

# DEC VAX-11 Systems

## MANAGEMENT SUMMARY

**UPDATE:** For years, Digital Equipment Corporation's flagship VAX-11 systems have been recognized both implicitly and explicitly as the standard against which other superminicomputers are judged. After eight-and-a-half years on the market, however, those machines seem to have reached the end of the line; they have been supplanted by their direct architectural descendants, the more powerful and expandable VAX 8000 systems, which debuted in October 1986 and have been augmented by six models since January 1986.

However, even though the erstwhile flagship is listing heavily to starboard, Digital has not yet finished scuttling it. The low-end VAX-11/725 and 11/730 and the dual-processor VAX-11/782 have been scrapped, but the company continues to market the VAX-11/750, 11/780, and 11/785—the three most popular models in the series. Just how great the demand for those older machines will be remains open to question; however, Digital generally is able to continue deriving a good deal of sales mileage from seemingly outmoded but not officially retired systems—witness the company's PDP-11 minicomputer.

The three VAX-11s are general-purpose systems, useful for tasks ranging from commercial data processing through office automation to computation-intensive engineering and scientific applications. ▶

Digital Equipment Corporation continues to market its VAX-11/750, 11/780, and 11/785 systems, even though they have been supplanted by comparable VAX 8000 models. The VAX-11 systems retain software and peripheral compatibility with the newer VAX 8000 line, as well as with the now-outmoded VAX-11/725, 11/730, and 11/782.

**MODELS:** VAX-11/750, VAX-11/780, and VAX-11/785.

**MAIN MEMORY:** 2MB to 64MB.

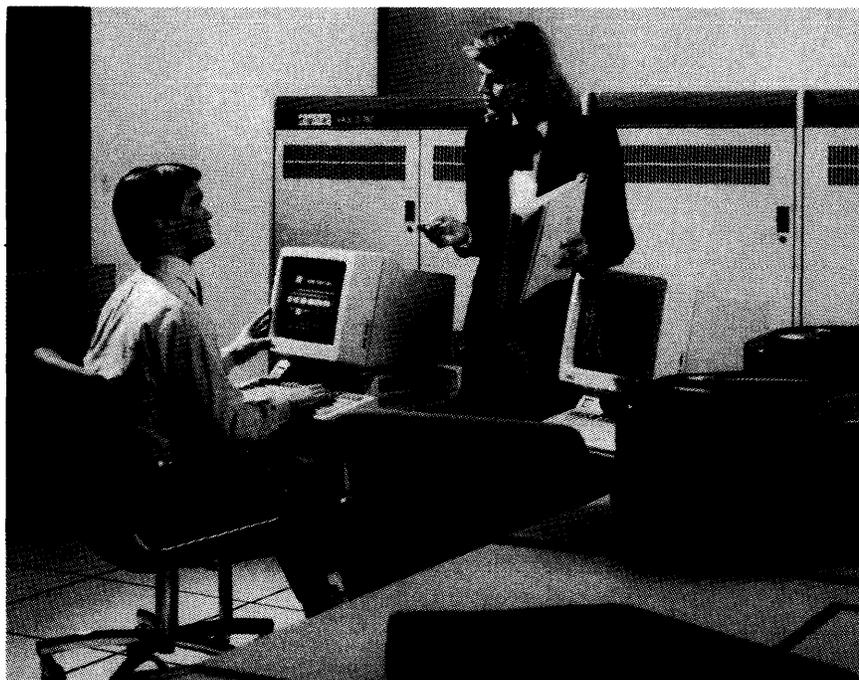
**DISK CAPACITY:** 205MB to 218.8GB.

**WORKSTATIONS:** Up to 384.

**PRICE:** \$54,000 to \$509,000 (base configuration prices).

## CHARACTERISTICS

The VAX-11 systems share many architectural and functional characteristics with Digital Equipment's newer VAX 8000 systems. Where the information on a specific topic is the same for both groups of systems, the reader will be referred to the "DEC VAX 8000 Systems" report in this volume of DATAPRO REPORTS ON MINICOMPUTERS. ▶



*The VAX-11/785 is the high-end system in Digital Equipment Corporation's VAX-11 Systems family. The VAX-11/785 supports over 300 terminals, and, like other VAX-11 and VAX 8000 systems, can be configured in multiprocessor VAXclusters for enhanced storage and computational power.*

## DEC VAX-11 Systems

CHART A. SYSTEM COMPARISON

MODEL	VAX-11/750	VAX-11/780	VAX-11/785
<b>SYSTEM CHARACTERISTICS</b>			
Date of introduction	October 1980	October 1977	April 1984
Date of first delivery	November 1980	January 1978	June 1984
Operating system	VAX/VMS, Ultrix-32	VAX/VMS, Ultrix-32	VAX/VMS, Ultrix-32
Upgradable from	Not applicable	Not applicable	VAX-11/780
Upgradable to	Not applicable	VAX-11/785	Not applicable
MIPS	0.72	1.06	1.5 (approx.)
Relative performance (based on a rating of the 11/780 at 1.0)	0.65	1.0	1.5-1.7
<b>MEMORY</b>			
Minimum capacity, bytes	2M	2M	8M
Maximum capacity, bytes	8M	64M	64M
Type	64K ECC MOS RAM	64K or 256K ECC MOS RAM	64K or 256K ECC MOS RAM
Cache memory	4KB	8KB	32KB
Cycle time, nanoseconds	400 (cache-enabled)	290 (cache-enabled)	166 (cache-enabled)
Bytes fetched per cycle	8	8	8
<b>INPUT/OUTPUT CONTROL</b>			
Number of channels	1-5	1-8	1-8
High-speed buses	Massbus (3 optional)	Massbus (4 optional)	Massbus (4 optional)
Low-speed buses	Unibus (1 std., 1 opt.)	Unibus (1 std., 3 opt.)	Unibus (1 std., 3 opt.)
<b>MINIMUM DISK STORAGE</b>			
	205MB	205MB	205MB
<b>MAXIMUM DISK STORAGE</b>			
	19GB local; 218.8GB in VAXcluster	30GB local; 218.8GB in VAXcluster	30GB local; 218.8GB in VAXcluster
<b>NUMBER OF WORKSTATIONS</b>			
	128	384	384
<b>COMMUNICATIONS PROTOCOLS</b>			
	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ The midsize VAX-11/750 implements custom bipolar LSI Schottky logic. It features a 4KB cache memory and can support from 2MB to 8MB of main memory. The VAX-11/750 can also accommodate up to 128 workstations and 205MB to 19GB of local disk storage. One Unibus adapter (integral to the processor) and up to three Massbus adapters or one additional Unibus and two Massbus adapters may be used for connection to mass storage devices and other peripherals.

The VAX-11/780, Digital's initial VAX-11 product offering, features an 8KB cache memory and can support between 2MB and 64MB of local main memory. (It can also support an additional 4MB of shared memory, as can the VAX-11/785.) The VAX-11/780 can accommodate between 205MB and 30GB of local disk storage, as well as 384 workstations. Up to four Unibus and four Massbus adapters may be used for connection to mass storage devices and other peripherals. The VAX-11/780 can be upgraded to the VAX-11/785.

The VAX-11/785 incorporates high-speed Schottky circuitry that, according to Digital, permits performance 50 to 70 percent greater than that provided by the VAX-11/780. The VAX-11/785, like the VAX-11/780, features a local main memory capacity of 64MB and a two-way set associative cache memory; cache size on the VAX-11/785, however, is 32KB. The floating-point instruction set on the VAX-11/785 features G and H data types, which are optional on the VAX-11/780. An optional floating-point accelerator is available for the VAX-11/785. The 11/780 ➤

➤ **MANUFACTURER:** Digital Equipment Corporation, 146 Main Street, Maynard, MA 01754-2571. Telephone (617) 897-5111.

**CANADIAN ADDRESS:** Digital Equipment of Canada Ltd., P.O. Box 13000, 100 Herzberg Road, Kanata, Ontario, Canada K2K 2A6. Telephone (613) 592-5111.

### DATA FORMATS

**BASIC UNIT:** 2-bit word.

**FIXED-POINT OPERANDS:** Please refer to the "DEC VAX 8000 Systems" report in this volume.

**FLOATING-POINT OPERANDS:** The VAX instruction set supports floating-point data in longwords, quadwords, and octawords. Four types of floating-point data are available. Two types—D and G—are eight bytes long; the third type—F—is four bytes long; the last type—H—is 16 bytes long. Data type F is single-precision; type D is double-precision.

An optional high-performance Floating-Point Accelerator (FPA) can be added to the VAX-11 systems. The FPA is an independent processor that executes in parallel with the base CPU. The FPA takes advantage of the CPU's instruction buffer to prefetch instructions and memory cache to access main memory. Once the CPU has the required data, the FPA overrides the normal execution flow of the standard floating-point microcode and forces use of its own code. Then, while the FPA is executing, the CPU can be performing other operations in parallel.

**INSTRUCTIONS:** The VAX-11/785 features an instruction set that performs 304 basic operations; the VAX-11/780 and 11/750 instruction sets perform 248 basic ➤

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➤ upgrade to the 11/785 can be accomplished with or without the floating-point accelerator.

Despite differences in processor technology, the VAX-11/785 employs the same bus structure and I/O capabilities as the VAX-11/780, handling the same amount of local disk storage and the same number of workstations.

The VAX-11 systems all run under Digital's general-purpose VAX/VMS operating system. The VAX-11s can also run under Ultrix-32, Digital's implementation of the Unix operating system.

VAX/VMS contains special features for VAXcluster support. A VAXcluster is composed of one or more VAX-11/750, 11/780, 11/785, or VAX 8000 processors or Hierarchical Storage Controllers (HSC) running under VAX/VMS and connected by a high-speed computer interconnect bus and communication links to the user community. Each processor or HSC in the configuration is considered a node. The smallest VAXcluster configuration can be two VAX processors connected by an interconnect and star coupler. No HSC is necessary; VAX/VMS allows locally connected Unibus and Massbus disks to be shared by VAXcluster users through an MSCP server. The HSC50, which supports up to 24 disk or tape devices in any combination, can provide a cluster with up to 164GB of disk storage; the HSC70 supports up to 32 disk and tape devices, endowing a VAXcluster with up to 218.8GB of storage. (The HSC50 is the standard HSC for VAX-11 clusters, although the HSC70 is available.)

Under VAX/VMS, the VAX-11s are software-compatible with one another and with the VAX 8000 systems, as well as with the MicroVMS-based MicroVAX II supermicro-computer. Thus, the VAX-11s run the full range of Digital's systems and applications software.

