexed sequential, and relative access data files.

Access to peripheral devices is generally open to all CTS-500 users under the resource sharing concept on a first-come, first-served basis. However, the capability is available to the system manager to intervene in peripheral assignment and permit assignment as he sees fit.

"Big Block Send and Receive" is available with CTS-500. The maximum number of bytes that can be transferred in a block is 512 bytes. The purpose is to allow one specialized program or group of programs to be shared. For example, one program group would handle screen I/O, another might handle disk access, and still another might handle other tasks. By swapping information back and forth, each job could share programming expertise while cutting down on the total memory requirements.

CTS-500 requires a system with a console terminal, real-time clock, and 64K bytes of parity memory with the memory management option (at least 128K bytes of memory are required to support RMS-11-based languages). In addition, the system requires a disk pack system or a dual-drive fixed-head disk or disk cartridge. Magnetic tape is also generally required for software distribution.

*RSX-11M Real-Time Operating System:* RSX-11M features event-driven multiprogrammed responses to real-time stimuli. The system handles many tasks (programs) concurrently, with requests for system resources handled on a priority basis. RSX-11M is a less flexible, lower-overhead subset of more powerful RSX operating systems. It supports checkpointing, and memory allocation is automatic. Hardware memory management is not required, but it can be utilized for memory protection and expansion.

Multi-user program development is accomplished using either of two supplied editors from terminals. The full range of language processors is available. A foreground-only (i.e., real-time execution only) system can operate in as little as 32K bytes, with program development taking place when no tasks are executing. RSX-11M is disk-based and requires a backup/distribution device in addition to the system disk drive.

The RSX-11M file management system uses the same file system used in CTS-500 (RMS-11K), providing keyed-access data file support in the form of a multi-key indexed sequential file organization. RMS-11K is composed of a set of run-time service routines and utility programs that enable keyed access data files to be defined, populated, updated, and maintained on direct-access storage devices. The RMS-11K run-time service routines provide an interface between PDP-11 multi-programmed operating systems and user-developed application programs. User programs can include RMS-11K function calls that provide logical record input/output access to data files.

RSX-11M has a program logical space extension feature that allows execution of very large application programs without requiring disk overlays. A single program can occupy all user space (less the resident system). This feature permits faster execution of larger programs, but at some expense to smaller, lower-priority programs that must be stored on disk while the larger program occupies main memory.

The minimum configuration for RSX-11M requires a central processor with 64K bytes of memory, a console terminal, a disk system, and a backup device. Memory can expand to 248K bytes on systems with the memory management unit, or to 3840K bytes on the PDP-11/70.

RSX-11M supports a wide range of laboratory, industrial control, and communications equipment, including the AR11

## DEC Datasystem D500, ST, and DM Series

### OPERATING SYSTEMS COMPARISON TABLE

	CTS-500	RSX-11M	TRAX
Hardware utilization:			
PDP-11/34A	Yes	Yes	Yes
PDP-11/60	Yes	Yes	Yes
PDP-11/70	Yes	Yes	Yes
Programming language support:			
APL	Optional	No	No
BASIC	Std./Opt.	Optional	No
BASIC-PLUS II	Std./Opt.	Optional	Std./Opt.
COBOL	Optional	Optional	Std./Opt.
DIBOL	Std./Opt.	No	No
FORTRAN IV	Optional	Optional	No
FORTRAN IV Plus	No	Optional	No
Macro Assembler	Standard	Standard	Standard
RPG II	Optional	Optional	No
Type of operating system:			
Single-user	No	No	No
Multi-user	Yes	Yes	Yes
Single-job	No	No	No
Foreground/background	Yes	Yes	Yes
Multiprogramming	No	Yes	Yes
Time-sharing	Yes	Yes (quasi)	Yes
Multi-user data base mgmt.	No	No	No
Dynamic memory allocation	Yes	Optional	Yes
Memory mgmt. support (swapping)	Yes	Yes	Yes
Program scheduling:			
By operator	Yes	Yes	Yes
By event interrupt	No	Yes	Yes
By another program/task	Yes	Yes	Yes
By time of day	No	Yes	Yes
No. of terminals in use simultaneously	63	16	64
Number of concurrent jobs	63	NSL*	256
Min. memory required (bytes)	48K	16K	160K
DBMS-11 support	No	Yes	No
Re-entrant I/O	—	Yes	Yes
I/O spooling	Yes	Yes	Yes
Concurrent batch & I/O spooling	Yes	Yes	Yes
Fixed & variable-length records	Yes	Yes	Yes
File access methods:			
Sequential	Yes	Yes	Yes
Index sequential	Optional	Yes	Yes
Direct access	Yes	Yes	Yes
Multi-keyed index sequential	Optional	Optional	Yes
Hierarchical	Yes	Yes	Yes
Usage accounting	Yes	No	Yes
Sharable data files	Yes	Yes	Yes
Program priority levels	255	250	250
Disk/memory program swapping	Yes	Yes	Yes
System generation on target equipment	Yes	Yes	Yes
Security:			
System level	Yes	Yes	Yes
File level	Yes	Yes	Yes

