DEC MicroVAX II and 2000

MANAGEMENT SUMMARY

UPDATE: *Since the last update of this report, Digital Equipment Corporation has added the MicroVAX 2000 and VAXstation 2000 to the MicroVAX product line. This report focuses on the two general-purpose MicroVAX supermicro systems; the VAXstation workstation products are covered in a separate, new report.*

"Ill can he rule the great, that cannot reach the small." Such would be Edmund Spenser's attitude today if he were employed within the computer industry. And such is Digital Equipment Corporation's attitude in introducing the four-user MicroVAX 2000, designed to meet the computing needs of the small workgroup.

Workgroup processing is a subset of departmental processing—the movement away from centralized mainframe processing to several smaller, more cost-effective mid-range systems installed within individual departments throughout an organization. A workgroup connotes fewer users and more closely related tasks than does departmental processing, and workgroup processing is normally implemented through low-end supermicrocomputers and networked PCs, which are viewed as more cost effective than minicomputers, just as minicomputers are viewed as more cost effective than mainframes.

Digital's VAX 8000 and MicroVAX II are widely recognized as the industry's leading departmental systems; however, up until the introduction of the MicroVAX 2000, Digital lacked a powerful but less expensive and smaller multiuser system suitable for small workgroups. To continue its challenge to IBM in the corporate marketplace, Digital must not only continue to offer cost-effective alternatives to traditional IBM mainframes, but also lower-priced alternatives to its own systems. Just as Digital has

The MicroVAX II and MicroVAX 2000 are multiuser supermicrocomputers designed for a range of commercial and technical applications. Either system can be used in standalone, networked, or clustered configurations. The systems are software compatible with Digital Equipment Corporation's line of VAX superminis.

MODELS: MicroVAX II and MicroVAX 2000.
MEMORY: 2MB to 16MB.
DISK CAPACITY: 31MB to 1.8GB.
WORKSTATIONS: Up to 48.
PRICE: $9,000 to $45,400 (base configuration prices).

CHARACTERISTICS

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

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

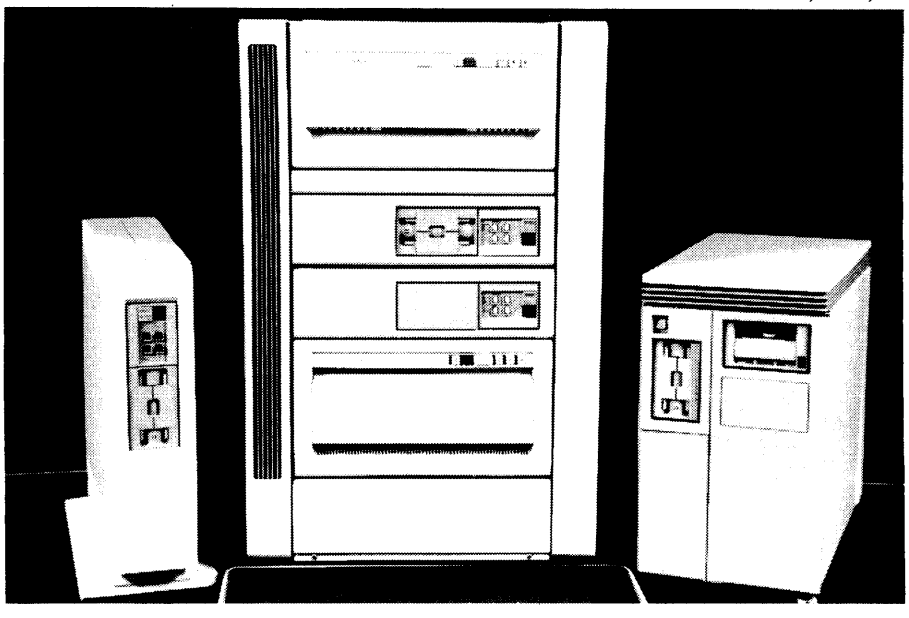
DATA FORMAT

BASIC UNIT: 32-bit word.

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

MAIN STORAGE

Memory is dynamic parity MOS RAM. Main memory cycle time is 400 nanoseconds. Main memory increments are 2MB, 4MB, and 8MB on the MicroVAX II and 2MB on the



Digital Equipment Corporation's MicroVAX II is available in three types of enclosures. It can serve as a multiuser supermicro for workgroup, departmental, and small organization computing. The system runs under either Digital's proprietary MicroVMS operating system or the Unix-derivative Ultrix-32m.

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DEC MicroVAX II and 2000

CHART A. SYSTEM COMPARISON

MODEL	MicroVAX II	MicroVAX 2000
SYSTEM CHARACTERISTICS		
Date of introduction	May 1985	February 1987
Date of first delivery	June 1985	—
Microprocessor type	MicroVAX 78032	MicroVAX 78032
Microprocessor cycle time	200 ns	200 ns
Operating system	MicroVMS, Ultrix-32m	MicroVMS, Ultrix-32m
Upgradable from	MicroVAX I, MicroPDP-11	Not applicable
Upgradable to	Not applicable	Not applicable
Number of serial/parallel I/O ports	Up to 49 serial	4
Number of expansion slots	7 (BA23); 11 (BA123); 13 (H9642)	0
MEMORY		
Minimum capacity (bytes)	2M	4M
Maximum capacity (bytes)	16M	6M
DISK STORAGE		
Minimum capacity (bytes)	31M	0 or 42M
Maximum capacity (bytes)	1.8G	142M
NUMBER OF WORKSTATIONS	Up to 48	Up to 4
COMMUNICATIONS PROTOCOLS	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; 3271; TCP/IP; LU6.2	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP

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

been able to invade the corporate environment at the department level because IBM did not offer a suitable departmental system—a problem soon to be addressed by the first deliveries of the 9370—Digital must fill gaps in the low end of its own product line to protect its installed base from intrusion by vendors that offer less expensive supermicrocomputers and PC LAN products.

The MicroVAX 2000 supports up to 4 directly connected users and up to 16 users through its Ethernet interface. Based on the same microprocessor chip set as the MicroVAX II, all electronics components—requiring four boards on the MicroVAX II—now reside on one board, resulting in a system small enough to be placed on a desktop. A MicroVAX 2000 is roughly half the price of a similarly equipped MicroVAX II, but offers much less expansion capability due to its busless architecture.