### COMPETITIVE POSITION

The VAX-11 systems can no longer be considered front-line competitors in the superminicomputer market. Although they still have many features to commend them, they have been effectively replaced—the VAX-11/750 by high-end configurations of the MicroVAX II and lower end VAX 8200 systems, the VAX-11/780 by the VAX 8200, and the VAX-11/785 by the VAX 8500. The VAX 8000 systems have significantly lowered the price/performance ratio, in a sense rendering the VAX-11s economically, if not technologically, obsolete. For example, when one compares the prices of basic VAX 8000 and VAX-11 System Building Blocks, one finds that the price of the VAX 8200 represents a \$6,600 per MIPS reduction over that of the VAX-11/780, while the VAX 8500 provides a saving of \$49,500 per MIPS over the 11/785.

### ADVANTAGES AND RESTRICTIONS

Despite their obsolescence, the VAX-11 systems still have a number of attractive features. In the first place, the systems feature a high degree of software compatibility under ➤

➤ operations. For additional information, refer to the "DEC VAX 8000 Systems" report in this volume.

**INTERNAL CODE:** ASCII for text-oriented data; binary for calculations.

### MAIN STORAGE

**TYPE:** Main memory for the VAX-11/750 processors is 64K-bit error-correcting code (ECC) MOS RAM. Both 64K-bit and 256K-bit ECC MOS RAMs are available for the VAX-11/780 and 11/785; the two types cannot share the same memory controller.

**CYCLE TIME:** Cache-enabled cycle times for the VAX-11 systems range from 160 to 400 nanoseconds. Refer to Chart A for the cycle times of individual machines.

**CAPACITY:** Main memory capacities range from 2MB to 64MB. All VAX systems provide up to 4GB of virtual memory space. For the main memory capacities of specific VAX 8000 systems, please refer to Chart A.

In addition to local memory, VAX-11/780 and 11/785 systems can use the MA780 Multiport Memory, a bank of ECC MOS semiconductor memory that can be shared by up to four systems in any combination. Each system can randomly access all of the shared memory in exactly the same way it accesses its local memory. CPUs accessing the MA780 can be arranged in either a parallel or pipelined manner.

**CHECKING:** The systems' ECC MOS memories incorporate Schottky TTL logic technology with automatic error checking, including parity checking on Massbus data, cache, translation buffer, and CPU microcode.

**STORAGE PROTECTION:** The systems' memory management logic divides memory into 512-byte pages. Each page is assigned a protection code specifying which, if any, access modes are to be permitted read or write access to the page. In addition, fault detection hardware causes a memory error-correcting code to detect all double-bit errors and correct all single-bit errors.

Battery backup is optional on all three VAX-11 systems.

**RESERVED STORAGE:** Minimum reserved storage for the VAX/VMS operating system is 512KB on all three systems, and 2MB on VAX-11/780 and 11/785 VAXclusters with the CI780 Computer Interconnect.

**CACHE MEMORY:** All VAX-11 systems include cache memory. Refer to Chart A for cache sizes on specific machines.

### CENTRAL PROCESSOR

**GENERAL:** The VAX-11/780 processor includes the basic CPU, synchronous system bus, intelligent microcomputer console, interval and time-of-year clocks, and 8KB of cache memory. The VAX-11/780 can be upgraded to a VAX-11/785.

Except for cache memory size and a larger translation buffer, the VAX-11/785 is essentially a higher speed version of the VAX-11/780. The VAX-11/785 features a CPU cycle time of 133 nanoseconds (compared to 200 nanoseconds on the VAX-11/780), and incorporates high-speed Schottky circuitry that, according to Digital, permits performance 50 to 70 percent greater than that provided by the VAX-11/780. The VAX-11/785 also features an average interrupt latency of 28 microseconds.

The VAX-11/785 also has 48KB of console memory, up from 16KB on the 11/780. Instruction microcode for the ➤

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CHART B. MASS STORAGE

MODEL	RA60	RA80	RA81	RL02	RC25
Type	Removable	Winchester	Winchester	Cartridge	Fixed/Removable
Controller model	UDA50 (Unibus), HSC5X-BA (on HSC50 or HSC70)	UDA50 (Unibus), HSC5X-BA (on HSC50 or HSC70)	UDA50 (Unibus), HSC5X-BA (on HSC50 or HSC70)	Integrated	Integrated
Drives per subsystem/controller	4	4	4	4	2
Formatted capacity per drive, megabytes	205	121	456	10.4	26/26
Number of usable surfaces	6	7	7	2	—
Number of sectors or tracks per surface	1,600 tracks	1,092 tracks	2,496 tracks	512 tracks	—
Bytes per sector or track	512/sector	512/sector	512/sector	256/sector	—
Average seek time	41.7 ms	25 ms	28 ms	55 ms	35 ms
Average rotational/relay time	8.3 ms	8.3 ms	8.3 ms	12.5 ms	10.5 ms
Average access time	50 ms	33.3 ms	36.3 ms	67.5 ms	45.5 ms
Data transfer rate	1.98MB/sec.	1.2MB/sec.	2.2MB/sec.	512KB/sec.	1.25MB/sec.
Supported by system models	All	All	All	All	All
Comments				Not supported as system disk; data transfer device only	Not supported as system disk; data transfer device only

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ VAX/VMS, both among themselves and with the VAX 8000s and the MicroVAX II grouping. Thus, users migrating from the VAX-11s to the newer members of the VAX family have a leg up, because they are able to transfer their systems and applications software with minimal effort. Also, because of the clustering facilities contained in VAX/VMS, the VAX-11s are still useful as members of multiprocessor VAXclusters.

The availability of the Unix-based Ultrix-32 operating system for VAX computers is also advantageous, for it allows users to choose between the realtime VAX/VMS and timesharing Unix environments, depending upon their application requirements. The Berkeley-based Ultrix-32 also contains features of AT&T's Unix System V, bringing it into closer conformity with the AT&T system, which is the version of Unix around which most supermicro, mini, and supermini vendors are converging.

### USER REACTION

Datapro's 1986 Computer Users Survey yielded responses from 265 VAX system users; the average installed life of the surveyed systems was approximately 43 months. All but five of the respondents were VAX-11 users; the rest used VAX 8600s. Because the survey was intended to cover all VAX systems installed at the time, the results discussed in this section combine those of each group.

Purchased systems constituted 78.9 percent of the sample; 5.3 percent had been rented or leased from Digital Equipment, and 15.1 percent had been leased from a third party. According to the survey, 86.4 percent of the VAXes were deployed as organizational systems; only 12.8 percent were used primarily for departmental computing. Of the sites surveyed, 33.2 percent had established an information center.

The application most frequently run by the respondents was accounting/billing, cited by 46 percent. Digital's well known strength in the technical and educational computing fields was also apparent in the application citations. Engineering/scientific applications were mentioned by 36.6 per-

➤ 11/785 is stored in RAM, rather than in ROM as on the 11/780. Despite the differences in processor technology and performance, however, the 11/785 employs the same bus structure and I/O capabilities as the 11/780.

Memory management on VAX-11/780 and VAX-11/785 systems includes four hierarchical processor access modes used by the system to provide read/write page protection between user software and system software. Memory is connected to the main control and data transfer path—the Synchronous Backplane Interconnect, or SBI—via a memory controller. Each memory controller includes a request buffer that substantially increases overall system throughput and eliminates the need for interleaving in most applications.

The intelligent console on the VAX-11/780 and 11/785 consists of an LSI-11 microcomputer with 16KB (11/780) or 48KB (11/785) of read/write memory and 8KB bytes of ROM, a diskette unit, a terminal for local operations, and an optional port for remote diagnosis.

The VAX-11/750 CPU includes the Processor Status Word for controlling the execution states of the CPU. The processor instruction set is defined by the microcode contained in its control store. The CPU also includes a 4KB bipolar cache memory, 10KB user control store, clocks, and console.

The VAX-11 processors use two standard clocks: a programmable realtime clock used by the operating system and by diagnostics, and a time-of-year clock used for system operations. The time-of-year clock includes battery backup for automatic system restart operations.

**CONTROL STORAGE:** The VAX-11/780 has a control store size of 5K 99-bit words, 4K words of ROM, and 1K words of user control store. The VAX-11/785 has a RAM-based control store of 8K words, with 0.5K ROM and 7.5K writable, 1K of which is user control store.

On the two 11/78X systems, 12K bytes (plus parity) of Writable Diagnostic Control Store (WDCS) are provided to allow the Diagnostic Console Microcomputer to verify the integrity of crucial parts of the CPU, the intelligent console, the SBI, and the memory controller. In addition, the WDCS can be used to implement updates to the system microcode.

The optional User Control Store (UCS) on the VAX-11/750 includes 10K bytes (1K bytes of 80-bit microwords) of writable storage. This allows users to augment the speed and power of the basic machine with customized microcode functions. Such customized functions include the loadable

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cent of the respondents, while 18.1 percent cited mathematics/statistics; 28.3 percent of the users said that they ran education/scheduling/administration programs. Other applications mentioned by significant portions of the respondent base were payroll/personnel (31.7 percent), order processing/inventory (27.2 percent), purchasing (18.9 percent), and manufacturing (15.1 percent).

Eighty percent of the users said that they employed in-house personnel to develop their applications programs; 54.3 percent turned to independent suppliers. An additional 34.7 percent obtained packaged programs from Digital Equipment, and 20.4 percent relied on contract programming; only 5.7 percent had customized programs developed by Digital Equipment's personnel. Basic, Fortran, and Cobol, cited by 29.2, 27.3, and 20.8 percent of the users, respectively, were the most popular programming languages on the VAXes.

As for the users' configurations, 90.1 percent of the systems had between 1MB and 16MB of main memory. The most commonly cited range of disk storage was 600MB to 1.2GB, reported by 42.5 percent of the users; 19.8 percent had between 100MB and 600MB of disk, while 26.6 percent had between 1.2GB and 4.8GB. Seventy-seven percent of the users reported having more than 16 workstations; 58.1 percent of the users reported between 1 and 30 remote workstations.

When asked if the computer system did what they expected it to do, 93.6 percent of the users said that it did; only 2.3 percent said that it did not. An overwhelming proportion (94.3 percent) of the users said that they would recommend a VAX system to another user; only 2.3 percent said that they would not do so.

