

DEC MicroVAX Family

MANAGEMENT SUMMARY

UPDATE: Since we last updated this report, Digital Equipment Corporation has added new midrange models to the MicroVAX Family, along with a new thin-film Winchester storage device. In addition, new versions of the proprietary VMS and the UNIX ULTRIX-32 operating systems enhance the MicroVAXs' capability to participate in multivendor networks.

The MicroVAX Family has emerged as a critical tool in Digital's overall strategy of targeting decentralized computing environments with networked systems. While the superminis in the VAX 6200 and 8000 Series are targeted toward large corporate and governmental departments and branch offices, the MicroVAXs are aimed at smaller departments and at intradepartmental workgroups.

Digital has added nine new models to the VAX supermini line since the beginning of 1988. It is important, then, that the company demonstrate a similar commitment to improving and extending the smaller systems that complement those superminis. A case in point is the introduction

In its 3½-year life, the MicroVAX Family has accounted for sales of over 100,000 units and has supplanted the PDP-11 Family as Digital Equipment Corporation's strategic low-end multiuser system. Targeted toward corporate departments and workgroups, the MicroVAX systems feature full software compatibility with Digital's VAX superminis in either the proprietary VMS or the ULTRIX-32 operating environment, based on UNIX.

MODELS: MicroVAX 2000, II, 3300, 3400, 3500, and 3600.

MEMORY: 1M bytes to 64M bytes.

DISK CAPACITY: 42M bytes to 2.8G bytes.

WORKSTATIONS: Up to 90 (48 active).

PRICE: \$7,800 to \$174,600 (base configuration prices).

GSA SCHEDULE: Yes.



Digital Equipment Corporation's newest MicroVAX systems, 3300 (pictured above) and 3400, support dual-ported strings of Digital's new RF30 Winchester storage unit; this scheme supports Digital's push into distributed transaction processing. Specialized laboratory data collection and workstation server configurations are also available.

CHARACTERISTICS

VENDOR: Digital Equipment Corporation, 146 Main Street, Maynard, Massachusetts 01754. Telephone (508) 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

Memory for the MicroVAX 2000 and II is dynamic parity MOS RAM. Main memory cycle time is 400 nanoseconds. Main memory increments are 4M and 8M bytes on the MicroVAX II; the MicroVAX 2000 comes with 4M or 6M bytes of memory.

The MicroVAX 3300 and 3400 include 4M bytes of error checking and correcting (ECC) system memory on the CPU board; memory can be expanded to 28M bytes in 8M-byte increments.

The MicroVAX 3500 and 3600 each support a total of four 8M-byte memory modules which use 256K-bit ZIP DRAM-based ECC memory or four 16M-byte modules using 1M-bit, surface mount DRAM-based ECC memory.

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

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CHART A. SYSTEM COMPARISON

MODEL	MicroVAX 2000	MicroVAX II	MicroVAX 3300	MicroVAX 3400	MicroVAX 3500	MicroVAX 3600
SYSTEM CHARACTERISTICS						
Date of introduction	February 1987	May 1985	October 1988	October 1988	September 1987	September 1987
Microprocessor type	MicroVAX 78032	MicroVAX 78032	CVAX 78034	CVAX 78034	CVAX 78034	CVAX 78034
Microprocessor cycle time	200 ns	200 ns	100 ns	100 ns	90 ns	90 ns
Operating system	VMS, ULTRIX-32	VMS, ULTRIX-32, VAXELN				
Upgradable from	Not applicable	MicroVAX I, MicroPDP-11	Not applicable	Not applicable	Not applicable	Not applicable
Upgradable to	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Number of serial/parallel I/O ports	Up to 12 serial	Up to 49 serial	40 serial w/modem control, 80 without			
Number of expansion slots	0	7 (BA23); 11 (BA123); 13 (H9642)	5	11	21	21
MEMORY						
Minimum capacity (bytes)	4M	1M	12M	12M	16M	16M
Maximum capacity (bytes)	6M	16M	28M	28M	64M	64M
DISK STORAGE						
Minimum capacity (bytes)	0 or 42M	71M	150M	300M	280M	622M
Maximum capacity (bytes)	318M	2.8G	750M	900M	1.16G	2.48G
NUMBER OF WORKSTATIONS						
	Up to 12	Up to 48	75 (48 active)	90 (48 active)	64 (40-60 typical)	64 (40-60 typical)
COMMUNICATIONS PROTOCOLS						
	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP; LU6.2; X.400	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP; LU6.2; X.400	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP; LU6.2; X.400	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP; LU6.2; X.400	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP; LU6.2; X.400
PURCHASE PRICE (Base configurations)						
	From \$7,800	From \$15,383	From \$40,950	From \$53,950	From \$76,900	From \$104,300

▷ of the MicroVAX 3300 and 3400. In the narrow sense, these machines provide greater power in the middle of the MicroVAX group—an area previously covered by large configurations of the 3½-year-old MicroVAX II. The addition of the new systems—based on the CVAX CPU used in the MicroVAX 3500 and 3600—brings the more recent technology lower into the MicroVAX Family.

Actually, the new MicroVAXs' I/O capabilities are more important in the broader context than their increased processor power. The new systems deliver more than three times the disk I/O provided by the MicroVAX II and support the RF30 Integrated Storage Element (ISE), a new 150M-byte, thin-film, Winchester storage module. Up to six RF30s can be configured in a dual-host cluster to provide high data availability. This fault-resistant mini-clustering capability (patterned on the VAXcluster scheme available for the VAX superminis) is important for Digital's DECTp program, the company's strategy for carving a significant niche in the distributed online transaction processing (OLTP) market. Digital targets the MicroVAXs as front ends in the OLTP network, and such systems must have continuous access to large storage facilities.

Digital, however, must figure out a way to enhance its RF series offerings for the OLTP environment; 900M bytes is not a lot of storage for two CPUs to share, especially when OLTP systems—and general-purpose supermicros, for that matter—routinely support 1G or 2G bytes of storage.

▶ PROCESSING COMPONENTS

The MicroVAX 3300, 3400, 3500, and 3600 use the CVAX 78034 CPU chip and CVAX 78134 floating-point unit (FPU). The use of CMOS technology in the CPU and floating-point unit on the 3500 and 3600 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 CPU features a cycle time of 90 nanoseconds.

The MicroVAX 3300 and 3400 CPU complex—called the KA640—includes 4M bytes of main memory; an Ethernet controller; and an adapter for the RF30 Integrated Storage Element (ISE), the systems' primary disk storage device.

The 3300 and 3400 provide from 2.5 to 3.0 times the performance of the entry-level MicroVAX II and 2000, delivering from 2.2 to 2.7 MIPS; the 3500 and 3600 feature performance 2.6 to 4.2 times that of the MicroVAX II, for a range of 2.3 to 3.7 MIPS.

The MicroVAX II and 2000 both employ a single-board CPU centered around the MicroVAX 78032, a Digital-designed and -manufactured ZMOS (double-metal NMOS) chip. The 78032 features 32-bit internal and external data paths, 200-nanosecond cycle time, two-stage pipelined architecture, and instruction prefetch. The chip also includes its own 20MHz clock generator and demand-paged virtual memory management. The 78032 provides sixteen 32-bit general registers, 31 interrupt levels, and 1G bytes of physical address space. The 78032 has a TTL-compatible interface.

The MicroVAX II and 2000 CPU boards also contain the MicroVAX 78132, a chip-level floating-point unit (FPU) that handles F (single-precision), D (double-precision), and

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CHART B. DISK/DISKETTE DEVICES

MODEL	RX33	RD32	RD53	RD54	RA60
Type	Diskette	Winchester	Winchester	Winchester	Removable
Size (inches)	5.25	5.25	5.25	5.25	14
Number of surfaces	2	—	—	—	6
Formatted capacity per drive (bytes)	1.2M	42M	71M	159M	205M
Interface/controller	—	ST412/506	RQDX3	RQDX3	KDA50
Number of drives per interface/controller	—	—	—	—	4
Average access time	—	48.3 ms	38.3 ms	38.3 ms	50.0 ms
Data transfer rate	500K bps	5M bps	625KB/sec	625KB/sec	1.98MB/sec
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector	512/sector
Purchase price	\$388	\$1,615	\$4,190	\$5,500	\$19,925

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

COMPETITIVE POSITION

Although “proprietary operating system” has become a term of opprobrium in some quarters, Digital’s VMS gives the MicroVAXs a competitive advantage. Digital continually enhances the operating and communications facilities available for VMS; a recent example is the company’s introduction of DECnet/OSI and Enterprise Networking tools based on the International Organization for Standardization’s Reference Model for Open Systems Interconnection (ISO/OSI). Adherence to OSI protocols ensures that VMS-based systems can work with computers in any environment that conforms to those international standards. Consequently, Digital users can create networks that integrate both proprietary and nonproprietary (e.g., UNIX) facilities.

Even though the proprietary VMS is, thus, relatively open, both the buying and the selling public tend to equate open systems with UNIX. Digital competes in that area as well, offering its Berkeley UNIX ULTRIX-32. The newest release, Version 3 (or V3, as it is colloquially called) gives the MicroVAXs enhanced credibility to compete against AT&T’s 3B2 Family, NCR’s Tower Series, Altos’ supermicros, Unisys’ U 5000 and 6000, and other UNIX supermicros. ULTRIX-32 V3 conforms to major standards, such as the X/Open and POSIX portability standards.

Even more importantly, ULTRIX-32, V3 conforms to the National Institute of Standards and Technology (formerly National Bureau of Standards) POSIX Federal Information Processing Standard (FIPS), and to AT&T’s System V Interface Definition (SVID). Adherence to those two standards is critical for any company interested in bidding seriously on contracts with the federal government, which mandates POSIX compatibility (which derives, ultimately, from UNIX) wherever application portability is required. The SVID conformity in ULTRIX-32, while desirable as a software portability feature, is a bit more problematic. Digital admits that the SVID conformity in ULTRIX-32 falls short of the level that would qualify Digital to bid the system for large Department of Defense (DoD) contracts, such as the AFCAC251 contract that AT&T won from the Air Force. Digital claims that the engineering effort required to bring ULTRIX-32 into full SVID compliance would not necessarily be offset by large contract income; the bidding alone can be a very expen-

G (extended-range, double-precision) floating-point data types. The 78132 also accelerates integer multiply and divide functions.

Digital claims that, depending upon the application, the 78032 and 78132 in conjunction deliver between 70 and 110 percent of the performance of the VAX-11/780 supermini, with an average of 90 percent. (That is, 0.7 to 1.1 MIPS, with an average of 0.9 MIPS.)

In addition to the CPU and FPU, the MicroVAX II CPU board includes 1M bytes of integral main memory, memory expansion control, a console serial line unit, 64K bytes of ROM containing power-up diagnostics and a bootstrap program, and a Q-bus interface containing an 8,000-entry map for virtual-to-physical I/O address translation. Digital’s older MicroVAX I can be field upgraded to the MicroVAX II. Digital’s MicroPDP-11 computers, which employ the same BA23, BA123, and H9642 enclosures as the MicroVAX II, can be upgraded to that system.

On the MicroVAX 2000 system, electronics have been reduced to one board from the four boards required on the MicroVAX II.

The MicroVAXs feature a 304-instruction set, similar to but implemented differently from that used by larger VAX systems. On the MicroVAX 2000 and II systems, 175 instructions are implemented in the 78032 and 70 in the 78132; 59 instructions are emulated in software macrocode. The emulated instructions, including the 128-bit H floating-point data format and some character strings and packed decimals, are reportedly those which are most complex but least frequently used. Some of the instructions implemented in software in the MicroVAX II CPU are implemented in hardware on the MicroVAX 3000 Series CPUs, resulting in improved performance for some applications.

INPUT/OUTPUT CONTROL

I/O on the MicroVAX II, 3500, and 3600 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; it also performs block-mode DMA data transfers on a bandwidth of up to 3M bytes per second.

The MicroVAX 3300 and 3400 also employ the Q-bus, but strictly for high-throughput I/O. The disk controller, which resides on the Q-bus in the other systems, is embedded in the RF30 ISE storage element, the system’s primary disk drive. An Ethernet controller and an ISE adapter reside in the CPU module itself.

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CHART B. DISK/DISKETTE DEVICES (Continued)

MODEL	RA70	RA81	RA82	SA482	RF30
Type	Winchester	Winchester	Fixed	Fixed	Winchester
Size (inches)	5.25	14	14	14	5.25
Number of surfaces	—	7	7	28	—
Formatted capacity per drive (bytes)	280M	456M	622M	1.24-2.48G	150M
Interface/controller	KDA50	KDA50	KDA50	KDA50	DSA
Number of drives per interface/controller	2	4	4	—	1 per controller
Average access time	27 ms	36.3 ms	32.3 ms	—	29.3 ms
Data transfer rate	1.4MB/sec	2.2MB/sec	2.4MB/sec	2.4MB/sec	1.5MB/sec
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector	—
Purchase price	\$9,000	From \$17,245	From \$17,000	From \$34,000	From \$5,500
Comments					Up to 6 drives can be configured for dual-font access

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▷ sive process. Still, we think that Digital should expend the effort to make ULTRIX-32 fully SVID compliant; by failing to do so, the company cuts itself off from full participation in a fast-growing market segment.

