DEC VAXstations

In this report:

Product Summary

Vendor
Digital Equipment Corp. (DEC)
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Product Type
Technical graphics workstations.

Editor's Note
Digital Equipment Corporation has again overhauled its VAXstation product line, introducing three new models: VAXStation 3100, 3520, and 3540.

Models
VAXstations 3100, 3200, 3500, 3520, and 3540.

System Requirements
The basic system package includes CPU, main memory, monitor, disk drive, and software (VMS or ULTRIX). ULTRIX-32 systems that are not networked require a TK50 tape drive.

Competitors
HP/Apollo, Sun Microsystems, and IBM.

Product Description
The VAXstations are desktop, technical graphics workstations ranging from small, diskless 2-D stations to multiprocessing 3-D stations.

Strengths
- VAXcluster networking capabilities
- Availability of diskless systems

Limitations
- Product line turnover

Price
Ranges from $7,950 to $52,818.

GSA Schedule
Yes.

Analysis

Product Strategy

The new VAXstation 3100 replaces the VAXstation 2000 at the low end of the line. VAXstations 3520 and 3540 are the new 3-D graphics engines, replacing the VAXstation 8000 at the high end. With *two* 3-D stations at the high end, Digital becomes a more credible contender in the technical workstation marketplace. The new product line offers improved memory, CPU performance, and pricing over the previous line.

Low End Sells Well

Digital's entire VAXstation line has sold well, but the bulk of the units shipped have been low-end VAXstation 2000s, which are frequently employed in diskless configurations networked around a server. Similar popularity is predicted for the new VAXstation 3100.

Digital increased the main memory capacity of the low-end machines to 32M bytes, surpassing the Sun 386i family's 16M-byte capacity.

Developing the High End

Digital has, in effect, shrunk the low end to expand the high end of the VAXstation line with its latest workstations. Digital's new emphasis on developing the high-performance workstations, as evidenced with the 3520 and 3540, will help it deliver an integrated line that can take full advantage of the company's networking capabilities. In a mechanical engineering application, for example, the VAXstation 3100 can be used for drafting; the design can be sent to the VAXstation 3200 or 3500 for modeling and testing and then on to the 3540 for wireframe, surface, and solids manipulation and graphic display.

Facing New Competition

Digital was forced to boost the power of its high-end offerings to compete with Sun. The company now also has stronger product offerings to compete with the new workstation giant, Hewlett-Packard/Apollo.

The UNIX Factor

A UNIX license has become integral to most workstations, and Digital can capitalize on this development if it maintains its commitment to delivering UNIX-compatible machines, especially at the high end.

A major shortcoming of the 3-D VAXstation 8000 was that it only supported VMS. Digital has corrected this problem with the VAXstation 3520, a 3-D station that supports both VMS and ULTRIX, Digital's implementation of the UNIX operating system. The more powerful VAXstation 3540, however, runs only under VMS.

Industry analysts predict healthy growth in the UNIX workstation market, and Digital's improved ULTRIX VAXstation line (not to mention the ULTRIX-only DECstation line) may be its ticket to market success.

Digital PHIGS

Previously available only under VMS, Digital's implementation of the popular Programmer's Hierarchical Interactive Graphics System (PHIGS) is now offered under ULTRIX as well as VMS. PHIGS, a 3-D graphics tool, provides the interface between an application program and the underlying graphics system, controlling the definition, modification, and display of hierarchical graphics data. This new ULTRIX compatibility reaffirms Digital's commitment to its VAXstation strategy for delivery under two separate operating environments.

DECwindows

Filling another gap in its UNIX offerings, Digital announced support for DECwindows under ULTRIX as well as under VMS. DECwindows is Digital's implementation of the X Window Version 11 interface mechanism. It allows users to run VMS, ULTRIX-32, and MS-DOS windows from the same workstation. Digital has proven its commitment to the UNIX workstation market with these latest product deliveries.

Company Profile Digital Equipment Corporation

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Sr. VP, Eng. & Mfg.: John F. Smith
Pres. & CEO, European Operations: Pier Carlo Falotti

Company Background
Year Founded: 1957
No. Employees: 125,000
No. of Systems Sold (cumulative): Over 500,000

Digital is a leading supplier of computer systems and associated peripherals, networks, communications, software, and services. The products are used in a variety of applications in business, industry, government, and scientific areas. Both direct and indirect channels are used to market and support products worldwide.

Financial Profile
For the 1989 fiscal year, Digital recorded revenues of $12.7 billion, up 11 percent from $11.5 billion the previous year. Net income was $1.1 billion, down 15 percent from $1.3 billion in 1988. According to the president's letter to Digital's shareholders, in 1989, "Digital's revenue growth came from overseas markets, particularly Europe and Japan."

Management Statement
Digital has a $1.5 billion dollar investment in new product development. According to the president's letter, Digital is "continuing to invest heavily in VAX and RISC-based systems and VMS and UNIX software." Within the next year, "Digital's strategy is to focus on the computing environment of the 1990s. Digital will offer the widest selection of technology and continue to make significant investments in R&D and new products in response to dynamically changing customer needs."

Applications

Applications are computer-aided design, simulation, artificial intelligence system development, and computer animation. Digital relies heavily on third-party software vendors for specialized applications.

Competitive Position

Digital Equipment Corporation's VAXstations face strong competition in the high-performance workstation market. Digital's toughest competition comes from the newly merged Hewlett-Packard/Apollo division and from Sun Microsystems.

With its new product line offerings, Digital has again filled some of the gaps that diminished its competitive position. Digital improved its 3-D workstations and finally released UNIX compatibility to Digital PHIGS and DECwindows. The move toward UNIX compatibility has especially attracted customers to the VAXstation line. The new, stronger offerings in 3-D graphics are another marketing advantage for Digital.

Trade-In Program

In October 1989, Digital launched an aggressive trade-in program for customers upgrading from VAXstation 2000s or migrating from Sun workstations to the VAXstation 3100. Digital says the program was prompted by requests from Sun users seeking trade-in opportunities with Digital; early response to the program has been good. According to Digital, many VAXstation 2000 users are also adopting the new workstation. The program offers from $2,000 to $4,000 toward the purchase of a VAXstation 3100.