The following table shows users' ratings of their VAX systems:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	175	85	4	1	3.6
Reliability of system	186	69	9	0	3.7
Reliability of peripherals	148	97	13	1	3.5
Maintenance service:					
Responsiveness	144	96	13	2	3.5
Effectiveness	129	106	18	2	3.4
Technical support:					
Troubleshooting	109	113	31	3	3.3
Education	92	124	30	5	3.2
Documentation	105	123	26	3	3.3
Manufacturer's software:					
Operating system	172	80	3	1	3.7
Compilers & assemblers	136	105	3	0	3.6
Application programs	58	125	26	3	3.1
Ease of programming	108	124	8	0	3.4
Ease of conversion	94	116	17	1	3.3
Overall satisfaction	130	118	3	0	3.5

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

To supplement our statistics, we contacted three of the respondents by telephone in July 1986 to solicit follow-up comments. Each was engaged in a different type of enterprise in a different section of the United States.

microcode package for extended precision floating-point arithmetic operations.

**REGISTERS:** Please refer to the "DEC VAX 8000 Systems" report in this volume.

**ADDRESSING:** Please refer to the "DEC VAX 8000 Systems" report in this volume.

**INTERRUPTS:** Please refer to the "DEC VAX 8000 Systems" report in this volume.

**OPERATING ENVIRONMENT:** Nominal operating environment for the VAX-11 processors is 70 degrees Fahrenheit  $\pm$  5 degrees Fahrenheit (21 degrees Celsius  $\pm$  3 degrees Celsius) at 50 percent relative humidity ( $\pm$  10 percent).

The VAX-11/780 and 11/785 processor cabinets are 60.5 inches (153.7 cm) high, 46.5 inches (118.1 cm) wide, 30 inches (76.2 cm) deep, and weigh 1,100 pounds (498 kg). Power requirements are 120/280 volts. Maximum AC power consumption is 6225 watts for the 11/780 and 2500 watts for the 11/785. Maximum heat dissipation is 21,230 Btu per hour.

The VAX-11/750 stands 42 by 29 by 30 inches (106 by 74 by 76 cm). Maximum weight is 400 pounds. Power requirements are 120 volts at 30 amp, and 240 volts at 15 amp, single-phase. Maximum power consumption is 1700 watts, and maximum heat dissipation is 5800 Btu per hour.

### INPUT/OUTPUT CONTROL

The input/output information provided here is for systems running under VAX/VMS; Ultrix-32 systems use the same I/O control devices, but are more restricted as to the number that can be configured.

All three VAX-11 systems support the *Unibus*, an asynchronous bidirectional bus, which controls all Digital- and user-developed realtime peripherals other than high-speed disk drives and magnetic tape transports. The Unibus is connected to the memory interconnect through the Unibus adapter. The Unibus adapter handles priority arbitration among devices on the Unibus. Unibus adapters may be placed on the memory interconnect as follows: up to four on the VAX-11/780 and 11/785, and up to two on the VAX-11/750.

The maximum Unibus I/O rate through buffered direct memory access (DMA) data paths is 1.5MB per second. Maximum system I/O rate on the VAX-11/785 is 13.3MB per second.

The three VAX-11s employ the *Massbus* adapter to attach high-speed disk or magnetic tape devices and perform control, arbitration, and buffering functions. Up to four Massbus adapters can be connected to the memory interconnect on the VAX-11/785 and 11/780; up to three such adapters can be connected to the 11/750.

Each Massbus adapter includes its own address translation map that permits scatter/gather disk transfers. In scatter/gather transfers, physically contiguous disk blocks can be read into or written from discontinuous blocks of memory. The translation map contains the addresses of the pages, which may be scattered throughout memory, from or to which the contiguous disk transfer takes place.

The VAX-11s also support the *Hierarchical Storage Controller (HSC)* family of intelligent, high-speed disk and tape controllers. The HSC50 is the standard HSC controller for the VAX-11 systems; the HSC70 may also be obtained. For specific details on the HSC controllers, please refer to the "DEC VAX 8000 Systems" report in this volume.

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CHART C. WORKSTATIONS

MODEL	VT220	VT240	VT241
DISPLAY PARAMETERS			
Max. chars./screen	3168	3168	3168
Buffer capacity	—	—	—
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132
Tilt/swivel screen	Tilt standard	Standard	Standard
Symbol formation	7 x 10 dot-matrix	8 x 10 dot-matrix	8 x 10 dot-matrix
Character phosphor	White, green, or amber	White, green, or amber	P4
Total colors/no. simult. displayed	Not applicable	Not applicable	—
KEYBOARD PARAMETERS			
Style	Typewriter	Typewriter	Typewriter
Character/code set	ASCII, Digital Special Graphics, and Supplemental	ASCII, Digital Special Graphics, and Supplemental	ASCII, Digital Special Graphics, and Supplemental
Detachable	Yes	Yes	Yes
Program function keys	15	15	15
TERMINAL INTERFACE	RS-232-C, RS-423, and 20 ma std.	RS-232-C, RS-423, and 20 ma std.	RS-232-C, RS-423, and 20 ma std.
COMMENTS		800 x 240 pixel graphics array	800 x 240 pixel graphics array; includes color monitor

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ The first user we contacted is affiliated with a health care/medical concern in the Southwest. His company is a long-time Digital shop, having chosen that company over Hewlett-Packard 10 years ago. His VAX-11/750 is the successor to a PDP-11/24 that his company still uses. He said that, in upgrading, he had settled on the VAX-11/750 because it was the largest computer he could afford at the time and because it provided software migration and peripheral transport paths from the PDP-11. He said that another reason for staying with Digital was that IBM offers nothing as good as either Digital system for running realtime biological research and clinical data management applications.

This user praised the VAX-11/750, with its VMS operating system, as “a workhorse,” and claims that he has derived VAX 8600-level performance from the system’s software. Still, he said, he finds it difficult “to wax ecstatic over any computer,” because a system tends to become obsolete in a very short time. He said that he sees such obsolescence occurring in the VAX-11 line; as much as he likes the VAX-11/750, he regards it as no more than the system which happens to be in place now, and would not recommend it to prospective users. He said he feels that the VAX 8000 systems represent the future of the line.

The first user did say, however, that Digital provides an effective growth path, allowing him to junk his PDP-11/24 and migrate to a newer VAX system above the 11/750 while retaining software functionality. He also said that Digital provides effective mechanisms for system expansion, calling it the best vendor in the country for networking and clustering.

The second user we spoke to works for an insurance firm in an Atlantic seaboard state; his company uses VAX systems primarily for order entry functions, such as policy quoting and writing. (Claims are handled through an IBM mainframe.) His organization had converted to the VAX from a PDP-11. The company stayed with Digital not only because of software compatibility, but also because it needed ➤

### ➤ CONFIGURATION RULES

**GENERAL:** *System Building Blocks (SBBs)* are available for all VAX-11 systems. SBBs begin with a core of components: CPU; main memory; cabinetry, and a VAX/VMS or Ultrix-32 operating system license and warranty. To the core of the SBB the user must add selections from the mass storage (system device and load device), communications interface, and console terminal menus; selections from the software and software services menus are optional. (See **EQUIPMENT PRICES**, at the end of this report, for further details on SBBs.)

The VAX-11 systems can be configured in *VAXclusters*, multiprocessing systems composed of one or more VAX-11/750, 11/780, and 11/785 (and or VAX 8000) processors and/or Hierarchical Storage Controllers running under VAX/VMS and connected by a high-speed Computer Interconnect bus. For specific details on VAXclusters, please refer to the “DEC VAX 8000 Systems” report in this volume.

In general, VAXclusters are based on *VAXcluster SBBs*, of which there are two types. The first type is a basic system element, which consists of a CPU with memory, a Computer Interconnect, a Hierarchical Storage Controller, a Star Coupler, a disk interface, and VAX/VMS and DECnet licenses. The basic SBB also requires a selection from the console terminal and communications device menus; depending on the system, a choice from the mass storage (load device and system device) menu may be required; choices from the software and software services menus are optional. The second type of VAXcluster SBB is an upgrade to an existing VAXcluster. The upgrade consists of a CPU with main memory, a Computer Interconnect, and VAX/VMS and DECnet licenses. A communications device and a console terminal must also be ordered with the upgrade SBB; mass storage devices can also be ordered.

Available for the VAX-11/750 is a dual-processor VAXminicluster. Each CPU comes with 4MB of main memory; also included are a four-node Star Coupler, an HSC50 controller and disk interface, a Computer Interconnect, and system software licenses. An installed unit upgrade kit is also available, permitting an existing VAX-11/750 CPU to be upgraded into a VAXminicluster. ➤

## DEC VAX-11 Systems

### CHART D. PRINTERS

MODEL	LXY12/22	LP25	LP26	LP27	LG01/LG02
Type	Dot-matrix	Band	Band	Band	Matrix
Speed	300/600 lpm	300 or 300/215 lpm	600 or 600/445 lpm	1200/800 lpm	600 lpm
Bidirectional printing	No	Not applicable	Not applicable	Not applicable	—
Paper size	—	Up to 15 inches	Up to 15 inches	Up to 18.75 inches	4-16 in. wide, 3-20 in. long
Character formation	Variable	Full	Full	Full	Dot-matrix
Horizontal character spacing (char./inch)	Variable	Variable	10	10	Variable
Vertical line spacing (char./inch)	—	6 or 8	6 or 8	6 or 8	—
Character set	96 or 192	64 or 64/96	64 or 64/96	64/96	64 (data proc. mode)
Controller/Interface	LP11, RS-232-C, DMF32	LP11, DMF32	LP11, DMF32	Integrated, DMF32	RS-232-C, Dataproducts parallel
No. of printers per controller/interface	—	—	—	—	—
Printer dimensions, in. (h x w x d)	46.5 x 30 x 24.3	43.8 x 30.3 x 33.6	43.8 x 30.3 x 33.6	49 x 35 x 38	38 x 33.5 x 22.3
Graphics capability	Yes	No	No	No	LG02 only
Comments					LG01 text printer upgradable to LG02 text/graphics printer

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

### CHART D. PRINTERS (Continued)

MODEL	LN01S	LN01B	LN03
Type	Laser	Laser	Laser
Speed	12 ppm	12 ppm	8 ppm
Bidirectional printing	Not applicable	Not applicable	Not applicable
Paper size	8.5 x 11 or 8.5 x 14 inches	8.5 x 11 or 8.5 x 14 inches	8.5 x 11 inches
Character formation	300 x 300 dots/sq. in.	300 x 300 dots/sq. in.	300 x 300 dots/sq. in.
Horizontal character spacing (char./inch)	Variable	Variable	Variable
Vertical line spacing (char./inch)	Variable	Variable	Variable
Character set	12 Courier-like fonts standard	16 Courier-like graphics labeling fonts std.	ASCII; 16 resident Courier/Elite fonts
Controller/Interface	LP11, DMF32	LP11, DMF32	RS-232-C
No. of printers per controller/interface	—	—	1
Printer dimensions, in. (h x w x d)	36 x 25.8 x 26	36 x 25.8 x 26	15 x 21 x 23.5
Graphics capability	Yes	Yes	150 dpi (average)
Comments		Includes PLOTLN software and 2 EPROMs.	Prints in landscape and portrait modes

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ Digital's Record Management System (RMS) file facilities and because the VAX system offered the horsepower required for larger applications. The user said that the file changes and application updates required for the conversion from the PDP-11 to the VAX were accomplished without inordinate effort.

