

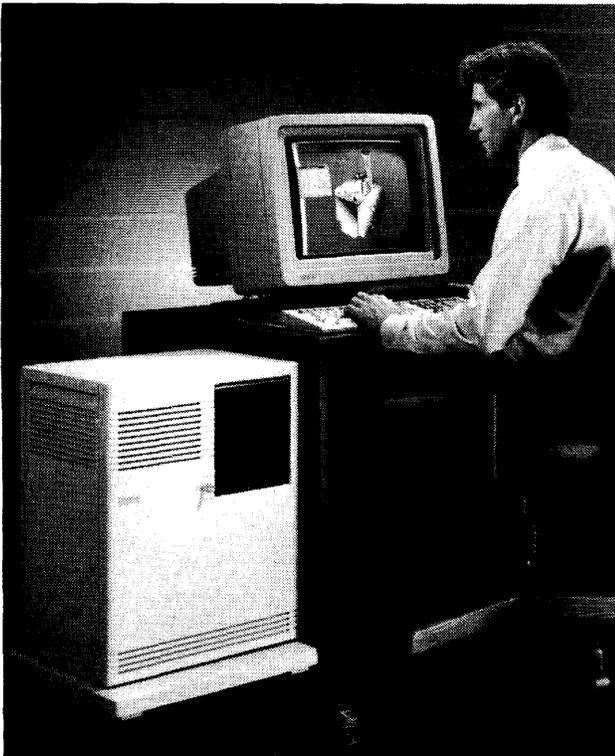
DEC VAXstations

MANAGEMENT SUMMARY

UPDATE: Since the last update of this report, Digital Equipment Corporation has added the VAXstation 3200 and 3500 to the high end of the VAXstation product line. The vendor has also introduced new, lower priced configurations of the mid-range VAXstation II/GPX.

Having secured a stronger position for itself at the low end of the technical workstation market with dramatic price reductions on the VAXstation 2000s in June 1987, Digital Equipment has turned its attention to gaining a position higher up the hill. Lured up the hillside by the music of Apollo and the warmth of Sun, Digital has introduced the VAXstation 3200 and 3500 to the VAXstation product line.

The earlier price reductions on Digital's entry-level workstations and the introduction of new high-end workstations reflect a high level of activity at both ends of the technical workstation market. Competition at the low end of the market comes from the traditional workstation vendors, as well as from several manufacturers of high-perfor-



Digital Equipment Corporation's new high-end VAXstation 3500 is a 3-MIPS workstation introduced to protect the vendor's user base from further intrusion by such competing vendors as Sun Microsystems and Apollo Computers. Though the workstation will be popular in VMS-based networked environments, it is not priced competitively enough, nor does it offer the graphics functionality to compete well with Sun and Apollo in more open environments based on UNIX.

VAXstations are technical workstations that Digital markets as part of its departmental and workgroup processing strategy. The workstations can be used in standalone, networked, or clustered configurations and are software compatible with Digital's MicroVAX supermicros and VAX 8000 superminis.

MODELS: VAXstation II, VAXstation II/GPX, VAXstation 2000, VAXstation 3200, and VAXstation 3500.

MEMORY: 2 megabytes to 32 megabytes.

DISK CAPACITY: 0 or 42 megabytes to 560 megabytes.

WORKSTATIONS: Up to three monitors and keyboards on VAXstation II/GPX.

PRICE: \$5,025 to \$63,395 (base configuration prices).

CHARACTERISTICS

VENDOR: Digital Equipment Corporation (DEC), 146 Main Street, Maynard, Massachusetts 01754-2571. Telephone (617) 897-5111.

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

DATA FORMAT

BASIC UNIT: 32-bit word.

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

MAIN STORAGE

The VAXstation 3200 and 3500 each support 8-megabyte memory modules which use 256K-bit ZIP DRAM-based ECC memory. The 3200 supports two of these modules (16 megabytes) and the 3500 supports four (32 megabytes). Addressable memory on the 3200 and 3500 is 64 megabytes. Memory boards based on 1-megabit chips will eventually be available, enabling the newer systems to take physical advantage of this increase in addressable memory. In addition, the newer ECC memory provides error correction code (ECC). ECC detects single- and double-bit errors and corrects single-bit errors; parity memory simply detects single-bit errors. ECC is necessary to provide the higher data integrity required when using larger amounts of memory.

Memory on the VAXstation II, II/GPX, and 2000 is dynamic parity MOS RAM. Main memory cycle time is 400 nanoseconds. Main memory increments are 2, 4, and 8 megabytes on the VAXstation II; 2, 4, and 8 megabytes on the VAXstation II/GPX; and 2 megabytes on the VAXstation 2000. Addressable memory on these systems is 16 megabytes.



CHART A. SYSTEM COMPARISON

MODEL	VAXstation II	VAXstation II/GPX	VAXstation 2000	VAXstation 3200	VAXstation 3500
SYSTEM CHARACTERISTICS					
Date of introduction	May 1985	January 1986	February 1987	September 1987	September 1987
Microprocessor type	MicroVAX 78032	MicroVAX 78032	MicroVAX 78032	CVAX 78034	CVAX 78034
Microprocessor cycle time	200 ns	200 ns	200 ns	90 ns	90 ns
Operating system	VMS, ULTRIX-32				
Upgradable from	Not applicable				
Upgradable to	Not applicable				
Number of expansion slots	8	8 (BA23); 12 (BA123)	0	8	12
MEMORY					
Minimum capacity (bytes)	2M	5M	4M	8M	16M
Maximum capacity (bytes)	16M	16M	6M	16M	32M
DISK STORAGE					
Minimum capacity (bytes)	71M	0 or 71M	0 or 44M	71M	159M
Maximum capacity (bytes)	477M	477M	318M	318M	560M
NUMBER OF MONITORS					
	1	3	1	1	1
COMMUNICATIONS PROTOCOLS					
	DECnet, TCP/IP, Ethernet, SNA, X.25				
PURCHASE PRICE					
System Building Blocks	\$17,750 to \$20,800	\$13,800 to \$36,475	Not applicable	Not applicable	Not applicable
Base configurations	\$26,000 to \$30,500	\$23,900 to \$63,395	\$5,025 to \$18,525	\$19,525 to \$34,575	\$50,005 to \$58,005

➤ mance microcomputers, including IBM's Personal System/2 (PS/2), which is based on the Intel 80386 microprocessor, as well as Apple Computer's Macintosh II, which is based on the Motorola 68020 microprocessor. At the high end of the market, the most visible rivals are Sun Microsystems and Apollo Computers.

Territorial boundaries are more firmly drawn at the high end of the market where technical workstations are much more costly and where the vendor is required to make a greater technological investment. Opportunities still exist at the high end, particularly for Digital, as the company's own users look to upgrade existing workstations and pursue better price/performance ratios by downsizing for certain applications from large-scale multiuser systems to a number of smaller, dedicated, yet sophisticated systems linked together through local area networks.

Sun and Apollo, however, have taken advantage of the performance gap that has existed between their workstations and Digital's products, and these rival vendors' products have become popular within Digital's VAX supermicro and supermini environments. Digital announced the VAXstation 3200 and 3500 in an attempt to narrow this performance gap and increase its revenues by capturing sales that would have gone to competitors. Though the gap still remains, the new VAXstations do improve upon the capabilities of the VAXstation product line, providing users with 2.6 to 4.2 times the computing power of the VAXstation II/GPX, Digital's previous high-end workstation model. (This performance comparison is derived from Digital's own benchmark testing using the industry-standard LINPACK, Whetstone, and Dhrystone testing procedures.)

The 3200 and 3500 offer not only greater performance but also larger memory and disk storage capacities than previous VAXstation models. The newer workstations use the same GPX graphics co-processor as the VAXstation II/GPX; therefore, even though the 3200 and 3500 perform faster than the II/GPX, graphics display capabilities are

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

PROCESSING COMPONENTS

The VAXstation 3200 and 3500 use the CVAX 78034 CPU chip and CVAX 78134 floating-point unit. The use of CMOS technology in the CPU and floating-point unit on the 3200 and 3500 results in a more efficient processor board layout that enables the implementation of dual-level cache memory. The CPU chip holds 1K bytes of cache memory, and an additional 64K bytes resides on the CPU board. The 3200 and 3500 CPU features a cycle time of 90 nanoseconds.

The utilization of CMOS technology plus cache memory enables the 3200 and 3500 to operate at speeds 2.6 to 4.2 times the processing speed of the previous VAXstations. This comparison is based on Digital's own benchmark testing results derived from Linpack, Whetstones, and Dhrystones testing procedures.

The VAXstation II, II/GPX, and 2000 utilize the MicroVAX 78032 CPU, MicroVAX 78132 Floating Point Unit (FPU), and VAX instruction set. A description of these processing units and the implementation of the instruction set is provided in the "DEC MicroVAX Family" report (M09-325-101) in *Dataprop Reports on Minicomputers*.

System electronics require four boards on the VAXstation II and II/GPX but have been reduced to one board on the VAXstation 2000 by using large-scale integration and proprietary standard cell and surface mount technologies.

GRAPHICS CO-PROCESSOR: The VAXstation 3200, 3500, and II/GPX also 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 bit-bit with rotation, fractional scaling, and Boolean operations; vector and text drawing; hardware clipping, tiling (stippling), and pattern fill; and smooth scrolling in both vertical and horizontal planes. The graphics 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 560 megabits per second.

➤ The GPX graphics co-processor is closely coupled to the double-buffered video memory. Graphics information is

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▷ still very much the same. The product line still lacks three-dimensional modeling capabilities, limiting its usefulness in some applications, such as solids modeling and simulation.

Despite adding the more powerful new systems, Digital continues to emphasize its mid-range VAXstation II/GPX. Shortly after the 3200 and 3500 were announced, new configurations of the II/GPX were also announced. Though all previous configurations are still available, the new configurations include many of the same hardware components and additional networking software in a smaller package for a lower price. For instance, the new II/GPX color system, housed in the 8-slot BA23 cabinet, is priced at \$36,475, compared to a similar, previously available configuration, housed in the 12-slot BA123 enclosure, priced at \$44,595. The new II/GPX's smaller size and additional DECnet and Local Area VAXcluster licenses equip the systems to participate in existing Digital networks, thus encouraging their use in small-scale networks and emphasizing Digital's workgroup and departmental computing strategies.

Because of its low cost, the VAXstation 2000, equipped with a GPX-compatible graphics co-processor and available with a 15- or 19-inch color or monochrome monitor, is suitable for users who cannot afford or don't need the more expensive Digital workstations. The VAXstation 2000 is intended for business environments where several workstations may be required for applications such as financial analysis. The VAXstation 2000 is also highly suitable for configuration in existing Local Area VAXclusters (LAVCs)—an interconnected group of up to 28 MicroVAXs, VAXstations, or VAX superminis—increasing the number of user seats in a localized configuration at a much lower cost.