Table 1. System Comparison

Model	VAXstation 3100	VAXstation 3200	VAXstation 3500	VAXstation 3520	VAXstation 3540
System Characteristics					
Date of introduction	January 1989	September 1987	September 1987	January 1989	January 1989
CPU type	MicroVAX	CVAX 78034	CVAX 78034	CVAX/CFPA	CVAX/CFPA
Operating system	VMS, ULTRIX-32	VMS, ULTRIX-32	VMS, ULTRIX-32	VMS, ULTRIX-32	VMS
Upgradable from	Not applicable	Not applicable	Not applicable	Not applicable	VAXstation 3520
Upgradable to	Not applicable	Not applicable	Not applicable	VAXstation 3540	Not applicable
Memory					
Minimum capacity (bytes)	8M	8M	16M	8M	8M
Maximum capacity (bytes)	32M	32M	64M	64M	64M
Disk Storage					
Minimum capacity (bytes)	1.44M	71M	159M	332M	332M
Maximum capacity (bytes)	208M	318M	560M	1.3G	1.3G
Communications Protocols	DECnet, TCP/IP, Ethernet, SNA, X.25	DECnet, TCP/IP, Ethernet, SNA, X.25	DECnet, TCP/IP, Ethernet, SNA, X.25	DECnet, TCP/IP, Ethernet, SNA, X.25	DECnet, Ethernet, SNA, X.25
Purchase Price (Base Configurations)	$7,950	$21,138	$52,818	$29,950	$49,950

Price/Performance

Apparently realizing that the VAXstation 8000 was too costly for what it could deliver, Digital not only improved 3-D graphics performance but improved the price too. The VAXstation 3520 and 3540 are now priced more competitively with Sun's 4/150 CXP machine.

Similarly, the new VAXstation 3100 improved the price/performance of the low end. The VAXstation 3100 is priced in the same range as Sun's 386i/150 machine but offers more processing power and double the memory.

User Opinion

Datapro recently spoke to users at a VAXstation site suggested to us by the Digital Equipment Computer Users Society (DECUS). The site is a small manufacturing and consulting firm in the Northeast U.S. The company employs a Local Area VAXcluster with three VAXstation 3200s. Each workstation is configured with a 159M-byte disk drive. Two workstations have 19-inch monochrome monitors, and one employs the 19-inch color monitor. The company chose Digital equipment based on the recommendation of an employee who had previous favorable experiences with Digital workstations at another company.

The first person we spoke to uses the equipment to monitor production and shipping. Although he has been using the equipment less than a year, he is very satisfied with its performance. The site has had no major problems to report; the company contacted Digital with some technical questions when the systems were first installed and were pleased with the response.

The second person we spoke to uses the VAXstation for his engineering consulting work. He is impressed with the 19-inch monitor, saying that for his computer-aided design work it is a vast improvement over the 15-inch monitors. This user also has had no major problems with the system and recalls being satisfied with Digital support in his previous work with MicroVAXs. The company debated the purchase of a 3-D workstation but decided that for its limited applications it was not cost effective.

Decision Points

Strengths

VAXcluster Networking Capabilities

Digital continues to offer innovative networking schemes for its VAXstations and other computers—a significant advantage in environments where sharing computational and peripheral resources is critical. Up to 42 VAXstation and MicroVAX nodes can be connected over Ethernet in a configuration called a Local Area VAXcluster (LAVC). In LAVCs, servers provide boot services,

Table 2. Disk/Diskette Devices

Model	RX33	RX50	RD32	RD53	RD54
Type	Diskette	Dual diskette	Winchester	Winchester	Winchester
Size (inches)	5.25	5.25 per diskette	5.25	5.25	5.25
Formatted capacity per drive (bytes)	1.2M	818K (409K per diskette)	42M	71M	159M
Interface/controller	RQDX3; integral (VAXstation 2000)	RQDX3; integral (VAXstation 2000)	RQDX3; integral (VAXstation 2000)	RQDX3; integral (VAXstation 2000)	RQDX3; KFBTA (VAXstation 8000); integral (VAXstation 2000)
Number of drives per interface/ controller	2	4	4	4	4
Average access time	175 ms.	264 ms.	48.3 ms.	38.3 ms.	38.3 ms.
Data transfer rate	500K bps	250K bps	5M bps	625KB/sec	625KB/sec
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector	512/sector
Purchase price	$396	$1,071 to $1,928	$2,200	$3,200 to $4,200	$4,590 to $5,610

including computational facilities and disk storage far exceeding those available to individual stations. (For example, Digital's VAXservers—specially configured MicroVAXs—can support almost 2G bytes of disk storage, compared to the 560M-byte limit on any single VAXstation.)

In addition, LAVCs can access the far greater storage and computational facilities of VAXclusters incorporating Digital's VAX superminis and Hierarchical Storage Controllers (HSCs). VAXclusters can incorporate the recently introduced Symmetrical Multiprocessor (SMP) VAX computers and the 9.7G-byte SA600 Storage Array, four of which can be supported per HSC, providing up to 37.8G bytes of online storage on each controller.

All models of the VAXstation line incorporate Digital's DECnet and LAVC software licenses in the basic configuration prices, so the networking functionality is available with each system at no extra cost. The UWS workstation software on the ULTRIX-32-based workstations provides compatibility with Sun Microsystems' Network File System (NFS), so those stations have access to a de facto industry standard for multivendor networking. Moreover, DECnet ULTRIX networking software, available for the workstations that run under UNIX, allows access to TCP/IP networks, which are heavily employed in the UNIX workstation environment.

Availability of Diskless Systems

Digital offers diskless configurations of its workstations, saving users the cost of storage hardware that they may not need if they intend to configure the stations in networks or LAVCs. Use of diskless stations can also enhance security in environments where data is critical or sensitive by forcing centralized storage.

Limitations

Product Turnover

While Digital has consistently improved the VAXstation line with each new model it introduces, it does not just add models to the line, it replaces old ones. This policy can be troublesome for potential customers looking for long-term solutions. While Digital supports all models, new equipment availability is the problem. Digital's continual enhancements to the VAXstations, however, provide features and performance that compensate for the interim product line instability.

Cross-Reference

For details on VAXclusters, refer to the "DEC VAX Systems" report on Page M11-325-501 in *Datapro Reports on Minicomputers.*

Table 3. Printers

Model	LA75	LA210	LN03	LN03R	LPS40
Type	Dot matrix	Dot matrix	Laser	Laser	Laser
Speed	32/42/125/250 cps	40/240 cps; 80 cps opt.	8 ppm	8 ppm	40 ppm
Bidirectional printing	Yes	Yes	Not applicable	Not applicable	Not applicable
Paper size	4.25 to 10.0 in. wide	3.5 to 14.9 in. wide	8.5 x 11.0 in.	8.5 x 11.0 in. or 8.3 x 11.7 in.	7.5 to 11.0 in. wide; 10.5 to 17.0 in. long
Character formation	36 x 18/36 x 17/24 x 9/12 x 9 dot matrix	33 x 18/7 x 9 dot matrix; 33 x 9 opt.	300 x 300 dots/in.	300 x 300 dots/in.	Electrophotographic
Horizontal character spacing (char./inch)	10.0, 12.0, 16.5, 17.1, or 5.0, 6.0, 8.25, 8.55	Variable	Variable	Variable	Variable
Vertical line spacing (lines/inch)	2, 3, 4, 6, 8, 12	Variable	Variable	Variable	Variable
Character set	ASCII, 8 others	94 ASCII; Courier, VT100 line-drawing std.; others opt.	ASCII; 16 resident Courier/Elite fonts	ASCII; technical; 29 resident fonts	29 resident typefaces
Controller/interface	RS-423	RS-232-C std.; Centronics parallel opt.	RS-232-C	RS-232-C	—
No. of printers per controller/interface	1	1	1	1	—
Printer dimensions, in. (h x w x d)	4.8 x 16.8 x 13.6	5.0 x 21.5 x 13.5	15.0 x 21.0 x 23.5	15.0 x 21.0 x 23.5	40.4 x 60.0 x 28.4
Graphics capability, dots per inch	180 x 144	132 x 72	Not applicable	300 x 300	300 x 300
Comments	Built-in LA50, LA100, LA210, IBM Proprinter emulation	Compatible with IBM PC/XT/AT	Prints in landscape and portrait modes	Includes PostScript Interpreter; prints ANSI/sixels, ReGIS, and Tektronix 4010/4014 files	Ethernet print server; uses PostScript; includes ANSI/sixel-, ReGIS-, Tektronix-to-PostScript translators
Purchase price	$795	$1,595	$2,895	$5,233	$49,900