Digital markets the MicroVAX II and 2000 for a full range of applications and views the systems as installable in a variety of office- or department-level computing environments. In marketing these machines, the company is pursuing its traditional scientific and engineering markets, such as computer-aided design and manufacturing (CAD/CAM), laboratory research, and process control and factory automation, as well as commercial applications like office automation, educational computing, electronic publishing, and general-purpose computing. For example, Digital intends entry-level MicroVAX II systems to be used for such tasks as realtime data acquisition or process control in Ethernet environments. Because the MicroVAX 2000 has no expansion slots, its capabilities for the attachment of data acquisitions and process control equipment are limited. The MicroVAX 2000 and small configurations (four to eight users) of the MicroVAX II can be used by workgroups or teams in small businesses or branch offices or in distributed data processing/LAN environments by small groups within larger organizations. Larger configurations of the MicroVAX II supporting up to 48 users can be em-

MicroVAX 2000. Like all VAX systems, the MicroVAX II and MicroVAX 2000 provide up to 4GB of virtual memory space.

PROCESSING COMPONENTS

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 1GB of physical address space. The 78032 has a TTL-compatible interface.

Also on the CPU board is the MicroVAX 78132, a chip-level floating-point unit (FPU) that handles F (single-precision), D (double-precision), and G (extended-range double-precision) floating-point data types. The 78132 also accelerates integer multiply and divide functions.

The MicroVAX II and MicroVAX 2000 feature a 304-instruction set, similar to but differently implemented than that used by larger VAX systems. On the MicroVAX 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.

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 1MB of integral main memory, memory expansion control, console serial line unit, 64KB of ROM containing power-up diagnostics and 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.

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CHART B. DISK/DISKETTE DEVICES

MODEL	RX33	RX50	RD32	RD52
Type	Diskette	Dual Diskette	Winchester	Winchester
Size (inches)	5.25	5.25 per diskette	5.25	5.25
Number of surfaces	2 per diskette	1 per diskette	—	—
Formatted capacity per drive (bytes)	1.2M	818K (409K per diskette)	42.8M	31M
Interface/controller	—	RQDX3	ST412/506	RQDX3
Number of drives per interface/controller	—	—	—	—
Average access time	—	264 ms	48.3 ms	57.5 ms
Data transfer rate	500K bps	250K bps	5M bps	625KB/sec
Sectors/tracks per surface	160 per diskette	80 tracks/diskette	—	—
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector

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ployed as departmental systems. A high-end configuration, supporting up to 1.8GB of disk, can be employed for both computation- and storage-intensive applications, like CAD and seismic analysis.

COMPETITIVE POSITION

The first comparison to make is between similar configurations of the MicroVAX 2000 and the MicroVAX II. A MicroVAX 2000 equipped with 4MB of memory, a 71MB disk drive, a 95MB cartridge tape drive, four terminals, and a two-to-eight user MicroVMS license costs $20,740, for a per-user cost of $5,180. A similarly equipped MicroVAX II costs $36,974, for a per-user cost of $9,243. Though nearly twice as expensive as the MicroVAX 2000, in this configuration, the MicroVAX II offers expansion capabilities far beyond those of the busless 2000 system (see Chart A for capacity comparison) and would be the system of choice for users who foresee the eventual need to increase user support and storage capacity beyond those available on the 2000. Of course, at these prices, a user could also consider the purchase of a second MicroVAX 2000, connected to the initial system through its Ethernet interface, to meet such needs.

A month after the introduction of the MicroVAX 2000—at the same time the VAX 8250, 8350, and 8530 were announced—Digital increased prices on MicroVAX II System Building Blocks and on MicroVMS operating system licenses. That made the MicroVAX 2000 even more attractive to potential customers who had already considered an entry-level MicroVAX II and found it too expensive—before it became even more expensive. Price increases were most dramatic on large MicroVAX II configurations, due to a 125 percent price increase on the unlimited-users MicroVMS license, resulting in price increases of up to 40 percent on total system configurations. The effect of these price increases was to narrow the price/performance gap between the Q-bus- and Unibus-based MicroVAX II and the entry-level VAX 8250, thus attracting more customers to the VAXBI-based architecture systems. It appears that Digital is trying to decrease demand for the MicroVAX II—odd indeed, considering that it is the industry's leading supermicrocomputer. Such market manipulation must have a purpose, however, which might be preparation for the introduction of a VAXBI-based MicroVAX III that supports more users and disk storage than the Micro-

Digital's MicroPDP-11 computers, which employ the same BA23, BA123, and H9642 enclosures as the MicroVAX II, can be upgraded to the MicroVAX II.

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

INPUT/OUTPUT CONTROL

I/O on the MicroVAX II is handled through the 22-bit extended Q-bus (also called the Q22), which provides a common communications path for the data, address, and control information passed among the CPU, memory, and device interfaces. The Q-bus provides 22-bit addressing and four interrupt levels and performs block-mode DMA data transfers on a bandwidth of up to 3MB per second. Larger MicroVAX II configurations also support the UNIBUS, which is described in the "DEC VAX 8000" report in *Datapro Reports on Minicomputers.*

The MicroVAX 2000 is based on a busless architecture and has no expansion slots. It is equipped with a modified Small Computer Systems Interface (SCSI) port designed to connect the expansion cabinet housing additional storage on the larger configuration.

CONFIGURATION RULES

The MicroVAX II comes in a choice of four enclosures: the BA23, a pedestal or rackmount box with 8 module slots and 2 slots dedicated for 5-inch mass storage devices; the BA123, a caster-mounted floorstanding enclosure with 12 module slots and 5 slots for mass storage; a cabinet system employing a 14-slot modified H9642 cabinet (the type used for larger VAX computers) containing two BA23 enclosures and providing space for two RA-class disks; and the Compact MicroVAX II, which includes integrated load and storage devices and two 8-slot BA23 backplanes for Q-bus expansion.