This user said that he particularly likes the VAXcluster architecture. His cluster comprises two VAX-11/780s, each with 12MB of main memory, and a VAX-11/785, with 16MB of memory; he is considering the addition of a fourth processor. He said that the cluster also includes 12 spindles, providing 2.5GB of disk storage. He is impressed by the single system image that the cluster provides; each new user is automatically assigned to the least fully utilized CPU.

His biggest problem with his VAXes, he said, comes from reliability problems with the RA81 disk units. He said that even when no one is working on the system, power outages cause the loss of blocks of data in files on each disk. He also said that he has had to have head/disk assemblies replaced. The Digital Equipment service people, he added, can't seem to come up with a solution to the problem. Regarding service, he also remarked that a four-hour response is built into his maintenance agreement; because his system is ➤

➤ A dual-CPU VAXcluster is also offered for the VAX-11/785. Each CPU comes with 8MB of main memory; the cluster also includes a Floating-Point Accelerator, a Computer Interconnect, a Star Coupler, an HSC50 with disk interface, and system software licenses.

**VAX-11 SBBs:** The configuration rules provided here are for SBBs under VAX/VMS. Systems operating under Ultrix-32 use the same components, but configurability is more limited.

The VAX-11/785 SBB comprises a CPU and cabinet, 8MB of main memory, an H9652 Unibus expansion cabinet with BA11-K expansion box and DD11-DK backplane, and a VAX/VMS license and warranty. The CPU cabinet includes a memory controller and basic memory, one DW780 Unibus adapter, and two option panel spaces (OPS). Along with the expansion box and backplane, the H9652 cabinet provides space for a second expansion box.

Memory on the VAX-11/785 can be expanded to 64MB with 256K-bit MS780-H memory. The memory must be added in 8MB increments; no expander cabinet or second memory controller is required. The 256K-bit memory cannot share the same memory controller with 64K-bit memory.

The VAX-11/780 SBB comprises a CPU cabinet containing a memory controller and 2MB of 64K-bit memory or 16MB of 256K-bit memory, a DW780 Unibus adapter, and two option panel spaces. Also included is an H9652 Unibus ➤

## DEC VAX-11 Systems

### CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	TA78	TU78	TA81	TU77
TYPE	Reel-to-Reel	Reel-to-Reel	Streaming	Reel-to-Reel
FORMAT				
Number of tracks	9	9	9	9
Recording density, bits per inch	1600/6250	1600/6250	1600/6250	800/1600
Recording mode	PE/GCR	PE/GCR	PE/GCR	NRZI/PE
CHARACTERISTICS				
Controller model	HSC5X-CA (on HSC50 or HSC70)	TA78 master (on HSC5X-CA) or Massbus adapter	HSC5X-CA (on HSC50 or HSC70)	Massbus adapter
Drives per controller	4 per HSC5X-CA	3 per TA78 or 32 on Massbus adapter	4 per HSC5X-CA	4
Storage capacity, bytes	40M PE, 145M GCR	145M GCR	40M PE, 145M GCR	20M NRZI, 40M PE
Tape speed, inches per second	125	125	75 and 25 (streaming)	125
Data transfer rate, units per second	200KB PE; 781KB GCR	781KB	468KB	200KB
Streaming technology	No	No	Yes	No
Start/stop mode; speed	Not applicable	Not applicable	Yes; 25 ips	Not applicable
Switch selectable	Yes	Yes	—	Yes

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

### CHART E. MAGNETIC TAPE EQUIPMENT (Continued)

MODEL	TU80	TU81	TS05	TK50
TYPE	Streaming	Streaming	Streaming	Streaming
FORMAT				
Number of tracks	9	9	9	22
Recording density, bits per inch	1600	1600/6250	1600	6667
Recording mode	PE	PE/GCR	PE	Serial, serpentine pattern
CHARACTERISTICS				
Controller model	Unibus adapter	Unibus or Massbus adapter; HSC5X-CA (on HSC50 or HSC70)	Integrated (for Unibus)	Integrated (for Unibus)
Drives per controller	1	4 per Unibus or HSC5X-CA; 8 per Massbus	1	1
Storage capacity, bytes	40M	40M PE, 145M GCR	40M	95M
Tape speed, inches per second	25 and 100 (streaming)	75 and 25 (streaming)	100	75
Data transfer rate, units per second	160KB	468KB	40KB/160KB	62.5KB (45KB user data)
Streaming technology	Yes	Yes	Yes	Yes
Start/stop mode; speed	Yes; 25 ips	Yes; 25 ips	Yes; 25 ips	—
Switch selectable	No	—	—	—
Comments				Uses CompacTape cartridge; for data interchange with MicroVAX II.

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ realtime, however, he finds that response inadequate. Still, he said that Digital personnel do attempt to better the contractually specified response.

The second user opined that Digital offers an effective growth path for VAX-11/78X-class users—not only laterally, through the VAX 8500 (which he is considering), but also downward, through the software-compatible MicroVAX II. For upward expansion, he cited the clustering capability of the VAX systems, noting that one can add a processor to an existing system and achieve the same level of computing as if one had originally purchased a more powerful system. ➤

➤ expansion cabinet with BA11-K expander box and DD11-DK backplane. The cabinet provides space for a second BA11-K box.

With 64K-bit MS780-F memory, main storage in the VAX-11/780 CPU box can be expanded to 16MB; another 16MB can be added in the H9652 expansion cabinet. Using 256K-bit MS780-H memory in 8MB increments, main storage can be expanded to 64MB; no expansion cabinet or second controller is necessary. The 256K-bit and 64K-bit memory arrays cannot share the same controller.

Options supported by the VAX-11/785 and 11/780 include one H7112 memory battery backup unit per memory controller, two MA780 multiport memory controllers, an FP785 or FP780 Floating-Point Accelerator, three additional Uni- ➤

## DEC VAX-11 Systems

▷ The third user represents a west coast engineering/scientific concern. His firm has two VAX-11/785s—one running under VAX/VMS and one under Unix. The two systems are used for text processing and software development; the VMS-based system also runs finite element analysis applications. One of the systems was an upgrade from a VAX-11/780. The conversion, necessitated by requirements for greater power, was complicated by problems with the diagnostic microcode in the VAX-11/780.

This user characterizes his company as “totally committed to Digital,” having originally settled on the VAX system as a local processing alternative to a large, centralized mainframe. In addition to the aforementioned VAX-11 systems, his shop also employs a VAX 8600 and a MicroVAX. When asked what advice he would give a prospective buyer of a Digital Equipment system, he replied, “Negotiate.” He said that Digital can give the discerning buyer a good deal for his or her money, particularly if the user is experienced and knows exactly what he or she wants to buy. □

▶ bus adapters, four Massbus adapters, and one DR780 general-purpose interface or one CI780 Computer Interconnect interface. Users with a Field Service Contract can configure a remote diagnostic unit. The VAX-11/780 also supports the KU780 user-writable control store and the KE780 G&H floating-point microcode.

Digital states that the maximum number of communications lines that can be configured on any VAX-11 system depends on total requirements and other considerations. However, the VAX-11/785 and 11/780 both support the following asynchronous interfaces: DHU11 and DMZ32 (not to exceed 96 lines per Unibus) and/or DMF32 (not to exceed 80 lines per Unibus). The DEUNA, DMR11, DMP11, and DUP11 communications interfaces are also supported by both VAX-11/78X systems.

The VAX-11/750 SBB includes the CPU and cabinet, 2MB of main memory, and VAX/VMS license and warranty. The cabinet contains a CPU backplane and a DD11 Unibus expansion backplane. The CPU backplane has dedicated slots for CPU options and additional memory, along with three general-purpose I/O adapter slots.

Up to 6MB of MS750 memory can be added to the VAX-11/750 (for up to 8MB of system memory on eight boards). The system can also support one FP750 Floating-Point Accelerator, a KU750 extended-range G&H floating-point data type option, an H7112 memory battery backup unit, a DW750 second Unibus adapter, a DR750 general-purpose interface, and a CI750 Computer Interconnect. The DR750 and CI750 are mutually exclusive. Customers with a Field Service Contract can attach a remote diagnostic unit.

For Unibus expansion beyond the DD11, or to use the DW750 interface, additional backplane space is required; an H9642 Unibus expansion cabinet, a BA11-K expansion box, and a DD11-CK/DK expansion backplane must be ordered.

The system supports the following asynchronous devices: DHU11 and/or DMZ32 (not to exceed 64 lines per Unibus) and DMF32 (not to exceed 64 lines per system). Synchronous interfaces supported include the DEUNA, DMP11, DMR11, and DUP11 options.

**WORKSTATIONS:** Digital says that, generally, the number of workstations that can be directly configured on a VAX-11 system equals the number of DMF32, DHU11,

and/or DMZ32 communications lines. Terminals can also be connected to DECserver 100 and Ethernet terminal servers. The maximum workstation figures usually quoted for the VAX-11/78X systems and the VAX-11/750 are 384 and 128, respectively.

**DISK STORAGE:** Each VAX-11 system allows configuration of one UDA50 disk controller on the first Unibus; the UDA50 supports up to four RA60 (205MB fixed/removable), RA80 (121MB Winchester), and RA81 (456MB Winchester) drives in any combination. The second Unibus on each system supports two UDA50s; if the two controllers are configured, no other options can go on the Unibus. On the VAX-11/750, the second UDA50 requires a DW750 Unibus, H9642 expansion cabinet, BA11-K expander box, and DD11-DK expansion backplane. On the VAX-11/780 and 11/785, only the DW780 Unibus, BA11-K, and DD11-DK are required for additional UDA50s.

Other attachable Unibus disk devices are the 10.4MB RL02 cartridge drive (four per system), the RC25 52MB fixed/removable drive (one per system) and the RX50 818KB dual diskette drive (one per system).