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

Characteristics

System Overview

The VAXstations are desktop technical graphics workstations, ranging from small, diskless 2-D graphics stations to multiprocessing 3-D stations.

Specifications

Data Formats

Basic Format: 32-bit word.

Internal Code: ASCII for text-oriented data; binary for calculations.

Main Storage

Memory on the VAXstation 3100 is dynamic parity MOS RAM. Main memory increments are 8M bytes. Addressable memory is 16M bytes.

The VAXstation 3200 and 3500 each support 8M-byte memory modules which use 256K-bit ZIP DRAM-based error correction code (ECC) memory. ECC detects single- and double-bit errors and corrects single-bit errors; parity memory simply detects single-bit errors. The 3200 supports four of these modules (32

megabytes), and the 3500 supports eight (64 megabytes). Addressable memory on the 3200 and 3500 is 64 megabytes.

The VAXstation 3520 and 3540 each support up to 64M bytes of memory, housed on four 16M-byte modules.

Like all VAX and MicroVAX systems, the VAXstations provide up to 4G bytes of virtual memory space.

Processing Components

The VAXstations employ the MicroVAX 78032 CPU, MicroVAX 78132 Floating Point Unit, VAX instruction set, and CMOS technology. The use of CMOS technology in the CPU and FPU results in a more efficient processor board layout that enables the implementation of dual-level cache memory. The CPU chip holds 1K byte of cache memory, and an additional 64K bytes reside on the CPU board (32K bytes for the VAXstation 3100). The CPUs feature a 90-nanosecond cycle time.

Graphics Co-Processors: The VAXstations 3200 and 3500, as well as certain configurations of the VAXstation 3100, feature the GPX graphics co-processor, which off-loads text and graphics computations from the CPU. The GPX provides a display list interface that supports a range of raster operations in hardware, including the following:

- Bit-blt with rotation, fractional scaling, and Boolean operations
- Vector and text drawing
- Hardware clipping, tiling (stippling), and pattern fill
- Smooth scrolling in both vertical and horizontal planes

The GPX co-processor also resolves conflicts resulting from the interaction of multiple video processes, such as CRT refresh, scrolling, and screen updates with new data. The GPX co-processor operates at speeds up to 560M bps.

The GPX graphics co-processor is closely coupled to the double-buffered video memory. Graphics information is stored in video memory rather than in system memory or on disk, resulting in faster text and graphics drawing speeds. The co-processor can also independently access display list instructions in virtual memory using Direct Memory Access (DMA).

The GPX graphics co-processor offers either four or eight planes of display memory. The four-plane co-processor has a display capability of 16 simultaneous colors from a palette of 16 million on a color monitor or 16 simultaneous shades of gray on a monochrome monitor. The eight-plane co-processor, available in either gray scale or color, has a display capability of 256 simultaneous colors from a palette of 16 million.

Input/Output Control

I/O on the VAXstations 3100, 3200, and 3500 is handled through the 22-bit extended Q-bus (also called the Q22), which provides a common communications path for the data, address, and control information passed among the CPU, memory, and device interfaces. The Q-bus provides four interrupt levels and performs block mode DMA data transfers on a bandwidth of up to 3M bytes per second.

The VAXstation 3100 employs a busless architecture and has no expansion slots. It is equipped with a modified Small Computer Systems Interface (SCSI) port designed to connect the expansion cabinet housing a TK50 tape drive and additional disk drive.

Configuration Rules

Since ULTRIX-32 software is available only on tape, ULTRIX-32 systems that are not networked require a TK50 tape drive. An ULTRIX-32 system without a TK50 must be networked to another ULTRIX-32 system running Remote System Manager (RSM) V1.1 to support downline loading of the operating system.

Similarly, a VMS system without a TK50 or an RX50 diskette must be networked to another VMS system running RSM V1.1 to support downline loading of the operating system.

The VAXstation 3100 is housed in a compact system box but maintains hardware and software compatibility with the larger VAXstation members. The VAXstation 3100 is available in a number of kernel configurations, to which options can be added. The kernels are designated as diskless, as RD53 kernels that include a 71M-byte RD53 disk, or as RD54 kernels that include a 159M-byte RD54 disk drive. Each of the kernels includes 8M bytes of memory; a 15- or 19-inch monochrome or color monitor; a ThinWire/ThickWire Ethernet interface; documentation; and VMS, VMS Workstation Software (VWS), DECnet, and Local Area VAXcluster (LAVC) licenses or ULTRIX-32 and ULTRIX Worksystem Software (UWS), Network File System (NFS), ULTRIX C, VAX C, ULTRIX Fortran, and ULTRIX Pascal licenses.

Each VAXstation 3100 kernel supports the following options:

- A keyboard.
- A pointing device (mouse or tablet).
- A four-plane graphics co-processor for monochrome, gray scale, or color display.
- An eight-plane graphics co-processor for gray scale or color display.
- Two half-height storage devices that can be added to the diskless configurations. These include the 1.2M-byte RX33 diskette drive and a 42M-byte RD32 disk drive. (Only one of each can be configured, and both must be housed in the system box; these devices are not supported under the ULTRIX-32 operating system.)
- The TK50 tape drive, available only in the BA40A expansion box.
- A second full-height RD53 or RD54 disk that can be added to the RD53 and RD54 kernels; this addition requires the BA40A expansion adapter. The BA40A

expansion adapter houses both a TK50 tape drive and an RD53 or RD54 disk drive. If both a second disk and the TK50 are added, only one expansion adapter need be ordered.

The VAXstation 3200, housed in the BA23 pedestal enclosure, is available in diskless configurations as well as in configurations with integral storage. It comes in either four-plane gray scale or eight-plane color versions.

A basic 3200 configuration includes the CMOS CPU and FPU, 8M bytes of memory, a four- or eight-plane graphics co-processor, a 19-inch monochrome or color monitor, a DELQA Ethernet interface, documentation, and one-year hardware and software warranty. A VMS-based system includes the VMS operating system, VWS, LAVC, and DECnet end node software licenses. A system based on ULTRIX—Digital's version of the Berkeley UNIX operating system—includes ULTRIX-32, UWS, Fortran, VAX-C, and Pascal licenses.

