

# DEC VAX-11 Systems

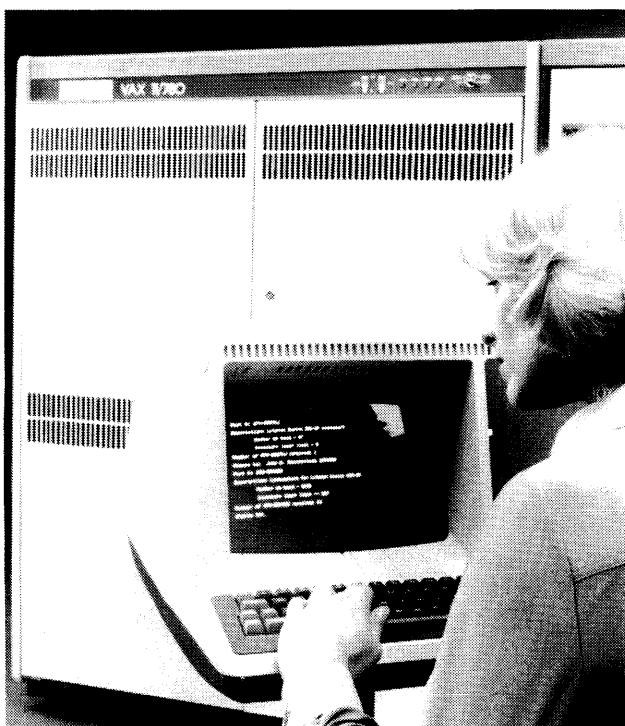
**UPDATE:** Over a decade after their announcement, Digital Equipment's VAX-11 Systems remain a touchstone of supermini performance. Digital continues to gauge the performance of recently announced VAX Systems—such as the 6200 Series, rolled out in April 1988—relative to that of the 1978-vintage VAX-11/780, which anchored the VAX line from its inception until the mid-1980s.

Because the VAX-11 Systems played such a significant role in establishing the midrange systems marketplace, and because Digital still uses them as reference points for system performance, Datapro continues to publish the specifications and last available CPU prices on the VAX-11/750, VAX-11/780, and VAX-11/785—the last VAX-11 models that Digital offered.

## CHARACTERISTICS

The VAX-11 Systems share many architectural and functional characteristics with Digital Equipment's newer VAX 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 Systems" report in *Datapro Reports on Minicomputers*.

**MANUFACTURER:** Digital Equipment Corporation, 146 Main Street, Maynard, Massachusetts 01754-2571. Telephone (508) 897-5111.



Digital Equipment's VAX-11/780 remains a standard by which supermini performance is measured. However, technological advances now allow mid-range MicroVAXes to deliver twice as much computing power as this old standby.

Although no longer marketed, Digital Equipment Corporation's VAX-11 Systems were long regarded as the standard of supermini systems. Although the VAX-11s have been replaced by systems ranging from the MicroVAX 3500 to the high-end VAX 8800 Series, support for Digital's VMS operating environment provides software compatibility and portability among old and new machines alike.

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

**MAIN MEMORY:** 2M bytes to 64M bytes.

**DISK CAPACITY:** 121M bytes to 218.8G bytes.

**WORKSTATIONS:** Up to 384 local.

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

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

## DATA FORMATS

**BASIC UNIT:** 32-bit word.

**FIXED-POINT OPERANDS:** Please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**FLOATING-POINT OPERANDS:** The VAX instruction set supports floating-point data in longwords, quadwords, and octwords. Four types of floating-point data are available. Two types—D and G—are 8 bytes long; the third type—F—is 4 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 performs 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 operations. For additional information, refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

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

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CHART A. SYSTEM COMPARISON

MODEL	VAX-11/750	VAX-11/780	VAX-11/785
SYSTEM CHARACTERISTICS			
Date of introduction	October 1980	October 1977	April 1984
Date of first delivery	November 1980	January 1978	June 1984
Operating system	VMS, ULTRIX-32, VAXELN	VMS, ULTRIX-32	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
MEMORY			
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
INPUT/OUTPUT CONTROL			
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.)
MINIMUM DISK STORAGE	121MB	121MB	121MB
MAXIMUM DISK STORAGE	19GB local; 218.8GB in VAXcluster	30GB local; 218.8GB in VAXcluster	30GB local; 218.8GB in VAXcluster
NUMBER OF WORKSTATIONS	128	384	384
COMMUNICATIONS PROTOCOLS	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
PURCHASE PRICE (Base systems)	From \$54,000	From \$105,000	From \$200,000

### ► 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 166 to 400 nanoseconds. Refer to Chart A for the cycle times of individual machines.