Nonetheless, sales of ULTRIX-based MicroVAXs could be hampered by the continuing unpleasantness over the future of UNIX between the Open Software Foundation (OSF)—in which Digital is a driving force—and AT&T's informal but powerful coalition of UNIX system, chip, and software vendors (the so-called "Archer Group"), including Unisys, NCR, Sun Microsystems, Intel, Motorola, Informix, and Unisoft. If those vendors succeed in making UNIX System V the accepted industry standard, ULTRIX-32 and OSF's UNIX implementation (based on IBM's AIX) will surely be less desirable, even though all three implementations will undoubtedly conform to the same sets of portability standards.

On the hardware side, the new MicroVAX 3300 and 3400 threaten to render the entire MicroVAX II grouping—and not just large configurations, which they admittedly replace—obsolete as general-purpose computers. The new systems double the price/performance delivered by midrange MicroVAXs. For example, if we assume a median performance of 2.5 MIPS for the 3300, a basic configuration with 12M bytes of memory and a 150M-byte storage device costs \$16,400 per MIPS; a basic MicroVAX II configuration with a 159M-byte disk and 5M bytes of memory costs \$38,000 per MIPS.

We anticipate, however, that the MicroVAX II will have prolonged usefulness as a special-purpose engine; for example, it already serves as the base for Digital's new MicroServer, which provides four times the functionality of the company's previous Ethernet terminal servers. (In that sense, the MicroVAX II will function much as the PDP-11 does; that system, still available but largely superseded by MicroVAXs for general-purpose computing, forms the core of Digital's powerful HSC family of high-end disk controllers.)

▶ 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 TK50 tape drives; external disks are connected through an ST506 interface.

CONFIGURATION RULES

The MicroVAX 3300 and 3400 CPU complex—called the KA640—includes 4M bytes of main memory; an Ethernet controller; and an adapter for the RF30 Integrated Storage Element (ISE), the systems' primary disk storage device. The MicroVAX 3300 comes with one 150M-byte RF30 and employs a five-slot enclosure for addition of Q-bus options. The 3400, which uses the 11-slot BA213 enclosure, includes two RF30s. Addition of an expansion pedestal enclosure allows up to three RF30s to be added to the 3300 and 3400.

Using the Digital Storage System Interconnect (DSSI) and Local Area VAXcluster software (discussed in detail in the SOFTWARE section of this report), up to six RF30s can be accessed by two hosts for high data availability. If one host fails, users' requests for data access are automatically routed through the other system.

The MicroVAX 3500, available in the 27-inch BA213 pedestal enclosure, includes 16M bytes of main memory (expandable to 64M bytes); a 280M-byte RA70 disk drive or two 159M-byte RD54 disk drives; a 296M-byte TK70 cartridge tape drive; an Ethernet controller; operating system software (a 1-to-20 user VMS license or 2-to-65 user ULTRIX-32 license); a DECnet End-Node license; and, with the VMS operating system, VMS Services for MS-DOS license. Two additional RA70 disk drives or one RD54 disk drive can be configured on the MicroVAX 3500.

The MicroVAX 3600 is available in a cabinet enclosure and includes either 16M or 32M bytes of main memory, one or two 622M-byte RA82 disk drives, a 296M-byte TK70 cartridge tape drive, an Ethernet controller, operating system software (a 1-to-20 user VMS license or 2-to-65 user ULTRIX-32 license), a DECnet end node or full-function license, and VMS Services for MS-DOS license (with VMS operating system only). Three additional RA disks in a separate cabinet can be configured on the system.

▶ The MicroVAX II comes in a choice of three enclosures: the BA23, a pedestal or rackmount box with 8 module slots for Q-bus options and space for two 5¼-inch mass storage devices; the BA123, a caster-mounted, floorstanding enclosure with 12 module slots for Q-bus options and space for up to three RD disk devices and one TK tape device; and a cabinet system employing a 14-slot, modified H9642 cabi-

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CHART C. WORKSTATIONS

MODEL	VT320	VT330	VT340
DISPLAY PARAMETERS			
Max. chars./screen	3,168	3,168	3,168
Buffer capacity	—	19K characters	19K characters
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132
Tilt/swivel screen	Optional	Standard	Standard
Symbol formation	9 or 15 x 12 dot matrix	10 x 20 dot matrix	10 x 20 dot matrix
Character phosphor	White, green, or amber	White, green, or amber	White, green, or amber
Total colors/no. simult. displayed	Not applicable	4 shades of gray	4,096/16
KEYBOARD PARAMETERS			
Style	Typewriter	Typewriter	Typewriter
Character/code set	ASCII, NRCS	ASCII, NRCS	ASCII, NRCS
Detachable	Yes	Yes	Yes
TERMINAL INTERFACE	RS-232-C, RS-423	RS-232-C, RS-423, and 20 mA std.	RS-232-C, RS-423, and 20 mA std.
COMMENTS	—	800 x 500 pixel graphics array; supports split-screen viewing	800 x 500 pixel graphics array; supports split-screen viewing
PURCHASE PRICE	\$545	\$1,990	\$2,935

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

▶ ADVANTAGES AND RESTRICTIONS

The MicroVAX Family provides numerous advantages to both first-time and current Digital users. The compatibility provided under the VMS environment allows software to be ported among systems; for example, under VMS Version 5.0 (the latest release), a Fortran program written on a MicroVAX can be sent to a VAX 6200 or 8800 Series system that uses the Symmetrical Multiprocessor (SMP) architecture and can be executed in parallel.

The MicroVAXs offer an impressive variety of connectivity and computational clustering schemes under both VMS and ULTRIX-32. Local Area VAXcluster Phase 2 (LAVC 2), for example, gives networked MicroVAXs access over Ethernet to the larger computational and storage facilities—the latter ranging up to hundreds of gigabytes—provided by the VAXclusters in which VAX superminis and HSC storage controllers can be configured. Similarly, the ULTRIX NFS Clusters scheme lets UNIX Digital systems share computational facilities, as well as data storage in excess of 75G bytes.

Although we have previously noted that the older MicroVAX II seems slated for oblivion in the foreseeable future, it nevertheless continues to provide an entry point into the VAX architecture for MicroPDP-11 users. Because the two lines of systems use the same BA23, BA123, and H9642 enclosures (“form factors,” to use Digital’s term), MicroPDP-11 users can perform board swaps to convert their systems to MicroVAX IIs if they find that they need extra power and direct VMS software compatibility in the same amount of space. Also, the MicroVAX II’s support for Q-bus and some UNIBUS peripherals (such as the RA60 and RA81 disks and the TU81-Plus tape) provides an additional boon for MicroPDP-11 or even UNIBUS PDP-11 users who want to upgrade to MicroVAX power; they can transfer their peripherals, rather than purchase new ones. Similarly, the support by some MicroVAX II configurations for the RA60 and RA81 disk drives and the TU81-Plus tape

▶ net (the type used for larger VAX computers) containing two BA23 chassis and providing space for two RA-class disks. A special configuration, the Compact MicroVAX II, includes integrated load and storage devices and two 8-slot BA23 backplanes for Q-bus expansion.

The MicroVAX 2000 is available in three basic configurations:

- The entry-level system includes 4M bytes of memory (upgradable to 6M bytes), an RX33 1.2M-byte, half-height diskette drive; an RD32 42M-byte, half-height Winchester disk; a disk controller and tape interface; four serial lines; and on-board diagnostics.
- A more powerful configuration includes 4M bytes of memory (upgradable to 6M bytes); an RD53 71M-byte, full-height Winchester disk drive; a disk controller and tape interface; four serial lines; on-board diagnostics; and an expansion adapter box that houses the optional TK50 95M-byte tape drive and additional disk storage.

On the above two MicroVAX 2000 configurations, the user must select either a VMS or an ULTRIX-32 operating system license.

- The diskless MicroVAX 2000 for LAVC configurations includes 6M bytes of memory; an Ethernet interface; a disk controller and tape interface; four serial lines; on-board diagnostics; and VMS operating system, DECnet end node, and LAVC software licenses.

The MicroVAX 2000 supports 12 directly connected users and the MicroVAX II supports 48. The 3500 and 3600 support up to 64 directly connected users, although the recommended range is 40 to 60 users, depending on the application. Additional users are connected through the Ethernet interface or terminal servers. Terminal servers will theoretically support up to 8,000 users; practical limits depend on the configuration’s capability of running the application load.

Also available are five VAXserver systems, based on MicroVAX systems but configured to function as resource servers in LAVCs or PC LANs. The current VAXserver product line includes the single-processor VAXservers 3300, 3400, 3500, and 3600, as well as the dual-CPU VAXserver 3602.

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CHART D. PRINTERS

MODEL	LA75	LA100	LA120	LA210	LN03	LN03 Plus
Type	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Laser	Laser
Speed	32/42/125/250 cps	40/240 cps; 80 cps opt.	180 cps	40/240 cps; 80 cps opt.	8 ppm	8 ppm
Paper size	4.25 to 10 in wide	Up to 14.9 in wide	3 to 15 in wide	3.5 to 14.9 in wide	8.5 x 11 in	8.5 x 11 in
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.	7 x 7 dot matrix	33 x 18/7 x 9 dot matrix; 33 x 9 opt.	300 x 300 dpi	300 x 300 dpi
Horizontal character spacing (char./inch)	10, 12, 16.5, 17.1 or 5, 6, 8.25, 8.55	5, 6, 6.6, 8.25, 10, 12, 13.2, 16.5	5, 6, 6.6, 8.25, 10, 12, 13.2, 16.5	Variable	Variable	Variable
Vertical line spacing (lines/inch)	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	Variable	Variable	Variable
Character set	U.S. ASCII, 8 others	Courier-10 or Orator-10 std.; others opt.	94 ASCII, APL	94 ASCII; Courier, VT100 line-drawing std.; others opt.	ASCII; 16 resident; Courier/Elite fonts	ASCII, technical; 17 resident fonts
Controller/Interface	RS-423	RS-232-C std.; 20 mA opt.	RS-232-C	RS-232-C std.; Centronics parallel opt.	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)	4.8 x 16.8 x 13.6	7 x 22 x 16	33.5 x 27.5 x 21.7	5.0 x 21.5 x 13.5	15.0 x 21.0 x 23.5	15.0 x 21.0 x 23.5
Graphics capability	180 x 144 dpi	132 x 72 dpi	Not applicable	132 x 72 dpi	Not applicable	300 x 300 dpi
Purchase price	\$835	\$2,640	\$3,197	\$1,675	\$2,895	\$3,995
Comments	Built-in LA50, LA100, LA210, IBM Proprinter emulation	Keyboard send/receive terminal		Compatible with IBM PC/XT/AT	Prints in landscape and portrait modes	Provides bit-mapped, Tektronix 4010/4014-compatible graphics

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drive—peripherals also employed by the VAX superminis—permits the transfer of peripherals by users who want to move up to a VAX 6200 or 8000 system.

In addition to dual-ported strings of the new RF30 storage devices, high-end MicroVAXs also permit dual porting of RA70 and RA82 disk drives. That capability allows two systems or network servers to access each of the disks, offering some data security in the event of a failure on one of the systems or networks. As we mentioned before, the increased data availability that such capabilities offer is critical in the OLTP area, which Digital now targets so intensively.

On the service end, Digital has recently introduced a warranty scheme that represents a mixed blessing for users. The minimum warranty no longer includes on-site service; instead, it constitutes a "return to Digital" scheme for parts and a one-year conformance warranty on software. This part of the program is explicitly aimed at cultivating resellers who don't want to inventory service warranties and is undoubtedly an effort to boost MicroVAX sales through indirect channels—a strategy that has worked marvelously for the PDP-11, which the MicroVAX has surpassed in annual sales.

Digital has not jettisoned on-site warranty support completely, though; the company now delivers that through three levels of support above the minimum. The second of those three—called "Standard" warranty support and expected by Digital to be the one chosen by the greatest number of users—raises basic system prices 6 to 9 percent over those charged for minimum warranty service. Simi-

VAXservers 3300 and 3400 each include a CPU with 4M bytes of system memory, an Ethernet controller, and an ISE adapter; a 150M-byte RF30 ISE; a 296M-byte TK70 streaming tape subsystem; 1-to-10 user VMS license; VMS File and Application Server, DECnet Full Function, and VAXcluster licenses; and documentation and diagnostics. For details on VAXservers 3500, 3600, and 3602, refer to the "DEC VAXstations" report in *Datapro Reports on Minicomputers*.