The VAX-11/750 supports up to three Massbus adapters, while the VAX-11/780 and 11/785 support up to four. Each Massbus adapter allows attachment of eight disk and tape devices in any combination. The attachable Massbus disk devices are Digital's older 516MB RP07 fixed disk drive (as data disk only) and 256MB RM05 removable drive. (Refer to the “Magnetic Tape” subsection for information on attachable Massbus tape formatters.)

The intelligent HSC50 and HSC70 storage controllers can be attached to the VAX-11 systems through the Computer Interconnect. As previously stated, the HSC50 is the standard HSC for VAX-11 systems, although the HSC70 can be configured. The HSC50 supports six HSC5X-BA disk and HSC5X-CA tape interfaces (24 devices) in any combination; the HSC70 supports eight (32 devices). Each HSC5X-BA disk interface supports up to four RA60, RA80, and RA81 drives in any combination.

**MAGNETIC TAPE:** All VAX-11 systems support both Unibus and Massbus tape devices. The VAX-11/780 and 11/785 support up to four TU80 and four TU81 subsystems per Unibus, and one TK50 cartridge drive per system. The VAX-11/750 permits attachment of two TU80 and two TU81 subsystems per system; one TK50 drive per system is also allowed.

The VAX-11/750 supports up to three Massbus adapters, while the VAX-11/780 and 11/785 support up to four. Eight TE16, TU77, and TU78 tape subsystems can be configured per Massbus adapter on the VAX-11 systems. Those devices can also be configured with the Massbus disk devices referenced in “Disk Storage” in any combination of up to eight total devices.

As stated in the “Disk Storage” subsection, the HSC50 and HSC70 controllers, attachable to all VAX-11 systems through the Computer Interconnect, support six and eight HSC5X-CA tape interfaces, respectively. Each HSC5X-CA supports four TA78 and TA81 tape drives in any combination. The HSC50 and HSC70 can each support up to eight TA81, TA78, and TU78 add-on units in any combination. (A TA78 can control three TU78s.)

**PRINTERS:** Up to 16 system printers may be configured with the VAX-11/780 and 11/785. The VAX-11/750 supports up to four printers. ▶

## DEC VAX-11 Systems

### MASS STORAGE

For information on available mass storage devices for VAX systems, please refer to Chart B, Mass Storage.

### INPUT/OUTPUT UNITS

Refer to Chart C for terminals, Chart D for printers, and Chart E for magnetic tape equipment.

**OTHER PERIPHERALS:** The VAX-11 systems also support console terminals, a color printer, a plotter, and a speech synthesis unit. For details on those devices, please refer to the "DEC VAX 8000 Systems" report in this volume.

### COMMUNICATIONS CONTROL

The VAX-11 systems support the same communications controllers as the VAX 8000 systems, with the exception of the DMB32, which is for VAXBI-based systems only. In addition, the VAX-11s support the interfaces detailed in the following paragraphs.

The *DZ11 Asynchronous Multiplexer* is an eight-line unit that provides control for up to eight EIA RS-232-C/CCITT V.28 or 20 ma terminals. The DZ11 operates at program-selectable line speeds up to 9600 bps full-duplex. The DZ11 is compatible with Digital's family of modems and with Bell 100 and 200 Series modems and their equivalents.

The *KMS11 Auxiliary Communications Microprocessor* is a full-duplex, eight-line synchronous communications front-end supporting concurrent data transfers over eight lines in half- or full-duplex with full synchronous modem control at speeds up to 56K bps. Electrical interfaces supported are RS-232-C/CCITT V.28, MIL-188-144 (unbalanced), and V.35.

The *KCT32 Communications Controller* is an intelligent front-end communications processor that permits users to develop networks that, while not based on DECnet, are centered around Digital Equipment products. The KCT32 features 56KB of user-programmable memory and supports two lines at 64K baud per line or a single line at 130K baud, full-duplex. Up to four KCT32s can be configured per system. The KCT32 accommodates on-board-selectable RS-232-C, RS-422, RS-423, and RS-449 standards. Bisync and HDLC framing are provided; the V.35 standard can also be supported.

### SOFTWARE

**OPERATING SYSTEMS:** Like all of Digital Equipment's VAX computers, the VAX-11 systems support the VAX/VMS operating system; they also support the Unix-based Ultrix-32. For details on those two operating systems, please refer to the "DEC VAX 8000 Systems" report in this volume.

The VAX-11/750 also supports a specialized environmental product, *VAXELN*, which acts as a compatible subsystem to the VMS operating system for development of applications in realtime control and distributed computing environments. It consists of development utilities for creating target applications and a runtime kernel of device drivers and service code that becomes a part of each application. Finished programs are entirely memory-resident, although optional disk support is available for data files.

VAXELN applications are written in an optimizing, native-mode version of Pascal. Completed applications can be downline-loaded across network (local or wide area) links or transferred to target systems by disk or tape.

**DATA BASE MANAGEMENT SYSTEM:** The data base management facilities for the VAX-11 systems are the same as those for the VAX 8000s. For details on specific concepts and products, please refer to the "DEC VAX 8000 Systems" report in this volume.

The VAX-11/750 also supports *VAX Rdb/ELN*, a relational data base management system for dedicated or distributed VAXELN environments. Like the VAX Rdb/VMS product, VAX Rdb/ELN uses the Digital Standard Relational Interface, the application interface that allows programs written for either relational product to access data managed by the other. VAX Datatrieve can be used to access VAX Rdb/ELN data bases on the same Ethernet as a VAX/VMS system.

**LANGUAGES:** For details on the languages supported by the VAX-11 systems—which are the same as those for the VAX 8000s—please refer to the "DEC VAX 8000 Systems" report in this volume.

**COMMUNICATIONS:** The communications schemes and products for the VAX-11 systems are the same as those for the VAX 8000s. For details, please refer to the "DEC VAX 8000 Systems" report in this volume.

**UTILITIES:** The utilities and tools available for the VAX-11 systems are the same as those for the VAX 8000 computers. For details, please refer to the "DEC VAX 8000 Systems" report in this volume.

**OFFICE AUTOMATION:** The VAX-11s use the same OA products as the VAX 8000. For specific details, please refer to the "DEC VAX 8000 Systems" report in this volume.

**APPLICATIONS:** For details on application availability for all VAX systems, please refer to the "DEC VAX 8000 Systems" report in this volume.

### PRICING

Pricing policy and support and education availability for the VAX-11 systems are the same as those for the VAX 8000s. For details, please refer to the "DEC VAX 8000 Systems" report in this volume.

**TYPICAL CONFIGURATIONS:** Sample configurations for the VAX-11/750 and VAX-11/785 are provided in the following tables. Complete hardware and software prices follow these configurations.

#### VAX-11/750:

750XA-AE(AJ)	VAX-11/750 CPU, 2MB ECC MOS memory, VAX/VMS license and warranty	\$ 54,000
MS750-CA	1MB ECC MOS expansion memory	4,900
RA81-AA(AD)	RA81 456MB Winchester disk	19,000
UDA50-A	UDA50 disk controller	5,500
RA60-CA(CD)	RA60 205MB removable disk	20,000
DHU11-M	Two DHU11 16-line async communications interfaces	6,840
LA100-BA	LA100 hardcopy console	2,195
VT220-A2(A3)	20 VT220 video terminals	17,600
VT22K-AA	20 VT220 data entry keyboards	4,300
LP11-EA	Two 600-lpm band printers	27,200

TOTAL  
PURCHASE  
PRICE:

\$161,535

## DEC VAX-11 Systems

▶ VAX-11/785:			DHU11-M	Three DHU11 16-line async communications interfaces	10,260
785XD-AE(AJ)	VAX-11/785 CPU, 8MB ECC MOS memory, VAX/VMS license and warranty	\$200,000	LA120-DA VT220-A2(A3) VT22K-AA	LA120 hardcopy console 40 VT220 video terminals 40 VT220 data entry keyboards	2,800 35,200 8,600
RA81-EA(ED)	Three RA81 456MB Winchester disk drives in cabinet	50,000	LP27-UA(UB) LN01S-CA(CB)	1200-/800-lpm band printer 12-ppm laser printer	29,990 19,995
UDA50-A TU81-AA(AB)	UDA50 disk controller TU81 streaming tape subsystem	5,500 25,500	TOTAL PURCHASE PRICE:		
					\$387,845

## EQUIPMENT PRICES

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
<b>VAX SYSTEM BUILDING BLOCKS (SBBs)</b>				
VAX System Building Blocks (SBBs) are available for the VAX-11/750, 11/780, and 11/785. SBBs begin with a core of components: CPU, main memory, cabinetry, and the VAX/VMS or Ultrix-32 operating system license and warranty. To this core the user must add selections from the mass storage (system device and load device), communications device, and console terminal menus. Selections from the software and software services menus are optional.				
<b>VAX-11/785 SBBs</b>				
785XD-AE(AJ)	VAX-11/785 CPU, 8MB of 256K-bit ECC MOS memory, Unibus expansion cabinet, and VAX/VMS license and warranty	200,000	588	700
785XD-BE(BJ)	Same hardware as 785XD-AE(AJ), but with Ultrix-32 license and warranty for 1 to 32 users	205,500	588	700
<b>VAX-11/780 SBBs</b>				
780RA-AE(AJ)	VAX-11/780 CPU, 2MB of 64K-bit ECC MOS memory, Unibus expansion cabinet, and VAX/VMS license and warranty	105,000	427	508
780RA-BE(BJ)	Same components as 780RA-AE(AJ), but with Ultrix-32 license and warranty for 1 to 32 users	110,500	427	508
780RC-AE	VAX-11/780 CPU, 16MB of 256K-bit ECC MOS memory, Unibus expansion cabinet, and VAX/VMS license and warranty	178,000	650	774
<b>VAX-11/750 SBBs</b>				
750XA-AE(AJ)	VAX-11/750 CPU, 2MB ECC MOS memory, and VAX/VMS license and warranty	54,000	237	282
750XA-BE(BJ)	Same hardware as 750XA-AE(AJ), but with Ultrix-32 license and warranty for 1 to 32 users	59,500	237	282

### VAXCLUSTER SBBs

A VAXcluster is composed of one or more VAX-11/750, 11/780, 11/785, or 8000 processors running on VAX/VMS connected by a high-speed bus, one or more mass storage servers, and communication links to the user community. Each cluster element connected to the high-speed bus is referred to as a cluster node. Cluster nodes interconnect via a Star Coupler. There are two types of VAXcluster SBBs. The first type is a basic system element comprising a CPU complex, Star Coupler, high-speed storage controller, disk and tape interfaces, Computer Interconnect, and VAX/VMS and DECnet licenses. Selections must be made from the mass storage (system and load devices), communications devices, and console terminals menus; selections from the software and software services menus are optional. The second type is an upgrade to an existing VAXcluster. It comprises a CPU, main memory, a Computer Interconnect, and VAX/VMS and DECnet licenses.