The MicroVAX II is available in seven basic Standard System packages:

- An Ethernet-node single-user configuration. It constitutes an entry-level Ethernet node and features 2MB of main memory, a single serial line unit, a 31MB RD52 Winchester disk subsystem, an 800KB RX50 dual diskette subsystem, and an Ethernet adapter, all housed in the BA23 pedestal enclosure. Up to 12 additional modem/data serial lines and one memory module can be added; additional networking options can also be selected.

- A four-user configuration intended for team or workgroup computing. It features 5MB of main memory, a 71MB

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CHART B. DISK/DISKETTE DEVICES (Continued)

MODEL	RD53	RD54	RA60	RA81
Type	Winchester	Winchester	Removable	Winchester
Size (inches)	5.25	5.25	14	14
Number of surfaces	—	—	6	7
Formatted capacity per drive (bytes)	71M	159M	205M	456M
Interface/controller	RQDX3	RQDX3	KDA50	KDA50
Drives per interface/controller	—	—	4	4
Average access time	38.3 ms	38.3 ms	50 ms	36.3 ms
Data transfer rate	625KB/sec.	625KB/sec.	1.98MB/sec.	2.2MB/sec.
Sectors/tracks per surface	—	—	1600 tracks	2496 tracks
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector

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VAX II and is even more compatible with the VAX 8000 systems. Digital has made no investments in Q-bus technology with the MicroVAX 2000 and could be trying to move away from that bus architecture entirely, just as at the upper end of the product line, it is trying to move away from the Massbus architecture implemented on the VAX 8600 and 8650.

The MicroVAX II's primary competition will come from the IBM 9370. The introduction of the 9370 is a very directed effort by IBM to close the gaps in its product line which created opportunities for Digital to establish a presence in the corporate environment at IBM's expense. Dubbed the "VAX killer," the 9370 provides the connectivity that had been lacking at the mid-range level on IBM's own System/36 and System/38; it also provides 370 compatibility at the application level.

The MicroVAX II competes most directly with the entry-level 9373 Model 20. The MicroVAX II supports up to 48 directly attached users; the 9373-20 supports up to 64. Both systems support up to 16MB of memory. The 9373-20 supports far more disk storage than the MicroVAX II: 6.5GB compared to 1.8GB. IBM-supplied figures rate the MicroVAX II at 0.13 MFLOPS and the 9373-20 at 0.137 MFLOPS, based on LINPACK full-precision performance comparisons. IBM also reports that the MicroVAX II processes up to 65 transactions per minute (tpm), while the 9373-20 processes up to 83 tpm.

Despite similarities in processing performance—and recent price increases on MicroVAX II hardware and software—prices for the 9373-20 are still much higher than those for comparable configurations of the MicroVAX II. A MicroVAX II with 9MB of memory, 318MB of disk storage, a 95MB tape drive, an eight-line multiplexer, eight displays, an Ethernet adapter, and an eight-user software license costs $57,380 ($7,172 per user). A similarly equipped 9373-20 with a VM/IS license costs $110,300 ($13,787 per user).

Because of hardware and software compatibility with the VAX 8000 computers, the MicroVAX II will remain attractive to users in fully Digital and mixed Digital/IBM environments where MicroVAX and VAX systems have already been implemented as departmental processors offloading an IBM mainframe. The MicroVAX II benefits

RD53 Winchester disk, a 95MB TK50 streaming cartridge tape drive, five serial lines (one console terminal and four modem/data), and a BA23 pedestal enclosure. Another main memory module, eight more modem/data serial lines, and networking options can be added.

- **An eight-user system intended for larger workgroups. This configuration includes 9 serial lines (one console terminal and eight modem/data); 12 more modem/data serial lines can be added. Also included in this configuration are 5MB of main memory, an RD53 disk, a TK50 streaming tape drive, an Ethernet adapter, and the BA123 cabinet. Two more RD53 disks or one RD53 and one RX50 diskette can be added, along with one more main memory module. Line printer and additional networking options can also be selected.**

- **A 16-user departmental system. This package features nine serial lines (one console terminal and eight modem/data), 9MB of main memory, three RD53 disks, a TK50 streaming tape drive, an Ethernet adapter, and the BA123 cabinet. One more main memory module can be configured, as can 12 more modem/data serial lines. Networking and line printer options may also be added.**

- **A departmental system for storage-intensive applications. Housed in the 40-inch modified H9642 cabinet, this configuration includes nine serial lines (one console terminal and eight modem/data), 16MB of main memory, a KDA50 disk controller (for RA60 and RA81 disks), a TK50 streaming tape drive, and an Ethernet interface. Purchasers must choose either an RA60 205MB removable or RA81 456MB Winchester disk as a system device and must also select an operating system license.**

  This configuration can support up to 1.8GB of disk storage. (One option is a 1.368GB, three-RA81 subsystem in a separate cabinet enclosure.) A TS05 tape drive can be configured if RA81 disks are chosen. Up to 40 more modem/data serial lines can be configured (fewer if RD53 and RX50 devices are also selected as options). Line printer and networking options can also be attached.

- **Compact MicroVAX II Version B. Housed in a 32-inch-high cabinet, this configuration includes 9MB of memory, two RD54 159MB disk drives, a TSV05 40MB tape drive, a TK50 tape cartridge load device, eight serial lines, and an Ethernet connection.**

- **Compact MicroVAX II Version E. Housed in a 32-inch-high cabinet, this configuration includes 5MB of memory, one RD53 disk drive, a TSV05 tape drive, a TK50 tape cartridge or RX50 diskette load device, and eight serial lines.**

Both Compact MicroVAX IIs support up to 32 serial lines, 16MB of memory, and 318MB of storage.