The VAXstation II, which supports a monochrome monitor, is suitable for applications such as Computer-Aided Software Engineering (CASE), data acquisition and laboratory analysis, and desktop publishing. The system does not support a graphics co-processor or color monitor and is more expensive than similar configurations of the II/GPX. Undoubtedly, this system will soon be phased out in favor of the II/GPX, a more highly marketable product.

Though Digital emphasizes the use of its VAXstations in a networked, proprietary VMS environment, it also recognizes that AT&T's UNIX operating system is fast becoming the standard operating system in the technical workstation market. Thus, Digital continues to offer configurations of all VAXstations models based on the ULTRIX-32 operating system—Digital's version of Berkeley UNIX, which also includes AT&T UNIX System V extensions. Furthermore, Digital has also released Version 2.2 of ULTRIX-32 which provides support for both Digital's ULTRIX-based and Sun's diskless workstations based on UNIX, enabling users to add additional seats to networks of workstations running UNIX for less cost than when adding disk-based workstations. Support for diskless workstations also permits the VAXstations equipped with

▷ stored in video memory rather than in the system memory or on the 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 system 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 system has a display capability of 256 simultaneous colors from a palette of 16 million. Each plane is a 1K-by-1K-by-2 video bit-map display. The "2" indicates an off-screen page that stores occluded or predrawn images.

The VAXstation 2000 utilizes a graphics co-processor that is based upon and performs the same graphics functions as the GPX graphics co-processor. The VAXstation 2000 graphics co-processor offers one of four planes of display memory and is packaged on a daughtercard that is tightly coupled to the single system board.

INPUT/OUTPUT CONTROL

I/O on all VAXstations but the 2000 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 22-bit addressing and four interrupt levels and performs block mode DMA data transfers on a bandwidth of up to 3 megabytes per second.

The VAXstation 2000, like the MicroVAX 2000, is based on 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

The *VAXstation 3200* is housed in the BA23 pedestal enclosure. A basic configuration includes the CMOS CPU and FPU, 8 megabytes 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, VMS Workstation Software (VWS), Local Area VAXcluster (LAVC), and DECnet end node software licenses; a system based on ULTRIX—Digital's version of the Berkeley UNIX operating system—includes ULTRIX-32, ULTRIX Workstation Software (UWS), Network File System (NFS), Fortran, VAX-C, and Pascal licenses. The VAXstation 3200 supports an additional 8 megabytes of memory, for a total of 16 megabytes, and up to 318 megabytes (two 159 megabyte RD54 disk drives) of disk storage. The system will accommodate an internal, 95-megabyte TK50 tape drive.

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

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CHART B. DISK/DISKETTE DEVICES

MODEL	RX33	RX50	RD32	RD53	RD54	RA70
Type	Diskette	Dual Diskette	Winchester	Winchester	Winchester	Winchester
Size (inches)	5.25	5.25 per diskette	5.25	5.25	5.25	5.25
Number of surfaces	2 per diskette	1 per diskette	—	—	—	7
Formatted capacity per drive (bytes)	1.2M	818K (409K per diskette)	42.8M	71M	159M	280M
Interface/controller	—	RQDX3	RQDX3	RQDX3	RQDX3	KDA50
Number of drives per interface/controller	—	4	4	4	4	4
Average access time	—	264 ms	48.3 ms	38.3 ms	38.3 ms	27 ms
Data transfer rate	500K bps	250K bps	5M bps	625KB/sec	625KB/sec	1.4MB/sec
Sectors/tracks per surface	80 tracks	80 tracks	80 tracks	—	—	1,507 tracks
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector	512/sector	512
Purchase price	\$788	\$1,050 to \$1,890	\$2,415	\$3,990 to \$5,303	\$6,900 to \$8,295	\$9,000

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

➤ large amounts of disk to act as network servers in an environment based on UNIX systems. This capability gives Digital greater parity in environments where both Digital and Sun workstations have already been installed. spscr Digital also has improved upon the graphics capabilities of the workstations' GPX co-processor when running under ULTRIX-32 by enhancing the ULTRIX-32 Workstation Software (UWS). Drawing speeds have been improved through code optimization of the workstation software. Interaction between the mouse and keyboard and the processor has also been improved. Features have been added to the X Window System, including the Xtoolkit, a window-based text editor that provides the ability to create new applications more quickly and efficiently.

COMPETITIVE POSITION

Every cloud does not spawn a storm, and so far there has not been a big reaction to the VAXstation 3200 and 3500 from other leading workstation vendors. The new VAXstations have necessitated no new offerings by either Sun or Apollo; nor have these systems forced those leading vendors to cut prices on workstation models which compete directly with the new VAXstations—the Sun 3/260 and the Apollo Domain 4000, both rated at 4 MIPS, compared to the 3 MIPS rating assigned the new high-end VAXstations.

By the time Digital came out with the VAXstation 3200 and 3500, Sun and Apollo had already engaged in a pricing skirmish that made it difficult for Digital to undercut them with a much lower-priced competitive workstation. When Apollo announced its Domain 4000 in June 1987, it priced the system aggressively enough to compete with the Sun-3/200 workstations, which had already been on the market for several months. Sun responded to this move one month later by cutting prices on all the Sun-3 workstations by up to 19 percent and by introducing the 10-MIPS Sun-4 workstation. By the time the VAXstation 3200 and 3500 were announced in September, the 4-MIPS workstation market sector had already become dominated by Sun and Apollo, who traditionally get their systems to market before anyone else. Furthermore, even though a 3-MIPS workstation is great improvement for Digital's workstation product line, it is not

➤ megabytes of memory, for a total of 32 megabytes, and an additional RA70 disk drive, for a total of 560 megabytes of disk storage.

The gray-scale version of the VAXstation 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, and power cord must be ordered separately.

The VAXstation II/GPX is housed in either the BA23 (four-plane) or BA123 (eight-plane) enclosure. It includes the MicroVAX II CPU and FPU and supports up to three graphics co-processors, three 19-inch monochrome or color monitors, and three keyboards and mice. The system supports up to 16 megabytes of memory; up to 477 megabytes of disk storage through three 159-megabyte RD54 disks in a desk-side enclosure; the DEQNA or DELQA Ethernet interface; and VMS and VWS or ULTRIX-32 and UWS licenses. The VAXstation II/GPX is available in the following configurations:

- A VAXstation II/GPX SBB in a BA23 enclosure which includes a 19-inch monochrome or color monitor and a four-plane graphics co-processor. SBBs in the BA123 enclosure are similar but include an eight-plane graphics co-processor.
- VAXstation II/GPX SBBs in a BA23 enclosure which includes 5 megabytes of memory; a 19-inch color monitor; a eight-plane graphics co-processor; a DELQA Ethernet interface; documentation; and VMS, VWS, and DECnet end node licenses or ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses. These SBB configurations are also available with an RD54 disk drive and TK50 tape drive.
- A two-user, eight-plane system in the BA123 enclosure, including 5 megabytes of memory, an RD53 disk, a TK50 tape drive, two color monitors, two keyboards, two mice, two eight-plane graphics co-processors, ULTRIX-32 and UWS licenses, and a DEQNA Ethernet interface.
- A gray-scale system, in the BA23 enclosure, including 5 megabytes of memory, an RD53 disk, a TK50 tape drive, one monochrome monitor, one keyboard, one mouse, one four-plane graphics co-processor, VMS and VWS or ULTRIX-32 and UWS licenses, and a DEQNA Ethernet interface.
- An entry-level four-plane color system that is the same as the gray-scale system but includes a color rather than a monochrome monitor.

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CHART C. GRAPHICS MONITORS

MODEL	VR150/VR260	VR160/VR290
DISPLAY PARAMETERS		
Screen size (inches)	15 (VR150); 19 (VR260)	15 (VR160); 19 (VR290)
Tilt/swivel screen	Standard	Standard
Total colors/no. simult. displayed	16 simultaneous shades of gray	16 million/16 (4-plane), 256 (8-plane)
Resolution (pixels)	1,024 x 864, 78 pixels per inch	1,024 x 864, 78 pixels per inch
KEYBOARD PARAMETERS		
Style	Typewriter	Typewriter
Character/code set	ASCII	ASCII
Detachable	Yes	Yes
Program function keys	20	20
PURCHASE PRICE	\$1,200 (VR150); \$2,300 (VR260)	\$2,000 (VR160); \$6,300 (VR290)

➤ considered a technological breakthrough for the industry at large, compared to Sun's 10-MIPS Sun-4 workstation.

The unaggressive pricing of the VAXstation 3200 and 3500 is also an indication of the markets that Digital intends to serve with these products—primarily its own base of technical users. Realizing that its users have long demanded a higher performance workstation featuring Digital/VMS compatibility and that they are willing to pay nearly the same or more than for competing products, Digital has priced the new workstations less competitively than in markets where the market share is still up for grabs.

For example, a VAXstation 3200 configured with 8 megabytes of memory, a 19-inch monochrome monitor (with a 1,024-by-864 pixel resolution), a 159-megabyte disk drive, the VMS or ULTRIX-32 operating system, and networking licenses is priced at \$26,575, or \$8,858 per MIPS. A comparably configured Apollo Domain Series 4000 (with a 1,280-by-1,024 pixel resolution monochrome monitor) is priced at \$23,900, or \$5,975 per MIPS. A comparably configured Sun-3/260 (with a 1,600-by-1,280 pixel resolution monochrome monitor and including a 141-megabyte tape drive) is priced at \$36,900, or \$9,225 per MIPS. Though Sun is reputed to offer the best price/performance ratios on the market, a comparison of the above configurations indicates that the Sun-3/260 has the highest cost per MIPS. This is attributed to a higher resolution monitor, the integrated cartridge tape drive, and the ability to perform 3-D wireframe modeling, which are lacking on the other competitive model configurations.

Though Digital has long been established as the key vendor of engineering/scientific computing systems, it was still operating very conservatively during the early 1980s when Sun and Apollo were pioneering technical workstation technology. Rather than jumping into the market in its early stages, Digital acted like IBM and waited for user demand to increase to the point of profitability. But by the time technical workstations became recognized as a viable and lucrative market, Digital found itself outpaced, and even threatened, by these pioneers. Now, even though Digital has been offering its own workstations for over four years, its own users are still going to Sun and Apollo for those vendors' superior graphics and emphasis on standards and open systems architectures, especially if the user wants to run UNIX.