### VAX-11/785 VAXcluster SBBs

785CE-AW(AZ)	Two VAX-11/785 CPUs; 8MB of 256K-bit ECC MOS memory, Floating-Point Accelerator, Computer Interconnect and cables, and Unibus expansion cabinet for each CPU; Star Coupler; HSC50 intelligent I/O controller with four-port disk interface; two VAX/VMS licenses and warranties; and DECnet and DECnet VAXcluster licenses	509,000	1,652	1,967
785CF-AE(AJ)	VAX-11/785 CPU; 8MB of 256K-bit ECC MOS memory; Unibus expansion cabinet; Computer Interconnect and cables; Star Coupler; HSC50 intelligent I/O controller and four-port disk interface; VAX/VMS license and warranty; and DECnet license	284,000	853	1,015

## DEC VAX-11 Systems

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
785CF-AP(AT)	VAXcluster upgrade; includes VAX-11/785 CPU; 8MB of 256K-bit ECC MOS memory; Unibus expansion cabinet; Computer Interconnect and cables; VAX/VMS license and warranty; and DECnet VAXcluster license	231,000	711	846
<b>VAX-11/780 VAXcluster SBBs</b>				
780CD-AE(AJ)	VAX-11/780 CPU; 4MB of 64K-bit ECC MOS memory; Unibus expansion cabinet; Computer Interconnect and cables; Star Coupler; HSC50 intelligent I/O controller and four-port disk interface; VAX/VMS license and warranty; and DECnet license	190,700	757	901
780CD-AP(AT)	VAXcluster upgrade; includes VAX-11/780 CPU; 4MB of 64K-bit ECC MOS memory; Unibus expansion cabinet; Computer Interconnect and cables; VAX/VMS license and warranty; and DECnet VAXcluster license	137,950	615	732
<b>VAX-11/750 VAXcluster SBBs</b>				
750CB-AW(AZ)	VAX-11/750 Minicluster SBB; includes two VAX-11/750 CPUs, each with 4MB of 64K-bit ECC MOS memory; two Computer Interconnects with cables and one 4-node Star Coupler; HSC50 intelligent I/O server and disk interface; two VAX/VMS licenses and warranties; DECnet license; and DECnet VAXcluster license	193,530	800	952
750UB-AW(AZ)	VAX-11/750 Minicluster installed unit upgrade; includes VAX-11/750 CPU with 4MB of 64K-bit ECC MOS memory; two Computer Interconnects with cables and one 4-node Star Coupler; HSC50 intelligent I/O server with disk interface; VAX/VMS license and warranty; and DECnet VAXcluster license	128,280	618	736
750CA-AE(AJ)	VAX-11/750 CPU; 4MB of 64K-bit ECC MOS memory; Computer Interconnect and cables; Star Coupler; HSC50 intelligent I/O server and disk interface; VAX/VMS license and warranty; and DECnet license	131,675	576	686
750CA-AP(AT)	VAXcluster upgrade; includes VAX-11/750 CPU; 4MB of 64K-bit ECC MOS memory; Computer Interconnect and cables; VAX/VMS license and warranty; and DECnet license	78,925	434	517
<b>CPU UPGRADES</b>				
<b>VAX-11/780 Upgrades</b>				
780UP-XA	Kit to upgrade VAX-11/780 with FP780 floating-point to VAX-11/785 with FP785 floating-point; Field Service installation included; requires trade-in	80,000	•	•
780UP-XB	Kit to upgrade VAX-11/780 to VAX-11/785; Field Service installation included; trade-in required	75,000	•	•
11780-VC(VD)	VAX-11/780 processor unit; 2MB of 64K-bit ECC MOS memory; LA120 console terminal; two Massbus adapters; one Unibus adapter; Unibus expansion cabinet; and VAX/VMS license; requires at least one system device (disk) and load device (disk or tape) supported by VAX/VMS	145,600	461	549
<b>VAX-11/750 Upgrade</b>				
11750-VH(VJ)	VAX-11/750 CPU with 1MB of 64K-bit ECC MOS memory; TU58 magnetic tape cartridge; and VAX/VMS license; requirements same as those for 11780-VC(VD)	53,200	255	304
<b>PROCESSOR AND MEMORY OPTIONS</b>				
<b>Options for All VAX-11s</b>				
H7112-A(B)	MOS memory battery backup	1,800	13	15
<b>VAX-11/780 Series Options</b>				
DR780-FA(FB)	General-purpose intelligent interface	18,700	92	110
DW780-AA(AB)	Unibus adapter; requires BA 11-K and DD 11-CK/DK	12,900	41	49
<b>VAX-11/785 Options</b>				
FP785-AA(AB)	High-performance floating-point accelerator for single- and double-precision floating-point instructions plus POLY, EMOD, and MULL; power supply included	14,000	53	63

\*Contact vendor.  
NA—Not applicable.  
NC—No charge.

## DEC VAX-11 Systems

		<b>Purchase Price (\$)</b>	<b>Basic Service (Monthly) (\$)</b>	<b>DECserv. (Monthly) (\$)</b>
<b>VAX-11/780 Options</b>				
FP780-AA(AB)	High-performance floating-point accelerator for single- and double-precision floating-point instructions plus POLY, EMOD, and MULL; power supply included	11,200	53	63
KE780-A	Extended range G&H floating-point data type option; includes microcode, single-user license, and support hardware; requires KU780-A	1,500	NC	NC
KU780-A	2K 99-bit words of User Control Store	11,000	56	67
<b>VAX-11/750 Options</b>				
FP750	High-performance floating-point accelerator for single- and double-precision F&D floating-point instructions plus POLY, EMOD, and MULL	8,500	47	56
DR750-F	Intelligent, high-performance, general-purpose interface to connect customer-designed devices to a VAX-11/750, to connect two VAX-11/750 systems together, or to connect a VAX-11/750 to a VAX-11/780 using a DR780	7,000	58	69
DW750	Second Unibus adapter	7,000	21	25
KU750-YG	Extended-range G&H floating-point data type option supported in KU750-loadable microcode; includes microcode, single-user license, and support hardware	6,000	49	58
<b>MEMORY EXPANSION OPTIONS</b>				
<b>VAX-11/780 Series Options</b>				
MS780-EC(ED)	2MB of 64K-bit ECC MOS memory with memory backplane, SBI interface, and one interleaved controller; includes power supply	28,900	132	157
MS780-FA	2MB of 64K-bit ECC MOS expansion memory; requires CPU with MS780-E memory or MS780-E upgrade	9,000	61	73
MS780-FB	4MB of 64K-bit ECC MOS expansion memory; same requirements as MS780-FA	12,240	122	145
MS780-FC	6MB of 64K-bit ECC MOS expansion memory; same requirements as MS780-FA	17,280	183	218
MS780-FF	10MB of 64K-bit ECC MOS expansion memory; same requirements as MS780-FA	27,900	305	363
MS780-HC(HD)	8MB of 256K-bit ECC MOS expansion memory; requires CPU with MS780-H memory	47,900	212	252
MS780-JA	8MB of 256K-bit ECC MOS expansion memory with controller; expandable to 64MB	28,000	144	171
<b>VAX-11/750 Options</b>				
MS750-CA	1MB of 64K-bit ECC MOS expansion memory; requires CPU with 64KB memory controller or MS750-D upgrade	4,900	30	36
MS750-CB	2MB of 64K-bit ECC MOS expansion memory; same requirement as MS750-CA	6,480	61	73
MS750-CC	3MB of 64K-bit ECC MOS expansion memory; same requirement as MS750-CA	9,090	91	108
MS750-CD	4MB of 64K-bit ECC MOS expansion memory; same requirement as MS750-CA	11,520	122	145
MS750-DA	Memory controller with 1MB of ECC MOS expansion memory (64K-bit arrays) to replace 16K-bit controller; requires VAX-11/750-BA CPU with serial number BT03096 or greater	10,000	30	36
MS750-DC	Memory controller and backplane with 1MB of ECC MOS expansion memory (64K-bit arrays) to replace 16K-bit controller; requires VAX-11/750-BA CPU with serial number less than BT03096	10,000	30	36
<b>VAXcluster OPTIONS</b>				
CI780-AA(AB)	Microcoded intelligent adapter to the dual path Computer Interconnect; for VAX-11/780 and 11/785	21,450	158	188
CI750-BC(BD)	Same as CI780-AA(AB), but for VAX-11/750	13,425	150	179
CI750-FA(FB)	Two-node starter kit containing two CI750 Computer Interconnect units and a 4-node Star Coupler in a single 40.6-inch (101.6-cm) cabinet	19,900	316	376
CI750-HA(HB)	Two CI750 Computer Interconnect units in a standard 40.6-inch (101.6-cm) cabinet	18,300	300	357
SC008-AC	Star Coupler; 8-node with cabinet; for all VAX 8000 systems	8,250	23	27
SC008-AD	Upgrade to Star Coupler; for 9 to 16 nodes	6,050	23	27
BNCIA-10	CI cable set; 32 ft. (10 m)	600	NC	NC
BNCIA-20	CI cable set; 65 ft. (20 m)	830	NC	NC
BNCIA-45	CI cable set; 145 ft. (45 m)	1,460	NC	NC

\*Contact vendor.  
NA—Not applicable.  
NC—No charge.