Specialized versions of the MicroVAXs—the rtVAX Series—are available for realtime applications, such as data acquisition.

INPUT/OUTPUT UNITS

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

OTHER PERIPHERALS: The TK70 streaming cartridge tape drive comes bundled with the MicroVAX 3000 Series systems and is optional for the MicroVAX II. The 48-track TK70 employs a 5¼-inch form factor and features a streaming speed of 100 ips and density of 10,000 bpi. The TK70 uses 296M-byte, ½-inch 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 is a 22-track, ½-inch cartridge unit that uses CompacTape cartridges; a single cartridge can back up any of the Winchester disks used on a MicroVAX II or MicroVAX 2000. This Q-bus drive, which uses a microprocessor-based controller, has a maximum storage capacity of 95M bytes and achieves 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

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CHART D. PRINTERS (Continued)

MODEL	ScriptPrinter (LNO3R)	PrintServer 40 (LPS40)	LJ250/LJ252	LG01/LG02	LG31	LP29
Type	Laser	Laser	—	Matrix	Matrix	Band
Speed	8 ppm	40 ppm	20-167 cps NLO	280/600 lpm	300 lpm	2,000 lpm
Paper size	8.5 x 11 in	7.5-11 in wide; 10.5-17 in long	—	4-16 in wide; 3- 20 in long	Up to 15 in wide	—
Character formation	300 x 300 dpi	Electrophoto- graphic	—	120 x 144/60 x 72 dots/in	Dot matrix	Full
Horizontal character spacing (char./inch)	Variable	Variable	—	Variable	5-16.7	—
Vertical line spacing (lines/inch)	Variable	Variable	—	—	—	6 and 8
Character set	ASCII; 29 Post- script fonts	29 resident typefaces	DEC technical, NCR, ISO-Latin, line drawing	Multiple	7 or 8 bit ANSI/ISO- compatible	64 and 96 ASCII; optimized LU ASCII; OCR-B RS-232-C
Controller/Interface	RS-232-C	—	RS-232-C (250), parallel (252)	LP11 or RS-232-C	RS-232-C	—
No. of printers per controller/ interface	1	—	—	—	—	1
Printer dimensions, in. (h x w x d)	15.0 x 21.0 x 23.5	40.4 x 60.0 x 28.4	—	38.0 x 33.5 x 22.3	—	—
Graphics capability	300 x 300 dpi	300 x 300 dpi	180 x 180 (7 colors), 90 x 90 (255 colors)	LG02 only	Not applicable	Not applicable
Purchase price	\$5,495	\$50,650	\$1,695	\$13,545/ \$16,695	\$8,450	\$38,500
Comments	Supports Post- script page description language	Ethernet print server subsystem	LJ252 supports HP-PCL for PC applications	LG01 text printer upgradable to LG02 text/ graphics printer	Prints OCR-A/B, bar code 39, and interleaved in 2 of 5	—

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

larly, separately purchased hardware and software options with such warranty coverage now carry price tags about 2 percent higher than previously. In effect, Digital now charges extra for the type of warranty service it used to include in the base prices of systems and add-on components.

USER REACTION

Datapro recently spoke to three MicroVAX II users who had responded to our 1988 U.S. Computer Users Survey.

Site One: The first user is president of an engineering consultancy in the South. He is a long-time Digital user who migrated to the MicroVAX from the PDP-11 Family to take advantage of specialized engineering software that runs only on Digital systems. His VMS-based, three-user configuration uses only 4M bytes of memory and 50M bytes of disk storage. Because the configuration is so manageable and reliable, he does his own maintenance instead of relying on Digital.

This user complains only about the unavailability of mainstream decision support software for the MicroVAX. He says that he has to buy PCs to run spreadsheets and other mainstream business packages.

Site Two: The second user is affiliated with a printing concern in the lower Midwest. The company employs a VMS-based Local Area VAXcluster featuring two MicroVAX IIs and two VAXstation 2000s. One MicroVAX supports 4M bytes of memory and 0.5G bytes of disk storage; the other uses 16M bytes of memory and 1.2G

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 MicroVAX 3500 and 3600, but the TK70 tape drive supported on these systems can read tapes written on a TK50.

The TS05 nine-track streaming tape drive is supported on larger, H9642-based MicroVAX II configurations. This ½-inch drive with a 40M-byte storage capacity features a 1600 bpi recording density, speeds of 25/100 ips, and a 40/160K bytes-per-second data transfer rate. One TS05 can be attached per controller. The TSV05 is a compact version of the TS05.

Additionally, the MicroVAX II, 3500, and 3600 support the TU81-Plus tape subsystem, which is also employed by Digital's VAXBI-based VAX systems and UNIBUS PDP-11 computers. The TU81-Plus is designed for applications requiring sustained input/output, such as disk backup, data archiving, data interchange, and recording of data from high-speed test equipment. This PE/GCR unit features a 256K-byte cache buffer, 1600/6250 bpi recording densities, and a streaming speed of 75 ips. A nine-track unit that employs ½-inch tape, the TU81-Plus also features a 25-ips start/stop speed and storage capacities of 145M bytes in GCR mode and 40M bytes in PE mode. Data transfer speed is 468K bytes per second.

The RRD50 Compact Disk Reader system is a read-only laser disk drive employing a compact, removable, 600M-byte Compact Disk Read-Only Memory (CD-ROM) optical disk. The disk itself is 4.7 inches (120 mm.) in diameter. The drive's average access time is 1.5 seconds; average data transfer rate is 150K bytes per second.

The RV20 write-once optical disk drive is a 2G-byte device featuring a data transfer rate of 262K bytes per second and an access time of 212.5 milliseconds. Four RV20 controllers can be configured per MicroVAX CPU, with four transports per controller. A single cabinet can contain up to four RV20 drives (one master and three slaves).

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▷ bytes of auxiliary storage. The workstations perform shop floor monitoring, while the MicroVAXs support accounting and office functions.

Although this user considers his hardware highly reliable, he expresses dissatisfaction with Digital's software support. He says that he has waited six months to have a third-party software package brought under Digital's support umbrella; he suspects that the paperwork required to authorize the support is still wending its way through the approval ranks.

Site Three: The third user we spoke to coordinates data processing for an engineering concern in the Middle Atlantic region. His MicroVAX II, which runs a mix of architectural, engineering, and mathematical/statistical applications, as well as general business programs such as billing and payroll, supports 12M bytes of memory, 1.25G bytes of disk storage, and 14 workstations. Because the system is nearing its memory limit, he must soon choose between migrating to a larger system, such as the MicroVAX 3500 or 3600, or configuring additional MicroVAX IIs in a Local Area VAXcluster with his present system.

No matter what growth option he chooses, he says, he will stay with Digital because the MicroVAX II performs well and he is pleased with the service he receives. Although he uses third-party software, he has not—unlike the second user—approached Digital about supporting it; he says that he is satisfied with the support he has received from the vendors of those packages.

As we went to press, the quantitative results of our 1988 Computer Users Survey had just come in. The following chart shows how the 12 MicroVAX respondents rated their systems.

MicroVAX User Ratings*

Ease of operation	8.6
Reliability of system	8.4
Reliability of peripherals	8.3
Maintenance service:	
Responsiveness	8.1
Effectiveness	8.0
Technical support:	
Troubleshooting	7.7
Education	7.7
Documentation	7.5
Vendor's software:	
Operating system	8.8
Compilers & assemblers	9.0
Application programs	8.6
Ease of programming	9.1
Ease of conversion	9.0
Overall satisfaction	8.8

*Average based on a scale from 1 (Poor) to 10 (Excellent).

▶ 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.

DECTalk, single-line (DTC01) or Multiline (DTC03) speech synthesis unit, converts standard ASCII text into speech output; it employs an RS-232-C interface and features modular telephone connections that allow users to access a data base with a standard touch-tone telephone.

COMMUNICATIONS

The MicroVAX systems also participate in LAVCs as either boot or satellite members. Up to 42 MicroVAX and VAXstation Family members (satellites) are interconnected through ThinWire Ethernet to two central MicroVAXs, VAXservers, or other VAX systems acting as servers (boot nodes). The servers manage system software, applications, and a shared common file system. Satellite members share system resources.

The MicroVAX II, 3500, and 3600 support the DZQ11 and DHQ11 asynchronous interfaces; the DSV11, DPV11, and DMV11 synchronous interfaces; and the DEQNA or DELQA Ethernet interface.

The *DZQ11* is a four-line asynchronous multiplexer that provides local or remote interconnection between MicroVAX II, 3500, and 3600 systems and EIA RS-232-C/CCITT V.28 and EIA RS-423-A/CCITT V.10 terminals or other systems. The *DZQ11* operates at program-selectable speeds up to 9600 bps full duplex with limited modem control on each line.

The *DHQ11* is a Q-bus communications controller that supplies eight asynchronous communications lines and operates in either direct memory access (DMA) or programmed output mode. The *DHQ11* provides RS-232-C or DEC-423 signaling to externally connected terminal devices at speeds up to 38.4K bps.

The *DSV11* wide area interface—part of Digital's Enterprise Networking program to link both Digital and non-Digital environments—provides up to two lines running different applications at 64K bps each or one line at 256K bps. (See the COMMUNICATIONS subsection of the SOFTWARE section for further details on Enterprise Networking.)

The *DPV11* is a single-line synchronous interface that provides local or remote interconnection between MicroVAX II, 3500, and 3600 systems and other systems with EIA RS-232-C/CCITT V.28 or V.11 interfaces. The *DPV11* operates at speeds up to 56K bps half or full duplex with full modem control. It is programmable for either byte-oriented protocols (DDCMP or Bisync) or bit-oriented protocols (SDLC or HDLC).

The *DMV11* is a microprocessor-controlled, single-line synchronous interface that provides local or remote interconnection between MicroVAX II, 3500, and 3600 systems and systems with EIA RS-232-C/CCITT V.28 or V.35 interfaces, or with EIA RS-423/-449 interfaces. The *DMV11* implements the DDCMP protocol in hardware and supports DMA data transfers, DECnet point-to-point or multipoint configurations, and full modem control. It operates at speeds from 19.2K bps to 56K bps at half or full duplex.

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► Also configurable on the MicroVAX II, 3500, and 3600 is the *H4005 Ethernet Transceiver*, detailed in the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

Quad-height communications boards available for use on the MicroVAX 3500 and 3600 include the following:

- The CXA16 provides an RS-423-A, 16-line asynchronous interface with no modem control.
- The CXB16 provides an RS-422, 16-line asynchronous interface with no modem control.
- The CXY08 provides an RS-232-C, eight-line asynchronous interface with modem control.
- The DRQ3B is a parallel I/O interface.

In addition to baseband Ethernet connection, to which the H4005 is relevant, Digital provides an alternative ThinWire scheme, which provides full Ethernet capability for personal computers, workstations, and low-end systems in offices and other local work areas. ThinWire Ethernet permits connection of up to 30 stations in one 185-meter (202 yard) segment.

The ThinWire Ethernet scheme allows the MicroVAXs to be networked to Digital's MS-DOS-based VAXmate personal computer. The VAXmate includes DECnet/ThinWire Ethernet support; through a server, this PC can store and access files on MicroVAX (and VAX) systems. (The VAXmate can participate in networks including VAXs, MicroVAXs, other VAXmates, Rainbows, and IBM PC/XT/ATs running Digital's DECnet software.)

The *ThinWire Ethernet Station Adapter (DESTA)* allows connection of a single Ethernet station to ThinWire Cabling through the DEQNA or DELQA controller. The DESTA has one 15-pin connector port that allows it to be mounted in or near the Ethernet station and a second port for connection to the ThinWire Ethernet cable. The DESTA contains Ethernet transceiver (IEEE 802.3) logic and provides transceiver functionality; it is powered from the controller.

The MicroVAX 3300 and 3400 contain built-in DESTA functionality, allowing a choice of thick- or thin-wire connection.

The *DEC MicroServer*—part of Digital's Enterprise Networking program (detailed in the COMMUNICATIONS subsection of SOFTWARE in this report)—for Ethernet communications incorporates MicroVAX II-based chip technology and reportedly provides up to four times the synchronous communications speed of Digital's other Ethernet communications servers. The MicroServer works with DECrouter 2000 software (also detailed in the SOFTWARE section below).

Comprising both hardware and software, *PC Integration Packages for MicroVAX II and MicroVAX 2000* include the elements users require to tie IBM PCs into DECnet networks using a MicroVAX system as a server. The PCs are full peers on the network; the MicroVAX provides transparent file and print services for the PCs. The packages support multiuser team applications such as data base, mail, videotex, accounting, and order processing. They also allow the PCs to share information with heterogeneous equipment types, such as workstations and terminals. Eligible PCs are the IBM PC Model 5150, PC XT Model 5160, and PC AT; all must have IBM DOS 3.10, one available PC option slot, 640K bytes of memory, CGA

or EGA graphics option, system ROM BIOS dated 10/27/82 or later (PC only), and 130 watts minimum power supply.