\*NSL (no software limitation); limited by hardware configuration or performance.

► Analog Real-Time Subsystem, LPS11 Lab Peripheral Systems (local and remote), modem control multiplexers, and the DMS Unibus link. Standard peripheral devices, such as floppy disks, cassettes, a card reader, paper tape reader/punch, and line printer, are also supported.

**TRAX**, announced in May 1978, is a multi-user, dedicated system that features advanced application development tools and data safeguards. TRAX provides a transaction proc-

essing environment for the ST30 and ST70 Datasystems. It supports concurrent transaction processing and program development, and includes screen formatting, transaction routing and logging, file update journaling, and automatic recovery/restart. TRAX can be configured with either COBOL or BASIC-PLUS II.

The TRAX RMS record management services support sequential, relative, and multi-key indexed file organizations. ►

## DEC Datasystem D500, ST, and DM Series

► The sort can reorder data files into new files based on key fields from input data records. Screen formats and individual data fields are defined through the Application Terminal Language.

The minimum main storage requirement for TRAX is 192K bytes; and memory management, a clock, a console terminal, a disk system, and a backup tape drive are also required.

An asynchronous 8-line multiplexer and 4 CRT terminals are included in all 11/34A systems running under TRAX, while an asynchronous 16-line multiplexer and 4 CRT terminals are standard with 11/70 systems.

**LANGUAGES:** Compilers are available for the following programming languages.

*APL-11* is a conversational language that is particularly well suited for operating on numeric and character array-structured data. Using *APL-11*, variables can be examined and changed; statements can be altered without recompilation; and program action can be readily traced. Features of *APL-11* include dynamically variable user's workspace size, chaining of *APL* programs to previously prepared run-time programs, multiple statement lines, standard PDP-11 file naming formats, and extended single operators which allow the user to fully evaluate character strings and write user-defined functions to perform output formatting and function editing. The language is built around a set of unique symbols, each of which represents a desired operation. The nature of the language is such that complex expressions are easily constructed by the programmer. According to DEC, *APL-11* produces concise code.

*APL-11* requires a processor with 48K bytes of memory and any valid CTS-500 configuration.

*COBOL* can be run in a conversational remote job entry mode simultaneously with several interactive BASIC-PLUS jobs. Both can access the same sequential files. This allows the user to create files interactively using BASIC-PLUS and then process that data in conversational remote job entry mode, through *COBOL*. The *COBOL* compiler requires an average of 40K to 48K bytes of memory to compile and execute all elements of the *COBOL* language. Because of *COBOL*'s interpretive architecture, the program size is almost unlimited. The procedure division resides in virtual memory as a string of blocks that are called in as needed.

*FORTRAN IV* is available on all Datasystems in the 500 series except the TRAX systems. It has been used mostly in problem-solving areas, although process control, information retrieval, and commercial data processing programs are sometimes written in *FORTRAN*.

As a final polish to each program, the *FORTRAN IV* compiler does extensive "peephole" organization, examining each sequence of operations and substituting a shorter, faster group if possible.

*FORTRAN IV* operates in interactive or batch mode under the CTS-500 or RSX-11M monitor and provides assembly language subprogram support, using the macro assembler. Although the assembly language subprogram cannot issue any monitor calls, the macro assembler provides a path to further enhance computational performance.

The *FORTRAN IV* compiler runs in a minimum partition of 16K bytes. If run in a larger partition, it uses the extra space for program and symbol table storage.