## DEC VAX-11 Systems

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
<b>EXPANSION OPTIONS</b>				
<b>Options for All VAX-11s</b>				
BA11-KU(KV)	Rack-mountable expansion box with slides for Unibus expansion cabinet; provides mounting space for five system units and is compatible with DD11-CK/DK expansion backplanes	3,500	25	30
DD11-CK	Expansion backplane mounting for BA11-K box; provides for two hex- and two quad-slot modules; mounts in one system unit	470	NC	NC
DD11-DK	Same as DD11-CK except for providing seven hex- and two quad-slot modules; mounts in two system units	940	NC	NC
DB11-MP	Unibus repeater; adds 19 unit bus loads and up to 50 ft. (15.2 m) of additional Unibus length to the system	2,240	8	10
H9646-CA	60-inch standalone communications cabinet	1,630	NA	NA
H9646-DA	Same as H9646-CA, but without end panels	1,256	NA	NA
H9544-MK	Shelf assembly for H9646 cabinet	54	NA	NA
H9544-JD	60-inch to 40-inch joiner panel to mount H9642	235	NA	NA
<b>VAX-11/780 Series Options</b>				
H9652-HA(HB)	Expansion cabinet; includes SBI backplane and power supply; provides four option panel spaces for additional memory, DW780, DR780, CI780, Massbus adapters, and MA780 multiport interfaces; also includes space for an H7112-A(B) battery backup option	5,000	NC	NC
H9652-MF(MH)	Single-width, high-boy general-purpose Unibus expansion cabinet, with space for two additional BA11-K expander boxes	3,700	NC	NC
<b>VAX-11/750 Options</b>				
H9642-FA(FB)	Unibus expansion cabinet with space for one BA11-K expander box and one 10.5-in. (26.6-cm) disk	2,200	NC	NC
H9642-FC(FD)	Fully shielded cabinet with controller, I/O connector panel, and space for a BA11-K or BA11-A expander box	2,050	NC	NC
<b>MASS STORAGE</b>				
HSC50-AA(AB)	HSC50 intelligent I/O server with space for six HSC5X; cables not included	34,500	100	119
HSC5X-BA(BB)	Data channel interface for interfacing up to four disk drives	9,500	45	54
HSC5X-EA(EB)	Second power supply for over three HSC5X on the HSC50	3,000	26	31
HSC70-AA(AB)	HSC70 Computer-Interconnect-based intelligent controller; includes space for eight HSC5X-BA; cables not included	51,600	200	238
UDA50-A	Unibus controller; allows attachment of up to four disk drives	5,500	53	63
RA60-AA(AD)	205MB rack-mounted RA60 drive (no cabinet); requires controller and mounting cabinet	17,500	105	125
RA60-CA(CD)	205MB cabinet-mounted RA60-AA add-on drive	20,000	105	125
RA60-EA(ED)	Three 205MB RA60 drives in cabinet	49,000	315	375
RA60-JA(JD)	Four 205MB RA60 drives in cabinet	66,000	420	500
RA60-UA	RA60 reconfiguration kit; for remounting RA60s originally configured in an H9642 cabinet in an H9646 cabinet	400	NA	NA
RA80-AA(AD)	121MB rack-mounted RA80 drive; requires controller and mounting cabinet	14,000	85	101
RA80-CA(CD)	121MB cabinet-mounted RA80 drive; requires controller	16,500	85	101
RUA80-UA(UD)	UDA50 controller for dual-porting RA80, RA81, and RA60 disks; includes cable	5,500	32	38
RA81-AA(AD)	456MB rack-mounted RA81 drive; requires controller and mounting cabinet	19,000	95	113
RA81-CA(CD)	456MB cabinet-mounted RA81 drive; requires controller	21,500	95	113
RA81-EA(ED)	Three 456MB RA81 drives mounted in a cabinet; requires controller	50,000	284	338
RA81-FA(AD)	456MB cabinet-mounted RA81 drive; requires controller	23,000	95	113
RA81-HA(HD)	456MB rack-mounted RA81 drive; requires controller, cabinet, and cable	18,640	95	113
RA81-JA(JD)	Four cabinet-mounted 456MB RA81 disk drives; requires controller	68,000	380	452
RA81-UA	RA81 reconfiguration kit; required for remounting RA81s originally configured in an H9642 cabinet; not required for RA81-AA	400	NA	NA
RL211-AK	10.4MB RLO2 top-loading, rack-mounting, removable cartridge drive and controller with interconnect cabling	7,900	75	89
RLO2-AK	10.4MB RLO2 add-on cartridge drive; requires RL211-AK	4,200	72	86
RLO2K-DC	10.4MB cartridge for the RLO2	230	NA	NA
RUC25-AA(AB)	Tabletop 26MB/26MB RC25 fixed/removable disk drive with Unibus adapter	6,250	39	46
RUC25-BA(BB)	Rack-mounted 26MB/26MB RC25 fixed/removable disk drive with Unibus adapter	6,250	39	46
RC25-DA(DB)	Tabletop add-on RC25 disk drive	5,500	33	39
RC25-EA(EB)	Rack-mounted add-on RC25 disk drive	5,500	33	39
RC25K-DC	Removable 26MB RC25 cartridge	299	NA	NA

\*Contact vendor.  
NA—Not applicable.  
NC—No charge.

## DEC VAX-11 Systems

		<b>Purchase Price (\$)</b>	<b>Basic Service (Monthly) (\$)</b>	<b>DECserv. (Monthly) (\$)</b>
<b>MAGNETIC TAPE EQUIPMENT</b>				
HSC70-AA(AB)	HSC70 Computer-Interconnect-based intelligent controller; includes space for eight HSC5X-CA; cables not included	51,600	200	238
HSC5X-CA	Tape interface for HSC50 I/O controller	9,500	45	54
TA78-BF(BJ)	TA78 PE/GCR tape subsystem; requires HSC50 with HSC5X-CA	52,000	357	425
TA81-AA(AB)	TA81 magnetic tape subsystem	29,500	150	179
TU81-AA(AB)	TU81 9-track streaming tape subsystem	25,500	140	167
TU80-AA(AB)	TU80 9-track magnetic tape subsystem in cabinet	12,500	89	106
TU78-AB(AD)	TU78 magnetic tape transport and formatter; requires TM78-C for dual-porting capability	48,000	322	383
TU78-AF(AJ)	TU78 magnetic tape transport without formatter; requires TU78 master	25,500	196	233
TM78-C	TU78 dual-port kit containing drive logic and cables to provide dual-porting capability	5,150	21	25
TGU78-FB(FD)	TU78 magnetic tape transport, formatter, and VAX-11/750 Massbus adapter	54,000	357	425
TEU78-FF(FJ)	Dual-ported TU78 magnetic tape transport, formatter, and two VAX-11/780 Massbus adapters	68,600	441	525
TU77-AF(AJ)	TU77 magnetic tape transport	23,800	222	264
TGU77-FB(FD)	TU77 magnetic tape transport, formatter, and VAX-11/750 Massbus adapter	36,800	272	324
TEU77-FB(FD)	TU77 magnetic tape transport, formatter, and VAX-11/780 Massbus adapter	36,800	272	324
TSU05-AA(AB)	Unibus TS05 magnetic tape subsystem with hardware for rack-mounting, control module, and cables; also available in 100 VAC (-AC) and 220 VAC (-AD) models	13,500	89	106
TK50-DA/-DB	TK50 desktop cartridge tape drive (120/240 VAC); includes 9-ft. cable	3,095	22	26
TK50-RA/-RB	TK50 rack-mounted cartridge tape drive (120/240 VAC); includes 9-ft. cable	3,095	22	26
TK50-K	CompacTape cartridge for TK50	29	NA	NA
TUK50-AB	Unibus controller for TK50-DX/RX drives; includes cabinet and bulkhead plate	1,895	8	10
<b>UNIBUS ASYNCHRONOUS OPTIONS</b>				
DMF32-M	Eight-line asynchronous multiplexer with single-line synchronous interface and dual-purpose parallel interface; for Unibus	2,815	58	69
DHU11-M	16-line multiplexer with direct memory access and full modem control for EIA/CCITT terminals; includes base module only; requires appropriate external cables and cabinet kit	3,420	45	54
DMZ32-M	24-line multiplexer with direct memory access for EIA/CCITT terminals; base module only, without modem control; requires appropriate cables and cabinet kit	3,215	90	107
DMZ32-N	Base module, modem control upgrade kit	700	NA	NA
DZ11-M	Eight-line multiplexer to connect EIA RS-232-C/CCITT V.28 or 20 ma terminals to a Unibus system; base module only; requires appropriate external cables and cabinet kit	2,440	35	42
DZ11-N	20 ma interface; base module only; requires appropriate external cables and cabinet kit	2,235	35	42
<b>UNIBUS SYNCHRONOUS OPTIONS</b>				
DMR11-M	Single-line interface for EIA/CCITT devices; base module only; requires appropriate external cable and cabinet kit	4,975	41	49
DUP11-M	Single-line, programmable EIA/CCITT interface	1,485	13	15
DMP11-M	Single-line, microprocessor-controlled EIA/CCITT interface; base module only; requires appropriate external cable and cabinet kit	9,290	78	93
<b>ETHERNET COMMUNICATIONS</b>				
DEUNA-M	Ethernet-to-Unibus synchronous communications controller	3,775	44	52
DELUA-M	Ethernet/IEEE 802.3 Unibus single-line interface communications controller	3,275	33	39
H4000	Ethernet transceiver	325	4	5
H4005	Ethernet/IEEE 802.3; version A has heartbeat, version B has not	300	.	.
DELNI-AA	Local Network Interconnect; supports up to eight Ethernet-compatible, nonterminal devices	1,275	10	12
DECSA-DA	32-line terminal server with 16 DCSAX-LC line cards	20,000	354	421
DECSK-AA	U.S. country kit for DECSA-DA; includes power cord, hardware manuals, and labels with front panel display; required	25	NC	NC
DCSAX-LC	Two-line asynchronous EIA RS-232-C/CCITT V.28 line card	375	7	8
DSRVA-AA	Eight-line DECserver 100, 120 V; includes U.S. country kit	2,950	30	36

\*Contact vendor.  
NA—Not applicable.  
NC—No charge.