The PC Integration package for the MicroVAX II includes an IBM PC Network Integration Package (including MS-Windows, keyboard, and mouse); two IBM PC Network Services packages; and a DECnet-VAX license (including VMS Services for MS-DOS license). The package for the MicroVAX 2000 includes a ThinWire Ethernet adapter, in addition to an IBM PC Network Services Package and a DECnet-VAX license with the components already cited for the MicroVAX II package.

SOFTWARE

The VMS operating system for the MicroVAX systems (formerly called MicroVMS) is the same as that which runs on the VAX superminis. Consequently, the MicroVAX computers run the same system and applications software as the larger VAX computers without recompilation or relinking, subject to the limitations of peripheral support. Unless noted, details on the software products referenced in this section are the same as those presented in the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

OPERATING SYSTEM: The VMS operating system for the MicroVAXs (and for the VAXstations as well) is the same as that which runs on the VAX superminis. Previously, a subset of VMS—MicroVMS—was offered for the MicroVAXs and VAXstations because the microsystems could not support full-sized VMS due to limitations of system disk size and distribution media. With VMS Version 5.0 (April 1988), Digital removed those constraints. Because the operating environments are fully compatible, MicroVAXs and VAXstations can run the same system and applications software as the larger VAX computers without recompilation or relinking, subject to peripheral support limitations.

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

For full details on the VMS operating system, refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

ULTRIX-32 is based on Berkeley 4.2 BSD UNIX with 4.3 BSD enhancements. The most recent release, Version 3.0 (also called V3), complies with the following standards and specifications:

- IEEE 1003.1 POSIX (Portable Operating System for Computer Environments).
- National Institute for Standards and Technology (formerly National Bureau of Standards) interim POSIX Federal Information Processing Standard (FIPS).
- X/Open Portability Guide XPG2 base-level specification; with available layered products, ULTRIX-32 meets X/Open's full Common Application Environment (CAE), as well as the Open Software Foundation (OSF) Application Environment Specification Level 0. Digital expects ULTRIX-32 to comply with X/Open XPG3 when the new specifications are released; the company also supports X/Open's Branding Program, which verifies that hardware and software products conform to the standards specified by that body.
- System V Interface Definition (SVID) Release II, Volume 1. ►

DEC MicroVAX Family

► (For a general overview of ULTRIX-32, refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.)

Communications software available under ULTRIX-32 V3 includes the Berkeley Internet Name Domain server (BIND) from BSD 4.3, Network File System (NFS) file locking, and the LAT/TELENET Gateway. Other facilities—VMS ULTRIX Connection, ULTRIX Mail Connection V1, and DECnet-ULTRIX V3—are discussed in the COMMUNICATIONS subsection below.

ULTRIX-32 provides MicroVAX and VAX systems with the ULTRIX NFS Clusters capability, which allows up to 14 CPUs and two HSC70 storage controllers to participate in a distributed file system environment over a dual-path, 70-megabit-per-second link using Sun Microsystems Network File System (NFS) protocols. Because the two HSC70s can support a total of 64 Digital Equipment R-class disk drives, the CPUs can share a data base of up to 76G bytes.

VAXELN, which is not so much an operating system as a development tool and specialized runtime environment, acts as a compatible subsystem to the VMS operating system for development of applications in realtime control and distributed computing environments. It consists of development utilities for creating target applications and a runtime kernel of device drivers and service code that becomes a part of each application. After development, VAXELN applications run standalone on MicroVAX target systems without the host operating system. VAXELN applications are written in an optimizing version of Pascal or C.

DATA BASE MANAGEMENT: The MicroVAXs employ the VAX data base management or information management architecture, which is arranged in layers above the operating system. For a general overview of the components of the VAX information architecture, refer to the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

Digital's DBMS products figure prominently in *DECtp*, a largely software-based systems environment that integrates facilities for developing distributed transaction processing applications: data bases, storage systems, data interoperability products, transaction processing monitors, and support programs. These products run on most MicroVAX (including VAXstation) and VAX Systems. *DECtp* includes the following major software components:

- DECintact Version 1, a transaction processing (TP) monitor based on Advanced Systems Concepts, Inc.'s (ASCI) Intact product. DECintact, intended for high-volume applications requiring transaction integrity, application availability, and transaction system recovery, supports and extends Digital's Record Management Services (RMS) capabilities. It allows users to insert and retrieve records from a data base via hashed key files and can be used as a platform to develop applications that can access VAX Rdb/VMS and VAX DBMS data bases. DECintact also includes an integrated restart/recovery system for both file and queue management systems, as well as security features, such as a hierarchical system menu.
- VAX Rdb/VMS Version 3, an enhanced version of Digital's relational data base management system (RDBMS). It implements the Digital Standard Relational Interface (DSRI), which allows Rdb/VMS to access any DSRI-compliant data base, including those on remote network nodes and IBM mainframes (through a gateway). This facility integrates the VAX.
- VAX SQL Version 2, Digital's implementation of the Structured Query Language (SQL) data base facility.

VAX SQL, included in VAX Rdb/VMS Version 3, provides a user interface to products using DSRI and can retrieve information in IBM data bases in read-only mode through Digital's VIDA with IDMS/R.

- VAX CDD/Plus Common Data Dictionary Version 4, which provides a single, logical repository for data definitions (metadata) and descriptions in a distributed environment. VAX CDD/Plus allows data definitions to be managed centrally or locally and permits data to be integrated and rolled up by applications across a network. VAX CDD/Plus—compatible with previous versions of VAX CDD, works with VAX Rdb/VMS and VAX Rally software.
- VAX Rally Version 2, a fourth-generation tool for VAX Rdb/VMS data base applications. Integrated with VAX CDD/Plus, VAX Rally automatically calls on the resources of the dictionary. VAX Rally also includes a runtime option that enables users to implement distributed applications on VAX processors.
- VAX DBMS Version 4, a general-purpose, Codasyl-compliant network data base management system (DBMS) designed to handle high transaction volumes for numerous, concurrent users.
- VAX Data Distributor Version 2, which allows relational data bases to be replicated across a distributed TP environment. The software can create one or more copies or subsets of an RDBMS on the same system or on remote systems. An Extraction Rollup feature enables Data Distributor to copy a selected subset of data from multiple sources and create a single target data base.
- VAX ACMS Version 3, an enhanced version of Digital's ACMS TP monitor and fourth-generation language facility. VAX ACMS Version 3 features facilities for queuing, storing, and forwarding transactions for deferred execution; the capability of integrating a variety of forms managers for online terminal entry or support for nonterminal devices; and application recovery and data integrity features.
- VAX TDMS Version 1.8, which enables TP system users to manage forms and other data presentation facilities by separating forms data from application code. With VAX TDMS, TP applications must provide only specific data; VAX TDMS provides the rest of the presentation independently.
- DEClink software, which provides access to IBM data bases. One component package, VAXlink, bridges Digital's Rdb/VMS data bases and IBM's IMS and VSAM structures so that data can be copied from IBM mainframes into distributed VMS environments. VIDA with IDMS/R, the other constituent DEClink package, allows users on a VAX system to log on to a central IBM system through an SNA gateway and use data in Cullinet IDMS/R data bases. Using the VMS operating system's Run-Time Library, VIDA with IDMS/R translates VAX user requests to a form compatible with Cullinet software and converts IBM EBCDIC values into those from the Digital Multinational Character Set (DMCS).

LANGUAGES: Programming languages available for the MicroVAXs include Ada, APL, Basic, Bliss-32, C, Cobol, Dibol, Digital Standard Mumps (DSM), Fortran, OPS5 (for artificial intelligence applications), Pascal, PL/1, RPG II, and Lisp.

COMMUNICATIONS: Like the larger VAX systems, the MicroVAXs support the *Digital Network Architecture (DNA)*, a set of protocols governing the format, control, and sequencing of message exchange for all DECnet imple- ►

DEC MicroVAX Family

► mentations. (Further information on DNA is included in the "DEC Digital Network Architecture (DNA) and DECnet" report in *Datapro Reports on Minicomputers*. Since the publication of that report, which discusses DNA development up through Phase IV, Digital has announced DNA Phase V, which embraces even more of the standards established by the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) model.

In anticipation of DECnet Phase V, Digital has announced the Enterprise Networking program, geared toward integrating multivendor environments. The following are software components of the program:

- DECrouter 2000
- X25router 2000
- Enhancements to DECnet/SNA Gateway, VMS/SNA, and Data Transfer Facility (DTF) software
- VAX File Transfer and Access Management (FTAM)

Those components are discussed individually throughout this subsection.

As another part of its strategy for multivendor networking, Digital provides *Network Applications Support* products that allow common access to services on DECnet/OSI networks. Those products provide application access, business communications, and information/resource sharing services for Digital's VT Series terminals, based on VAX Systems running either VMS or UNIX, Apple Macintosh microcomputers, and MS-DOS- and OS/2-based PCs. As part of this program, Digital has made publicly available the specifications for Compound Document Architecture (CDA), an integrated scheme for creating, revising, managing, and distributing compound documents through an enterprise-wide DECnet/OSI network. The documents are interchangeable among VMS-, ULTRIX-, MS-DOS-, OS/2-, and Apple Macintosh-based systems.

Digital provides toolkits, documentation, and training for CDA application developers. Over time, the toolkit and documentation will become standard components of all VMS- and ULTRIX-32-based systems. The company has also published a manual of specifications for the Digital Document Interchange Format (DDIF); a technical description of CDA toolkit routines; and information on the CDA Converter, which is designed to simplify development of software converters.

The specifications for CDA define a networked environment for creating and manipulating compound documents containing "live" links to text, graphics, images, spreadsheets, charts, and tables. Live links allow automatic updating of data contained in a compound document when source information has changed. Future versions of the CDA specs will also address documents integrating voice and video.

CDA is designed to accommodate emerging international standards, including the International Organization for Standardization (ISO) Office Document Architecture/Office Document Interchange Format (ODA/ODIF), Standard Generalized Markup Language (SGML), and Adobe Systems, Inc.'s PostScript page description language.

DECnet-VAX permits suitably configured VMS-based systems to participate as routing or end nodes in DECnet computer networks. It offers task-to-task communications, file transfer, downtime system and task loading, network command terminals, and network resource-sharing capabil-

ities through DNA protocols. The MicroVAX 2000 can function as an end node but not as a router in a DECnet network.

DECnet-ULTRIX Version 3 (V3) is a Phase IV, Ethernet-based, end-node implementation of the Digital Network Architecture (DNA). It allows communications among networked Digital systems that use DNA Phase III/IV protocols, as well as with non-Digital systems using Internet (TCP/IP) protocols. Thus, an ULTRIX-based system can serve as an Internet Gateway between DECnet/OSI and TCP/IP-based networks, allowing semitransparent, bidirectional access in a multivendor environment.

DECnet-ULTRIX also permits task-to-task communications, network virtual terminal functions, remote file transfer, mail, network-wide resource sharing, and management as defined by DNA protocols.

The *VMS/ULTRIX Connection*—available for the MicroVAX 3600 and larger VAX systems—provides VMS services to UNIX clients by adding TCP/IP and NFS to VMS. (For example, on larger VAX systems, it allows a VMS-based VAXcluster system to act as an NFS server to UNIX workstations; the UNIX systems can thus take advantage of VAXcluster data management features, such as volume shadowing for data preservation.)

ULTRIX Mail Connection Version 1 (V1) provides ULTRIX-based systems with access to Digital's MAILbus enterprise-wide message transfer service. This connection allows ULTRIX Mail users to exchange messages with users of Digital's ALL-IN-1 and VMS Mail; other X.400 systems; IBM PROFS and DISOSS/Personal Services; and non-Digital, UNIX mail systems.

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, such as disks, tapes, and printers, and to employ a single distributed file system that manages access of files at the record level.

A single system manager can perform all necessary management functions for all members of an LAVC from any member system. Utilities are provided to allow the manager to add, delete, and manage the client systems.

Server systems supporting large disks can be employed, permitting workstation users to access and share data and applications that cannot be stored locally. The client systems can be diskless, allowing the central server to maintain all data locally and to manage data and file backups to enhance system security and reduce individual management tasks.

LAVCs also permit integration of terminal servers, allowing users who do not require workstations to access the data and resources of the cluster transparently across Ethernet.

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 superminis thus have access to the far greater computational and storage facilities offered by the larger VAX systems.

DEC MicroVAX Family

► 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.

Remote System Manager (RSM), layered on top of Digital's DECnet software, is a central management facility for distributed systems. It permits a MicroVAX II, 3500, or 3600, or a VAX running RSM server software, to perform system management functions for MicroVAX systems running RSM client software in an Ethernet LAN. The number of clients supported varies with the size, power, and storage of the server. According to Digital, the range runs from a minimum of 5 MicroVAX systems under a MicroVAX II server to a maximum of 40 VAXstations with a VAX server.