The VAXstation 3200 supports a total of 32M bytes of memory. (Up to four memory modules can be configured per system.) The system also supports up to 318M bytes of disk storage (two 159M-byte RD54 drives). The system will accommodate an internal, 95M-byte TK50 tape drive; it also supports the 296M-byte TK70 tape drive.

Because of power and cooling restrictions, a VAXstation 3200 configuration (the VS315) that includes the RD54 disk can accommodate only 8M bytes of memory if both disk and tape are added internally.

The *VAXstation 3500* is housed in the BA213 pedestal enclosure and comes with the CMOS CPU and FPU, 16M bytes of memory, a four- or eight-plane graphics co-processor, a 19-inch monochrome or color monitor, a DELQA Ethernet interface, a 280M-byte RA70 disk drive, a 296M-byte TK70 tape drive, documentation, and one-year hardware and software warranty.

A VMS-based 3500 system includes VMS, VWS, LAVC, and DECnet end node software licenses; an ULTRIX-based system includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses.

The VAXstation 3500 supports an additional 16M bytes of memory (i.e., two 8M-byte memory modules can be added to the integral system memory), for a total of 32M bytes. An additional RA70 disk drive can be configured in the pedestal enclosure for a total of 560M bytes of disk storage.

The gray scale version of the VAXstations 3200 and 3500 includes a four-plane graphics co-processor and a monochrome monitor; the color version includes an eight-plane graphics co-processor and color monitor. The keyboard, mouse or tablet, and power cord must be ordered separately.

The VAXstation 3520 includes 8 bytes of memory; 8-plane 3-D graphics subsystem; 19-inch color monitor; keyboard/mouse; DELQA Ethernet adapter and software licenses.

The VAXstation 3540 includes 8M bytes of memory; 8-plane, 3-D graphics subsystem; 19-inch color monitor; keyboard/mouse; 296M-byte tape drive; DELQA Ethernet adapter and software licenses.

Artificial Intelligence

VAXstations are available in special VMS- and ULTRIX-based configurations for development of artificial intelligence applications. The AI VAXstation 3200 and 3500 include a Lisp license. A license for the OPS5 AI language is also included with VMS-based AI VAXstations.

VAXlabs

Specialized VMS-based realtime workstation systems, called VAXlabs, are offered for laboratory data acquisition and experiment control applications. The VAXlab 3200 includes the following facilities:

- Subroutine libraries for realtime I/O, mathematical and statistical analysis, signal processing, and scientific graphics
- Realtime support for analog I/O, digital I/O, IEEE 488 realtime clock, and serial I/O options
- Special interface panels for connecting laboratory instruments

VAXservers

Specialized configurations of Digital's MicroVAX systems, called VAXservers, are available as boot nodes and resource servers for distributed workstations in network and Local Area VAXcluster environments. (For details on LAVCs, see the Software section below.) The servers are the VAXserver 3100, 3300, 3400, 3800, and 3900.

Input/Output Units

See Table 2 for disk and diskette devices and Table 3 for printers.

Note: *The following items are options, unless otherwise noted.*

Other Peripherals: The *TK70* streaming cartridge tape drive, bundled with the VAXstation 3500 and supported on the VAXstation 3200, has a 5¼-inch form factor. The TK70 uses 296M-byte CompacTape-II tape cartridges (developed by Digital in conjunction with 3M Company), which hold the entire contents of the 280M-byte RA70 disk drive. The TK70 transfers data at 90K bytes per second and features ECC, CRC, and a read-after-write procedure to verify data.

The TK50 streaming tape drive—optional on the VAXstation 3200—is a ½-inch cartridge unit that uses CompacTape cartridges; a single cartridge can back up any of the Winchester disks used on a VAXstation 3200. This Q-bus drive, which uses a microprocessor-based controller, has a maximum storage capacity of 95M bytes and achieves a read/write speed of 75 ips in streaming mode. The TK50 has a peak data transfer rate of 62.5K bytes per second (45K bytes per second for user data). Recording density is 6667 bpi. The TK50 also features read-after-write operation and emulates

reel-to-reel tape drive operation. The TK50 is not supported by the VAXstation 3500; however, the TK70 supported by that system can read tapes written on a TK50.

The RRD50 CD reader, an optical disk device supported on all VAXstations except the 3100, can randomly access 600M bytes of formatted user data from a Compact Disk Read-Only Memory (CD-ROM). The drive has an access time of 1.5 milliseconds and a data transfer rate of 150K bytes per second. The RRD50 employs the Philips/Sony standard for compact disks, as well as the Uni-File data format. The RRD50 comes with a one-year on-site hardware warranty.

The three-button *mouse*—a standard feature on the VAXstations—provides X and Y relative displacement and a 100-pulse-per-inch output rate. The VAXstations also support an optional *digitizing tablet* with light pen or cross-haired puck.

Communications

The *DELQA Ethernet interface*, included with the VAXstation 3200, 3500, 3520, and 3540 connects these systems to Ethernet V2.0 or IEEE 802.3 LANs. DELQA provides on-board Maintenance Operation Protocol (MOP), which offers enhanced network management features, including remote circuit loopback, system identification messages, remote booting or diskless systems, and maintenance of data link counters.

The *ThinWire Ethernet Multiport Repeater (DEMPR)* provides eight ports for connecting eight ThinWire Ethernet segments and one port for connecting to an H4000 transceiver. As a repeater, the DEMPR extends the length, topology, or interconnection of the physical network medium beyond the limits imposed by a single segment. Each segment can have 29 stations, for a total of 232 stations.

The *ThinWire Ethernet Single-Port Repeater (DESPR)* connects a single ThinWire segment to a standard Ethernet network. The ThinWire segment can be up to 600 feet (185 meters) long and can accommodate up to 29 stations. The DESPR connects to standard Ethernet using an H4000 transceiver or a DELNI eight-device concentrator. When the DESPR/DELNI combination is used, the DELNI must be connected to the standard Ethernet using an H4000-BA transceiver. The DESPR must be counted as a repeater when configuring a standard Ethernet network.

The *ThinWire Ethernet Station Adapter (DESTA)* is an Ethernet/IEEE 802.3 transceiver that connects a single Ethernet station to ThinWire cabling. The DESTA has two ports: one connects to the T-connector attached to ThinWire, while the other leads to a station. The DESTA can be attached to current Ethernet controllers, such as the DELQA, allowing UNIBUS, Q-bus, and Pro 380 devices to connect to ThinWire Ethernet. The DESTA also allows Digital's Ethernet communications and terminal servers to connect to ThinWire Ethernet.

Software

System Software: The VAXstations run the VMS and ULTRIX-32 operating systems.