The *BASIC-PLUS II* language is an enhanced version of Dartmouth *BASIC*, featuring more than 40 basic commands, 35 built-in functions, and 3 different data types: integer, string, and floating-point (single and double precision). A commercial extension package is available to provide out-

put formatting features such as comma insertion, floating dollar sign, trailing minus, asterisk protect and sort, line printer spooling, and indexed access file method routines.

*BASIC-PLUS II* supports indexed sequential (ISAM) files, and thus supports DEC's RMS-11 record management system. It also features the *CALL* statement found in *BASIC-11* and is compatible with other DEC *BASIC* language processors. *BASIC-PLUS II* also includes debugging aids such as breakpoints, step mode, and change of variables. Other important features include support for block-mode terminals, long variable names, record I/O, and a decimal arithmetic package.

The Datasystem 500 version of *RPG II* is said to be 99% source-code compatible with the *RPG II* that is used on the IBM System 3 Model 10. In addition, the DEC version offers extensions such as the use of terminals as I/O devices.

*DIBOL-11* is an enhanced version of the *DIBOL* language that was available on the Datasystem 340 and other DEC computers. *DIBOL-11* provides software compatibility throughout the Datasystem family, from the 11/34A to the 11/70-based systems. The Datasystem 310 can be included in this family through the use of *DITRAN*, which translates *DIBOL-8* into *DIBOL-11*, thereby providing the multi-user programming elements that allow several application programs to run simultaneously.

*DATATRIEVE-11* is an inquiry and report writing system that allows interactive data retrieval, sorting, and updating; report generation and creation; and maintenance and accessing of data dictionary entries that define RMS-11K records. *DATATRIEVE-11* runs under CTS-500, TRAX, or RSX-11M. The system has capabilities to handle RMS-11K files created by *COBOL*, *BASIC-PLUS II*, *DIBOL*, and macro assembler programs. *DATATRIEVE-11* provides 10 query commands, 6 parameters for report writing, 5 commands for report writing, 5 statistical functions, and a process for storing often-used statements in the data dictionary as procedures.

*DATATRIEVE-11* requires a CTS-500, TRAX, or RSX-11M configuration including memory management hardware, 64K bytes of user memory, and hardware multiply/divide.

*DECFORM* is an easy-to-use generative programming aid that allows a customer to tailor screen formatting, file interaction, and editing procedures. *DECFORM* is capable of screen formatting, checking, prompting, file examination with update, and inquiring. It runs under both CTS-500 and CTS-300 (for Datasystem 300's).

There are five basic tasks that can be performed:

- Add—for basic data entry.
- Inquiry—for examination without change.
- Change—for file maintenance.
- Verify—pre-selected fields may be re-keyed.
- Delete (not available for sequential files).

Screen formatting is simply a matter of building a table describing field size, field name, horizontal position, and vertical position for each field on the screen that is desired. This table is passed over to the *DECFORM* compiler along with the name of the file to be accessed. The *DECFORM* compiler then generates a *DIBOL-11* program. Formats can be divided into multiple screens to allow for more logical layouts and to eliminate crowding. Provisions are also made for passwords and other security procedures as well as format menus. Once the format is displayed, the operator may begin keying in data. Prompting and error messages are also displayed. ►

## DEC Datasystem D500, ST, and DM Series

► Editing functions of DECFORM include: display leading zeros, stop after every field is entered, retain previous screen when starting a new record, override checks through special characters, automatic duplication of fields, automatic incrementing of fields, establish initial values for fields, check digits, perform arithmetic functions (extensions, taxes, etc.), hide a field, and list running totals.

The following checks are available in DECFORM: alphanumeric, numeric, field required, field must be filled, constant insertion, range checks on numeric fields, table look-up, cross field comparisons, field protection (unalterable), subfield checking to individual character level, and data retrieval from other files. According to DEC, it is possible to use the above procedures to extend, discount, and tax an invoice while pulling alphanumeric descriptions from a table.

*DITRAN*, a recent software offering of the Digital Equipment Computer Users Society (DECUS), is a translator that converts DIBOL-8 into DIBOL-11. This enables users of the DEC PDP-8-based Datasystem 310 to convert to a larger Datasystem with a minimum of effort. Since *DITRAN* is not provided by DEC, the company offers no guarantees, and may not officially support *DITRAN*.