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CHART C. WORKSTATIONS

MODEL	VT220	VT240	VT241	VT330	VT340
DISPLAY PARAMETERS					
Max. chars./screen	3,168	3,168	3,168	3,168	3,168
Buffer capacity	—	—	—	19,000 characters	19,000 characters
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132
Tilt/swivel screen	Tilt standard	Standard	Standard	Standard	Standard
Symbol formation	7 x 10 dot matrix	8 x 10 dot matrix	8 x 10 dot matrix	10 x 20 dot matrix	10 x 20 dot matrix
Character phosphor	White, green, or amber	White, green, or amber	P4	White, green, or amber	White, green, or amber
Total colors/no. simult. displayed	Not applicable	Not applicable	—	4 shades of gray	4,096/16
KEYBOARD PARAMETERS					
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character/code set	ASCII, Digital Special Graphics, and Supplemental	ASCII, Digital Special Graphics, and Supplemental	ASCII, Digital Special Graphics, and Supplemental	ASCII, NRCS	ASCII, NRCS
Detachable	Yes	Yes	Yes	Yes	Yes
Program function keys	15	15	15	—	—
TERMINAL INTERFACE	RS-232-C, RS-423, and 20 ma std.	RS-232-C, RS-423, and 20 ma std.	RS-232-C, RS-423, and 20 ma std.	RS-232-C, RS-423, and 20 ma std.	RS-232-C, RS-423, and 20 ma std.
COMMENTS		800 x 240 pixel graphics array	800 x 240 pixel graphics array; includes color monitor	800 x 500 pixel graphics array; supports split-screen viewing	800 x 500 pixel graphics array; supports split-screen viewing

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

from a large base of existing software, while the 9370 software base is just beginning to be built up. However, for users who have remained consistently IBM or who have not yet implemented a departmental solution, the MicroVAX II will have a difficult time competing with an IBM mid-range system that runs IBM mainframe software.

Until recently, Digital has tended to focus on the engineering and scientific market and has not aggressively pursued the commercial markets. However, since the MicroVAX II and higher end VAX systems have become so popular outside of the engineering/scientific computing environment, the company has increased its efforts to tap commercial markets as well, especially now at the low end where users are looking for the best price/performance advantages. In the commercial marketplace, the MicroVAX 2000 faces competition from the many vendors that offer 32-bit supermicrocomputers, networked PCs, and Intel 80386-based systems—including the new IBM PS/2, especially when multiuser OS/2 becomes available. All of these alternatives are less expensive than the MicroVAX 2000.

Because of its capability to handle scientific/engineering applications, the MicroVAX 2000 also competes with Sun Microsystems' and Apollo Computers' technical workstations, though these vendors' systems offer more direct competition for the Digital VAXstations, which are discussed in the "DEC VAXstations" report in *Datapro Reports on Minicomputers.*

The primary source of sales for the MicroVAX 2000 will be Digital's installed customer base—both commercial and technical users looking for an inexpensive means to add small increments of user support capacity to existing VAXcluster configurations. The major advantage that the MicroVAX 2000 has over the alternatives cited above is its software and hardware compatibility with and connectivity to Digital's entire supermini product line, ensuring ease of upward migration to more powerful processors.

Standard systems require selection of a MicroVMS, Ultrix-32m, or VAXELN license.

The MicroVAX II is also available in various BA23-, BA123-, and H9642-based System Building Block (SBB) configurations, which require selection of specific CPU packages, mass storage devices, and software licenses. Selections from console terminal and communications/networking menus are optional. Users must select either a MicroVMS, Ultrix-32m, or VAXELN operating system license.

A specialized, MicroVAX-based realtime system, *VAXlab*, is offered for laboratory data acquisition and experiment control in mid-range to high-performance applications. Two versions are based on MicroVAX II configurations. (Two others are based on the VAXstation II. See the "DEC VAXstations" report in *Datapro Reports on Minicomputers* for details.

- **VAXlab/STD, a multiuser packaged system built on the MicroVAX II in a BA123 enclosure.**
- **VAXlab/RM, a rackmount multiuser packaged system built on the MicroVAX II in a BA23 enclosure.**

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

The MicroVAX 2000 is available is three basic configurations:

- **The entry-level system includes 4MB of memory (upgradable to 6MB), an RX33 1.2MB half-height diskette drive, an RD32 42MB half-height Winchester disk, disk controller and tape interface, four serial lines, and onboard diagnostics.**
- **A more powerful configuration includes 4MB of memory (upgradable to 6MB), an RD53 71MB full-height Win-**

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CHART D. PRINTERS

MODEL	LA50	LA75	LA100	LA120	LA210	LQP02
Type	Dot-matrix	Dot-matrix	Dot-matrix	Dot-matrix	Dot-matrix	Daisywheel
Speed	50/100 cps	32/42/125/250 cps	40/240 cps; 80 cps opt.	180 cps	40/240 cps; 80 cps opt.	32 cps
Bidirectional printing	Yes	Yes	Yes	Yes	Yes	Yes
Paper size	4.5 to 10 in. wide	4.25 to 10 in. wide	Up to 14.9 in. wide	3 to 15 in. wide	3.5 to 14.9 in. wide	Up to 15 in. wide
Character formation	13 x 9/7 x 9 dot-matrix	36 x 18/36 x 17/24 x 9/12 x 9 dot-matrix	33 x 18/7 x 9 dot-matrix; 33 x 9 opt.	7 x 7 dot-matrix	33 x 18/7 x 9 dot-matrix; 33 x 9 opt.	Full
Horizontal character spacing (char./inch)	10, 12, 16.5 or 5, 6, 8.25	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
Vertical line spacing (lines/inch)	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	Variable	Variable (includes proportional)
Character set	96 ASCII, others	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
Controller/Interface	RS-232-C	RS-423	RS-232-C std.; 20 ma opt.	RS-232-C	RS-232-C std.; Centronics parallel opt.	RS-232-C
No. of printers per controller/ interface	1	1	1	1	1	1
Printer dimensions, in. (h x w x d)	5 x 15.7 x 11.2	4.8 x 16.8 x 13.6	7 x 22 x 16	33.5 x 27.5 x 21.7	5 x 21.5 x 13.5	7 x 25 x 16
Graphics capability, dots per inch	72 x 180	180 x 144	132 x 72	Not applicable	132 x 72	Yes; opt.
Comments		Built-in LA50, LA100, LA210, IBM Proprinter emulation	Keyboard send/ receive terminal		Compatible with IBM PC, PC XT, PC AT	

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

Implemented as a general-purpose multiuser system with technical workstation capabilities, the MicroVAX 2000 competes with low-end models of the IBM RT PC. The MicroVAX 2000 supports up to 4 directly connected users, and up to 16 via an Ethernet interface; 6MB of memory; and 142MB of disk storage. A comparable model of the RT PC—the 6151-15—supports up to 16 users; 8MB of memory; up to 70MB of internal disk storage; and up to 5.6GB of external disk storage. Aside from supporting much more disk storage, the RT PC also has four available expansion slots, while the 2000 has none. A MicroVAX 2000 with 4MB of memory, 71MB of disk storage, and a 95MB magnetic tape drive and a two-to-eight user operating system license is priced at $20,195. A comparably equipped RT PC 6151-15 is priced at $18,650.