**CAPACITY:** Main memory capacities range from 2M bytes to 64M bytes. All VAX Systems provide up to 4G bytes of virtual memory space. For the main memory capacities of specific 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 VMS operating system is 512K bytes on all three systems and 2M bytes on VAX-11/780 and -11/785 VAX-clusters 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 8K bytes of cache memory. The VAX-11/780 can be upgraded to a VAX-11/785.

Except for cache memory size (32K bytes) 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 48K bytes of console memory, up from 16K bytes on the -11/780. Instruction microcode for the -11/785 is stored in RAM, rather than in ROM, as

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► 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 (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 16K bytes (-11/780) or 48K bytes (-11/785) of read/write memory and 8K 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 4K-byte bipolar cache memory, 10K-byte 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 microcode package for extended precision, floating-point arithmetic operations.

**REGISTERS:** Please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**ADDRESSING:** Please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**INTERRUPTS:** Please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**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, 30.0 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 (I/O) information provided here is for systems running under 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 1.5M bytes per second. Maximum system I/O rate on the VAX-11/785 is 13.3M bytes 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 discontiguous 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 Systems" report in *Datapro Reports on Minicomputers*.

### 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 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 6200 or 8000) processors and/or Hierarchical Storage Controllers run-

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► ning under VMS and connected by a high-speed Computer Interconnect bus. For specific details on VAXclusters, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

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 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 VMS and DECnet licenses. A communications device and a console terminal must also be ordered with the upgraded SBB; mass storage devices can also be ordered.

Available for the VAX-11/750 is a dual-processor VAXminicuster. Each CPU comes with 4M bytes 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 VAXminicuster.

A dual-CPU VAXcluster is also offered for the VAX-11/785. Each CPU comes with 8M bytes 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 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, 8M bytes of main memory, an H9652 UNIBUS expansion cabinet with BA11-K expansion box and DD11-DK backplane, and a 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 64M bytes with 256K-bit MS780-H memory. The memory must be added in 8M-byte 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 2M bytes of 64K-bit memory or 16M bytes of 256K-bit memory, a DW780 UNIBUS adapter, and two option panel spaces. Also included is an H9652 UNIBUS 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 16M bytes; another 16M bytes can be added in the H9652 expansion cabinet. Using 256K-bit MS780-H memory in 8M-byte increments, main storage can be expanded to 64M bytes; 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 UNIBUS 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, 2M bytes of main memory, UNIBUS adapter, and 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 6M bytes of MS750 memory can be added to the VAX-11/750 (for up to 8M bytes 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 second DW750 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-C/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 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 (205M-byte fixed/removable), RA80 (121M-byte Winchester), and RA81 (456M-byte 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 10.4M-byte RL02 cartridge drive (four per system), the RC25 ►

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- 52M-byte fixed/removable drive (one per system), and the RX50 818K-byte 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 516M-byte RP07 fixed disk drive (as data disk only) and 256M-byte 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, or 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 or TA81 tape drives in any combination. The HSC50 and HSC70 can each support up to eight TA81, TA78, or 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.

### COMMUNICATIONS CONTROL

The VAX-11 Systems support the same UNIBUS communications controllers as the newer VAX Systems. (They do not support devices configurable solely on VAXBI-bus-based systems, however.) 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 56K bytes 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 VMS operating system; they also support the UNIX-derived ULTRIX-32. For details on these two operating systems, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

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 other VAXs. For details on specific concepts and products, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

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 VMS system.