DECNET permits users to create communications networks merely by adding appropriate software and hardware to existing computer systems. It is actually a number of specific products aimed at several broad markets, consisting of a series of hardware and software extensions to standard systems.

DECNET is not a turnkey solution. Customers must purchase communications links, one or more of DEC's communications interfaces for each computer in the network, and modems. Some of the more complicated applications will require considerable programming, as well.

DECNET allows customers to:

- Transmit data files across a room or around the world.
- Share expensive peripherals among several CPU's, some of which may be remote.
- Use another tool in the creation of high-availability (super-reliable) systems, adding to the Unibus links and multi-port options that Digital already supplies.
- Make more extensive use of memory-only systems.

DECNET is also the collective name for the set of software products which extend various DEC operating systems so they can be interconnected with each other to form computer networks. The DECNET user can configure a variety of net-

works by choosing the appropriate CPU's, line interfaces (and speeds), and operating systems software. Such networks typically fall into one of three classes: 1) those that move data from one physical location to another; 2) file-oriented networks, often the case for remote job entry systems; or 3) line-oriented networks, as occurs with the concentration of interactive terminal data.

**APPLICATION SOFTWARE:** All applications software must be developed either by the user or by a systems house. DEC does not directly provide application packages at this time.

### PRICING

**POLICY:** The DEC Datasystems are available for purchase or on third-party, full-payout leases for one-, three-, and five-year terms (arranged by DEC through Digital Leasing, a joint venture with U.S. Leasing Corporation).

The CTS-500, TRAX, and RSX-11M operating systems are available only as part of a Datasystem configuration, not separately.

**SUPPORT:** Separately priced hardware maintenance by DEC is available through a worldwide field support force of more than 2,500. Purchase of a Datasystem generally includes full installation/setup of the hardware and desired operating system.

Software support is available in two categories: license-only or continuing software support services.

**EQUIPMENT:** The following typical system purchase prices include all controllers, adapters, and software.

A typical PDP-11/34A CTS-500 system consisting of 256K bytes of memory, an LA36 DECwriter console, two 14-megabyte RK06 disk drives, five VT52 terminals, and a printer is priced at \$74,680.

A typical PDP-11/70 TRAX system, including 20 VT62 terminals, 384K bytes of MOS memory, 134 megabytes of RM03 disk storage, and a TE16 9-track tape drive, is priced at \$260,120.

For a more "in-depth" listing of the Datasystem peripherals, mass storage, and pricing, please see the tables and price list in this report. ■

## EQUIPMENT PRICES

### DATASYSTEM 500 BASIC SYSTEMS UNDER CTS 500

#### PDP-11/34A PACKAGED SYSTEMS

PDP-11/34A packaged systems under all operating systems include a processor with memory management, parity control, Extended Instruction Set, LA36 DECwriter console, and programmer console.

Four levels of software support are offered with the 11/34A systems. They include the BASIC-PLUS or DIBOL program language, RMS or DMS file management system with either single- or multiple-key ISAM, and Sort-11. Prices shown are for Level 2A; Level 3B, the most expensive package, increases the purchase price by \$5,500.

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
D533A	With 256 bytes of MOS memory, one RP06 disk pack drive (176 million bytes)	\$ 81,280	\$ 381
D534A	With 128K bytes of MOS memory, two RK05J or one RK05J and one RK05F disk cartridge drives (2.5 or 5.0 million bytes, respectively)	42,800	313
D535A	With 128K bytes of MOS memory, two RL01 disk cartridge drives (10 million bytes)	38,420	215
D536A	With 256K bytes of MOS memory, one RM02 disk pack drive (67 million bytes)	61,030	331
D537A	With 256K bytes of MOS memory, two RK06 disk cartridge drives (14 million bytes)	60,600	389
D538A	With 256K bytes of MOS memory, two RK07 disk cartridge drives (56 million bytes)	62,280	421