VMS

The *VMS* operating system for the VAXstations (and for the MicroVAX supermicros as well) is the same as that which runs on the VAX superminis. Previously, a subset of VMS was offered for the VAXstation and the MicroVAX; the microsystems could not support full-sized VMS due to limitations of system disk size and distribution media. Digital has now removed those constraints. Because the operating environments are fully compatible, VAXstations and MicroVAXs can run the same system and applications software as the larger VAX computers without recompilation or relinking, subject to the limitations of peripheral support.

Version 5.0, the most recent release of VMS, includes support for Local Area VAXcluster Systems Phase II, described later in this section.

VMS Workstation Software (VWS) is a layered product that provides graphics support for the VAXstations. VWS provides multiple, overlapping windowing capabilities; VT220 emulation with technical character set; Tektronix 4014 emulation; a mouse-based interface for window manipulation; a graphics programming interface; a device driver interface to graphics hardware; and hard copy graphics support.

On VAXstations configured in an LAVC, VWS runs on the workstation itself but is stored on and loaded from the server.

The workstation software features a Graphical Kernel System (GKS) library, a layered product that includes a high-level graphics and text programming interface; ANSI standard level 0b is provided, with GKS output directed through the windowing system. VT102 and Tektronix 4014 emulators running through the X Window server allow many applications to run unchanged in a windowed environment. A low-level graphics programming interface allows direct procedural access to hardware for customized applications requiring higher graphics speeds. VAX GKS Version 3 conforms to level 2c of the ANSI/ISO GKS standard for two-dimensional, device-independent graphics. Applications developed with VAX GKS software on the VAXstation will run on all other VMS-based systems.

ULTRIX

ULTRIX-32, Digital's derivative of UNIX, is based on Berkeley 4.2 BSD UNIX. It includes extensions from 4.3 BSD and AT&T UNIX System V. It does not comply fully with AT&T's System V Interface Definition (SVID). ULTRIX-32 does, however, comply with the IEEE's 1003.1 standard for a portable environment (POSIX) and with the National Institute of Standards and Technology's interim Federal Information Processing Standard (FIPS).

ULTRIX-32 supports workstation configurations with a server and up to 26 diskless stations. The server provides centralized system management and remote

restarting for client systems. The server downloads the operating system and applications onto the diskless workstation clients; it can also install software over the network for disk-based clients.

Equipped with the ULTRIX Worksystem Software V1.1 Server Kit, the server can install the graphics subsystem, including software libraries and commands for the client stations. (Details on UWS are provided below.) The server can also execute graphics applications and display them on the client devices.

Users can configure the client systems to share local area network resources, such as printers, disk storage, and CPU facilities. Central file resources can also be shared to reduce disk space requirements and to simplify file administration.

ULTRIX-32 permits applications to be ported from one VAX system—workstation, supermicro, or supermini—to another without modification or recompilation.

ULTRIX-32 Worksystem Software (UWS) provides windowing and graphics capabilities under ULTRIX-32. UWS also supports diskless VAXstations and Sun Microsystems workstations through the virtual disk operation. The virtual disk facility allows users to connect lower-priced diskless workstations into existing networks and access the disk storage on other systems in the network. Both ULTRIX-32 and UWS are fully compatible with Sun Microsystems' Network File System, allowing VAXstations to coexist in multivendor networked environments and to access files transparently over an Ethernet network.

The ULTRIX Window Manager (UWM) provides a multiwindow environment, including support for resizing, restacking, moving, and iconifying windows.

Windowing facilities are provided for ULTRIX-32 and VMS. DECwindows provides enhanced X Window System Version 11 for both ULTRIX-32 and VMS. DECwindows will provide network-transparent interactions with applications by enabling users to run VMS, ULTRIX-32, and MS-DOS windows on their workstations simultaneously and with a consistent interface.

Other Software

VAX Programmer's Hierarchical Interactive Graphics System (PHIGS), Digital's implementation of the ANSI draft standard for three-dimensional, device-independent graphics software, provides facilities for development and display of 3-D graphics applications.

The VAXstations support the same *database management*, *communications facilities*, *applications*, *tools and utilities*, and *languages* as the MicroVAXs. Some programs, such as the Remote System Manager (RSM), allow a VAXstation to function as a client but not as a server in a distributed processing environment.

The VAXstations also support the facilities of Digital's DECtp transaction processing environment.

Local Area VAXcluster (LAVC) software allows the interconnection through Ethernet of up to 42 VAXstation and MicroVAX systems. At least one system must serve as a boot node; all others can be configured as satellites. The LAVC creates a unified system, allowing all participating nodes to remain independent while equally sharing resources and to employ a single distributed file system that manages access of files at the record level.

Version 5.0 of VMS provides support for *LAVC Phase II* (also called LAVC 2), in which the LAVCs can be connected over Ethernet to VAXclusters of VAX superminis and Hierarchical Storage Controllers (HSCs) linked by Digital's Computer Interconnect (CI). The workstations and supermicros thus have access to the far greater computational and storage facilities offered by the larger VAX systems.

LAVC 2 creates a so-called mixed interconnect VAXcluster in which the CI- and HSC-connected VAX systems service boot and I/O requests from the computers in the LAVC.

Applications

More than 3,000 VAX applications can run unmodified on the VAXstations. Digital also depends very heavily on third-party software vendors to provide specialized applications software for various industries and marketplaces. Digital enters into Cooperative Marketing Program (CMP) relationships with firms that are leading application solutions suppliers in specific vertical market segments. System Cooperative Marketing Program (SCMP) participants are OEMs that offer their applications products in combination with Digital hardware.

Allied with third-party software vendors, Digital has designed, configured, and tested fully integrated systems, called VAX Solution Systems, for specific industry applications such as artificial intelligence, electronics design, computer-integrated manufacturing, mechanical design and analysis, and electronic publishing. A number of these packages incorporate hardware configured in LAVCs.

Operating Environment

All VAXstations operate between 50 and 90 degrees Fahrenheit and within a humidity range of 20 to 80 percent (noncondensing). The physical and environmental specifications of the VAXstations are highlighted in the following tables.

Physical Specifications

Model	Height (in.)	Width (in.)	Depth (in.)
3100	5.9	18.3	15.75
3200	24.5	10.0	28.5
3500	27.0	21.0	17.8
3520	27.0	21.0	17.8
3540	27.0	21.0	17.8

Electrical Specifications

Model	Voltage	Amperage	Power Consumption (kVA)
3100	120/240	2.8/1.5	3.5
3200	120/240	6	3.5
3500	120/240	12/6	6.9
3520	120/240	12/6	6.9
3540	120/240	12/6	6.9

Support Services

Documentation: Hardware documentation is included with each VAXstation. The documentation consists of Owner and Technical Manuals. Documentation Kits are optionally available for selected software packages; the kits include Reference Manuals, User's Guides, and other instructional materials.

Training/Education: Digital maintains over 25 training centers worldwide. Courses cover both equipment and non-product-related topics. A variety of teaching methods is available, including instructor-led courses and self-paced instruction. Digital's Educational Services division publishes a digest listing available courses four times a year. On-site training at the customer's installation can also be provided.