RSM supports central software installation and updating; provides a facility for the system manager to keep libraries of software required for particular applications; and supports central file backup, allowing the system manager to perform file backups over the network for multiple-client systems. Central queuing and print services are also provided.

Because RSM software is layered over DECnet, it provides a complete range of DECnet functionality, including electronic mail, file transfer, network management, and multi-vendor interconnect capabilities.

The MicroVAXs support Digital's *Internet* products, which provide interconnection of VMS-based Digital computers and Digital networks to systems built by IBM and other manufacturers. Members of the Internet group, prefixed DECnet/SNA, are Gateway; DISOSS Document Exchange Facility (DDXF); Application Programming Interface (API); Printer Emulator (PrE); and the 2780/3780 Protocol Emulator. The MicroVAX II, 3500, and 3600 also support two other Internet products, Advanced Program-to-Program Communications/LU6.2 Programming Interface (APPC) and the 3271 Protocol Emulator. These products are discussed in detail in the "Communications Software" section of the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

DECnet/SNA Gateway-Channel Transport (CT) and Gateway-Synchronous Transport (ST) provide users of IBM's SNA with a network-to-network interface to Digital applications. Using either gateway, users can simultaneously perform large quantity processing functions, such as terminal emulation, file transfer, and mail and document exchange; they can also distributed applications between Digital and SNA systems.

DECnet/SNA Gateway-CT supports 255 concurrent sessions. The gateway uses DEC ChannelServer hardware, providing users with a direct connection from an IBM 370 channel environment to Ethernet. DECnet/SNA Gateway-ST provides up to 128 concurrent sessions and employs DEC Microserver hardware.

Also available are two other access products: *DECnet/SNA RJE Facility*, which allows a MicroVAX to function as a remote SNA batch workstation, and *DECnet/SNA 3270 Terminal Emulator*, which provides access to 3270 programs, principally those executing under IMS or CICS.

VMS/SNA layered software enables individual MicroVAX systems to connect directly to an IBM SNA network; it does not require a gateway or participation in a DECnet environment. With VMS/SNA, a MicroVAX system appears to the SNA network as a Physical Type 2 cluster controller. Among other functions, a Digital system can exchange documents and electronic mail messages between

the VMS operating system and DISOSS and can implement distributed application programs that run between VMS and IBM systems.

Digital targets VMS/SNA toward geographically dispersed sites that require a single connection to a corporate data base; DECnet/SNA Gateway-CT and -ST are targeted toward departmental networks with heavier communication requirements. VMS/SNA complements the DECnet/SNA Gateway, supporting many of the same access routines and user interfaces; applications written for VMS/SNA can be migrated to the Gateway with no changes to software.

Using either DECnet/SNA Gateway or VMS/SNA, *DECnet/SNA Data Transfer Facility (DTF)* permits bidirectional file transfer and access between a Digital network and systems running IBM's MVS-family operating systems in an SNA environment. Recent enhancements to DTF extend file transfer capabilities to MS-DOS and DECnet-ULTRIX, increase support for IBM file structures, and improve security.

VAX File Transfer and Access Management (FTAM) software allows transparent file transfer and management between a DECnet/OSI-based network and any system that complies to the FTAM Open Systems Interconnection (OSI) specification. VAX FTAM protects the semantics and structure of the file data exchanged between open systems.

VMS Services for MS-DOS is a software product that allows a MicroVAX (or a larger VAX) to act as a server for a group of VAXmate PCs in a DECnet ThinWire network. The product allows resource sharing between VMS and MS-DOS and permits server-based licensing of MS-DOS applications. (Through server-based licensing, Digital licenses applications for a specific number of users on a single server; only one license per server need be purchased, rather than one license per user.)

VAX VIDA is a software component in a VAX- or MicroVAX-to-IBM interconnect system; it permits access to IBM mainframe data bases. VIDA conforms to a read-only subset of the Digital Standard Relational Interface (DSRI) architecture. Users can access IBM data through products such as DATATRIEVE, Rdb/VMS utilities and embedded Data Manipulation Language, and other layered products that use DSRI to access data. VIDA uses Digital's SNA Gateway products to communicate with software from Cullinet Software, Inc. running on the IBM mainframe. The Cullinet software accesses the data from the IBM mainframe data base and sends it across the SNA Gateway to the MicroVAX user's application software. The accessed data can also be stored in a MicroVAX data base or file.

MAILbus is a set of distributed applications software that links Digital's ALL-IN-1 users, IBM SNADS and DISOSS users, and users of other X.400-compliant mail systems into a global electronic messaging network. MAILbus comprises the *VAX Message Router/S Gateway* and *VAX Message Router Version 3.0*. The Message Router/S Gateway allows for transparent exchange of electronic mail messages, revisable and final form documents, and MS-DOS files between users of Digital and IBM office automation systems networks. It also provides a network server function for the interchange of electronic information between Digital's messaging service and an IBM SNADS environment.

The VAX Message Router provides store-and-forward message transfer. It consists of the Message Router Base, which contains the message transfer system, a gateway directory service, and management services; the Message

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► Router VMSmail Gateway, which interfaces VMSmail to Message Router, supporting VMS-style addressing and converting incoming Digital DX format and WPS-Plus documents into ASCII before delivering them to the VMS user; and the Message Router Programmer's Kit, which provides a set of high-level interfacing routines for writing a user agent, gateway, or other application to run on the Message Router.

DECnet System Services (DSS) is a set of products that facilitates access to distributed information and peripherals within a network environment. DSS consists of *VAX Distributed File Service (DFS)*, which provides MicroVAX users with transparent access to files stored on remote systems in a DECnet network; *VAX Distributed Queuing Service (DQS)*, which allows any VMS user in a DECnet network to access any printer in the network; and *VAX Distributed Name Service (DNS)*, which provides consistent, network-wide naming of network resources, allowing DFS and RSM users to refer to network resources using the same name from any system on the network.

DECrouter 2000, which runs on Digital's DEC MicroServer hardware, supports up to four high-speed synchronous lines and allows users to send and receive messages among 63 geographically remote areas, each having up to 1,023 system nodes.

X25router 2000 extends the capabilities of *DECrouter 2000* to wide area environments. Based on the International Telegraph and Telephone Consultative Committee (CCITT) X.25 recommendation for packet switched networks, this facility allows users on a DECnet/OSI network to share information and resources with users on other geographically remote DECnet/OSI segments.

APPLICATIONS: Applications and special-purpose products for the MicroVAX are available directly from Digital. The *WPS-Plus* document processing system and the *ALL-IN-1* integrated office system (which incorporates WPS-Plus) are principal office automation systems. Detailed information on these products is contained in *Datapro Reports on Office Automation*. Detailed information on *DE-Cpage*, a primary tool for office publishing, can be found in *Datapro Reports on Electronic Publishing*.

Also available are *A-to-Z* software, a group of general-purpose application and office packages, and the *VTX* videotex system. Special-purpose products include *DEC-shell*, *Code Management System (CMS)*, *Application Development Environment (ADE)*, *DECalc*, and *VAX GKS/0b* (for graphics).

Two interdependent tools are the *VAX Language-Sensitive Editor* and the *VAX Source Code Analyzer*. The former is a multilanguage, multiwindow, screen-oriented editor designed for program development and maintenance. The latter product, which works in conjunction with the Language-Sensitive Editor, allows software developers to cross-reference, navigate, and analyze an entire software system, rather than just individual components.

VAX-11 RSX allows MicroVAX systems to run and develop programs for the RSX-11 operating systems that run on Digital's PDP-11 minicomputers.

Digital also offers third-party application packages for VAX systems. The company's External Applications Software (EAS) Library service acquires software from third parties and makes it available through Digital's software distribution channels. Software is tested by Digital for operation, documentation, and ease of installation prior to being included in the EAS Library. Software products from

the EAS Library are sold on an "as is," unsupported basis, although the author of the software may offer a separate maintenance agreement.

Digital is also involved in two types of cooperative marketing agreements with a range of software vendors. In a Cooperative Marketing Program (CMP), Digital and the independent software vendor combine forces in sales calls, trade shows, and technical demonstrations and recommend each other's products to prospective buyers. Digital has CMPs with vendors in the petroleum/geotechnical, investment management, UNIX office automation, integrated banking, funds transfer, and human resources management (payroll/personnel) application areas, among others.

System Cooperative Marketing Programs (SCMPs) are agreements through which Digital works with OEMs to market, demonstrate, and sell turnkey systems incorporating Digital hardware and the vendors' products. Digital's SCMP program encompasses manufacturing resource planning (MRP), mechanical computer-aided design (MCAD), electronic computer-aided engineering (CAE), and health care/medical information management.

The VAX Solution System Program is a combined effort between Digital and its CMPs and SCMPs to define, build, and test integrated hardware, software, communications, and service packages targeted at workgroup computing environments. Complete packages are available for artificial intelligence and management information systems development, laboratory research, manufacturing, electronics design, mechanical design and analysis, seismic modeling, publishing, sales forecasting, and PC ALL-IN-1 office automation.

Yet another program, Digital Distributed Software (DDS), allows Digital itself to sell and distribute tools from third-party vendors. Under this program, Digital distributes, among other products, Philon, Inc.'s Fast/Basic and Fast/Cobol compilers; the Informix relational data base management system from Informix, Inc.; and Oracle Corporation's Oracle RDBMS.

Further details on applications software for the VAX and MicroVAX systems can be found in the *Datapro Directory of Software* and the *Datapro Directory of Microcomputer Software*.

OPERATING ENVIRONMENT

The MicroVAX 3500 pedestal enclosure (which incorporates the B213 chassis) measures 27.0 inches high by 21.0 inches wide by 17.8 inches deep (60 cm. by 53 cm. by 45 cm.). The MicroVAX 3600 H9644 cabinet (which also incorporates the B213 chassis) measures 41.6 inches high by 21.0 inches wide by 32.5 inches deep (106.8 cm. by 54 cm. by 80.0 cm.).

The MicroVAX II's BA123 enclosure measures 24.5 inches high by 13.0 inches wide by 27.5 inches deep (62.2 by 33.0 by 70.0 cm.); it is mounted on casters. The BA23 pedestal enclosure measures 24.5 by 10.4 by 28.5 inches (62.2 by 25.4 by 72.4 cm.). The modified H9642 measures 41.7 inches high by 25.7 inches wide by 36.0 inches deep (106.0 by 65.6 by 91.4 cm.). Power requirements are 120 V AC, single-phase, 60 Hz, 88 to 128 VRMS, 47 to 63 Hz. Maximum running current is 12 Amp for the BA123 and 6 Amp for the BA23; maximum power consumption is 690 watts for the BA123, 345 watts for the BA23, and 1400 watts for the H9642. MicroVAX II operating temperatures range from 59 to 90 degrees Fahrenheit (15 to 32 degrees Celsius) at 20 to 80 percent humidity, noncondensing.



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► The Compact MicroVAX II measures 32.0 inches high by 21.3 inches wide by 33.0 inches deep (81.3 by 54.1 by 83.8 cm.) and weighs 286 pounds (130 kg.). Power requirements are 110/120 V AC at 60 Hz, 240/220 V AC at 50 Hz. Maximum power consumption is 1600 watts. Operating temperatures for the Compact MicroVAX II range from 59 to 90 degrees Fahrenheit (15 to 32 degrees Celsius) at 20 to 80 percent humidity, noncondensing. Heat dissipation is 3,500 Btu/hour.

The MicroVAX 2000 entry-level, half-height configuration measures 5.5 inches high by 12.75 inches wide by 11.25 inches deep (14 by 33 by 29 cm.) and weighs 28 pounds (12.7 kg). The full-height configuration, with added expansion adapter, measures 7.0 inches high by 12.75 inches wide by 11.25 inches deep (18 by 33 by 29 cm.) and weighs 30 pounds (13.6 kg.). The full-height configuration also includes an expansion box with dimensions equal to the entry-level configuration system unit. Power requirements are 88 to 132 VRMS or 176 to 267 VRMS, 47 to 63 Hz. Maximum power consumption is under 160 watts. Maximum heat dissipation is 155 watts. Operating temperatures for the MicroVAX 2000 range from 50 to 104 degrees Fahrenheit (10 to 40 degrees Celsius) at 10 to 90 percent humidity, noncondensing, without diskette, and 20 to 80 percent, noncondensing, with diskette.

The MicroVAX 3400 uses the 12-slot BA213 enclosure; the MicroVAX 3300 employs the newer BA215. The BA215 measures 27.0 inches high by 13.6 inches wide by 17.8 inches deep (69 by 35 by 45 cm.).