- • An entry-level eight-plane color system, in the BA123 enclosure, including 5 megabytes of memory, an RD53 disk, a TK50 tape drive, one color monitor, one mouse, one keyboard, an eight-plane graphics co-processor, VMS and VWS or ULTRIX-32 and UWS licenses, and a DEQNA Ethernet interface.
- An extended color system, in the BA123 enclosure, including 5 megabytes of memory, a 159-megabyte RD54 disk, a TK50 tape drive, one color monitor, one keyboard, one mouse, an eight-plane graphics co-processor, VMS and VWS or ULTRIX-32 and UWS licenses, and a DEQNA Ethernet interface.
- An extended color system, in the BA123 enclosure, including 16 megabytes of memory, two RD54 disks, a TK50 tape drive, one color monitor, one keyboard, one mouse, an eight-plane graphics co-processor, VMS and VWS or ULTRIX-32 and UWS licenses, and a DEQNA Ethernet interface.
- A diskless four-plane system, in the BA23 enclosure, including 5 megabytes of memory; one color monitor; one mouse; one keyboard; a four-plane graphics co-processor; a DEQNA Ethernet interface; and LAVC, DECnet, and VMS and VWS or ULTRIX-32 and UWS licenses.
- A diskless eight-plane system with the same features as the diskless four-plane system but including an eight-plane, rather than a four-plane, graphics co-processor.
- An Artificial Intelligence system, in the BA123 enclosure, includes 16 megabytes of memory, two RD54 disk drives, a TK50 tape drive, a color monitor, an eight-plane graphics co-processor, mouse, keyboard, DEQNA interface, VAX/Lisp, and VMS and VWS or ULTRIX-32 and UWS licenses.

The VAXstation II is housed in either the BA23 or BA123 pedestal enclosure and includes the MicroVAX II CPU and FPU. In its various configurations, the VAXstation II supports one 19-inch monochrome monitor, a graphics subsystem, up to 16 megabytes of main memory, and 477 megabytes of disk storage (through three 159-megabyte RD54 disks). RD53 disk drives are also supported.

The VAXstation II is available in the following configurations:

- A VAXstation II System Building Block (SBB) in the BA23 with 1 megabyte of memory.
- A VAXstation II SBB in the BA123 enclosure with 1 megabyte of memory, 19-inch monitor, three-button mouse, and keyboard.

CHART D. PRINTERS

MODEL	LA50	LA75	LA210	LN03	LN03 Plus	LN03R
Type	Dot matrix	Dot matrix	Dot matrix	Laser	Laser	Laser
Speed	50/100 cps	32/42/125/250 cps	40/240 cps; 80 cps opt.	8 ppm	8 ppm	8 ppm
Bidirectional printing	Yes	Yes	Yes	Not applicable	Not applicable	Not applicable
Paper size	4.5 to 10.0 in. wide	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.	8.5 x 11.0 in.; or 8.3 x 11.7 in.
Character formation	13 x 9/7 x 9 dot matrix	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.	300 x 300 dots/in.
Horizontal character spacing (char./inch)	10.0, 12.0, 16.5 or 5.0, 6.0, 8.25	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	2, 3, 4, 6, 8, 12	Variable	Variable	Variable	Variable
Character set	96 ASCII, others	ASCII, 8 others	94 ASCII; Courier, VT100 line-drawing std.; others opt.	ASCII; 16 resident Courier/Elite fonts	ASCII, technical; 17 resident fonts	ASCII, technical; 29 resident fonts
Controller/Interface	RS-232-C	RS-423	RS-232-C std.; Centronics parallel opt.	RS-232-C	RS-232-C	RS-232-C
No. of printers per controller/interface	1	1	1	1	1	1
Printer dimensions, in. (h x w x d)	5.0 x 15.7 x 11.2	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	15.0 x 21.0 x 23.5
Graphics capability, dots per inch	72 x 180	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	Provides bit-mapped, Tektronix 4010/4014-compatible graphics	Includes POSTSCRIPT Interpreter; prints ANSI/sixels, ReGIS, and Tektronix 4010/4014 files
Purchase price	\$795	\$835	\$1,675	\$3,070	\$4,245	\$6,610

➤ However, because they are designed to protect Digital's user base, the new VAXstations offer particular advantages to Digital's current users who wish to use the workstations in a VMS-based environment. The VAXstation 3200 and 3500 provide connectivity features as well as hardware and software compatibility with the rest of the Digital product line, enabling the workstations' smooth integration into existing Digital environments. Until these systems became available, workstation users who desired compatibility with the VMS environment had to make do with a narrow product range and only 0.9 MIPS of computing power offered by the VAXstation II and II/GPX.

On the other hand, users for whom higher graphics functionality and performance have outweighed VMS compatibility have purchased the more powerful workstations from Sun and Apollo. These vendors include support for both AT&T and Berkeley versions of UNIX as the primary operating environment. Though Digital offers ULTRIX-32, based on Berkeley 4BSD, the vendor's primary emphasis is on VMS. Digital's lateness to market with a high-performance, VMS-based workstation forced users to turn to systems based on UNIX, creating a window of opportunity for the workstation vendors within Digital environments. So now, Digital must not only catch up technologically with competitors' hardware but must also continually upgrade ULTRIX-32 to keep pace with developments within the world of UNIX computing.

Both Sun and Apollo base their workstations on industry-standard Motorola microprocessors, allowing them to keep pace with industry-wide microprocessor develop-

- • A packaged VAXstation II housed in the BA123 enclosure with 5 megabytes of memory, a TK50 tape drive, an RX50 diskette drive, an RD53 71-megabyte Winchester disk, DEQNA Ethernet controller, VMS and VWS, or ULTRIX-32 and UWS, a three-button mouse, a keyboard, and a display monitor. A similar configuration housed in a BA23 enclosure and with 2 megabytes of memory and is also available.
- An Artificial Intelligence Workstation housed in the BA123 enclosure with 9 megabytes of memory, the TK50 tape drive, an RD53 Winchester disk, DEQNA Ethernet interface, VAX/Lisp license, VMS and VWS, a three-button mouse, and keyboard, and display monitor.

The VAXstation 2000 is housed in a compact system box but maintains hardware and software compatibility with the larger VAXstation members. The VAXstation 2000 is available in a number of kernel configurations to which options may be added. The kernels are designated as diskless kernels: RD53 kernels which include a 71-megabyte RD53 disk and RD54 kernels which include a 159-megabyte RD54 disk drive. Each of the kernels includes either 4 megabytes or 6 megabytes of memory (6 megabytes is the maximum memory supported), a 15- or 19-inch monochrome or color monitor, a ThinWire Ethernet interface, documentation, VMS, VWS, DECnet, and LAVC licenses or ULTRIX-32 and UWS, NFS, ULTRIX-C, VAX-C, Fortran, and Pascal licenses.

Each VAXstation 2000 supports the following options:

- A keyboard.
- A pointing device (mouse or tablet).
- A four-plane graphics co-processor for monochrome kernels only.

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► ments as well as save on R&D expenses, and thus offer less expensive systems. Sun and Apollo also offer higher performance and a wider range of workstations than does Digital, providing users with a better upward migration path. Sun and Apollo emphasize open system architectures and multivendor compatibility while Digital continues to stress its closed architecture, conceding only to those industry standards that give it enough edge to protect its own user base.

Sun is recognized as the leader in price/performance and its workstations are very popular in Digital environments, not only for their low prices but for a strong emphasis on open architectures and connectivity to Digital's proprietary architectures systems. In an attempt to match Sun's multivendor compatibility, Digital provides support for Sun's Network File System (NFS), which allows transparent file access among computers from different manufacturers over one or more networks. ULTRIX-32's newly announced support for Sun's diskless workstations provides Digital with some multivendor support but also gives Sun another advantage within Digital environments.

Sun is a particular challenge for Digital. Sun not only supports existing industry standards but also pushes for the acceptance of new technologies it has developed as standards. For instance, the vendor is currently licensing its RISC-based SPARC processor to other vendors, including AT&T and Xerox. By establishing industry-wide support for the RISC architecture, Sun seeks to ensure that its own RISC-based products will be considered as viable computing tools and not industry freaks. Digital has yet to show an active interest in RISC computing, though Ken Olsen says the company is "half working" on it.

To protect its user base from further intrusion by Sun and Apollo, Digital must continue to expand its workstation offerings and not necessarily pursue technical computing from a totally proprietary point of view. Digital must also take care now to protect its target markets from intrusion by Sun and Apollo since both of those vendors are beginning to move away from strictly technical workstation applications into commercial computing. For example, Sun is involved in a joint development and cooperative marketing agreement with Stratus Computer under which the two vendors will integrate and jointly market their systems to provide a fault-tolerant server for networks of Sun workstations. Such an alliance could certainly be a threat to Digital in the OLTP marketplace—where the company's activity is just getting under way.

On the other hand, Digital has to balance viable, high-performance workstation products against sales of its larger VAX 8000 systems, which bring the company more revenue. It does not benefit the company to lose sight of the larger picture in an attempt to dominate a smaller and comparatively less lucrative market. To an extent, Sun and Apollo may actually be serving Digital's purpose by providing a small number of Digital's users with the higher capability they require. Meanwhile, by not offering

- • Two half-height storage devices that may be added to the diskless configurations. These include the 1.2-megabyte RX33 diskette drive and a 42-megabyte RD32 disk drive (only one of each may be configured and both must be housed in the system box).
- The TK50 tape drive, available only in the BA40A expansion adapter.
- A second full-height RD53 or RD54 disk that can be added to the RD53 and RD54 kernels; this requires the BA40A expansion adapter. The BA40A expansion adapter houses both a TK50 tape drive and an RD53 or RD54 disk drive.

A fully configured VAXstation 2000 includes 6 megabytes of memory, two 159-megabyte RD54 disk drives, a TK50 tape drive, monitor, keyboard, and mouse. This configuration requires the BA40A expansion adapter to house the tape drive and second disk drive.

Since ULTRIX-32 software is available only on tape, ULTRIX-32 systems that are not networked require a TK50. ULTRIX-32 systems 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.

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

A specialized, MicroVAX-based realtime system, *VAXlab*, is offered for laboratory data acquisition and experiment control in mid-range to high-performance applications. Two of the four versions are based on VAXstation configurations:

- VAXlab/VS2, a high-resolution, multiwindow graphics workstation built on the VAXstation II.
- VAXlab/GPX, based on the VAXstation/GPX eight-plane color graphics workstation.