Warranty: The VAXstations, as well as all peripherals, are covered by a one-year warranty. Warranty coverage can be extended for up to three years.

Maintenance: Digital's Field Service organization offers both on-site and off-site support services for the VAXstations. Standard on-site services include the Basic Service Agreement, the extended DECservice Agreement, and Per Call service. Off-site maintenance is available through Digital's Customer Returns Center, Product Repair Center, and Digital Servicenters, which are all equipped with parts inventories, special diagnostic systems, and repair kits.

Two other types of integrated service are offered for the VAXstations. Basic System Support (BSS) and DECsystem Support (DS9) provide On-site Basic Hardware Service and Right to Use Updates.

Pricing

Policy: Digital provides the VAXstations on a purchase basis with separately priced maintenance agreements beyond the initial one-year warranty period. Leasing arrangements are available through Digital's U.S. Customer Finance Group.

Digital software is licensed rather than sold. Users purchase licenses and distribution rights separately. Customers ordering ULTRIX-32 software receive a UNIX operating system binary license directly from Digital. For new VAXstation purchasers, an ULTRIX-32 license is included in the price of the system. Current users of Digital's VMS operating system and VAX users with third-party UNIX licenses can order the ULTRIX-32 license as an add-on product.

A software license can either be purchased outright or obtained through Digital's Periodic Payment License (PPL) option, through which the user pays an initial license fee and then makes monthly payments thereafter. The software is licensed with a 90-day cancellation option.

The price of a VAXstation includes operating system and DECnet licenses. The PPL option for those products includes the initial license charge and 12 months of PPL fees for both products.

Digital also offers VAXcluster software pricing options based on system capacity ratings for VMS layered software. Those ratings equalize the cost between a standalone computer and a VAXcluster of equivalent capacity. Under this scheme, the cost of a layered software product used in a VAXcluster does not increase incrementally as new processors are added.

Digital's Volume Software Pricing and VAX Software Portfolio programs are available for VAXstation users.

Prices for VAXstation hardware and related software are provided in the Equipment Prices.

Equipment Prices

		Purchase Price ($)	Basic Monthly Charge (Monthly) ($)	Basic System Support (Monthly) ($)	DEC System Support (Monthly) ($)
VAXstation 3100					
PV010-BC	MicroVAX CMOS CPU/FPU, Model 30, 8M bytes of main memory; 19-in. monochrome monitor, ThinWire/ThickWire Ethernet interface, hardware documentation, one-year hardware/software warranty; bundled software licenses include VMS, VWS DECwindows, LAVC, and DECnet	7,950	32	76	82
PV010-BG	Same as PV010-BC except with 15-inch color monitor	10,950	51	95	105
PV010-BH	Same as PV010-BC except with 19-inch color monitor	13,450	57	101	112
PV010-JC	Same as PV010-BC except bundled software licenses include ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	7,950	32	76	82
PV010-JT	Same as PV010-JC except with 15-inch color monitor	10,950	51	95	105
PV010-JW	Same as PV010-JT except with 19-inch color monitor	13,450	57	101	112
PV011-BC	MicroVAX CMOS CPU/FPU, Model 30; 8M bytes of main memory; 19-inch monochrome monitor, ThinWire/ThickWire Ethernet interface; RZ22 52M-byte disk drive; RX23 diskette drive; hardware documentation; one-year hardware/software warranty; bundled sofware licenses include VMS, VWS DECwindows, LAVC, and DECnet	10,600	47	91	100
PV011-BG	Same as PV011-BC except with 15-inch color monitor	13,600	66	110	123
PV011-BH	Same as PV011-BC except with 19-inch color monitor	16,100	72	116	130
PV011-JC	Same as PV011-BC except bundled software licenses include ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	10,600	47	91	100
PV011-JT	Same as PV011-JC except with 15-inch color monitor	13,600	66	110	123
PV011-JW	Same as PV011-JC except with 19-inch color monitor	16,100	72	116	130
PV012-BC	MicroVAX CMOS CPU/FPU, Model 30 Networked workstation; 8M bytes of main memory; 19-inch monochrome monitor; ThinWire/ThickWire Ethernet interface; two RZ23 104M-byte disk drives; RX23 diskette drive; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS DECwindows, LAVC, and DECnet	13,900	76	120	134
PV012-BG	Same as PV012-BC except with 15-inch color monitor	16,900	95	139	157
PV012-BH	Same as PV012-BC except with 19-inch color monitor	19,400	101	145	164
PV012-JC	Same as PV012-BC except bundled software licenses include ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	13,900	76	120	134
PV012-JT	Same as PV012-JC except with 15-inch color monitor	16,900	95	139	157
PV012-JW	Same as PV012-JC except with 19-inch color monitor	19,400	101	145	164
PV014-BA	MicroVAX CMOS CPU/FPU, Model 30 Standalone; 8M bytes of main memory; 15-inch monochrome monitor; ThinWire/ThickWire Ethernet interface; two RZ23 104M-byte disk drives; RX23 diskette drive; RRD40 CD reader; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS DECwindows, LAVC, and DECnet	14,900	92	136	154
PV014-BC	Same as PV014-BA except with 19-inch monochrome monitor	15,500	98	142	161
PV014-BG	Same as PV014-BA except with 15-inch color monitor	18,500	117	161	183
PV014-BH	Same as PV014-BA except with 19-inch color monitor	21,000	123	167	190
PV014-JA	Same as PV014-BA except bundled software licenses include ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	14,900	92	136	154
PV014-JC	Same as PV014-JA except with 19-inch monochrome monitor	15,500	98	142	161
PV014-JT	Same as PV014-JA except with 15-inch color monitor	18,500	117	161	183
PV014-JW	Same as PV014-JA except with 19-inch color monitor	21,000	123	167	190
—	MicroVAX CMOS CPU/FPU, Model 38; 8M bytes of main memory; 19-inch monochrome monitor; ThinWire/ThickWire Ethernet interface; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS, DECwindows, LAVC, and DECnet **or** ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	10,950	—	—	—