SUPPORT SERVICES

DOCUMENTATION: With each MicroVAX II and 2000, the user must order documentation (and installation diagnostics) on TK50 tape or RX50 diskette media. Documentation for the MicroVAX 3500 and 3600 is available on TK70 tape. 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-related and non-product-related topics are offered. A variety of instructional 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 MicroVAXs, as well as all peripherals, are covered by a one-year warranty with four levels of service. The minimum option—List Price Warranty—features one year of "return to Digital" support for parts and one year of conformance warranty for software. Three alternative selections of System Warranty Support are offered at increasing service levels and prices, ranging from Basic support to the more extensive Standard coverage to comprehensive Optimum support. Hardware and software options purchased with a system will receive the same level of warranty that the user selects for the base system.

EDITOR'S NOTE: According to Digital, prices for systems featuring List Price Warranty remain the same. For systems featuring Standard Warranty Support, list price will increase from 6 to 9 percent for most average configurations. List prices for most hardware and software options purchased separately as add-ons have increased by 2 percent; Standard Warranty terms for those options are available.

Digital's expanded warranty support program, available in the United States as of October 1988, will be available worldwide in 1989.

MAINTENANCE: Digital's Field Service organization offers both on-site and off-site support services for the MicroVAX II, 3500, and 3600. Standard on-site services include the Basic Service Agreement, the extended DEC-service 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. Details of Digital's service programs and software support services are provided in the SUPPORT section of the "DEC VAX Systems" report in *Datapro Reports on Minicomputers*.

Two types of integrated service are offered for the MicroVAX 2000. Basic System Service is offered on systems used as LAVC boot nodes or as standalone systems. Basic Node Service is offered on systems used as LAVC nodes only. Both plans provide Onsite Basic Hardware Service, Right to Use Updates, Digital Software Information Network, and Hardware and Software Telephone Support through the System Administrator. Basic System Service is slightly more expensive than Basic Node Service.

PRICING

POLICY: Digital provides the MicroVAX systems 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. The company provides a number of licensing options for VMS Version 5.0 software, including Clusterwide licensing. ULTRIX-32 software receive an AT&T UNIX binary license directly from Digital.

Digital offers a Volume Software Pricing program that allows users to acquire large numbers of licenses for a single product at a discount; options for a single software product run from 8-license to 160-license bundles.

Another program, VAX Software Portfolio, allows users to obtain software development and information management products for a flat fee per month per system under an annually renewable agreement. The fee is lower than a cumulative fee based on a separate charge for each product license. Individual licensing applies even to systems connected in LAVCs.

Three development portfolios are offered under this program. The base portfolio contains 29 products, including language compilers, software development tools, and information management facilities. The extended portfolio adds specialized languages, such as Ada, OPSS, Lisp, VAX Cobol Generator, and VIDA. The runtime-only portfolio—available for the MicroVAX II, 3500, and 3600—comprises a runtime library for use with applications developed under Digital's ACMS, DBMS, VAX/Rdb, and other data management products.

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

**DEC MicroVAX Family
 EQUIPMENT PRICES**



		Purchase Price (\$)*	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
MICROVAX 3000 SYSTEMS				
—	MicroVAX 3300 system; KA640 CPU, including 4M-byte ECC memory, Ethernet controller, and Integrated Storage Element (ISE) adapter; 8M bytes of add-on memory; RF30 150M-byte Winchester ISE; TK70 296M-byte streaming tape subsystem; 1-to-10 user VMS or 1-to-32 user ULTRIX-32 operating system license; DECnet End Node license; documentation and diagnostics; BA215 pedestal enclosure	40,950	—	—
—	MicroVAX 3400 system; same as MicroVAX 3300 system, but includes two RF30 ISEs and uses BA213 pedestal enclosure	53,950	—	—
DU-350T1-A2/A3	MicroVAX 3500 CPU/Floating-Point Unit; 16M bytes of memory; BA213 enclosure; 280M-byte RA70 disk drive; 296M-byte TK70 tape drive; Ethernet adapter; unlimited-user ULTRIX and DECnet End Node licenses; one-year on-site hardware and software warranty	76,900	568	676
DU-350T1-AA	Same as DU-350T1-A2/A3, but includes documentation, diagnostics, and U.S. power cord	77,200	568	676
DV-350T1-A2/A3	Same as DU-350T1-A2/A3, but with 1-to-20 user VMS, DECnet End Node, and VMS services for MS-DOS licenses	76,900	568	676
DV-350T1-AA	Same as DU-350T1-AA, but with 1-to-20 user VMS, DECnet End Node, and VMS services for MS-DOS licenses	77,200	568	676
DU-360T1-A2/A3	MicroVAX 3600 CPU/Floating-Point Unit; 32M bytes of memory; B213 enclosure; 622M-byte RA82 disk drive; 296M-byte TK70 tape drive; Ethernet adapter; unlimited-user ULTRIX and DECnet End Node licenses; one-year on-site hardware and software warranty	104,300	582	693
DU-360T1-AA	Same as the DU-360T1-A2/A3, but also includes documentation, diagnostics, and U.S. power cord	104,600	582	693
DV-360T1-A2/A3	Same as the DU-360T1-A2/A3, but with 1-to-20 user VMS, DECnet End Node, and VMS services for MS-DOS licenses	104,300	582	693
DV-360T1-AA	Same as the DV-360T1-A2/A3, but also includes documentation, diagnostics, and U.S. power cord	104,600	582	693
DU-360T2-A2/A3	Same as DU-360T1-A2/A3, but also includes expanded cabinet containing a second 622M-byte RA82 disk drive and TU81-Plus tape drive	154,300	781	930
DU-360T2-AA	Same as DU-360T2-A2/A3, but also includes documentation, diagnostics, and U.S. power cord	154,600	781	930
DV-360T2-A2/A3	Same as DU-360T2-A2/A3, but with 1-to-40 user VMS, DECnet End Node, and VMS services for MS-DOS licenses	174,300	781	930
DV-360T2-AA	Same as DV-360T2-A2/A3, but also includes documentation, diagnostics, and U.S. power cord	174,600	781	930
DV-350T2-A2/A3	MicroVAX 3500 CPU/Floating-Point Unit; BA213 enclosure; two 159M-byte RD70 disk drive; 296M-byte TK50 tape drive; 10 user VMS licenses; DECnet licenses; VMS services for MS-DOS	63,440	615	732
DV-350T2-AA	Same as DV-350T2-AA, but includes documentation, diagnostics, and power cord	63,740	615	732
DU-350T2-AA	MicroVAX 3500 CPU/Floating-Point Unit; BA213 enclosure; two 159M-byte RD54 disk drive; 296M-byte TK50 tape drive; 16 user ULTRIX licenses and DECnet End Node licenses	61,340	615	732
MICROVAX 2000 SYSTEMS				
DH-625N1-B2	MicroVAX 2000 CPU/Floating-Point Unit; 4M bytes of main memory; RD32 42M-byte Winchester drive; RX33 1.2M-byte diskette drive; expansion adapter; and one-year hardware/software warranty	8,050	156	186
DH-625N1-BA(B3)	Same as DH-625N1-B2, but with documentation	8,150	156	186
DH-625N2-B2(B3)	Same as DH-625N1-B2, but with 6M bytes of memory	10,350	156	186
DH-625N2-BA	Same as DH-625N1-B2, but 6M bytes of memory and documentation	10,450	156	186
DH-625N3-A2	MicroVAX 2000 CPU/Floating-Point Unit; 4M bytes of memory; RD53 71M-byte Winchester disk; BA40A expansion adapter; one-year hardware/software warranty	7,800	166	198
DH-625N3-AA(A3)	Same as DH-625N3-A2, but includes documentation	7,900	166	198
DH-625N4-A2	Same as DH-625N3-A2, but with 6M bytes of memory	10,100	166	198
DH-625N4-AA(A3)	Same as DH-625N3-A2, but with 6M bytes of memory and documentation	10,200	166	198
SV-PXXGB-EK(FN)	MicroVAX 2000 CPU/Floating-Point Unit; 6M bytes of memory; ThinWire Ethernet interface; 4-user MicroVMS license; DECnet End Node and LAVC licenses; documentation	12,980	146	167
DH-625N6-A2	Same as DH-625N4, but with 159M-byte RD54 disk drive	12,300	227	191
DH-625N6-AA(A3)	Same as DH-625N6-A2, but with documentation and power cord	12,400	227	191
DH-630Q5-H2(H3)	MicroVAX II CPU/Floating-Point Unit; 16M bytes of main memory (two MS630-CA memory boards); H9642 style cabinet; TK70 296M-byte cartridge tape drive; KDA50 disk controller; DNQ-11 8-line multiplexer	46,700	361	430
DH-630Q5-HA	Same as DH-630Q5-H2(H3), but with documentation/diagnostics software kit	47,000	361	430

NA—Not applicable.

NC—No charge.

*For systems with List Price Warranty. Effective October 1988, prices for systems with Standard Warranty Support can be 6 to 9 percent higher; prices for hardware add-ons purchased separately are priced 2 percent higher than shown.



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		Purchase Price (\$)*	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
DH-630Q6-B2(B3)	Same as DH-630Q5-H2(H3), but with RA82 622M-byte disk drive	67,700	420	500
DH-630Q6-BA	Same as DH-630Q6-B2(B3), but with documentation/diagnostics software kit	68,000	420	500

MICROVAX II SYSTEM BUILDING BLOCKS (SBBs)

630QB-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1M bytes of main memory; BA123 enclosure	19,320	223	265
630QE-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1M bytes of main memory; H9642 enclosure	23,835	229	273
630QY-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1M bytes of main memory; BA23 pedestal enclosure	15,540	213	254
630QZ-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1M bytes of main memory; BA23 rackmount enclosure	15,383	213	254

MICROVAX II SYSTEM PACKAGES

DH-630Q1-F2(F3)	MicroVAX II CPU/Floating-Point Unit; 5M bytes of main memory; BA23 pedestal enclosure; RD53 71M-byte Winchester disk; DEQNA Ethernet controller	21,550	282	336
DH-630Q1-FA	Same as DH-630Q1-F2(F3), but with documentation/diagnostics software kit	21,650	282	336
DH-630Q2-F2(F3)	MicroVAX II CPU/Floating-Point Unit; 5M bytes of main memory; RQDX3 disk controller; RD53 71M-byte Winchester disk drive; TK50 95M-byte cartridge tape drive; DZQ-11 4-line multiplexer	23,094	308	367
DH-630Q2-FA	Same as DH-630Q2-F2(F3), but with documentation/diagnostics software kit	23,409	308	367
DH-630Q2-H2(H3)	Same as DH-630Q2-F2(F3), but with RD54 159M-byte disk drive	25,025	396	333
DH-630Q2-HA	Same as DH-630Q2-H2(H3), but with documentation/diagnostics software kit	25,350	396	333
DH-630Q3-H2(H3)	MicroVAX II CPU/Floating-Point Unit; 5M bytes of main memory (1M-byte with CPU and one MS630-BB 4M-byte memory board); RQDX3 disk controller; RD53 71M-byte Winchester disk drive; TK50 95M-byte cartridge tape drive; DHQ-11 8-line multiplexer	31,350	401	337
DH-630Q3-HA	Same as DH-630Q3-H2(H3), but with documentation/diagnostics software kit	31,650	337	401
DH-630Q3-J2(J3)	Same as DH-630Q3-H2(H3), but with RD54 159M-byte disk drive	34,350	362	431
DH-630Q3-JA	Same as DH-630Q3-J2(J3), but with documentation/diagnostics software kit	34,650	362	431
DH-630Q4-J2(J3)	MicroVAX II CPU/Floating-Point Unit; 9M bytes of main memory (1M-byte with CPU and one MS630-CA 8M-byte memory board); BA123 enclosure; two RD54 159M-byte Winchester disk drives; TK70 296M-byte cartridge tape drive; DHQ-11 8-line multiplexer	45,550	435	518
DH-630Q4-JA	Same as DH-630Q4-J2(J3), but with documentation/diagnostics software kit	45,850	435	518
DJ-630P1-BA	Diskless compute server for Local Area VAXcluster; includes MicroVAX II CPU/Floating-Point Unit; 6M bytes of main memory, DELQA Ethernet interface, VMS single user, DECnet End Node, and VAXcluster licenses	28,000	228	271
DJ-630P5-BA	Full Boot Node; includes MicroVAX II CPU/Floating-Point Unit; 16M bytes of main memory, RA81 456M-byte disk, TU81 tape drive, and MicroVMS, DECnet, and VAXcluster software licenses	102,000	574	683

COMPACT MICROVAX II

SS-630Q6-J2/J3/J4/J5	Compact MicroVAX II with 9M bytes of memory, two 159M-byte RD54 disk drives, TK50 tape drive	54,210	460	548
SS-630Q6-H2/H3/H4/H5	Compact MicroVAX II with 5M bytes of memory, one RD53 disk drive, one TK50 tape drive	38,560	357	425

RTVAX SYSTEMS

—	rtVAX 3300 system; includes BA215 pedestal or wall-mount enclosure; KA640 CPU module (includes 4M bytes of memory, Ethernet controller, and Integrated Storage Element adapter); VAXELN target license; and documentation	12,430	—	—
—	rtVAX 3400 system; same components as rtVAX 3300, except it uses BA213 enclosure	19,930	—	—

NA—Not applicable.