Each VAXlab system includes a CPU/FPU; 5 megabytes of main memory; a 71-megabyte RD53 disk; a TK50 streaming tape drive; an Ethernet interface; distribution panels for attachment of I/O connections to realtime devices; a realtime clock; the VMS operating system; DECnet end node license; and Graphical Kernel System (GKS) software. Also included is Labstar software for realtime I/O; scientific plotting; mathematical, statistical, and signal processing operations; and system management. A variety of analog-to-digital, digital-to-analog, and parallel digital options can be added.

INPUT/OUTPUT UNITS

Refer to Chart B for disk and diskette devices, to Chart C for graphics monitors, and to Chart D for printers.

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

► The TK50 streaming tape drive is a ½-inch cartridge unit that uses CompacTape cartridges; a single cartridge can ►

▷ VMS-based workstations comparable in speed and performance to competitors' offerings, Digital forces its users into the more expensive multiuser VAX 8000 line.

ADVANTAGES AND RESTRICTIONS

Because the VAXstations are based on the MicroVAX architectures, they offer the same advantages as the MicroVAX systems, including software compatibility and limited peripheral compatibility with the entire line of VAX computer systems. The VAXstations also inherit the same restrictions as the comparable MicroVAX models. Please refer to the "DEC MicroVAX Family" report (M09-325-101) in *Datapro Reports on Minicomputers* for a full description of these advantages and restrictions.

As for their capabilities as technical workstations, the VAXstations offer all the basic requirements for adequate workstation functionality: a dedicated 32-bit microprocessor; graphics I/O device support (e.g., mouse and tablet); graphics co-processors on the 3200, 3500, II/GPX, and 2000; multivendor networking capabilities based on industry-standard Ethernet; and disk storage capacities sufficient for technical computing applications such as CAD/CAM and electronic publishing. These capabilities are not necessarily advantages, though, since all other workstation vendors offer the same features; however, the lack of any one of the above would detract from workstation functionality.

The particular advantage that may be cited in addition to these basic elements is the capability to be clustered with larger VAX systems, drawing upon the VAX's additional processing power and storage capacities. Like Sun, Digital also offers less expensive, diskless models of the VAXstations which can be added to existing LAVCs, increasing the processing power and number of user seats without the added cost of disk storage local to each workstation. Digital also offers several MicroVAX-based systems, called VAXservers, configured to act as a workgroup server and/or boot node in a LAVC resource sharing scheme which supports up to 28 nodes.

The VAXstations 3200 and 3500 offer numerous advantages over Digital's older offerings, such as the previously mentioned greater CPU performance and increased memory which increase systems speed and also enable the new workstations to perform more CPU- and memory-intensive applications. In addition, the 3500 is housed in the 12-slot BA213 enclosure (also used to house the MicroVAX 3500 and 3600). This cabinet has been ruggedized and is suitable for both factory and office installation. The disadvantage of this packaging is that it requires quad-height boards rather than the dual-height boards used on the other models, including the VAXstation 3200, which is housed in the older BA23 system enclosure (also used to house certain configurations of the VAXstation II and II/GPX). VAXstation 3200 users who want to transfer existing CPU, memory, and communications boards to the larger cabinet—which supports more memory and

▶ back up any of the Winchester disks used on a VAXstation II, II/GPX, or 2000. This Q-bus drive, which uses a microprocessor-based controller, has a maximum storage capacity of 95 megabytes and achieves a read/write speed of 75 ips in streaming mode. The TK50 has a peak data transfer rate of 62.5 kilobytes per second (45.0 kilobytes per second for user data). Recording density is 6667 bpi. The TK50 also features read-after-write operation and emulation of reel-to-reel tape drive operation. The TK50 is not supported by the VAXstation 3500, but the TK70 supported by this system can read tapes written on a TK50.

The *LCG01 color printer* is an ink jet color graphics device that provides output on paper and transparencies. It provides print resolution of 154 dots per inch, a print rate of approximately two minutes per copy, and up to 216 shades. Interfaces available for the LCG01 are RS-232-C, RS-422, and 20 mA. The printer supports REGIS, GIDIS, NAPLPS, and bit-map image (color pixel format) graphics protocols.

The *LVPI6 color graphics plotter* is a desktop, six-pen device that draws on plain paper or transparencies. It is compatible with the HP-GL graphics protocol and prints graphics at 15 inches per second. An RS-232-C interface is standard.

The three-button *mouse* features X and Y relative displacement and a 100-pulses-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, and certain configurations of the II/GPX, connects these systems to Ethernet V2.0 or IEEE 802.3 LANs. DELQA provides onboard 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.

Via the *DEQNA Ethernet interface*, the VAXstation II, II/GPX, and 2000 can be connected to local and wide area networks and share resources with systems running VMS and UNIX operating systems, and systems running on SNA and X.25 networks. It operates at 10M bps and is supported under DECnet Phase IV software. DEQNA allows a system to communicate with up to 1,023 addressable devices on an Ethernet LAN.

Also configurable on the VAXstation family is the *H4005 Ethernet Transceiver*, detailed in the "DEC VAX 8000 Systems" report (M11-384-501) in *Datapro Reports on Minicomputers*.

SOFTWARE

The VAXstations run the VMS and ULTRIX-32 operating systems which are described in the "DEC MicroVAX Family" report (M09-325-101) in *Datapro Reports on Minicomputers*. The VMS operating system for the VAXstations is based on the same architecture as VAX/VMS, which runs on the VAX superminis. Consequently, the VAXstations run the same system and applications software as the larger VAX computers without recompilation or relinking, subject to the limitations of peripheral support.

▶ *VWS (VMS Workstation Software)* is a layered product for VMS or VAX/VMS which provides graphics support ▶

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▷ disk storage—are required to modify the boards to fit the wider backplane slots, entailing some extra cost and inconvenience.

All of the VAXstation model configurations, except the VAXstation II, now include DECnet and LAVC software, which equips the systems for immediate participation in existing DECnet and LAVC environments. Inclusion of networking software with all models is evidence of Digital's commitment to provide workgroup and departmental computing in corporate-wide networked environments.

Digital is now demonstrating more commitment to industry-compatible workstation environments. The ULTRIX operating system has been enhanced to support both ULTRIX-based and Sun diskless workstations. The VAXstations support not only general networking and communications standards but also Sun's Network File System (NFS), which allows different hardware and networks to communicate with each other, thus enabling the VAXstations to coexist in multivendor environments.

The ULTRIX-32 Workstation Software (UWS) includes the Graphics Kernel System (GKS) library, which is emerging as the worldwide industry-standard programming interface. The GKS library assists in the development of device-independent applications which can be ported to other vendors' workstations.

UWS also includes windowing facilities provided by the industry-standard X Window System developed by MIT. Users can run graphics applications on remote ULTRIX nodes and have the graphics presented on their local workstations, providing access to the additional processing and storage capacity of other workstations in the network.

Notable restrictions are the lack of a more powerful graphics co-processor on the newer VAXstation 3200 and 3500. All the workstations lack three-dimensional graphics, limiting their use in some applications, such as solids modeling and simulation. Competitors, like Sun, Apollo, Hewlett-Packard, and Prime Computer are now offering 3-D workstations. □

▶ 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 standalone VAXstations, VWS runs on the workstation's VMS operating system. On VAXstations configured in an LAVC, VWS runs on the VAX/VMS operating system of the server system.

ULTRIX-32, Digital's derivative of UNIX, is based on Berkeley 4.2 BSD UNIX and also includes extensions of AT&T's UNIX System V extensions. The *ULTRIX-32 Workstation Software (UWS)* (formerly called *ULTRIX-32w*) features windowing and graphics capabilities. Fully compatible with *ULTRIX-32*, UWS also supports diskless VAXstations and Sun Microsystems' workstations through

the virtual disk operation, which allows users to connect lower-priced diskless workstations into existing networks and make use of the disk storage on other systems in the network. Both *ULTRIX-32* and UWS are also fully compatible with Sun Microsystems' Network File System (NFS), allowing VAXstations to coexist in multivendor networked environments.

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

The windowing facilities of UWS are provided by *X-Window*, an enhanced version of the package developed by MIT's Project Athena and the MIT Laboratory for Computer Science. A network-based system, *X-Window* provides workstations running the UNIX operating system with remote graphics windowing. Users can run applications on remote *ULTRIX-32* nodes and have the graphics output presented transparently on their local workstations. *X-Window* also supports multiple view ports that can overlap and run even while occluded by another window.

The workstation software features a GKS library 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.

UWS is a modular system, providing developers with access to the workstation's capabilities at any one of several levels. Depending upon performance needs, users can interface an application directly to the driver, to the hardware-level graphics library, to the window server, or to the GKS module.

The VAXstations support the same data base management, communications, applications, tools and utilities, and languages as the *MicroVAXs*. Descriptions of the software supported are provided in the "DEC *MicroVAX Family*" report in *Datapro Reports on Minicomputers*. 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. Unless noted, details on the software referenced in this section are also the same as those presented in the "DEC VAX 8000 Systems" report in *Datapro Reports on Minicomputers*. Further details on VAX and *MicroVAX* software can be found in the *Datapro Directory of Software* and the *Datapro Directory of Microcomputer Software*.

LAVC software allows the interconnection through Ethernet of up to 26 *MicroVAX* and VAXstation satellite systems with two central *MicroVAXs* or VAXservers or with a single dual-CPU VAXserver 3602. The *LAVC* creates a unified system, allowing all participating nodes to remain independent while equally sharing resources, such as disks, tapes, and printers, and to employ a single distributed file system that manages access of files at the record level.

APPLICATIONS: More than 3000 Digital 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 indus-

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► tries 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 combinations with Digital hardware. CMPs and SCMPs currently offer over 130 applications packages tailored for the VAXstation product line, including the following packages recently announced for the VAXstation 3200 and 3500:

- Applix, Inc. *Alis* office automation software
- Autodesk, Inc. *AutoCAD* design and drafting software
- Auto-trol Technology *Graphics Systems*
- BBN Software Products *RS/I*, *RS/Explore*, *RS/Discover*, and *QCA* data analysis software
- Cadre Technologies Inc. *Teamwork* CASE tools
- Cognos, Inc. *PowerHouse* application development language
- Ge Calma *Prism/DDM* and *DIMENSION III* CAE/CAD/CAM software
- Impell Computer Systems *Re:Vision* and *Re:Design* engineering drawing tools
- Index Technology Corp. *Excellerator* CASE tools
- Racal-Redac, Inc. *VISULA* CAE/CAD software
- Structural Dynamics Research Corp. *I-DEAS* MCAE software
- Sierra Geophysics, Inc. *MIMIC*, *QUIKLOG*, *STRATLOG*, *QUIKRAY*, *QUIKSHOT*, *QUIKVSP*, *QUIKCDP*, *RAYMAP*, *SIVA*, *VESPA*, and *STATIX* seismic processing software
- Signal Technology, Inc. *ILS* laboratory signal processing software
- Tektronix CAE Systems *PCB*, *Gate Array*, and *Full Custom Logic WorkSystems*

Allied with third-party software vendors, Digital has designed, configured, and tested fully integrated systems, called VAX Solution Systems, for specific industry applications. VAX Solution Systems currently available include the following:

- The Advanced Electronics Design System consisting of Valid Logic Systems *ValidGED*, *ValidCOMPILER*, *Realchip*, and *ValidPACKAGER*, and Digital's MicroVAX II and VAXstation 2000 configured in an LAVC.
- The Artificial Intelligence (AI) Development Solution System combines Quintus Computer Systems *QUINTUS Prolog* with VAX Lisp, VAX OPS5, and Digital networking software on the VAX 8500 and VAXstation 2000s.
- The High-End Electronics Design Solution System is an LAVC consisting of a VAX 8550 and 12 VAXstation 2000s running Tektronix/CAE *DDSC* for schematic capture and GenRad Corp. *HIL0-3* for logic simulation.