		Purchase Price ($)	Basic Monthly Charge (Monthly) ($)	Basic System Support (Monthly) ($)	DEC System Support (Monthly) ($)
VAXstation 3100 (Continued)					
—	Same as above except with 16-inch color monitor	15,050	—	—	—
—	Same as above except with 19-inch color monitor	16,450	—	—	—
—	MicroVAX CMOS CPU/FPU, Model 38 Standalone workstation; 8M bytes of main memory; 19-inch monochrome monitor; ThinWire/ThickWire Ethernet interface; two RZ23 104M-byte disk drives; RX23 diskette drive; RRD40 CD Reader; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS, DECwindows, LAVC, and DECnet **or** ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	17,950	—	—	—
—	Same as above except with 12M bytes of main memory	20,350	—	—	—
—	Same as above except with 8M bytes of main memory and 16-inch color monitor	22,050	—	—	—
—	Same as above except with 12M bytes of main memory	24,450	—	—	—
PV053-CC	MicroVAX CMOS CPU/FPU, Model 40 Server/Workstation; 16M bytes of main memory; 19-inch monochrome monitor; ThinWire/ThickWire Ethernet interface; three RZ23 104M-byte disk drives; TZ30 95M-byte tape drive; RRD40 CD Reader; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS DECwindows, LAVC, and DECnet	28,000	154	198	227
PV053-CT	Same as PV053-CC except with 15-inch color monitor	31,000	173	217	250
PV053-CW	Same as PV053-CC except with 19-inch color monitor	33,500	179	223	257
PV053-KC	Same as PV053-CC except bundled software licenses include ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	28,000	154	198	227
PV053-KT	Same as PV053-KC except with 15-inch color monitor	31,000	173	217	250
PV053-KW	Same as PV053-KC except with 19-inch color monitor	33,500	179	223	257
—	MicroVAX CMOS CPU/FPU, Model 48 Server/Workstation; 16M bytes of main memory; 19-inch monochrome monitor; ThinWire/ThickWire Ethernet interface; three RZ23 104M-byte disk drives; TZ30 95M-byte tape drive; RRD40 CD Reader; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS DECwindows, LAVC, and DECnet **or** ULTRIX-32, UWS DECwindows, NFS, VAX C, TCP/IP, and Pascal	27,600	—	—	—
—	Same as above except with 16-inch color monitor	31,700	—	—	—
—	Same as above except with 19-inch color monitor	33,100	—	—	—
VAXstation 3200					
Each VAXstation 3200 includes a MicroVAX 3500/3600 CMOS CPU and FPU. The VAXstation 3200 is housed in the BA23 enclosure.					
VS300-AA	Grayscale system; includes 8M bytes of memory; four-plane graphics co-processor; 19-in. monochrome monitor; DELQA Ethernet interface; documentation; one-year hardware/software warranty; and VMS, VWS, LAVC, and DECnet end node licenses	21,138	164	219	250
VS300-BA	Same as VS300-A3(AA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	21,138	164	219	250
VS305-AA	Color system; includes 8M bytes of main memory; eight-plane graphics co-processor; 19-in. color monitor; DELQA Ethernet interface; documentation; one-year hardware/software warranty; and VMS, VWS, LAVC, and DECnet end node licenses	29,138	179	234	268
VS305-BA	Same as VS305-A3(A4/AA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	29,138	179	234	268
VS310-AA	Same as VS300-A3(AA) but also includes an RD54 159M-byte disk drive	27,775	243	298	344
VS310-BA	Same as VS300-A3(AA) except with ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses; also includes RD54 disk drive	27,775	243	298	344
VS315-AA	Same as VS305-A3(A4/AA) but also includes an RD54 disk drive	35,775	258	313	362
VS315-BA	Same as VS305-A3(A4/AA) except with ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal; also includes an RD54 disk drive	35,775	258	313	362

		Purchase Price ($)	Basic Monthly Charge (Monthly) ($)	Basic System Support (Monthly) ($)	DEC System Support (Monthly) ($)
VAXstation 3500					
Each VAXstation 3500 includes a MicroVAX 3500/3600 CMOS CPU and FPU. The VAXstation 3500 is housed in the BA213 enclosure.					
VS350-AA	Grayscale system; includes 16M bytes of main memory; four-plane graphics co-processor; 19-in. monochrome monitor; DELQA Ethernet interface; RA70 280M-byte disk drive; TK70 296M-byte tape drive; documentation; one-year hardware/software license; and VMS, VWS, LAVC, and DECnet end node licenses	52,818	314	369	430
VS350-BA	Same as VS350-A3(AA) but with ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	52,818	314	369	430
VS355-AA	Color system; includes 16M bytes of main memory; eight-plane graphics co-processor; 19-in. color monitor; DELQA Ethernet interface; RA70 disk drive; TK70 tape drive; documentation; one-year hardware/software warranty; and VMS, VWS, LAVC, and DECnet end node licenses	60,818	329	384	448
VS355-BA	Same as VS355-A3(A4/AA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	60,818	329	384	448
VS355-CA	Same as VS355-AA except AI VAXstation software also includes VAX Lisp and VAX OPS5	61,905	329	384	448
VAXstation 3520					
—	Dual MicroVAX CMOS CPU/FPU, eight-plane graphics; 19-inch color monitor; 8M-byte memory; Ethernet interface; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS, DECnet, LAVC, and Digital PHIGS **or** ULTRIX-32, UWS, NFS, VAX-C, DECnet, TCP/IP, DECwindows, and Digital PHIGS	29,950	—	—	—
—	Two Dual MicroVAX CMOS CPUs/FPU, eight-plane graphics; 19-inch color monitor; 8M bytes of main memory; Ethernet interface; one 296M-byte tape drive; hardware documentation; one-year hardware/software warranty; bundled software licenses include VMS, VWS, DECnet, LAVC, and Digital PHIGS	49,950	—	—	—
VAXServers					
DU-31ASB-AA	VAXserver 3100 Model 10, 4M bytes of memory, 104M-byte disk drive, ULTRIX license	6,680	40	84	92
DU-330S1-AA	VAXserver 3300, 4M bytes of memory, 150M-byte disk drive, 296M-byte tape drive, ULTRIX license	23,130	135	244	270
DV-330S1-AA	Same as above, except with VMS license	23,130	135	244	270
DU-340S2-bA	VAXserver 3400, 4M bytes of memory, 400M-byte disk drive, ULTRIX license	27,730	120	229	252
DV-340S2-BA	Same as above, except with VMS license	27,730	120	229	252
DU-340S2-AA	VAXserver 3400, 4M bytes of memory, two 150M-byte disk drives, ULTRIX license	27,730	115	224	246
DV-340S2-AA	Same as above except with VMS license	27,730	115	224	246
DU-380S1-AA	VAXserver 3800, 16M bytes of memory, 400M-byte disk drive, 296M-byte tape drive, ULTRIX license	56,100	242	297	343
DV-380S1-AA	Same as above except with VMS license	56,100	242	297	343
DU-390S1-AA	VAXserver 3900, 16M bytes of memory, KDA50 disk controller, 1.2G-byte disk drive, 296M-byte tape drive, ULTRIX license	84,900	301	356	413
DV-390S1-AA	Same as above except with VMS license	84,900	301	356	413