## DEC Datasystem D500, ST, and DM Series

DATASYSTEM 500 BASIC SYSTEMS UNDER CTS 500 (Continued)		Purchase Price	Monthly Maint.
<b>PDP-11/60 PACKAGED SYSTEMS</b>			
PDP-11/60 packaged systems under all operating systems include a processor with hardware memory management, 2K bytes of cache memory, and an LA36 DECwriter.			
D566A	With 192K bytes of ECC/MOS memory, one RM02 disk pack drive (67 million bytes)	72,450	408
D567A	With 192K bytes of ECC/MOS memory, two RK06 disk cartridge drives (14 million bytes)	67,300	466
D568A	Same as D567B except two RK07 disk cartridge drives (56 million bytes)	71,820	498
<b>PDP-11/70 PACKAGED SYSTEMS</b>			
PDP-11/70 packaged systems under all operating systems include a processor and an LA36 DECwriter.			
D573A	With 256K bytes of core memory, 2K bytes of cache memory, one RP06 disk pack drive (176 million bytes)	118,000	537
D573B	Same as 573A except 256K bytes of ECC/MOS memory	123,000	507
D576A	With 256K bytes of core memory, 2K bytes of cache memory, one RM03 disk pack drive (67 million bytes)	87,780	487
D576B	Same as D576A except 256K bytes of ECC/MOS memory	93,000	457
D577A	With 256K bytes of core memory, 2K bytes of cache memory, two RK06 disk cartridge drives (28 million bytes)	95,000	545
<b>BASIC SYSTEMS UNDER TRAX</b>			
<b>PDP-11/34A PACKAGED SYSTEMS</b>			
ST-30U	With 192K bytes of MOS memory, one RM02 disk cartridge drive (67 million bytes), one TE16 magnetic tape transport, 8-line asynchronous multiplexer, four VT62 CRT's, and either BASIC-PLUS-2 or COBOL	117,990	704
ST-30H	Same as ST-30U except two RK07 disk cartridge drives (28 million bytes)	117,990	794
<b>PDP-11/70 PACKAGED SYSTEMS</b>			
ST-70CV	With 512K bytes of ECC/MOS memory, 2K bytes of bipolar cache memory, RP06 disk pack drive (176 million bytes), one TE16 magnetic tape transport, 16-line asynchronous multiplexer, four VT62 CRT's, and either BASIC-PLUS-2 or COBOL	195,420	974
ST-70CW	Same as ST-70CV except TU45 magnetic tape transport	199,570	1,034
ST-70T	With 256K bytes of ECC/MOS memory, 2K bytes of bipolar cache memory, RM03 disk pack drive (67 million bytes) one TE16 magnetic tape transport, 16-line asynchronous multiplexer, four VT62 CRT's, and either BASIC-PLUS-2 or COBOL	141,620	844
CT-70T	Same as ST-70T except 256K bytes of core memory	141,620	874
CT-70CV	Same as ST-70CV except 512K bytes of core memory	195,420	1,064
CT-70CW	Same as CT-70CV except TU45 magnetic tape transport	199,570	1,124
<b>BASIC SYSTEMS UNDER RSX-11M</b>			
<b>PDP-11/34A PACKAGED SYSTEMS</b>			
DM-30C	With 256K bytes of MOS memory, Extended Instruction Set, one RP06 disk pack drive (176 million bytes), one TE16 magnetic tape transport	91,480	521
DM-30F	Same as DM-30C except 64K bytes of MOS memory, one RK05F disk cartridge (5 million bytes), and one RK05J disk cartridge drive (2.5 million bytes)	31,000	263
DM-30L	Same as DM30C except 128K bytes of MOS memory, dual RL01 disk cartridge drive (10 million bytes)	37,070	215
DM-30U	Same as DM-30L except RM02 disk pack drive (67 million bytes), TE16 magnetic tape transport	70,030	413
DM-30K	Same as DM-30F except two RK06 disk pack drives (28 million bytes)	42,900	359
DM30H	Same as DM-30L except two RK07 disk cartridge drives (56 million bytes)	51,410	383
<b>PDP-11/70 PACKAGED SYSTEMS</b>			
DM-70CW	With 256K bytes of core memory, Extended Instruction Set, one RP06 disk pack drive (176 million bytes), TE16 magnetic tape transport	133,000	657
DM-70CV	Same as DM-70CW except 256K bytes of interleaved ECC/MOS memory	133,000	627
DM-70TC	Same as DM-70CW except RM03 disk pack drive (67 million bytes)	103,200	577
DM-70TA	Same as DM-20TC except 256 bytes of interleaved ECC/MOS memory	103,000	577
DM-70HC	Same as DM-70CW except dual RK07 disk cartridge drives (28 million bytes)	96,000	577
DM-70HA	Same as DM-70HC except 256 bytes of interleaved ECC/MOS memory	96,000	547
<b>PROCESSOR OPTIONS</b>			
FP11-A	Floating Point Processor for the 11/34, offers single and double precision operands	2,900	21
FP11-C	Floating-Point Processor for the 11/70; offers single and double precision operands and integer to floating-point conversions	5,600	30
FP11-EA	High Speed Floating-Point Processor for the 11/60; offers single and double precision operands and 17 digits of accuracy	5,600	42
KMC11-A	MSI microprocessor; utilizes 72-bit microcode and includes 1K words of 16-bit writable control memory and 1K words of 16-bit data memory; for systems running under RSX-11M, or TRAX	2,200	21