- The Low-Cost Electronic Design Solution System is an LAVC consisting of a MicroVAX II; two VAXstation 2000s; and two VAXstation II/GPXs running CASE Technology's *CT3000 Schematic Design System*, *CT5000 Schematic Design System*, *CT5400 PCB Layout System*, *SCALD Hardware Compiler*, *Netlist Post Processor*, *Hardcopy Post Processor*, *Timing Verifier*, and *CADAT Logic Simulator*.
- The Integrated Manufacturing Services Work Group Solution System consists of two VAXmates; two MicroVAX 2000s; one VAXstation II/GPX; and a MicroVAX II configured in an LAVC and running BBN, Inc. *RS/I*, DataMyte Corp. *DataMyte*, Gately & Glew Data Services, Inc. *EPIS*, Systems Coordination, Inc. *CHAMPS*, and Pritsker Associates' *TESS*.
- The Mechanical Design and Analysis Solution System consists of a MicroVAX II, VAXstation II/GPXs, and VAXstation 2000s configured in an LAVC and running Digital's Engineering Data Control System, Structural Dynamics Research Corp. *I-DEAS*, and Interleaf, Inc. *Interleaf Word Processing*.

Several publishing solution packages, consisting of VAXstations and third-party software, are also available.

OPERATING ENVIRONMENT

The VAXstation 3500 is housed in the BA213 enclosure. The VAXstation 3200 is housed in the BA123 enclosure. The VAXstation II and II/GPX are housed in the same BA23 and BA123 enclosures as the MicroVAX II. The dimensions and operating environments of these system units are described in the "DEC MicroVAX Family" report in *Datapro Reports on Minicomputers*.

The dimensions of the VAXstation 2000 are the same as those of the MicroVAX 2000 and are also given in the report cited above. However, the VAXstation 2000's operating environment differs slightly; the operating temperatures for the VAXstation 2000 range from 60 to 90 degrees Fahrenheit (15.5 to 35.5 degrees Celsius) at 40 to 80 percent relative humidity, noncondensing.

SUPPORT SERVICES

DOCUMENTATION: With each VAXstation, the user must order documentation (and installation diagnostics) on TK50 tape or RX50 diskette media. 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 covering both Digital equipment-related and nonproduct-related topics are offered. A variety of teaching methods is used, 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 may be extended for up to three years.

MAINTENANCE: Digital's Field Service organization offers both on-site and off-site support services for the VAXstation 3200, 3500, II, and II/GPX. Standard on-site services include the Basic Service Agreement, the extended

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► **DECservice Agreement, and Per Call service.** Off-site maintenance is available through Digital's Customer Returns Center, Product Repair Center, and Digital Servicers, which are all equipped with parts inventories, special diagnostic systems, and repair kits. Details of Digital's service programs and of software support services available are provided in the "DEC VAX 8000 Systems" report in *Datapro Reports on Minicomputers*.

Two other types of integrated service are offered for the VAXstations. Basic System Service (BSS) is offered on systems used as LAVC boot nodes or as standalone systems. Basic Node Service (BNS) is offered on systems used as LAVC nodes only. Both plans provide Onsite Basic Hardware Service and Right to Use Updates. BSS also provides Digital Software Information Network, and Hardware and Software Telephone Support through the System Administrator.

PRICING

POLICY: Digital provides the VAXstations on a purchase basis, with separately priced maintenance agreements. 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.

Digital's Volume Software Pricing and VAX Software Portfolio programs are available for VAXstation users. A description of these programs is provided in the "DEC MicroVAX Family" report in *Datapro Reports on Minicomputers*.

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

EQUIPMENT PRICES

VAXSTATION 3200

Each VAXstation 3200 includes a MicroVAX 3500/3600 CMOS CPU and FPU. The VAXstation 3200 is housed in the BA23 enclosure.

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)	Basic Node Service (Monthly) (\$)	Basic System Service (Monthly) (\$)
VS300-A3(AA)	Grey-scale system; includes 8MB of memory; four-plane graphics co-processor; 19-in. monochrome monitor; DELQA Ethernet interface; documentation; one-year hardware/software warranty; VMS, VWS, LAVC, and DECnet end node licenses	19,525	219	261	171	219
VS300-B3(BA)	Same as VS300-A3(AA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	19,525	219	261	171	219
VS305-A3(A4/AA)	Color system; includes 8MB of main memory; eight-plane graphics co-processor; 19-in. color monitor; DELQA Ethernet interface; documentation; one-year hardware/software warranty; VMS, VWS, LAVC, and DECnet end node licenses	27,525	259	308	202	259
VS305-B3(B4/BA)	Same as VS305-A3(A4/AA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	27,525	259	308	202	259
VS310-A3(AA)	Same as VS300-A3(AA) but also includes an RD54 159MB disk drive	26,575	298	355	250	298
VS310-B3(BA)	Same as VS300-A3(AA) except with ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses; also includes RD54 disk drive	26,575	298	355	250	298
VS315-A3(A4/AA)	Same as VS305-A3(A4/AA) but also includes an RD54 disk drive	34,575	338	402	281	338
VS315-B3(B4/BA)	Same as VS305-A3(A4/AA) except with ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal; also includes an RD54 disk drive	34,575	338	402	281	338

VAXSTATION 3500

Each VAXstation 3500 includes a MicroVAX 3500/3600 CMOS CPU and FPU. The VAXstation 3500 is housed in the BA213 enclosure.

VS350-A3(AA)	Grey-scale system; includes 16MB of main memory; four-plane graphics co-processor; 19-in. monochrome monitor; DELQA Ethernet interface; RA70 280MB disk drive; TK70 296MB tape drive; documentation; one-year hardware/software license; VMS, VWS, LAVC, and DECnet end node licenses	50,005	484	576	386	495
VS350-B3(BA)	Same as VS350-A3(AA) but with ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	50,005	484	576	386	495

FS—Contact Digital Field Service.
 NA—Not applicable.
 NC—No charge.

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		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)	Basic Node Service (Monthly) (\$)	Basic System Service (Monthly) (\$)
▶ VS355-A3(A4/AA)	Color system; includes 16MB 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; VMS, VWS, LAVC, and DECnet end node licenses	58,005	524	624	417	435
VS355-B3(B4/BA)	Same as VS355-A3(A4/AA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	58,005	524	624	417	435

VAXSTATION II

Each VAXstation II includes a MicroVAX II CPU and FPU. The VAXstation II is housed in either the BA23 or BA123 enclosure.

VAXstation II System Building Blocks (SBBs)

VS210-A2(A3)	Includes BA23 enclosure, 1MB of main memory, graphics subsystem, 19-in. monochrome monitor, and mouse	17,750	275	FS	249	301
VS215-A2(A3)	Includes BA123 enclosure, 1MB of main memory, graphics subsystem, 19-in. monochrome monitor, and mouse	20,800	285	FS	259	311

VAXstation II Configurations

SU-LV55B-EK(EN)	Includes BA123 enclosure; 5MB of main memory (1MB on CPU board and one 4MB MS630-BB memory board); RD53 71MB fixed disk; TK50 95MB tape; RX50 diskette; DEQNA Ethernet controller; video graphics subsystem; keyboard; mouse; monochrome monitor; ULTRIX-32 and UWS licenses	30,500	210	FS	180	228
SU-LV55H-EK(EN)	Includes BA23 enclosure; 2MB of main memory (1MB on CPU board and one 1MB MS630-AA memory board); RD53 71MB fixed disk; TK50 95MB tape; DEQNA Ethernet controller; video graphics subsystem; keyboard; mouse; monochrome monitor; ULTRIX-32 and UWS licenses	26,000	200	FS	170	218
SV-LV55B-EK(EN)	Includes BA123 enclosure; 5MB of main memory (1MB on CPU board and one 4MB MS630-BB memory board); RD53 71MB fixed disk; TK50 95MB cartridge tape; VMS 1-2 user license, and VWS license	30,500	FS	FS	180	228
SV-LV55H-EK(EN)	Same as SV-LV55B-EK(EN), but with 2MB of main memory (1MB with CPU and one MS630-AA 1MB memory board)	26,000	200	—	170	218

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SV-LV55F-EK(EN)	Same as SV-LV55B-EK(EN), but includes 9MB of main memory (1MB with CPU and two 4MB MS630-BB memory boards) and VAX Lisp license	42,300	196	FS	166	214
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VAXSTATION II/GPX

Each VAXstation II/GPX includes a MicroVAX II CPU and FPU. The VAXstation II/GPX is housed in either the BA23 or BA123 enclosure.

VAXstation II/GPX SBBs

VS230-F3(F4/FA)	Color system; includes 5MB main memory; BA23 enclosure; 19-in. color monitor; eight-plane graphics co-processor; DELQA; documentation; VMS, VWS, DECnet end node, and LAVC licenses; one-year hardware/software warranty; must order keyboard, pointing device, and power cord	21,525	239	285	—	—
VS230-G3(G4/GA)	Same as VS230-F3(F4/FA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses	21,525	239	285	—	—
VS230-H3(H4/HA)	Same as VS230-F3(F4/FA) but also includes RD54 159MB disk drive	28,575	318	379	—	—
VS230-J3(J4/JA)	Same as VS230-F3(F4/FA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal licenses; also includes RD54 disk drive	28,575	318	379	—	—

FS—Contact Digital Field Service.
 NA—Not applicable.
 NC—No charge.