The MicroVAX 2000 performs from 0.7 to 1.1 MIPS, while the RT PC 6151-15 performs from 1.5 to 2.1 MIPS. However, a Digital representative claims that comparing the systems on the basis of MIPS ratings is misleading, since the RT PC is RISC based and requires more RISC instructions to do what one MicroVAX instruction does. When Digital compared the performance of popular workstation packages on the two systems, he said the MicroVAX ran the programs twice as fast as the RT PC.

The MicroVAX 2000 has not been introduced into an untapped niche market. The computer market has matured to the point that there are few wide-open frontiers left to explore, and now that IBM is increasing its defenses, Digital will have less opportunity to encroach upon lucrative territory to increase its market shares. Digital must try even harder to win sales in an increasingly competitive and protectionistic market. The company must also become

chester disk drive, disk controller and tape interface, four serial lines, on-board diagnostics, and an expansion adapter box that houses the optional TK50 95MB tape drive and additional disk storage.

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

- **The diskless MicroVAX 2000 for LAVC applications includes 6MB of memory, an Ethernet interface, 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 4 and the MicroVAX II supports 48 directly connected users. Additional users can be 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 to run the application load.

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 TK50 streaming tape drive is a ½-inch cartridge unit that uses CompacTape cartridges, developed by Digital in conjunction with 3M Company; 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 95MB and achieves read/write speed of 75 ips in streaming mode. The TK50 has a peak data transfer rate of 62.5KB per second (45 KB/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 TS05 9-track streaming tape drive is supported on larger, H9642-based MicroVAX II configurations. The

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DEC MicroVAX II and 2000

CHART D. PRINTERS (Continued)

MODEL	LQP03	LN03	LN03 Plus	LG01/LG02	LXY12/22	LPS40
Type	Daisywheel	Laser	Laser	Matrix	Dot-matrix printer/plotter	Laser
Speed	25/34 cps	8 ppm	8 ppm	280/600 lpm	300/600 lpm	40 ppm
Bidirectional printing	—	Not applicable	Not applicable	—	No	Not applicable
Paper size	8.5 x 11 in.	8.5 x 11 in.	8.5 x 11 in.	4-16 in. wide; 3-20 in. long	—	7.5-11 in. wide; 10.5-17 in. long
Character formation	Full	300 x 300 dots/in.	300 x 300 dots/in.	120 x 144/60 x 72 dots/in.	Variable	Electrophotographic
Horizontal character spacing (char./inch)	Variable	Variable	Variable	Variable	Variable	Variable
Vertical line spacing (lines/inch)	Variable (includes proportional)	Variable	Variable	—	—	Variable
Character set	ASCII	ASCII; 16 resident Courier/Elite fonts	ASCII, technical; 17 resident fonts	Multiple	96 ASCII; 192 opt.	29 resident typefaces
Controller/Interface	RS-232-C	RS-232-C	RS-232-C	LP11 or RS-232-C	RS-232-C	—
No. of printers per controller/interface	1	1	1	—	—	—
Printer dimensions, in. (h x w x d)	7.75 x 20.75 x 15.25	15 x 21 x 23.5	15 x 21 x 23.5	38 x 33.5 x 22.3	46.5 x 30 x 24.3	40.4 x 60 x 28.4
Graphics capability, dots per inch	Yes; opt.	Not applicable	300 x 300	LG02 only	Yes	300 x 300
Comments	Prints in landscape and portrait modes	Prints in landscape and portrait modes	Provides bit-mapped, Tektronix 4010/4014-compatible graphics	LG01 text printer upgradable to LG02 text/graphics printer	LXY12 plots at 16.7 in./min., LXY22 at 33.3 in./min.	Ethernet print server subsystem

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

more concerned with fortifying its own product line by leaving no holes through which a competitor could gain entry or win back formerly lost territory.

ADVANTAGES AND RESTRICTIONS

The MicroVAX II and 2000 afford numerous advantages to both first-time and current Digital users. The software compatibility provided under the VMS environment protects users' application investments, allowing MicroVAX II users to move up to VAX 8000 systems as their needs increase, and permitting VAX 8000 users to install smaller departmental systems on which their software can run unchanged. In addition, the choice of MicroVMS and Ultrix-32m operating systems allows users to employ either a traditional realtime system or a timesharing Unix system, depending upon their computing needs.

The MicroVAX II has upgradability advantages for MicroPDP-11 users. Because the two lines of systems use the same BA23, BA123, and H9642 enclosures (the same "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 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 of the RA60 and RA81 disk drives and the TU81-Plus tape—peripherals also employed by the VAX 8000 superminis—allows the transfer of peripherals by users who want to move up to a full-fledged VAX 8000 system.

On the subject of peripherals, Digital needs to develop larger disk drives to keep the MicroVAXs competitive. The

TS05 features a 1600-bpi recording density, speeds of 25/100 ips, and a 40KB/160KB-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 supports the TU81-Plus tape subsystem, which is also employed by Digital's VAXBI-based VAX 8000 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 data from high-speed test equipment. This PE/GCR unit features a 256KB cache buffer, 1600-/6250-bpi recording densities, and a streaming speed of 75 ips.

The CD (Compact Disk) Reader system is a read-only laser disk drive employing a compact, removable 600MB CDROM (Compact Disk Read Only Memory) 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 150KB per second.

The LCG01 color printer is an inkjet color graphics device that provides output on paper and transparencies. It provides print resolution of 154 dots per inch, a print rate of approximately two minutes per copy, and up to 216 shades. Interfaces available for the LCG01 are RS-232-C, RS-422, and 20 ma. The printer supports ReGIS, GIDIS, NAPLPS, and BIT MAP IMAGE (color pixel format) graphics protocols.