NC—No charge.

*For systems with List Price Warranty. Effective October 1988, prices for systems with Standard Warranty Support can be 6 to 9 percent higher; prices for hardware add-ons purchased separately are priced 2 percent higher than shown.



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		Purchase Price (\$)*	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
VAXSERVERS				
—	VAXserver 3300 system; KA640 CPU, including 4M-byte ECC memory, Ethernet controller, and Integrated Storage Element (ISE) adapter; RF30 150M-byte Winchester ISE; TK70 296M-byte streaming tape subsystem; 1-to-10 user VMS operating system license; DECnet full-function, File and Application Server, and VAXcluster licenses; documentation and diagnostics; BA215 pedestal enclosure	25,630	—	—
—	VAXserver 3400 system; same as VAXserver 3300 system, but includes two 150M-byte ISEs and uses BA213 pedestal enclosure	38,630	—	—
—	VAXserver 3300 system			
VAXLAB				
LABVX-AD	VAXlab/STD; includes MicroVAX II CPU/Floating-Point Unit; 9M bytes of memory; BA123 cabinet; 71M-byte RD53 disk drive; 95M-byte TK50 tape drive; DNQ-11; 8-user MicroVMS, VAX GKS, DECnet End Node licenses and VAXlab software library	46,784	302	360
LABVX-CC	VAXlab/GPX; same as VAXlab/STD, but with VAXstation II CPU/Floating-Point Unit; QDSS graphics module; 19-inch monitor	42,481	475	565
LABVX-EA	VAXlab/2000; includes VAXstation 2000; 4M bytes of memory; 15-in. monitor; 71M-byte RD53 disk drive; Ethernet controller; single-user MicroVMS, VAX GKS, DECnet End Node licenses and VAXstation and VAXlab software	9,225	96	114
LABVX-SA	VAXlab/3500; includes KA650 CPU/Floating-Point Unit; 16M bytes of memory; BA213 cabinet; 280M-byte RA70 disk drive; 296M-byte TK70 tape drive; QDSS graphics module; 19-inch monitor; Ethernet controller and software (same as VAXlab/2000)	64,550	543	646
VAXLAB REALTIME OPTIONS				
ADV11-DA	50KHz, DMA 16-channel, 12-bit resolution analog-to-digital converter	2,200	45	54
AAV11-DA	300KHz, DMA 2-channel, 12-bit resolution digital-to-analog converter	2,200	45	54
AXV11-C	25KHz, 16-channel, analog-to-digital converter with 2-channel digital-to-analog; 12 bits	1,428	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	540	9	11
DRV11-WA	DMA 16-bit input/output parallel digital interface	1,040	9	11
MEMORY				
MS630-BA	2M-byte memory increment	1,575	—	—
MS630-BB	4M-byte memory increment	1,968	—	—
MS630-CA	8M-byte parity memory increment	3,583	—	—
MS630-CF	MV11 expansion memory for BA21X	3,583	NC	NC
MS650-AA	8M-byte ECC memory for MV3XXX (BA23)	6,000	NC	NC
MS650-AF	8M-byte ECC memory for MV3XXX (BA21X)	6,000	NC	NC
MASS STORAGE				
—	RF30 150M-byte, 5.25-inch Winchester Integrated Storage Element (ISE)	5,500		
—	Standard expansion cabinet (27 in by 14 in by 18 in) with two 150M-byte RF30 ISEs; 120/240 VAC at 50/60 Hz	11,900	—	—
RQDX3-AA/BA	RQDX3 controller for RD53 disk; for BA23(AA), BA123(BA), or BA2XX 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 a BA23-CC expander enclosure	263	NA	NA
RX33-A	1.2M-byte diskette drive	388	8	10
RX50A-AA/BA	RX50 800K-byte dual diskette drive with cables for BA23(AA) or BA123(BA) enclosure	1,050	8	10
RX50-AA	RX50 800K-byte dual diskette drive	1,050	8	10
RX50-D	RX50 800K-byte dual diskette drive mounted in desktop enclosure with I/O cable	1,890	20	24
RX50-R	RX50 800K-byte dual diskette drive for mounting in 19-inch standard equipment rack	1,890	20	24
RD32-A	42M-byte Winchester disk drive	1,615	20	24
RD53-A	RD53 71M-byte, 5¼-in. Winchester disk drive	4,190	38	45
RD53A-AA/BA/SA	RD53 71M-byte drive with cables for BA23(AA), BA123(BA) or BA213 enclosure	4,190	38	45

NA—Not applicable.

NC—No charge.

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DEC MicroVAX Family



		Purchase Price (\$)*	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
RD53-DA/DB	RD53 71M-byte drive mounted in desktop enclosure with I/O cables	4,850	38	45
RD53-EA	71M-byte Winchester disk drive for MicroVAX 2000	4,190	38	45
RD53-FA/F3	71M-byte Winchester disk in expansion box for MicroVAX 2000	5,570	38	45
RD53-RA/RB	RD53 71M-byte drive in 19-inch standard equipment rack; requires H9302 enclosure	4,850	38	45
RD54-DA/DB/RA/RB	RD54 159M-byte Winchester disk drive	5,500	63	75
KDA50-QA	Q-bus controller for RA series disk drives	6,825	50	60
RA60-AF	RA60 205M-byte, 14-in. removable disk; requires 6-ft. cable	19,925	105	125
RQA60-AA	RA60 205M-byte removable disk drive with KDA50 controller	26,670	155	185
RA60-CA	RA60 205M-byte removable disk drive in H9642 cabinet	23,060	105	125
RQA60-CA	RA60-CA with KDA50 controller; for H9642	29,295	155	185
RA70E-SA/SF	280M-byte RA70 disk drive for MicroVAX 3500 and 3600	9,000	45	45
RA81-HA/HD	RA81 456M-byte, 14-in. rack-mountable Winchester disk drive; requires cable, controller, and cabinet	17,245	95	113
RA81-EA/EE	Three RA81 456M-byte disk drives mounted in H9642 cabinet; requires KDA50 controller	55,125	284	338
RQA81-AA	RA81 456M-byte rack-mountable disk drive with KDA50 controller; requires cabinet	17,640	95	113
RA82-EA/ED	Three 622M-byte disk drives mounted in H9642 cabinet	51,000	177	211
RA82-AA/AD	622M-byte rack-mountable disk drive	17,000	59	70
RA82-CA/CD	One 622M-byte disk drive mounted in H9642 cabinet	17,000	59	70
RA82-DA/DD	Two 622M-byte disk drives mounted in H9642 cabinet	34,000	118	140
SA482-AA/AD	2.48G-byte (four-drive) Storage Array	66,000	236	281
SA482-LA/LD	1.86G-byte (three-drive) Storage Array	51,000	177	211
SA482-HA/HD	1.24G-byte (two-drive) Storage Array	34,000	118	140
KDA50-QA	Controller for SA482	6,825	50	60
OPTICAL DISK				
RRD50-QA	600M-byte Compact Disk Read-Only Memory (CD-ROM) disk drive with MicroVAX II and VAXstation controller	1,325	28	33
RRD50-QC	CD-ROM drive with Q-bus control kit	1,160	28	33
RRD50-A2	600M-byte CD-ROM add-on disk drive; requires RRD50-QA or QC	1,050	24	29
RRD50-EA	600M-byte CD-ROM disk drive with controller for IBM PC-compatible products	1,325	28	33
RRD50-EB	600M-byte CD-ROM disk drive with controller for VAXmate	1,160	24	29
RQV20-PA/PD	2G-byte WORM optical disk drive; master drive with MicroVAX II KLESI, cabinet, and cabling	35,000	200	238
RSV20-PA/PD	Same as RQV20-PA/PD, but with BA213 KLESI	35,000	200	238
RQV20-A	Add-in RV20 master drive with MicroVAX II KLESI and cabling	30,000	200	238
RSV20-A	Same as RQV20-A, but with BA213 KLESI	30,000	200	238
RV20-B	RV20 slave drive with cabling	25,000	170	202
MAGNETIC TAPE				
TK50E-SA	TK50 tape drive for BA2XX enclosure	3,749	22	26
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 95M-byte cartridge streaming tape drive	3,087	22	26
TK50-DA/DB	TK50 desktop tape drive	3,749	22	26
TK50-RA/RB	TK50 rackmount tape drive	3,749	22	26
TK50Z-FA/F3	TK50 in expansion box for MicroVAX 2000	4,956	30	36
TK70E-AA/SA	296M-byte TK70 tape drive for BA23/BA123 on BA2XX box	5,880	30	36
BA40A-AA	Expansion Adapter for MicroVAX 2000	1,200	NA	NA
TSV05-SA/SB	Q-bus TSV05 magnetic tape system with hardware for rackmounting, control module, cables, and top-access cover	10,800	89	106
TU81E-DA(DD)	TU81-Plus 1600/6250 bpi PE/GCR tape drive	30,098	140	167
PRINTERS				
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
LA75X-SF	Single-tray sheet feeder for LA75	394	NC	NC
LA75-CA	32/42/125/250 cps dot matrix tabletop printer	835	8	10
LG31-A2	300 lpm dot matrix line printer	8,450	85	101
LJ250/252-CA	20-167 cps color dot matrix tabletop printer	1,695	11	13
LCG01-AA	Ink jet color printer with graphics processor and RS-232-C serial interface interface)	17,490	125	149
LG01-BA	Q-bus text printer; requires cabinet kit	13,545	127	151

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DEC MicroVAX Family

		Purchase Price (\$)*	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
LG02-BA	Q-bus text and graphics printer; requires cabinet kit	16,695	127	151
LG01-UG	Upgrade kit to convert LG01 text printer to LG02 text and graphics printer	3,850	NA	NA
LN03-AA	LN03 8-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	2,895	49	58
LN03S-AA	LN03 Plus 8-ppm desktop graphics laser printer; includes 1M-byte RAM, Modern Gothic typeface, two toner cartridges, organic photoreceptor cartridge, AC power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation	3,995	56	67
LN03S-UA	Graphics board to upgrade LN03 to LN03 Plus	1,095	7	8
LPS40-AA	Print Server 40, 40-ppm Ethernet printer with power cord	50,650	475	565
LN03R-AA	PostScript version of LN03-AA	5,495	56	67
LN03R-UA	LN03 to LN03R conversion kit	2,795	18	21
LP29-SA/S3	2000 lpm band printer with LPV11-SA controller, 9.5-m data cable, and powered paper stacker; for BA213 enclosures only	38,500	400	476

WORKSTATIONS/TERMINALS

VT320-AA	White text terminal with standard keyboard	545	3	4
VT320-BA	Green text terminal with standard keyboard	545	3	4
VT320-CA	Amber text terminal with standard keyboard	545	3	4
VT320-DA	White text terminal with word processing keyboard	545	3	4
VT320-FA	Amber text terminal with word processing keyboard	545	3	4
VT330-AA	White graphics terminal with standard keyboard	1,990	19	23
VT330-BA	Green graphics terminal with standard keyboard	1,990	19	23
VT330-CA	Amber graphics terminal with standard keyboard	1,990	19	23
VT330-DA	White graphics terminal with word processing keyboard	1,990	19	23
VT330-EA	Green graphics terminal with word processing keyboard	1,990	19	23
VT330-FA	Amber graphics terminal with word processing keyboard	1,990	19	23
VT340-AA	Color graphics terminal with standard keyboard	2,935	26	31
VT340-DA	Color graphics terminal with word processing keyboard	2,935	26	31
VT3XX-CA	VT320 tilt/swivel base	20	NA	NA
VSXXX-AA	Mouse for VT330 and 340	195	NC	NC
VSXXX-AB	Graphics tablet for VT330 and 340	1,095	8	10
LA100-BA	LA100 40/80/240 cps keyboard send/receive printing terminal with keyboard, numeric keypad, tractors, cable, ribbon cartridge, package of paper, and Courier-10/Orator-10 fonts	2,640	27	32
LA100-CA	LA100 with keyboard, tractors, cable, ribbon cartridge, package of paper, Courier-10/Orator-10 fonts, and multiple-font option	2,750	27	32
LA120-DA	LA120 180 cps keyboard send/receive terminal for use with 1-to-6 part forms	3,197	34	40

VOICE SYNTHESIS MODULE

DTC01-AA	Single-line DECtalk text-to-speech unit; includes cables	4,200	22	26
DTC03-AA	Multiline DECtalk 8-channel text-to-speech unit; cables not included	27,200	250	298
DTC03-SL	Dual-line DECtalk 2-channel text-to-speech unit; cables not included	8,000	100	119
DTC03-AM	Add-on single-channel board for dual-line DECtalk; requires power and mechanical mounting (user supplied)	3,400	32	38