DEC VAXstations

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)	Basic Node Service (Monthly) (\$)	Basic System Service (Monthly) (\$)
▶ VS235-F3(F4/FA)	Same as VS230-F3(F4/FA) except includes RD54 disk drive and TK50 95MB tape drive	36,475	475	565	—	—
VS235-G3(G4/GA)	Same as VS230-F3(F4/FA) except includes ULTRIX-32, UWS, NFS, Fortran, VAX-C, and Pascal; also includes RD54 disk drive and TK50 tape drive	36,475	475	565	—	—
VS265-A2(A3)	Gray-scale system; includes BA23 enclosure; mouse, monochrome monitor; four-plane graphics co-processor; requires power cord, documentation/diagnostics software, mass storage, keyboard, operating system license, main memory	13,800	171	—	168	201
VS265-B2(B3)	Color system; same as VS265-A2(A3), but includes color monitor	14,800	189	—	184	221
VS270-A2(A3)	Gray-scale system; includes BA 123 enclosure, mouse, monochrome monitor, eight-plane graphics co-processor requires power cord, documentation/diagnostics software, keyboard, operating system license, and main memory	23,395	214	—	207	249
VS270-B2(B3)	Color system; same as VS270-A2(A3), but includes color monitor	25,595	235	—	226	271

VAXstation II/GPX Configurations

SU-LV55W-EK(EN)	Gray-scale system; includes BA23 enclosure, 5MB of main memory (1MB with CPU and one MS630-BB 4MB memory board), RD53 71MB fixed disk, TK50 95MB cartridge tape, DEQNA Ethernet controller, four-plane graphics co-processor, keyboard, mouse, monochrome monitor, and ULTRIX-32 and UWS licenses	24,995	229	—	208	250
SU-LV55Y-EK(EN)	Same as SU-LV55W-EK(EN), but includes color monitor	25,995	238	—	217	260
SU-LV55U-EK(EN)	Entry-level eight-plane color system; same as SU-LV55Y-EK(EN), but with BA123 enclosure and eight-plane graphics co-processor	39,950	412	—	351	450
SU-LV55R-EK(EN)	Two-user, eight-plane color system; same as SU-LV55U-EK(EN), but includes two eight-plane graphics co-processors	48,700	446	—	406	487
SU-LV59B-EK(EN)	Includes BA 123 enclosure; 5MB of main memory (1MB with CPU and one MS630-BB 4MB memory board); BA 123 enclosure; RD54 159MB fixed disk; TK50 95MB cartridge tape; DEQNA Ethernet Controller; eight-plane graphics co-processor, keyboard; mouse, color monitor, and ULTRIX-32 and UWS binary licenses	44,595	437	—	376	475
SU-LV59C-EK(EN)	Same as SU-LV59B-EK(EN), but with 16MB of memory (two MS630-CA 8MB boards) and two RD54 159MB fixed disks	58,595	500	—	439	538
SU-LV59D-EK(EN)	Same as SU-LV59C-EK(EN), but including Lisp license	63,395	500	FS	439	538
SV-LV55U-EK(EN)	Color system; includes BA 123 enclosure, 5MB of main memory (1MB on CPU board and one 4MB MS630-BB memory board), RD53 71MB fixed disk, TK50 95MB tape, DEQNA Ethernet controller, eight-plane graphics co-processor, keyboard, mouse, color monitor, and VMS and VWS licenses	39,950	FS	FS	439	538
SV-LV55W-EK(EN)	Gray-scale system; includes BA23 enclosure, 5MB of main memory (1MB on CPU board and one 4MB MS630-BB memory board), RD53 71MB fixed disk, TK50 95MB tape, DEQNA Ethernet controller, four-plane graphics co-processor, keyboard, mouse, monochrome monitor, and VMS and VWS licenses	24,995	229	FS	208	250
SV-LV55Y-EK(EN)	Color system; same as SV-LV55W-EK(EN), but with color monitor	25,995	238	FS	217	260
SV-LV59B-EK(EN)	Color system; includes BA 123 enclosure, 5MB of main memory (1MB on CPU board and one 4MB MS630-BB memory board), RD54 159MB fixed disk, TK50 95MB tape, DEQNA Ethernet controller, eight-plane graphics co-processor, keyboard, mouse, color monitor, and VMS and VWS licenses	44,595	437	FS	376	475
SV-LV59C-EK(EN)	Color system; includes BA 123 enclosure, 16MB of main memory (two MS630-CA 8MB memory boards), two RD54 159MB fixed disks, TK50 95MB tape, DEQNA Ethernet controller, eight-plane graphics co-processor, keyboard, mouse, color monitor, and VMS and VWS licenses	58,595	500	FS	439	538 ▶

FS—Contact Digital Field Service.

NA—Not applicable.

NC—No charge.

DEC VAXstations

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)	Basic Node Service (Monthly) (\$)	Basic System Service (Monthly) (\$)
▶ SV-LV59D-EK(EN)	Same as SV-LV59C-EK(EN), but also includes Lisp license	63,395	500	F/S	439	538
SV-LVXGA-EK(EN)	Diskless color system; includes pedestal enclosure, 5MB of main memory, four-plane graphics co-processor, 19-in. color monitor, Ethernet controller, mouse/keyboard, VMS, VWS, DECnet, and LAVC licenses	19,900	182	FS	166	199
SV-LVXGB-EK(EN)	Same as diskless color system above, but with eight-plane graphics co-processor	23,900	219	FS	199	239
VAXSTATION 2000						
VS450-DA(D3)	MicroVAX II CPU/FPU; 4MB of main memory; 19-in. monochrome monitor; ThinWire Ethernet interface; English hardware documentation, one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	5,025	NA	NA	50	64
VS450-EA(E3)	Same as VS450-DA(D3) except with 6MB of memory	7,025	NA	NA	50	64
VS450-FA(F3)	Same as VS450-DA(D3) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	5,025	NA	NA	50	64
VS450-GA(G3)	Same as VS450-FA(F3) except with 6MB of memory	7,025	NA	NA	50	64
VS451-DA(D3)	MicroVAX II CPU/FPU with 4MB of memory, 15-in. monochrome monitor, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	4,225	NA	NA	45	58
VS451-EA(E3)	Same as VS451-DA(D3) except with 6MB of memory	6,225	NA	NA	45	58
VS451-FA(F3)	Same as VS451-DA(D3) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	4,225	NA	NA	45	58
VS451-GA(G3)	Same as VS451-FA(F3) except with 6MB of memory	6,225	NA	NA	45	58
VS452-DA(D3)	MicroVAX II CPU/FPU, with 4MB of memory, 19-in. monochrome monitor, RD53 71MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	7,825	NA	NA	88	102
VS452-EA(E3)	Same as VS452-DA(D3) except with 6MB of memory	9,825	NA	NA	88	102
VS452-FA(F3)	Same as VS452-DA(D3) except bundled software includes ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	7,825	NA	NA	88	102
VS452-GA(G3)	Same as VS452-FA(F3) except with 6MB of memory	9,825	NA	NA	88	102
VS453-DA(D3)	MicroVAX II CPU/FPU with 4MB of memory, 15-in. monochrome monitor, RD53 71MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	7,025	NA	NA	83	96
VS453-EA(E3)	Same as VS453-DA(D3) except with 6MB of memory	9,025	NA	NA	83	96
VS453-FA(F3)	Same as VS453-DA(D3) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	7,025	NA	NA	83	96
VS453-GA(G3)	Same as VS453-FA(F3) except with 6MB of memory	9,025	NA	NA	83	96
VS454-DA(D3)	MicroVAX II CPU/FPU with 4MB of memory, 19-in. monochrome monitor, RD54 159MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	10,025	NA	NA	113	127
VS454-EA(E3)	Same as VS454-DA(D3) except with 6MB of memory	12,025	NA	NA	113	127
VS454-FA(F3)	Same as VS454-DA(D3) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	10,025	NA	NA	113	127
VS454-GA(G3)	Same as VS454-FA(F3) except with 6MB of memory	12,025	NA	NA	113	127
VS455-DA(D3)	MicroVAX II CPU/FPU with 4MB of memory, 15-in. monochrome monitor, RD54 159MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	9,225	NA	NA	108	121
VS455-EA(E3)	Same as VS455-DA(D3) except with 6MB of memory	11,225	NA	NA	108	121
VS455-FA(F3)	Same as VS455-DA(D3) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	9,225	NA	NA	108	121

FS—Contact Digital Field Service.

NA—Not applicable.

NC—No charge.

DEC VAXstations

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)	Basic Node Service (Monthly) (\$)	Basic System Service (Monthly) (\$)
▶ VS455-GA(G3)	Same as VS455-FA(F3) except with 6MB of memory	11,225	NA	NA	108	121
VS460-DA(D3/D4)	MicroVAX II CPU/FPU with 4MB of memory, 19-in. color monitor, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	11,525	NA	NA	105	134
VS460-EA(E3/E4)	Same as VS460-DA(D3/D4) except with 6MB of memory	13,525	NA	NA	105	134
VS460-FA(F3/F4)	Same as VS460-DA(D3/D4) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	11,525	NA	NA	105	134
VS460-GA(G3/G4)	Same as VS460-FA(F3/F4) except with 6MB of memory	13,525	NA	NA	105	134
VS461-DA(D3/D4)	MicroVAX II CPU/FPU with 4MB of memory, 15-in. color monitor, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	7,525	NA	NA	88	113
VS461-EA(E3/E4)	Same as VS461-DA(D3/D4) except with 6MB of memory	9,525	NA	NA	88	113
VS461-FA(F3/F4)	Same as VS461-DA(D3/D4) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	7,525	NA	NA	88	113
VS461-GA(G3/G4)	Same as VS461-FA(F3/F4) except with 6MB of memory	9,525	NA	NA	88	113
VS462-DA(D3/D4)	MicroVAX II CPU/FPU with 4MB of memory, 19-in. color monitor, RD53 71MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	14,325	NA	NA	143	172
VS462-EA(E3/E4)	Same as VS462-DA(D3/D4) except with 6MB of memory	16,325	NA	NA	143	172
VS462-FA(F3/F4)	Same as VS462-DA(D3/D4) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	14,325	NA	NA	143	172
VS462-GA(G3/G4)	Same as VS462-FA(F3/F4) except with 6MB of memory	16,325	NA	NA	143	172
VS463-DA(D3/D4)	MicroVAX II CPU/FPU with 4MB of memory, 15-in. color monitor, RD53 71MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	10,325	NA	NA	126	151
VS463-EA(E3/E4)	Same as VS463-DA(D3/D4) except with 6MB of memory	12,325	NA	NA	126	151
VS463-FA(F3/F4)	Same as VS463-DA(D3/D4) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	10,325	NA	NA	126	151
VS463-GA(G3/G4)	Same as VS463-FA(F3/F4) except with 6MB of memory	12,325	NA	NA	126	151
VS464-DA(D3/D4)	MicroVAX II CPU/FPU with 4MB of memory, 19-in. color monitor, RD54 159MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	16,525	NA	NA	168	197
VS464-EA(E3/E4)	Same as VS464-DA(D3/D4) except with 6MB of memory	18,525	NA	NA	168	197
VS464-FA(F3/F4)	Same as VS464-DA(D3/D4) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	16,525	NA	NA	168	197
VS464-GA(G3/G4)	Same as VS464-FA(F3/F4) except with 6MB of memory	18,525	NA	NA	168	197
VS465-DA(D3/D4)	MicroVAX II CPU/FPU with 4MB of memory, 15-in. color monitor, RD54 159MB disk drive, ThinWire Ethernet interface, hardware documentation, and one-year hardware/software warranty. Bundled software licenses include VMS, VWS, LAVC, and DECnet.	12,525	NA	NA	151	176
VS465-EA(E3/E4)	Same as VS465-DA(D3/D4) except 6MB of memory	14,525	NA	NA	151	176
VS465-FA(F3/F4)	Same as VS465-DA(D3/D4) except bundled software licenses include ULTRIX-32, UWS, NFS, Fortran, VAX C, and Pascal	12,525	NA	NA	151	176
VS465-GA(G3/G4)	Same as VS465-FA(F3/F4) except with 6MB of memory	14,525	NA	NA	151	176
VAXLAB						
LABVX-BB(BC)	VAXlab/VS2; VAXstation II-based configuration	35,128	389	463	NA	NA
LABVX-CA(CB)	VAXlab/GPX; VAXstation II/GPX-based configuration	47,964	460	548	NA	NA ▶