**LANGUAGES:** For details on the languages supported by the VAX-11 Systems—which are the same as those for the other VAXs—please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**COMMUNICATIONS:** The communications schemes and products for the VAX-11 Systems are the same as those for the other VAXs. For details, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**UTILITIES:** The utilities and tools available for the VAX-11 Systems are the same as those for the other VAX computers. For details, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

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► **OFFICE AUTOMATION:** The VAX-11s use the same OA products as the newer VAXs. For specific details, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

**APPLICATIONS:** For details on application availability for all VAX Systems, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

### PRICING

Pricing policy and support and training for the VAX-11 Systems are the same as for the newer VAX computers. For details, please refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

The last published CPU prices follow.

### EQUIPMENT PRICES

	Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
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#### VAX SYSTEM BUILDING BLOCKS (SBBs)

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 VMS or ULTRIX-32 operating system license and warranty. To this core the user must add mass storage (system device and load device), communications device, and console terminal selections. Software and software services selections are optional.

#### VAX-11/785 SBBs

785XD-AE(AJ)	VAX-11/785 CPU, 8MB of 256K-bit ECC MOS memory, UNIBUS expansion cabinet, and VMS license and warranty	200,000	715	851
785XD-BE(BJ)	Same hardware as 785XD-AE(AJ), but with ULTRIX-32 license and warranty for 1 to 32 users	205,500	715	700

#### VAX-11/780 SBBs

780RA-AE(AJ)	VAX-11/780 CPU, 2MB of 64K-bit ECC MOS memory, UNIBUS expansion cabinet, and VMS license and warranty	105,000	588	700
780RA-BE(BJ)	Same components as 780RA-AE(AJ), but with ULTRIX-32 license and warranty for 1 to 32 users	110,500	588	700
780RC-AE	VAX-11/780 CPU, 16MB of 256K-bit ECC MOS memory, UNIBUS expansion cabinet, and VMS license and warranty	178,000	588	700

#### VAX-11/750 SBBs

750XA-AE(AJ)	VAX-11/750 CPU, 2MB ECC MOS memory, UNIBUS adapter, and VMS license and warranty	54,000	262	312
750XA-BE(BJ)	Same hardware as 750XA-AE(AJ), but with ULTRIX-32 license and warranty for 1 to 32 users	59,500	262	312

#### VAXCLUSTER SBBs

A VAXcluster is composed of one or more VAX-11 or VAX processors running on 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 called 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 VMS and DECnet licenses. Mass storage devices (system and load), communications devices, and console terminals must be selected; software and software services selections are optional. The second type is an upgrade to an existing VAXcluster. It comprises a CPU, main memory, a Computer Interconnect, and 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 VMS licenses and warranties; and DECnet and DECnet VAXcluster licenses	509,000	2,126	2,531
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; VMS license and warranty; and DECnet license	284,000	1,041	1,239
785CF-AP(AT)	VAXcluster upgrade; includes VAX-11/785 CPU; 8MB of 256K-bit ECC MOS memory; UNIBUS expansion cabinet; Computer Interconnect and cables; VMS license and warranty; and DECnet VAXcluster license	231,000	873	1,039

**DEC VAX-11 Systems****VAX-11/780 VAXcluster SBBs**

		<b>Purchase Price (\$)</b>	<b>Basic Service (Monthly) (\$)</b>	<b>DECserv. (Monthly) (\$)</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; VMS license and warranty; and DECnet license	190,700	914	1,088
780CD-AP(AT)	VAXcluster upgrade; includes VAX-11/780 CPU; 4MB of 64K-bit ECC MOS memory; UNIBUS expansion cabinet; Computer Interconnect and cables; VMS license and warranty; and DECnet VAXcluster license	137,950	746	888

**VAX-11/750 VAXcluster SBBs**

750CB-AW(AZ)	VAX-11/750 Miniclusler 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 VMS licenses and warranties; DECnet license; and DECnet VAXcluster license	193,530	1,001	1,192
750UB-AW(AZ)	VAX-11/750 Miniclusler 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; VMS license and warranty; and DECnet VAXcluster license	128,280	1,001	1,192
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; VMS license and warranty; and DECnet license	131,675	588	700
750CA-AP(AT)	VAXcluster upgrade; includes VAX-11/750 CPU; 4MB of 64K-bit ECC MOS memory; Computer Interconnect and cables; VMS license and warranty; and DECnet license ■	78,925	420	500