## DEC Datasystem D500, ST, and DM Series

### EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>MEMORY</b>			
FOR PDP-11/34A SYSTEMS			
KK11-A	2K-byte RAM cache memory	3,900	17
MS11-JP	32K-byte MOS Module; with parity and control	2,200	25
FOR PDP-11/60 SYSTEMS			
MS11-KE	64K byte Module; with error checking and correction (ECC)	4,500	15
CORE PACKAGES FOR PDP-11/70 SYSTEMS			
MJ11-BA	128K-byte Module with parity, control, frame and power supplies for up to 512K bytes for the 11/70	18,590	70
MJ11-BE	128K-byte Module with Parity	11,550	60
MJ11-BG	512K-byte Memory Expansion Unit, with power supplies, control and frame	53,240	250
ECC/MOS PACKAGES FOR PDP-11/70 SYSTEMS			
MK11-BA	128K byte Memory Expansion System includes frame power supplies, control, battery backup	22,500	70
MK11-BE	128K-byte Module	10,800	30
MK11-BF	512K-byte Memory Unit	40,000	120
MK11-BG	1024K-byte Memory Unit, includes memory, frame, power supply, and control	93,000	280
<b>MASS STORAGE</b>			
RX11	Dual floppy disk drive; 256,256 bytes each, 10K bytes/sec. transfer rate, 357-msec average access time	4,300	33
RL01	Cabinet-Mountable Add-on 5.0-megabyte Removable Cartridge Disk Drive	3,800	50
RK05J	2.4-megabyte removable disk cartridge drive, 180K bytes/sec. transfer rate, 70-msec average access time	5,100	46
RK05F	4.8-megabyte non-removable disk drive, 180K bytes/sec transfer rate, 70-msec average access time	5,100	
RK06	Single-access 14-megabyte disk cartridge drive, 538K bytes/sec. transfer rate, 50.5-msec average access time	7,500	99
RK07	Free-Standing, Add-on, Single-Access, 28-megabyte Cartridge Disk Drive; not for 11/03	10,500	115
RM02	Free-Standing, Add-on, Single-Access, 67-megabyte Disk Pack Drive	18,000	140
RM03	Free-Standing, Add-on, Single-Access, 67-megabyte Disk Pack Drive	19,000	140
RP06	Single-access 176-megabyte disk pack drive; 806K bytes/sec. transfer rate, 36.3-msec average access time	34,000	190
<b>MAGNETIC TAPE EQUIPMENT</b>			
TE16	Industry-compatible tape unit; 45 inches/second; 9-track; 800/1600 bpi; 7200 cps transfer rate; 12-inch reel	11,290	60
TJU45-EA	Magnetic Tape Subsystem; includes TU45-EE drive in a dedicated cabinet and control for up to eight drives	23,000	180
TS03-SA	Magnetic Tape Transport; 9-track, 800 bpi, 12.5 ips, cabinet-mounted	3,850	50
TE10W-AE	Magnetic Tape Transport; 9-track, 800 bpi, 45 ips, cabinet-mounted, for 11/60	11,555	74
<b>CARD UNITS</b>			
CR11	Card reader, 80-column, 300 cpm	6,170	53
<b>PRINTERS</b>			
DS3D6	132 positions; 96 characters; 7x7 matrix; 30 cps (LA35)	2,940	27
LA180	132 positions; 96 characters; 7x7 matrix; 180 cps	3,770	55
LP11-WA	132 positions; 96 characters; drum; 230 lpm	14,050	114
LP11-VA	132 positions; 64 characters; drum; 300 lpm		
LP11-CA	132 positions; 96 64 characters; drum; 900 lpm	24,000	185
<b>TERMINALS</b>			
VT52	DECscope CRT/keyboard; 1920 characters; numeric keypad; direct cursor addressing; 64-char. set; 9600 bps	1,900	20
VT62	DECscope CRT/keyboard; 1920 characters, alphanumeric keypad; automatic cursor positioning, reverse video, local error detection capability; for TRAX systems only	3,150	50
LA36	DECwriter II printer/keyboard; 132 positions; 96-char. set; 7x7 dot matrix; 300 bps	2,200	19
<b>COMMUNICATIONS EQUIPMENT</b>			
SINGLE-LINE ASYNCHRONOUS INTERFACES			
DL11-E	Modem-Controlling EIA CCITT Interface; includes customer specifications	770	6
DL11-WC	Serial Line Interface and Real-Time Clock; EIA/CCITT interface	770	5