FS—Contact Digital Field Service.
 NA—Not applicable.
 NC—No charge.

DEC VAXstations

OPTIONS PRICES

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
▶ VAXLAB REALTIME OPTIONS				
ADV11-DA	50KHz, DMA 16-channel, 12-bit resolution analog-to-digital converter	2,095	40	48
AAV11-DA	300KHz, DMA 2-channel, 12-bit resolution digital-to-analog converter	2,095	45	54
AXV11-C	25KHz, 16-channel, analog-to-digital converter with 2-channel digital-to-analog; 12 bits	1,360	32	38
KWV11-C	Programmable realtime clock, 16-bit counter, two Schmitt triggers	940	25	30
DRV11-J	64-bit, user-configurable parallel digital interface	515	9	11
DRV11-WA	DMA 16-bit input/output parallel digital interface	1,040	9	11
VAXSTATION OPTIONS				
VS40X-MA	Four-plane graphics co-processor for VAXstation 2000	2,000	NA	NA
MEMORY				
MS400	4MB memory increment for the VAXstation 2000	3,500	NC	NC
MS630-BA	2MB memory increment	1,575	NC	NC
MS630-BB	4MB memory increment	1,418	NC	NC
MS630-CA	8MB memory increment	2,783	NC	NC
MS650-AA	8MB ECC memory increment for VAXstation 3200	4,000	NC	NC
MS650-AF	8MB ECC memory increment for VAXstation 3500	4,000	NC	NC
GRAPHIC INPUT DEVICES				
VSXXX-AA	Mouse	184	NC	NC
VSXXX-AB	Tablet with stylus and puck	1,045	8	10
LK201-LA/MA	Keyboard	210	NA	NA
MASS STORAGE				
KDA50-QA	DSA Controller for BA23	6,825	50	60
RQDX3-AA/BA	RQDX3 controller for RD53 disk; for BA23(AA) or BA123(BA) enclosure; cables and distribution panel (for Model BA) included	2,142	16	19
RQDX3-M	Q-bus controller without cables; for use when replacing existing RQDX2 controllers (cables can be reused)	2,090	16	19
RQDXE-AA	Dual-height disk drive bus extender for use with RQDX2 or RQDX3 controller in a BA23 enclosure and for external disk	263	NA	NA
RQDXE-FA	Dual-height disk drive bus extender for use with RQDX2 or RQDX3 controller and disk in BA23-CC expander enclosure	263	NA	NA
RX33-A	1.2MB diskette drive	788	8	10
RX50A-AA/BA	RX50 800KB dual diskette drive with cables for BA23(AA) or BA123(BA) enclosure	1,050	8	10
RX50-AA	RX50 800KB dual diskette drive	1,050	8	10
RX50-D	RX50 800KB dual diskette drive mounted in desktop enclosure with I/O cable	1,890	20	24
RX50-R	RX50 800KB dual diskette drive for mounting in 19-in. standard equipment rack	1,890	20	24
RD32-A	42MB Winchester disk drive	2,415	20	24
RD53-A	RD53 71MB, 5¼-in. Winchester disk drive	5,303	38	45
RD53A-AA/BA	RD53 71MB drive with cables for BA23(AA) or BA123(BA) enclosure	3,990	38	45
RD53-DA/DB	RD53 71MB drive mounted in desktop enclosure with I/O cables	4,620	38	45
RD53-EA	71MB Winchester disk drive for VAXstation 2000	3,990	38	45
RD53-FA/F3	71MB Winchester disk in expansion box for VAXstation 2000	5,303	38	45
RD53-RA/RB	RD53 71MB drive in 19-in. standard equipment rack; requires H9302 enclosure	4,620	38	45
RD54-DA/DB/RA/RB	RD54 159MB Winchester disk drive	8,295	63	75
RD54-A(AA/BA)	RD54 159MB Winchester disk drive for BA23	7,245	63	75
RD54-FA(F3)	RD54 159MB Winchester disk drive in expansion box for VAXstation 2000	8,150	63	75
RA70-A	RA70 280MB disk drive	9,000	45	54
MAGNETIC TAPE				
TQK50-AA	TK50 controller with cables for BA23 enclosure	1,155	8	10
TQK50-AB	Q22 controller for TK50-D/R in BA23 enclosure	1,155	8	10
TQK50-BA	TK50 controller with cables for BA123 enclosure	1,045	8	10
TQK50-BB	Q22 controller for TK50-D/R in BA123 enclosure	1,155	8	10
TK50-AA	TK50 95MB cartridge streaming tape drive	2,940	22	26
TK50-DA/DB	TK50 desktop tape drive	3,570	22	26
TK50-RA/RB	TK50 rackmount tape drive	3,570	22	26
TK50Z-FA/F3	TK50 in expansion box for VAXstation 2000	4,720	30	36
BA40A-AA	Expansion Adapter for VAXstation 2000	1,200	NA	NA

DEC VAXstations

▶ PRINTERS

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
LA50-RA	LA50 50/100 cps dot matrix tabletop printer with push tractor feed and 110-V AC power supply	795	8	10
LA75-CA	LA75 32/42/125/250 cps dot matrix printer	835	8	10
LA120-DA	LA120 180-cps dot-matrix printer; for 1- to 6-part forms	3,045	34	40
LA210-AA	LA210 40/80/240 cps dot matrix printer	1,675	28	33
LA21X-BT	Bidirectional tractor for LA210	257	NA	NA
LA21X-SF	Single-tray sheet feeder for LA210	105	NA	NA
LN03-AA	LN03 eight-ppm laser printer; includes two toner cartridges, organic photo receptor cartridge, AC power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation	3,070	49	58
LN03S-AA	LN03 Plus eight-ppm desktop graphics laser printer; includes 1MB of RAM, Modern Gothic typeface, two toner cartridges, organic photoreceptor cartridge, AC power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation	4,245	56	67
LN03S-UA	Graphics board to upgrade LN03 to LN03 Plus	1,175	7	8
LN03R	LN03R eight-ppm PostScript laser printer	6,610	56	67
LPS40-AA	Print Server 40, 40-ppm Ethernet printer with power cord	60,795	775	923
LVP16-AA	Graphics pen plotter with documentation and supplier	2,200	10	12

COMMUNICATIONS/NETWORKING

DPV11-M	DPV11 single-line synchronous interface; requires cable	755	14	17
DPV11-SA	DPV-11 single-line synchronous interface for BA213	809	14	17
DMV11-M	DMV11 single-line synchronous interface; requires cable	2,231	41	49
DMV11-N	Integral modem interface	1,890	41	49
H4005	Ethernet/IEEE 802.3 transceiver	315	4	5
DESTA-AA	ThinWire Ethernet station adapter	289	4	5
DSRVB-AA	Eight-line DECserver 200	3,806	28	33
DEQNA-SA/SF	DEQNA Ethernet-to-Q-bus synchronous communications controller for BA213	2,231	15	18
DEQNA-M	DEQNA Ethernet-to-Q-bus synchronous communications controller; requires cable	2,625	15	18
DELQA-M	Ethernet/802.3 Adapter	2,500	15	18
DELQA-SA/SF	DELQA for BA213	2,500	FS	FS

SOFTWARE PRICES

		License Fee (\$)
OPERATING SYSTEM		
Q1001-UZ	VMS two-user license for VAXstation 3200 and 3500	2,000
Q4001-CZ	VMS two-user license for VAXstation II and II/GPX	1,050
Q8001-CZ	VMS two-user license for VAXstation 2000	1,050
Q12EK-UZ	ULTRIX-32 two-user license for VAXstation 3200 and 3500	2,500
Q42EK-UZ	ULTRIX-32 two-user license for VAXstation II and II/GPX	3,150
Q82EK-UZ	ULTRIX-32 two-user license for VAXstation 2000	2,625
Q8A96-UZ	VMS Workstation Software for VAXstation 2000	263
Q4Z33-UZ	ULTRIX-32 Workstation Software for VAXstation II and II/GPX	788
Q8Z33-UZ	ULTRIX-32 Workstation Software for VAXstation 2000	1,050
COMMUNICATIONS		
Q1D04-UZ	DECnet end node license for VAXstation 3200 and 3500	500
Q8D04-UZ	DECnet end node license for VAXstation 2000	525
Q4D04-UZ	DECnet end node license for VAXstation II and II/GPX	715
Q1D05-UZ	DECnet full license for VAXstation 3200 and 3500	855
Q8D05-UZ	DECnet full license for VAXstation 2000	898
Q4D05-UZ	DECnet full license for VAXstation II and II/GPX	1,796
Q1D09-UZ	DECnet end node to full license upgrade for VAXstation 3200 and 3500	620
Q8D09-UZ	DECnet end node to full license upgrade for VAXstation 2000	651
Q4D09-UZ	DECnet end node to full license upgrade for VAXstation II and II/GPX	1,297
Q1363-UZ	DECnet/SNA 3270 for VAXstation 3200 and 3500	375
Q8363-UZ	DECnet/SNA 3270 for VAXstation 2000	394
Q4363-UZ	DECnet/SNA 3270 for VAXstation II and II/GPX	394
Q1455-UZ	DECnet/SNA Application Programming Interface (API) for VAXstation 3200 and 2300	300
Q8455-UZ	DECnet/SNA Application Programming Interface (API) for VAXstation 2000	315
Q4455-UZ	DECnet/SNA Application Programming Interface (API) for VAXstation II and II/GPX	315
Q1022-UZ	DECnet/SNA Advanced Program-to-Program Communications (APPC) for VAXstation 3200 and 3500	450