COMMUNICATIONS/NETWORKING

DHQ11-M	DHQ11 eight-line asynchronous Q-bus communications controller	1,675	15	18
DZQ11-M	DZQ11 four-line asynchronous multiplexer; requires cable	930	11	13
DPV11-M	DPV11 single-line synchronous interface; requires cable	826	14	17
DHT32-AA	8-line asynchronous interface for MicroVAX 2000	1,714	—	—
DST32-AA	1-line synchronous interface for MicroVAX 2000	1,530	—	—
DPV11-SA	Single-line synchronous interface for 3500/3600	969	14	17
DMV11-M	DMV11 single-line synchronous interface; requires cable	2,550	41	49
DMV11-N	Integral modem interface	2,160	41	49
H4005	Ethernet/IEEE 802.3 transceiver	225	4	5
DESTA-AA	ThinWire Ethernet station adapter	289	4	5
DSRVB-AA	8-line DECserver 200	3,806	27	44
DSRVS-AD	128-line DECserver 500	15,250	165	196
DELQA-M	DELQA Ethernet-to-Q-bus high-performance synchronous communications controller; requires cable	2,500	15	18
DELUA-M	Ethernet/IEEE 802.3 to Unibus single-line interface	4,354	33	39
DESPA-AA	Ethernet to MicroVAX 2000 synchronous communications controller	1,313	12	14
DEPCA-AA	Ethernet/IEEE 802.3 to PC bus synchronous communications controller	677	8	10
CXA16-AA	16-line asynchronous interface RS-423-A for 3500/3600	2,725	15	18
CXB16-AA	16-line asynchronous interface RS-422 for 3500/3600	2,725	15	18
CXY08-AA	8-line asynchronous interface RS-232-C for 3500/3600	1,885	15	18
DFA01-AA	2-line asynchronous interface with integral modems for 3500/3600	1,650	19	23

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DEC MicroVAX Family

SOFTWARE PRICES

		License Fee (\$)*
OPERATING SYSTEM		
QL-001AB-B2	VMS (11-20 user) upgrade license for 3500/3600	—
QL-001AB-B3	VMS (21-40 user) upgrade license for 3500/3600	20,000
QL-001AB-B4	VMS (41-n user) upgrade license for 3500/3600	20,000
QL-001AN-BB	VMS (single user) license for MicroVAX II	2,100
QL-001AN-BE	VMS (1-8 user) license for MicroVAX II	6,300
QL-001AN-BF	VMS (1-16 user) license for MicroVAX II	13,650
QL-001AN-BZ	VMS (1-n user) license for MicroVAX II	18,900
QL-001AP-BD	VMS (1-4 user) license for MicroVAX 2000	3,150
QL-001AP-BE	VMS (1-8 user) license for MicroVAX 2000	6,300
QL-001AP-BF	VMS (1-16 user) license for MicroVAX 2000	13,650
QL-001AP-BZ	VMS (1-n user) license for MicroVAX 2000	18,000
COMMUNICATIONS		
QL-D04AN-AA	DECnet End Node license for MicroVAX II	1,649
QL-D04AP-AA	DECnet End Node license for MicroVAX 2000	819
QL-D05AN-AA	DECnet full license for MicroVAX 2000	4,127
QL-D05AP-AA	DECnet full license for MicroVAX II	2,069
QL-D09AN-AA	DECnet End Node to full license upgrade for MicroVAX II	2,982
QL-D09AP-AA	DECnet End Node to full license upgrade for MicroVAX 2000	1,491
QL-363AN-AA	DECnet/SNA 3270 for MicroVAX II	2,048
QL-363AP-AA	DECnet/SNA 3270 for MicroVAX 2000	1,029
QL-455AN-AA	DECnet/SNA Application Programming Interface (API) for MicroVAX II	1,638
QL-455AP-AA	DECnet/SNA Application Programming Interface (API) for MicroVAX 2000	819
QL-022AN-AA	DECnet/SNA Advanced Program-to-Program Communications (APPC) for MicroVAX II	1,890
QL-022AP-AA	DECnet/SNA Application Programming Interface (API) for MicroVAX 2000	945
QL-454AN-AA	DECnet/SNA 3270 Terminal Emulator (TE) for MicroVAX II	882
QL-454AP-AA	DECnet/SNA 3270 Terminal Emulator (TE) for MicroVAX 2000	441
QL-453AN-AA	DECnet/SNA RJE for MicroVAX II	882
QL-453AP-AA	DECnet/SNA RJE for MicroVAX 2000	441
QL-452AN-AA	DECnet/SNA Gateway Management for MicroVAX II	378
QL-452AP-AA	DECnet/SNA Gateway Management for MicroVAX 2000	189
QL-042AN-AA	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for MicroVAX II	1,323
QL-044AN-AA	DECnet/SNA Printer Emulator (PrE) for MicroVAX II	882
QL-042AP-AA	DECnet/SNA Gateway Management for MicroVAX 2000	662
QL-044AP-AA	DECnet/SNA Gateway Management for MicroVAX 2000	441
QL-111AN-AA	DECnet/SNA 2780/3780 Protocol Emulator for MicroVAX II	3,833
QL-B12AP-AA	DECnet/SNA VAX VIDA for MicroVAX 2000	5,513
QL-362AN-AA	VMS/SNA for MicroVAX II	2,625
QL-B12AN-AA	VAX VIDA for MicroVAX II	11,025
Q3-ZCEAP-AA	Local Area VAXcluster for MicroVAX 2000	683
Q2-ZCEAN-AA	Local Area VAXcluster for MicroVAX II	1,995
QL-022AB-AA	DECnet/SNA (API) for 3500/3600	5,670
QL-042AB-AA	DECnet/SNA Gateway Management for 3500/3600	3,969
QL-044AB-AA	DECnet/SNA PRE for 3500/3600	2,646
QL-111AB-AA	DECnet/SNA 2780/3780 Protocol Emulation for 3500/3600	11,508
QL-452AB-AA	DECnet/SNA Gateway Management for 3500/3600	1,080
QL-453AB-AA	DECnet/SNA RJE for 3500/3600	2,646
QL-454AB-AA	DECnet/SNA 3270 Emulation for 3500/3600	2,646
QL-363AB-AA	DECnet/SNA 3270 Emulation for 3500/3600	6,143
QL-455AB-AA	DECnet/SNA API for 3500/3600	4,914
QL-362AB-AA	VMS/SNA for 3500/3600	7,500
QL-B12AB-AA	VAX VIDA for 3500/3600	31,500
QL-D04AB-AA	DECnet End Node for 3500/3600	4,935
QL-D05AB-AA	DECnet Full License for 3500/3600	12,390
QL-D09AB-AA	DECnet End Node to Full License Upgrade for 3500/3600	8,946
DATA BASE MANAGEMENT		
QL-898AN-AA	Datatrieve for MicroVAX II	5,156
QL-898AP-AA	Datatrieve for MicroVAX 2000	2,583
QL-897AN-AA	Common Data Dictionary (CDD) for MicroVAX II	1,438
QL-897AP-AA	Common Data Dictionary (CDD) for MicroVAX 2000	714
QL-D07AN-AA	Rdb/ELN Development License for MicroVAX II	4,725
QL-D07AP-AA	Rdb/ELN Development License for MicroVAX 2000	2,363
QL-358AP-AA	Rdb/MicroVMS Run Time Option (RTO) for MicroVAX 2000	1,433
QL-358AN-AA	Rdb/MicroVMS Run Time Option (RTO) for MicroVAX II	2,867
QL-D07AB-AA	Rdb/ELN Development License for 3500/3600	13,500
QL-358AB-AA	Rdb/MicroVMS (RTO) for 3500/3600	8,190
QL-897AB-AA	Common Data Dictionary for 3500/3600	4,100
QL-898AB-AA	Datatrieve for 3500/3600	14,760

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DEC MicroVAX Family

		License Fee (\$)*
LANGUAGES		
QL-018AN-AA	Dibol for MicroVAX II	2,615
QL-018AP-AA	Dibol for MicroVAX 2000	1,312
QL-130AN-AA	DSM (Digital Standard Mumps) for MicroVAX II	5,670
QL-130AP-AA	DSM (Digital Standard Mumps) for MicroVAX 2000	2,835
QL-100AN-AA	Fortran for MicroVAX II	3,255
QL-100AP-AA	Fortran for MicroVAX 2000	1,628
QL-917AN-AA	Lisp for MicroVAX II	5,040
QL-917AP-AA	Lisp for MicroVAX 2000	2,520
QL-126AN-AA	Pascal for MicroVAX II	2,982
QL-126AP-AA	Pascal for MicroVAX 2000	1,491
QL-114AN-AA	PL/1 for MicroVAX II	5,019
QL-114AP-AA	PL/1 for MicroVAX 2000	2,510
QL-056AN-AA	Ada for MicroVAX II	15,687
QL-056AP-AA	Ada for MicroVAX 2000	7,844
QL-020AN-AA	APL for MicroVAX II	5,019
QL-020AP-AA	APL for MicroVAX 2000	2,501
QL-095AN-AA	Basic for MicroVAX II	3,339
QL-095AP-AA	Basic for MicroVAX 2000	1,670
QL-106AN-AA	Bliss-32 for MicroVAX II	3,643
QL-106AP-AA	Bliss-32 for MicroVAX 2000	1,799
QL-015AN-AA	C for MicroVAX II	2,982
QL-015AP-AA	C for MicroVAX 2000	1,501
QL-099AN-AA	Cobol for MicroVAX II	5,019
QL-099AP-AA	Cobol for MicroVAX 2000	2,510
QL-913AN-AA	OP5 for MicroVAX II	3,150
QL-913AP-AA	OP5 for MicroVAX 2000	2,363
QL-015AB-AA	C for 3500/3600	8,510
QL-018AB-AA	Dibol for 3500/3600	7,470
QL-020AB-AA	APL for 3500/3600	14,350
QL-056AB-AA	Ada for 3500/3600	44,820
QL-095AB-AA	Basic for 3500/3600	9,540
QL-099AB-AA	Cobol for 3500/3600	14,350
QL-100AB-AA	Fortran for 3500/3600	9,310
QL-106AB-AA	Bliss for 3500/3600	10,400
QL-114AB-AA	PL/1 for 3500/3600	14,350
QL-126AB-AA	Pascal for 3500/3600	8,510
QL-130AB-AA	DSM for 3500/3600	16,200
QL-913AB-AA	OP5 for 3500/3600	9,000
QL-917AB-AA	Lisp for 3500/3600	14,400
UTILITIES AND TOOLS		
QL-425AN-AA	Application Development Environment (ADE) for MicroVAX II	1,701
QL-425AP-AA	Application Development Environment (ADE) for MicroVAX 2000	851
QL-310AN-AA	DECalc for MicroVAX II	1,502
QL-310AP-AA	DECalc for MicroVAX 2000	1,071
QL-360AN-AA	DECgraph for MicroVAX II	1,575
QL-360AP-AA	DECgraph for MicroVAX 2000	788
QL-361AN-AA	DECslide for MicroVAX II	1,575
QL-361AP-AA	DECslide for MicroVAX 2000	788
QL-038AN-AA	DEctype for MicroVAX II	1,260
QL-038AP-AA	DEctype for MicroVAX 2000	630
QL-007AN-AA	DEC/CMS (Code Management System) for MicroVAX II	5,465
QL-007AP-AA	DEC/CMS (Code Management System) for MicroVAX 2000	2,730
QL-143AN-AA	DECshell for MicroVAX II	2,993
QL-143AP-AA	DECshell for MicroVAX 2000	1,501
QL-810AN-AA	GKS/Ob for MicroVAX II	3,780
QL-810AP-AA	GKS/Ob for MicroVAX 2000	1,890
QL-706AN-AA	TDMS for MicroVAX II	2,604
QL-706AP-AA	TDMS for MicroVAX 2000	1,302
QL-375AN-AA	VAXELN Toolkit for MicroVAX II	4,221
QL-375AP-AA	VAXELN Toolkit for MicroVAX 2000	2,100
QL-382AN-AA	VAX-11 RSX for MicroVAX II	2,520
QL-382AP-AA	VAX-11 RSX for MicroVAX 2000	1,260
QL-007AB-AA	DEC/CMS for 3500/3600	15,620
QL-038AB-AA	DEctype for 3500/3600	3,600
QL-143AB-AA	DECshell for 3500/3600	8,550
QL-310AB-AA	DECalc for 3500/3600	6,120
QL-360AB-AA	DECgraph for 3500/3600	4,500
QL-361AB-AA	DECslide for 3500/3600	4,500
QL-375AB-AA	VAXELN for 3500/3600	12,000
QL-382AB-AA	VAX RSX for 3500/3600	7,200
QL-425AB-AA	ADE for 3500/3600	4,860
QL-706AB-AA	TDMS for 3500/3600	7,430
QL-810AB-AA	GKS/Ob for 3500/3600	10,800

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