The LVP16 color graphics plotter is a desktop, six-pen device that draws on plain paper or transparencies. It is compatible with the HP-GL graphics protocol and prints graphics at 15 inches per second. An RS-232-C interface is standard.

DECtalk, a 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.

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DEC MicroVAX II and 2000

456MB RA81 is the largest drive available for the MicroVAX II; that is overpowered, for example, by the 824MB 9335 DASD offered on IBM's 9373-20, a direct competitor. That drive allows the 9373-20 to handle up to 6.5GB of disk, more than three times that available on the MicroVAX II.

Disk storage limitations are alleviated somewhat when the MicroVAX systems are configured into a Local Area VAXcluster (LAVC) with a larger VAX system acting as the "boot" member. LAVCs interconnect up to 13 MicroVAX systems, allowing each to share centralized software and hardware resources, including the disk storage supported by the larger VAX system.

As stated previously, the MicroVAX 2000's chief advantages—its small size and low price—are also the reasons for its chief restriction: lack of expandability. Based on a busless architecture, the 2000 has no expansion slots, limiting the addition of users and disk storage to the system. Though it can operate as a standalone system, the chief merit of the MicroVAX 2000 is recognized when it is added to an existing LAVC. Adding a single MicroVAX 2000 to an LAVC increases user support capacity by up to 16 users through the system's Ethernet connection. Because it is primarily intended for use as a node within an Ethernet environment, the MicroVAX 2000 is also somewhat limited in its communications capabilities. For instance, the MicroVAX 2000 can function as a DECnet end node but not as a router. Also, according to a Digital representative, the system supports IBM synchronous but not asynchronous communications.

Digital is rather evasive about the MicroVAX 2000's modified SCSI-like expansion port, which is intended for the connection of the expansion box housing additional storage. The company is offering no assurance that the port will support SCSI-compatible peripherals from third-party vendors. This is in keeping with Digital's attempts to make it more difficult for third-party peripheral vendors to remain competitive in the Digital-compatible market. Without the assurance that a third-party disk or tape drive will run on the MicroVAX 2000, customers will be forced to purchase more expensive peripherals from Digital.

However, Digital is making it much easier for third-party software vendors to profit from sales of the MicroVAX systems. This is not surprising, since the larger the existing software base for the system, the more attractive the system is to potential customers. The company has publicized details on third-party software and also instituted the VAX Solution System Program. VAX Solution Systems combine Digital hardware, communications, and service with software from Digital's System Cooperative Marketing Program (SCMP) and Cooperative Marketing Program (CMP) suppliers. The Solution Systems are preconfigured to meet specific workgroup needs, relieving the customer of the responsibility of building a specialized system.

Digital's Volume Software Pricing and VAX Software Portfolio programs are also advantageous. The former allows

COMMUNICATIONS

The MicroVAX II products support the DZQ11 and DHV11 asynchronous interfaces; the DPV11 and DMV11 synchronous interfaces; and the DEQNA Ethernet interface.

The *DZQ11* is a 4-line asynchronous multiplexer that provides local or remote interconnection between MicroVAX II 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 *DHV11* is an 8-line asynchronous, direct memory access (DMA) multiplexer that provides local or remote interconnection between MicroVAX II systems and EIA RS-232-C/CCITT V.28 terminals or other systems. It operates at program- or jumper-selectable speeds up to 38.4K bps full duplex with full modem control on each line.

The *DPV11* is a single-line synchronous interface that provides local or remote interconnection between MicroVAX II 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 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.

The *DEQNA* is an Ethernet synchronous communications controller which connects MicroVAX II and 2000 systems to Ethernet local area networks. It operates at 10M bps and is supported under DECnet Phase IV software. DEQNA allows a system to communicate with up to 1,023 addressable devices on an Ethernet LAN.

Also configurable on the MicroVAX II family is the *H4005 Ethernet Transceiver*, detailed in the "VAX 8000 Systems" report in *Datapro Reports on Minicomputers*.

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 MicroVAX II and 2000 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 controller. The DESTA has one 15-pin connector port that allows it to be mounted in or near the

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multiple-system users to acquire software licenses at substantial bulk discounts; the latter permits users to license aggregations of software products for a good deal less than they would pay if the license for each product were purchased individually.

USER REACTION

Datapro spoke to a MicroVAX II user affiliated with a transportation concern in the Southwest. The user had recently installed an LAVC.

The user said that he had originally purchased the MicroVAX II to replace a VAX-11/780; he found that the MicroVAX II provides as much power for lower acquisition and maintenance costs. The conversion from the VAX-11/780, he said, required absolutely no software changes; he was also able to port some peripherals to the new system from the old one.

He now has several MicroVAX IIs configured in the LAVC, which, he said, provides the functionality of a VAX 8550—a mid-range supermini—for far lower cost. He uses a MicroVAX II configured with two 456MB RA81 disk drives as a boot, or central, node; another node has two more RA81s in case the boot node fails.

When asked if he would recommend the MicroVAX II to a prospective purchaser, this user said that he definitely would. "I can't see anybody in the industry having anything to compete with it," he said, singling out the LAVC as a solid vehicle for system growth: "If you need more power, just add another MicroVAX II." □

Ethernet station and a second port for connection to the ThinWire Ethernet cable. The DESTA contains Ethernet transceiver (IEE 802.3) logic and provides transceiver functionality; it is powered from the controller.

The MicroVAX systems can also participate in LAVCs as either boot or satellite members. Up to 13 MicroVAX family members can be interconnected through ThinWire Ethernet to a central MicroVAX II or other VAX system. The central system manages system software, applications, and a shared common file system. Satellite members function together and share system resources.

SOFTWARE

The MicroVMS operating system is based on the same architecture as VAX/VMS, 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 8000 Systems" report in *Datapro Reports on Minicomputers*. Further details on VAX and MicroVAX software can be found in the *Datapro Directory of Software* and the *Datapro Directory of Microcomputer Software*.

OPERATING SYSTEM: *MicroVMS* is a specially packaged version of the VAX/VMS operating system that runs on Digital's VAX superminis. It is a general-purpose operating system that provides the environment for the concurrent execution of multiuser timesharing, batch, and time-critical applications.