## DEC VAX-11 Systems

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
<b>COMMUNICATIONS PROCESSORS</b>				
KMS11-BD	Intelligent, full-duplex, eight-line, synchronous communications front-end interface; includes auxiliary processor unit, line terminator, modem control unit, I/O connection panel, double system unit, and internal cables	12,500	102	121
KMS11-BE	Same as KMS11-BD without double system unit	12,200	102	121
KMS1P-M	One-line intelligent synchronous communications controller; includes micro-processor and line unit modules	5,710	80	95
KCT32-AB	Dual-line communications sync/async controller; includes 56KB of user-programmable memory	5,200	80	95
KCT32-AD	Basic KCT32 system unit with one sync/async dual-line T11 communications board	4,300	80	95
KCT32-AE	EIA RS-422/CCITT V.11 version of KCT32 with basic system unit, interface panel, and test connector	4,700	80	95
KCT32-FA	EIA RS-232-C/CCITT V.28 version of KCT32 with basic system unit, interface panel, and test connector	4,700	80	95
KCT32-FF	EIA RS-423/RS-449 version of KCT32 with basic system unit, interface panel, and test connector	4,700	80	95
<b>BAND PRINTERS</b>				
LP11-AA	132-column, 64-character LP25 Unibus band printer; 300 lpm	8,350	105	125
LP11-BA	132-column, 64- and 96-character LP25 Unibus band printer; 300/215 lpm	8,950	105	125
LP32-AA	132-column, 64-character LP25 printer and universal power supply, 300 lpm; prerequisite, DMF32 Unibus controller	8,350	98	117
LP32-BA	Same as LP32-AA, but can also operate at 215 lpm with a 96-character set	8,950	98	117
LSP25-CA	Longline LP25 Unibus printer, 300/215 lpm; includes U.S./U.K. bands, universal power supply, and 50-ft. cable	9,990	119	142
LP11-EA	LP26 Unibus band printer, 600 lpm	13,600	150	179
LP11-EB	LP26 Unibus band printer, 600/445 lpm; includes both 64- and 96-character sets	14,400	150	179
LP32-EA	LP26 Unibus band printer, 600 lpm; includes 30-ft. cable; requires DMF32 controller	13,600	143	170
LP32-EB	LP26 Unibus band printer, 600/445 lpm; includes both 64- and 96-character sets and 30-ft. cable; requires DMF32 controller	14,400	143	170
LSP26-CA	Longline LP26 Unibus band printer, 300/215 lpm; includes U.S./U.K. bands, universal power supply, and 50-ft. cable	15,600	172	205
LP27-UA(UB)	LP27 Unibus band printer, 1200/800 lpm	29,990	259	308
LP27-DA(DB)	Longline LP27 Unibus band printer, 1200/800 lpm	32,990	310	369
LP27-VA(VB)	LP27 Unibus band printer with 30-ft. data cable and controller; requires DMF32	28,990	252	300
<b>MATRIX LINE PRINTERS</b>				
LG01-AA	600-lpm matrix text printer with 64-character data processing mode; Unibus device	11,950	128	152
LG01-CA	Same type as LG01-AA, but requires DMF32 controller	11,950	118	140
LG02-AA	600-lpm matrix text and graphics printer with 64-character data processing mode; Unibus device	14,000	128	152
LG02-CA	Same type as LG02-AA, but requires DMF32 controller; includes 30-ft. cable	14,000	118	140
LG02-DA	Same type as LG02-AA, but requires DMF32 controller and RS-232-C serial interface; includes 25-ft. cable	14,000	118	140
LG01-UG	Upgrade kit to convert LG01 to LG02	3,500	NA	NA
<b>LASER PRINTERS</b>				
LN01S-CA	12-ppm laser printer with LP11 interface and 30-ft. cable	19,995	353	420
LN01S-DA	Same as LN01S-CA, but with DMF32-compatible interface	19,995	353	420
LN01B-CA(CB)	12-ppm laser printer; includes PLOTTLN VMS software, EPROMs, LP11 interface, and 30-ft. cable	13,995	310	369
LN01B-DA(DB)	Same as LN01B-CA(CD), but with DMF32 interface	13,995	310	369
LN01K-AA	Parallel longline kit for operation up to 1,000 ft. from CPU; cables not included	1,995	20	24
LN01K-LS	Serial RS-232-C kit	495	5	6
LN03-AA	8-ppm desktop laser printer; includes two toner cartridges, organic photo receptor (OPC) cartridge, AC power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation	3,495	49	58

\*Contact vendor.  
NA—Not applicable.  
NC—No charge.

## DEC VAX-11 Systems

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
<b>PRINTERS/PLOTTERS</b>				
LXY12-CA(CB)	Freestanding line printer/plotter, 170/240/300 lpm; with LP11 controller for Unibus interface, 30-ft. cable, pedestal with basket, and paper guide	11,250	104	124
LXY12-DA(DB)	Same type as LXY12-CA(CB), but with RS-232-C interface cable, pedestal with basket, and paper guide	11,250	104	124
LXY12-EA(EB)	Same type as LXY12-CA(CB), but with DMF32 interface cable, pedestal with basket, and paper guide	11,250	104	124
LXY22-CA(CB)	Freestanding line printer/plotter, 320/465/600 lpm; with LP11 controller for Unibus interface, 30-ft. cable, pedestal with basket, and paper guide	15,800	135	161
LXY22-DA(DB)	Same type as LXY22-CA(CB), but with RS-232-C interface cable, pedestal with basket, and paper guide	15,800	135	161
LXY22-EA(EB)	Same type as LXY22-CA(CB), but with DMF32 interface cable, pedestal with basket, and paper guide	15,800	135	161
<b>COLOR GRAPHICS PEN PLOTTER</b>				
LVP16-AA	Six-color graphics pen plotter, 15 ips; includes RS-232-C interface, documentation, and initial supplies; requires interface cable	1,995	10	12
<b>COLOR PRINTER</b>				
LCP01-AA	Inkjet color printer with graphics processor	14,595	125	149
<b>RECEIVE-ONLY PRINTING TERMINAL</b>				
LA120-RA	DECprinter III, 180 cps; for use with 1- to 6-part forms	2,420	39	46
<b>CONSOLE TERMINALS</b>				
LA100-BA	KSR 30/80/240 cps hardcopy terminal with keyboard, numeric keypad, tractors, cable, ribbon cartridge, package of paper, and Courier-10/Orator-10 fonts in U.S./U.K. character sets only	2,195	27	32
LA10X-SL	Stand for LA100-BA; required with VAX-11/780 and 11/785; optional with 11/750	159	NA	NA
LA120-DA	Freestanding DECwriter III KSR hardcopy terminal; 180 cps bidirectional	2,800	34	40
<b>TERMINALS</b>				
VT220-A2(A3)	VT220 terminal with white phosphor, nonglare screen	880	12	14
VT220-B2(B3)	VT220 terminal with green phosphor, nonglare screen	880	12	14
VT220-C2(C3)	VT220 terminal with amber phosphor, nonglare screen	880	12	14
VT22K-AA	Data entry keyboard for VT220	215	NC	NC
VT22K-BA	Word processing keyboard for VT220	215	NC	NC
VT22X-AA	Integral 300-/1200-baud auto-answer modem for VT220 series	395	6	7
VT240-A2(A3)	VT240 text/graphics terminal; includes monochrome monitor, system box with logic and power supply, and keyboard; white phosphor, nonglare screen	1,980	19	23
VT240-B2(B3)	VT240 terminal with green phosphor, nonglare screen	1,980	19	23
VT240-C2(C3)	VT240 terminal with amber phosphor, nonglare screen	1,980	19	23
VT241-AA	VT241 color text/graphics terminal; includes monitor, system box with logic and power supply, and keyboard	2,980	26	31
VT24K-AA	Data entry keyboard for VT240/VT241 terminals	215	NC	NC
VT24K-BA	Word processing keyboard for VT240/VT241 terminals	215	NC	NC
VT24X-AA	300-/1200-baud autodial integral modem for VT240 series	495	6	7
<b>VOICE SYNTHESIS MODULE</b>				
DTC01-AA	Single-line DECTalk text-to-speech unit; includes cable	4,000	22	26
DTC03-AA	8-channel DECTalk text-to-speech unit; cables not included	24,000	500	595

\*Contact vendor.  
NA—Not applicable.  
NC—No charge.

## DEC VAX-11 Systems

### SOFTWARE PRICES

License  
Fee\*  
(\$)

#### VAX/VMS SOFTWARE

##### Operating System

QD001-UZ	VAX/VMS for VAX-11/750	11,000
QE001-UZ	VAX/VMS for VAX-11/780 and 11/785	12,000

##### Communications

QXD05-UZ	DECnet-VAX	4,648
QX545-UZ	DECnet/SNA Gateway	2,000
QX727-UZ	DECnet Router/X.25 Gateway	2,926
QX044-UZ	DECnet/SNA VMS Printer Emulator	1,000
QX070-UZ	Mux200/VAX	6,380
QX708-UZ	DECdx/VMS	2,585
QX071-UZ	VAX Packetnet System Interface (PSI) and PSI Access	1,650
QX111-UZ	VAX 2780/3780 Protocol Emulator	5,300
QX112-UZ	VAX 3271 Protocol Emulator	6,400
QX730-UZ	VMS Message Router	2,420
QX416-UZ	VAX Bisynchronous Terminal Support (BTS)	1,650
QX726-UZ	Ethernet Terminal Server	1,000
QX925-UZ	DECserver 100 Terminal Server	150

##### Data Base Management/Data Management

QX897-UZ	VAX Common Data Dictionary (CDD)	1,452
QX898-UZ	VAX Datatrieve; requires VAX CDD	7,260
QX899-UZ	VAX DBMS; requires VAX CDD	14,520
QX706-UZ	VAX Terminal Data Management System (TDMS); requires VAX CDD	3,025
QX079-UZ	VAX Application Control and Management System (ACMS); requires VAX CDD	10,890
QX354-UZ	VAX Rdb/VMS	9,900

##### Languages

QX056-UZ	VAX Ada	27,390
QX020-UZ	VAX APL	8,767
QX095-UZ	VAX Basic	5,844
QX014-UZ	VAX Bliss-16	6,050
QX106-UZ	VAX Bliss-32	6,353
QX015-UZ	VAX C	5,198
QX099-UZ	VAX Cobol	8,767
QX018-UZ	VAX Dibol	4,565
QX130-UZ	VAX Digital Standard Mumps (DSM)	9,900
QX100-UZ	VAX Fortran	5,687
QX107-UZ	Fortran IV/VAX-to-RSX Cross Compiler	770
QX917-UZ	VAX Lisp	8,800
QX913-UZ	VAX OPS5	5,500
QX126-UZ	VAX Pascal	5,198
QX114-UZ	VAX PL/1	8,767
QX631-UZ	VAX RPG II	3,465

#### ULTRIX-32 SOFTWARE

##### Operating System

QX821-UZ	Ultrix-32 maximum 32-user license only	17,050
QX822-UZ	32-user to 64-user Ultrix-32 upgrade	4,400
QE823-UZ	64-user to 65+ -user Ultrix-32 upgrade; for VAX-11/780 and 11/785	5,500
QE824-UZ	32-user to 65+ -user Ultrix-32 upgrade; for VAX-11/780 and 11/785	8,250
QX825-UZ	Ultrix-32 encryption license	220

##### Communications

QX716-UZ	DECnet-Ultrix	1,848
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##### Language

QX917-UZ	VAX Lisp-Ultrix	8,800
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\*Non-hardware-dependent single-use license and warranty. An "X" in an order number stands for the following specific Digital ordering designations: "D" for VAX-11/750 and "E" for VAX-11/780 and 11/785. ■