DEC VAXstations

► COMMUNICATIONS (Continued)		License Fee (\$)
Q8022-UZ	DECnet/SNA Advanced Program-to-Program Communications (APPC) for VAXstation 2000	473
Q4022-UZ	DECnet/SNA Advanced Program-to-Program Communications (APPC) for VAXstation II and II/GPX	473
Q1454-UZ	DECnet/SNA Terminal Emulator (TE) for VAXstation 3200 and 3500	150
Q8454-UZ	DECnet/SNA Terminal Emulator (TE) for VAXstation 2000	158
Q4454-UZ	DECnet/SNA Terminal Emulator (TE) for VAXstation II and II/GPX	158
Q1453-UZ	DECnet/SNA RJE for VAXstation 3200 and 3500	150
Q8453-UZ	DECnet/SNA RJE for VAXstation 2000	158
Q4453-UZ	DECnet/SNA RJE for VAXstation II and II/GPX	158
Q1452-UZ	DECnet/SNA Gateway Management for VAXstation 3200 and 3500	75
Q8452-UZ	DECnet/SNA Gateway Management for VAXstation 2000	79
Q4452-UZ	DECnet/SNA Gateway Management for VAXstation II and II/GPX	236
Q1042-UZ	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for VAXstation 3200 and 3500	225
Q8042-UZ	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for VAXstation 2000	236
Q4042-UZ	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for VAXstation II and II/GPX	236
Q1044-UZ	DECnet/SNA Printer Emulator (PrE) for VAXstation 3200 and 3500	150
Q8044-UZ	DECnet/SNA Printer Emulator (PrE) for VAXstation 2000	158
Q4044-UZ	DECnet/SNA Printer Emulator (PrE) for VAXstation II and II/GPX	158
Q4111-UZ	DECnet/SNA 2780/3780 Protocol Emulator for VAXstation II and II/GPX	1,181
Q4112-UZ	DECnet/SNA 3271 Protocol Emulator for VAXstation II and II/GPX	1,181
Q1B12-UZ	VAX VIDA for VAXstation 3200 and 3500	2,625
Q8B12-UZ	VAX VIDA for VAXstation 2000	2,756
Q4B12-UZ	VAX VIDA for VAXstation II and II/GPX	2,756
Q8ZCE-UZ	Local Area VAXcluster for VAXstation 2000	525
Q4ZCE-UZ	Local Area VAXcluster for VAXstation II and II/GPX	1,050

DATA BASE MANAGEMENT

Q1898-UZ	Datatrieve for VAXstation 3200 and 3500	1,230
Q8898-UZ	Datatrieve for VAXstation 2000	1,292
Q4898-UZ	Datatrieve for VAXstation II and II/GPX	1,292
Q1897-UZ	Common Data Dictionary (CDD) for VAXstation 3200 and 3500	340
Q8897-UZ	Common Data Dictionary (CDD) for VAXstation 2000	358
Q4897-UZ	Common Data Dictionary (CDD) for VAXstation II and II/GPX	358
Q1800-UZ	Forms Management Systems (FMS) for VAXstation 3200 and 3500	620
Q8800-UZ	Forms Management Systems (FMS) for VAXstation 2000	651
Q4800-UZ	Forms Management System (FMS) for VAXstation II and II/GPX	651
Q1D07-UZ	Rdb/ELN Development license for VAXstation 3200 and 3500	1,125
Q8D07-UZ	Rdb/ELN Development license for VAXstation 2000	1,181
Q4D07-UZ	Rdb/ELN Development License for VAXstation II and II/GPX	1,181
Q4D08-UZ	Rdb/ELN Run Time Option (RTO) for VAXstation II and II/GPX	263
Q1354-UZ	Rdb/Micro VMS for VAXstation 3200 and 3500	1,770
Q8354-UZ	Rdb/Micro VMS for VAXstation 2000	1,859
Q4354-UZ	Rdb/MicroVMS for VAXstation II and II/GPX	1,859
Q1357-UZ	Rdb/MicroVMS Remote for VAXstation 3200 and 3500	205
Q8357-UZ	Rdb/MicroVMS Remote for VAXstation 2000	215
Q4357-UZ	Rdb/MicroVMS Remote for VAXstation II and II/GPX	215
Q1358-UZ	Rdb/MicroVMS Run Time Option (RTO) for VAXstation 3200 and 3500	683
Q8358-UZ	Rdb/MicroVMS Run Time Option (RTO) for VAXstation 2000	717
Q4358-UZ	Rdb/MicroVMS Run Time Option (RTO) for VAXstation II and II/GPX	717

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Q1018-UZ	Dibol for VAXstation 3200 and 3500	623
Q8018-UZ	Dibol for VAXstation 2000	654
Q4018-UZ	Dibol for VAXstation II and II/GPX	654
Q1130-UZ	Digital Standard Mumps (DSM) for VAXstation 3200 and 3500	1,350
Q8130-UZ	DSM for VAXstation 2000	1,418
Q4130-UZ	DSM for VAXstation II and II/GPX	1,418
Q1100-UZ	Fortran for VAXstation 3200 and 3500	780
Q8100-UZ	Fortran for VAXstation 2000	814
Q4100-UZ	Fortran for VAXstation II and II/GPX	814
Q1917-UZ	Lisp for VAXstation 3200 and 3500	2,400
Q8917-UZ	Lisp for VAXstation 2000	2,520
Q4917-UZ	Lisp for VAXstation II and II/GPX	5,040
Q1126-UZ	Pascal for VAXstation 3200 and 3500	710
Q8126-UZ	Pascal for VAXstation 2000	744
Q4126-UZ	Pascal for VAXstation II and II/GPX	744
Q1114-UZ	PL/1 for VAXstation 3200 and 3500	1,200
Q8114-UZ	PL/1 for VAXstation 2000	1,255
Q4114-UZ	PL/1 for VAXstation II and II/GPX	1,255
Q1631-UZ	RPG II for VAXstation 3200 and 3500	470
Q8631-UZ	RPG II for VAXstation 2000	497
Q4631-UZ	RPG II for VAXstation II and II/GPX	496
Q1056-UZ	Ada for VAXstation 3200 and 3500	3,735
Q8056-UZ	Ada for VAXstation 2000	3,922
Q4056-UZ	Ada for VAXstation II and II/GPX	3,922

DEC VAXstations

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Q1020-UZ	APL for VAXstation 3200 and 3500	1,200
Q8020-UZ	APL for VAXstation 2000	1,255
Q4020-UZ	APL for VAXstation II and II/GPX	1,255
Q1095-UZ	Basic for VAXstation 3200 and 3500	1,200
Q8095-UZ	Basic for VAXstation 2000	835
Q4095-UZ	Basic for VAXstation II and II/GPX	835
Q1106-UZ	Bliss-32 for VAXstation 3200 and 3500	870
Q8106-UZ	Bliss-32 for VAXstation 2000	909
Q4106-UZ	Bliss-32 for VAXstation II and II/GPX	909
Q1015-UZ	C for VAXstation 3200 and 3500	710
Q8015-UZ	C for VAXstation 2000	744
Q4015-UZ	C for VAXstation II and II/GPX	744
Q1099-UZ	Cobol for VAXstation 3200 and 3500	1,200
Q8099-UZ	Cobol for VAXstation 2000	1,255
Q4099-UZ	Cobol for VAXstation II and II/GPX	1,255
Q1913-UZ	OPS5 for VAXstation 3200 and 3500	1,500
Q8913-UZ	OPS5 for VAXstation 2000	1,575
Q4913-UZ	OPS5 for VAXstation II and II/GPX	3,150
UTILITIES AND TOOLS		
Q1425-UZ	Application Development Environment (ADE) for VAXstation 3200 and 3500	405
Q8425-UZ	Application Development Environment (ADE) for VAXstation 2000	425
Q4425-UZ	Application Development Environment (ADE) for VAXstation II and II/GPX	425
Q1451-UZ	DECcor for VAXstation 3200 and 3500	900
Q8451-UZ	DECcor for VAXstation 2000	945
Q4451-UZ	DECcor for VAXstation II and II/GPX	945
Q1310-UZ	DECalc for VAXstation 3200 and 3500	510
Q8310-UZ	DECalc for VAXstation 2000	536
Q4310-UZ	DECalc for VAXstation II and II/GPX	536
Q1038-UZ	DEctype for VAXstation 3200 and 3500	300
Q8038-UZ	DEctype for VAXstation 2000	315
Q4038-UZ	DEctype for VAXstation II and II/GPX	315
Q1007-UZ	DEC/CMS (Code Management System) for VAXstation 3200 and 3500	1,301
Q8007-UZ	DEC/CMS (Code Management System) for VAXstation 2000	1,366
Q4007-UZ	DEC/CMS (Code Management System) for VAXstation II and II/GPX	1,366
Q1500-UZ	DEC/MMS (Module Management System) for VAXstation 3200 and 3500	320
Q8500-UZ	DEC/MMS (Module Management System) for VAXstation 2000	331
Q4500-UZ	DEC/MMS (Module Management System) for VAXstation II and II/GPX	331
Q1143-UZ	DECshell for VAXstation 3200 and 3500	710
Q8143-UZ	DECshell for VAXstation 2000	748
Q4143-UZ	DECshell for VAXstation II and II/GPX	748
Q1810-UZ	GKS/Ob for VAXstation 3200 and 3500	900
Q8810-UZ	GKS/Ob for VAXstation 2000	945
Q4810-UZ	GKS/Ob for VAXstation II and II/GPX	945
Q1706-UZ	TDMS for VAXstation 3200 and 3500	620
Q8706-UZ	TDMS for VAXstation 2000	651
Q4706-UZ	TDMS for VAXstation II and II/GPX	651
Q1375-UZ	VAXELN Toolkit for VAXstation 3200 and 3500	1,000
Q8375-UZ	VAXELN Toolkit for VAXstation 2000	1,050
Q4375-UZ	VAXELN Toolkit for VAXstation II and II/GPX	1,407
Q1382-UZ	VAX-11 RSX for VAXstation 3200 and 3500	600
Q8382-UZ	VAX-11 RSX for VAXstation 2000	630
Q4382-UZ	VAX-11 RSX for VAXstation II and II/GPX	630 ■