Options Prices

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
Memory				
MS42-AB	4M-byte memory increment for VAXstation 3100	3,000	NC	NC
MS42-BA	12M-byte memory increment for VAXstation 3100	9,000	NC	NC
MS42-CA	16M-byte memory increment for VAXstation 3100	12,000	NC	NC
MS650-AA	8M-byte ECC memory increment for VAXstation 3200	6,000	NC	NC
MS650-AF	8M-byte ECC memory increment for VAXstation 3500	6,000	NC	NC
MS60-AA	8M-byte ECC memory increment for VAXstation 3520/3540	6,000	NC	NC
MS60-CA	32M-byte expansion memory for VAXstation 3520/3540	26,400	NC	NC
Graphics Monitors				
VR262-AA	19-inch monochrome monitor; 120 V	1,800	12	14
VR299-DA	19-inch color monitor; 120 V	4,900	22	26
Graphics Input Devices				
VSXXX-AA	Mouse	199	NC	NC
VSXXX-AB	Tablet with stylus and puck	1,117	8	10
LK201-NA	Keyboard	214	NA	NA
Mass Storage				
KDA50-QA	DSA Controller for BA23	6,961	50	60
RX23-EF/EG	2M-byte 3.5-inch diskette drive for VAXstation 3100	350	4	5
RX33-A	1.2M-byte diskette drive	396	8	10
RX50A-AA/BA	RX50 800KB dual diskette drive with cables for BA23(AA) or BA123(BA) enclosure	1,071	8	10
RX50-D	RX50 800KB dual diskette drive mounted in desktop enclosure with I/O cable	1,928	20	24
RD32-A	42M-byte Winchester disk drive	2,200	20	24
RD53-RA	RD53 71M-byte, 5¼-in. Winchester disk drive	4,200	38	45
RD53A-AA/BA	RD53 71M-byte drive with cables for BA23(AA) or BA123(BA) enclosure	3,200	38	45
RD53-DA	RD53 71M-byte drive mounted in desktop enclosure with I/O cables	4,200	38	45
RD53-RA	RD53 71M-byte drive in 19-in. standard equipment rack; requires H9302 enclosure	4,200	38	45
RD54-DA	RD54 159M-byte Winchester disk drive	5,610	63	75
RD54-AA/BA	RD54 159M-byte Winchester disk drive for BA23/BA123	4,590	63	75
RA70E-SA/SF	RA70 280M-byte disk drive	9,180	45	54
RA60-CA	205M-byte removable disk drive with cabinet	23,460	105	125
RA82-CA	622M-byte fixed disk drive with cabinet	17,340	59	70
RA82-DA	Two 622M-byte fixed disk drives in cabinet	34,360	118	140
RA82-EA	Three 622M-byte fixed disk drives in cabinet	52,020	177	211
RA90-CA	1.2G-byte fixed disk drive with cabinet	27,500	59	70
RA90-FA	Two 1.2G-byte fixed disk drives in cabinet	51,500	118	140
RRD40-DC	600M-byte CD-ROM disk drive and controller	1,600	22	26
Magnetic Tape				
TQK50-AA	TK50 controller with cables for BA23 enclosure	1,237	8	10
TQK50-AB	Q22 controller for TK50-D/R in BA23 enclosure	1,237	8	10
TQK50-BA	TK50 controller with cables for BA123 enclosure	1,237	8	10
TK50-AA	TK50 95M-byte cartridge streaming tape drive	3,149	22	26
TK50-DA	TK50 desktop tape drive	3,824	22	26
TK50-RA	TK50 rackmount tape drive	3,824	22	26
TQK70-AA	Controller for TK70 tape unit	1,400	10	12
TK70-AA	296M-byte TK70 cartridge tape drive for BA23/BA123 boxes	4,600	30	36
TSV05-SE	9-track, 1600 bpi TSV05 magnetic tape subsystem with cabinet and Q-bus controller	13,056	89	106
TU81E-SA	TU81-Plus magnetic tape subsystem with Q-bus controller	32,650	140	167

NA—Not applicable.
NC—No charge.

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
Printers				
LA75-CA	LA75 32/42/125/250 cps dot matrix printer	795	8	10
LA210-AA	LA210 40/80/240 cps dot matrix printer	1,595	28	33
LN03-AA	LN03 8-ppm laser printer	2,895	54	64
LNO3R	LNO3R 8-ppm PostScript laser printer	5,233	62	74
LPS40-DA/FA	Print Server 40	49,900	NA	NA
Communications/Networking				
DPV11-M	DPV11 single-line synchronous interface; requires cable	1,185	14	17
DPV11-SA	DPV11 single-line synchronous interface for BA213	1,425	14	17
DMV11-M	DMV11 single-line synchronous interface; requires cable	3,500	41	49
DESVA-AA	ThinWire Ethernet interface	1,339	12	14
DELQA-M	Ethernet/802.3 Adapter	2,750	15	18
DESQA-SA	Q-bus adapter for BA2XX	3,009	15	18

NA—Not applicable.
NC—No charge.

Software Prices

		License Fee ($)
Operating System		
QL001AC-BB	VMS for VAXstation 3XXX	Bundled
QL0JQAC-BC	ULTRIX-32 two-user license for VAXstation 3200/3500/3520	Bundled
QLVVTAC-BC	ULTRIX-32 two-user license for VAXstation 3100	Bundled
Communications		
QLD04-AA	DECnet end node license for VAXstation 3XXX	439
QLD05-AA	DECnet full license for VAXstation 3XXX	1,082
QLD09-AA	DECnet end node to full license upgrade for VAXstation 3XXX	782
QL363-A9	DECnet/SNA 3270 for VAXstation 3XXX	546
QL455-A9	DECnet/SNA Application Programming Interface (API) for VAXstation 3XXX	435
QL454-A9	DECnet/SNA Terminal Emulator (TE) for VAXstation 3XXX	234
QL453-A9	DECnet/SNA RJE for VAXstation 3XXX	234
QL042-A9	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for VAXstation 3XXX	357
QL044-A9	DECnet/SNA Printer Emulator (PrE) for VAXstation 3XXX	234
QLB12-A9	VAX VIDA for VAXstation 3XXX	2,930
Database Management		
QL898-A9	DATATRIEVE for VAXstation 3XXX	1,370
QL897-A9	Common Data Dictionary (CDD) for VAXstation 3XXX	388
QLVD7-A9	Forms Management Systems (FMS) for VAXstation 3XXX	697
QLD07-A9	Rdb/ELN Development license for VAXstation 3XXX	1,258
Languages		
QL018-A9	Dibol for VAXstation 3XXX	691
QL100-A9	Fortran for VAXstation 3XXX	868
QL917A-AA	Lisp (VMS) for VAXstation 3XXX	1,359
QL418A-AA	Lisp (ULTRIX) for VAXstation 3XXX	2,673
QL126-A9	Pascal for VAXstation 3XXX	790
QL056-A9	Ada for VAXstation 3XXX	4,226
QL095-A9	Basic for VAXstation 3XXX	891

		License Fee ($)
Languages (Continued)		
QL015-A9	C for VAXstation 3XXX	798
QL099-A9	Cobol for VAXstation 3XXX	1,336
QL913A-AA	OPS5 for VAXstation 3XXX	6,240
Utilities and Tools		
QL425-A9	Application Development Environment (ADE) for VAXstation 3XXX	457
QL451-A9	DECor for VAXstation 3XXX	1,003
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QL007-A9	DEC/CMS (Code Management System) for VAXstation 3XXX	1,448
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