## DEC Datasystem D500, ST, and DM Series

## EQUIPMENT PRICES

<b>COMMUNICATIONS EQUIPMENT (Continued)</b>		<u>Purchase Price</u>	<u>Monthly Maint.</u>
<b>SINGLE-LINE SYNCHRONOUS INTERFACE</b>			
DUP11	Full/Half Duplex Synchronous Interface; programmable characteristics; speed to 9600 bps	1,380	9
<b>ASYNCHRONOUS MULTIPLEXERS</b>			
DZ11-A	EIA/CCITT Asynchronous 8-Line Multiplexer; speeds and formats are programmable on a per-line basis	2,310	25
DZ11-B	EIA/CCITT 8-Line Multiplexer Expansion Unit for DZ11-A	1,800	21
DZ11-E	EIA/CCITT Asynchronous 16-Line Multiplexer; speeds and formats are programmable on a per-line basis	3,850	46
DZV11-B	EIA/CCITT Asynchronous 4 Line Multiplexer; speeds and formats are programmable on a per-line basis	850	9
DH11-AD	Programmable Asynchronous 16-Line Multiplexer; EIA/CCITT interface and modem controls; cables not included	7,600	56
DH11-AE	Same as DH11-AD without modem controls	6,700	46
<b>COMMUNICATIONS OPTION</b>			
KG11 Parity	Check option; computes cyclic redundancy check (CRC), longitudinal redundancy check (LRC), and block check characters (BCC)	1,270	6

## SOFTWARE PRICES

## CTS-500 SYSTEMS

QJ906	APL-11/CTS500; without support services	\$ 825
QP552	RPG II/CTS500; with support services	5,500
QP516	BASIC-PLUS-2/RMS-11K; with support services	5,500
QR435	FORTRAN IV/CTS500; with support services	1,820
QP690	DECnet/E; with support services	2,700
QP300	DATA RETRIEVE-11/CTS-500; with support services	4,500
QP511	DIBOL-11/DECFORM; with support services	4,400
QPD10	CTS-500/2780 Emulators; with support services	4,400

## TRAX SYSTEMS

QP402	COBOL/TRAX; with support services	7,700
QP403	BASIC-PLUS-2/TRAX; with support services	4,400
QP404	3271-TL/TRAX Protocol Emulator; with support services	4,500
QP405	TL/TRAX Transaction Link; with support services	2,500

## RSX-11M SYSTEMS

QP012	COBOL-11 V3; with support services	7,700
QJA18	BASIC-PLUS-2; with support services	4,400
QP100	FORTRAN IV PLUS; with support services	3,300
QJ681	DECnet-11M; with support services	2,700
QP376	DBMS-11; with support services	16,500
QP301	DATA RETRIEVE-11/RSX-11M; with support services	4,500
QP901	RMS-11K	2,750
QJD68	RSX-11M/2780 Emulator	3,030
QP602	SORT-11 V2; with support services	370
QJD76	RSX-11M/3271 Protocol Emulator; with support services	4,500