MicroVMS allows an absolute limit of 8,192 concurrent processes. It requires a minimum of 1MB of physical memory. MicroVMS includes routines found in VAX/VMS for backup, copy, rename, delete, and edit functions. Programming aids include macro and object libraries, assembler, debugger, and system programming utilities.

***Ultrix-32m*, based on Berkeley 4.2 BSD Unix with 4.3 BSD enhancements, is an implementation of the Ultrix-32 operating system that runs on VAX superminis. Ultrix-32m uses two command language interfaces: Unix Version 7 Bourne Shell and Berkeley C Shell. The C programming language and additional programming tools are also provided. Ultrix-32m provides kernel configuring capability, allowing the user to add and remove device drivers to match the hardware configuration.**

Ultrix-32m is compatible at the source, object, and executable image levels with Ultrix-32. Source programs written in the C language and containing no architectural dependencies are compatible among Ultrix-32m, Digital's Ultrix-11 (for the PDP-11 family), and AT&T's Unix System V. Ultrix-32m is fully syntax compatible with the Bourne Shell script of Berkeley 4.2 and 4.3 Unix, Ultrix-11, and AT&T Unix System V, as well as with Digital's VAX/VNX products, which provide Unix-like operations for systems running under VAX/VMS. It is also syntax compatible with the C Shell script on Ultrix-32 and Ultrix-11 systems.

***VAXELN*, which is not so much an operating system as a development tool and specialized runtime environment, acts as a compatible subsystem to the MicroVMS 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. On the top layer, the MicroVAX languages and *Forms Management System (FMS)* provide a user interface for interactive and language-callable video forms. On the next level, the *Common Data Dictionary (CDD)* integrates the other components of the architecture. The CDD provides a facility for storing logical data definitions. Also on this level are the *Datatrieve* high-level and distributed data access facilities.

On the lowest level are the two Rdb **relational data base management systems. Rdb/ELN is used in dedicated or distributed VAXELN environments; Rdb/MicroVMS runs on purely MicroVMS-based systems.**

LANGUAGES: Programming languages available for the MicroVAX II and 2000 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 MicroVAX II and 2000 support the Digital Network Architecture (DNA)*, a set of protocols governing the format, control, and sequencing of message exchange for all DECnet**

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implementations. (Further information on DNA is included in the "DEC Digital Network Architecture (DNA) and DECnet" report in *Datarpo Reports on Minicomputers.*)

DECnet-VAX permits suitably configured MicroVMS- and VMS-based systems to participate as routing or end nodes in DECnet computer networks. It offers task-to-task communications, file transfer, downline system and task loading, network command terminals, and network resource-sharing capabilities through DNA protocols. The MicroVAX 2000 can function as an end node but not as a router in a DECnet network.

DECnet-Ultrix is a Phase IV Ethernet-based end-node implementation of the Digital Network Architecture for the Ultrix-32m operating system. It allows communications among Digital systems using DNA protocols, as well as communications, including electronic mail, with non-Digital systems using TCP/IP protocols. It allows data and file transfers between Ultrix- and VMS-based systems, and also permits DECnet and TCP/IP protocols to share system resources.

LAVC software allows the interconnection through Ethernet of up to 13 MicroVAX and VAXstation client systems with a central MicroVAX II or VAX server. The server manages the system software—VMS, DECnet, and Ethernet—in a shared central file system. 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. Through those functions, an LAVC provides the participating computers with the same services available on the high-performance VAXclusters that serve the VAX 8000 and VAX-11 series.

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.

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 or a VAX running RSM server software to perform system management functions for MicroVAX II and MicroVAX 2000 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 8000 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 multivendor interconnect capabilities.

The MicroVAX II and 2000 support Digital's *Internet* products, which provide interconnection of MicroVMS-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 also supports 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 8000 Systems" report in *Datapro Reports on Minicomputers.*

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 MicroVMS operating system and DISOSS and can implement distributed application programs that run between MicroVMS and IBM systems. According to Digital, 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.

VAX/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-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.

APPLICATIONS: A range of applications and special-purpose products is available directly from Digital for the MicroVAX II and 2000. 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 those two office products is contained in *Datapro Reports on Office Automation.*

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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 *DECshell, 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 II and 2000 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 applications packages for VAX systems. The company's External Applications Software (EAS) Library service acquires software from third parties and makes it available through the company'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-based office automation, 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.

OPERATING ENVIRONMENT

The BA123 enclosure of the MicroVAX II measures 24.5 inches high by 13 inches wide by 27.5 inches deep (62.2 by 33 by 70 cm); it is mounted on casters. The BA23 box 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 inches deep (106 by 65.6 by 91.4 cm). Power requirements are 120 VAC, 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.

The Compact MicroVAX II measures 32 inches high by 21.3 inches wide by 33 inches deep (81.3 by 54.1 by 83.8 cm) and weighs 286 pounds (130 kg). Power requirements are 110/120 VAC at 60 Hz, 240/220 VAC 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 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.

SUPPORT SERVICES

DOCUMENTATION: With each MicroVAX II and 2000, the user must order documentation (and installation diagnostics) on TK50 tape or RX50 diskette media. The documentation consists of Owner and Technical Manuals. Documentation Kits are optionally available for selected software packages; the kits include Reference Manuals, User's Guides, and other instructional materials.

TRAINING/EDUCATION: Digital maintains over 25 training centers worldwide. Courses covering both Digital equipment-related and nonproduct-related topics are offered. A variety of instructional methods are 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 MicroVAX II and 2000, as well as all peripherals, are covered by a one-year warranty. Warranty coverage may be extended for up to three years.

MAINTENANCE: Digital's Field Service organization offers both on-site and off-site support services for the MicroVAX II. Standard on-site services include the Basic Service Agreement, the extended DECservice Agreement, and Per Call service. Off-site maintenance is available through Digital's Customer Returns Center, Product Repair Center, and Digital Servicenters, which are all equipped with parts inventories, special diagnostic systems, and repair kits. Details of Digital's service programs and of software support services available are provided in the "Support" section of the "DEC VAX 8000 Systems" report in *Datapro Reports on Minicomputers.*

Two types of integrated service are offered on 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.

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DEC MicroVAX II and 2000

PRICING

POLICY: Digital provides MicroVAX II and 2000 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. Customers ordering Ultrix-32m software receive a 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 evelopment tools, and information management facilities. The extended portfolio adds specialized languages, such as Ada, OPS5, Lisp, VAX Cobol Generator, and VIDA. The runtime-only portfolio—available only for the MicroVAX II—comprises a runtime library for use with applications developed under Digital's ACMS, DBMS, VAX/Rdb, and other data management products.

Prices for MicroVAX II and 2000 hardware and related software are provided in the following list.

EQUIPMENT PRICES

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
MICROVAX II SYSTEM BUILDING BLOCKS (SBBs)				
630QB-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; BA123 enclosure	18,400	163	194
630QE-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; H9642 enclosure	22,700	100	119
630QY-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; BA23 pedestal enclosure	14,800	153	182
630QZ-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; BA23 rack-mount enclosure	14,650	153	182
MICROVAX II SYSTEM PACKAGES				
DH-630Q1-D2(D3)	MicroVAX II CPU/Floating-Point Unit; 2MB of main memory (1MB with CPU and one MS630-AA 1MB memory board); BA23 pedestal enclosure; RD52 31MB Winchester disk; RX50 800KB dual diskette; DEQNA Ethernet controller	23,515	211	251
DH-630Q1-DA	Same as DH-630Q1-D2(D3), but with documentation/diagnostics software kit	23,815	211	251
DH-630Q2-D2(D3)	MicroVAX II CPU/Floating-Point Unit; 2MB of main memory; (1MB with CPU and one MS630-AA 1MB memory board; RQDX3 disk controller; RD53 71MB Winchester disk drive; TK50 95MB cartridge tape drive; DZQ11 4-line multiplexer	26,335	248	295
DH-630Q2-DA	Same as DH-630Q2-D2(D3), but with documentation/diagnostics software kit	26,635	248	295
DH-630Q2-F2(F3)	Same as DH-630Q2-D2(D3), but with 5MB of main memory (1MB with CPU and one MS630-BB 4MB memory board)	21,280	248	295
DH-630Q2-FA	Same as DH-630Q2-F2(F3), but with documentation/diagnostics software kit	21,580	248	295
DH-630Q3-E2(E3)	MicroVAX II CPU/Floating-Point Unit; 5MB of main memory (1MB with CPU and one MS630-BB 4MB memory board); RQDX3 disk controller; RD53 71MB Winchester disk drive; RX50 800KB dual diskette drive; TK50 95MB cartridge tape drive; DHV11 8-line multiplexer	31,650	270	321
DH-630Q3-EA	Same as DH-630Q3-E2(E3), but with documentation/diagnostics software kit	31,950	270	321
DH-630Q3-F2(F3)	Same as DH-630Q3-E2(E3), but excluding RX50 diskette and including DEQNA Ethernet/Q-bus adapter	29,130	277	330
DH-630Q3-FA	Same as DH-630Q3-F2(F3), but with documentation/diagnostics software kit	29,430	277	330
DH-630Q4-E2(E3)	MicroVAX II CPU/Floating-Point Unit; 9MB of main memory (1MB with CPU and two MS630-BB 4MB memory boards); BA123 enclosure; three RD53 71MB Winchester disk drives; TK50 95MB cartridge tape drive; DHV11 8-line multiplexer	44,020	361	430
DH-630Q4-EA	Same as DH-630Q4-EA, but with documentation/diagnostics software kit	44,320	361	430
DH-630Q4-F2(F3)	Same as DH-630Q4-E2(E3), but with one MS630-CA 8MB memory board in place of two MS630-BB; also includes DEQNA Ethernet/Q-bus adapter	42,400	353	420

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DEC MicroVAX II and 2000

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
DH-630Q4-FA	Same as DH-630Q4-F2(F3), but with documentation/diagnostics software kit	42,700	353	435
DH-630Q4-H2(H3)	MicroVAX II CPU/Floating-Point Unit; 9MB of main memory (1MB with CPU and one MS630-CA 8MB memory board); BA123 enclosure; two RD54 159MB Winchester disk drives; TK50 95MB cartridge tape drive; DHV11 8-line multiplexer; DEQNA Ethernet/Q-bus adapter	45,100	365	435
DH-630Q4-HA	Same as DH-630Q4-H2(H3), but with documentation/diagnostics software kit	45,400	3651	435
DH-630Q5-E2(E3)	MicroVAX II CPU/Floating-Point Unit; 9MB of main memory (1MB with CPU and two MS630-BB memory boards); two BA23 enclosures and H9642 cabinet; KDA50 disk controller; TK50 95MB cartridge tape drive; DHV11 8-line multiplexer; DEQNA Ethernet/Q-bus adapter; requires RA60 or RA81 disk	44,205	279	332
DH-630Q5-EA	Same as DH-630Q5-E2(E3), but with documentation/diagnostics software kit	44,505	279	332
DH-630Q5-F2(F3)	MicroVAX II CPU/Floating-Point Unit; 16MB of main memory (1MB with CPU and two MS630-CA 8MB memory boards); H9642 cabinet; KDA50 disk controller; TK50 95MB cartridge tape drive; DHV11 8-line multiplexer; DEQNA Ethernet/Q-bus adapter; requires RA60 or RA81 disk	42,205	279	332
DH-630Q5-FA	Same as DH-630Q5-F2(F3), but with documentation/diagnostics software kit	42,505	279	332
—	Local Area VAXcluster configuration; includes MicroVAX II CPU/FPU, 5MB of main memory, RD53 71MB disk (for local paging and swapping), and DEQNA Ethernet interface	19,900	—	—
DJ-630P1-AA	Diskless compute server for Local Area VAXcluster; includes MicroVAX II CPU/FPU, 16MB of main memory, and DEQNA Ethernet interface	24,400	168	200
DJ-630P5-AA	Fully configured Local Area VAXcluster system; includes MicroVAX II CPU/FPU, 16MB of main memory, RA81 456MB disk, TU81-Plus tape drive, and MicroVMS, DECnet, and Local Area VAXcluster software licenses	94,855	514	612
MICROVAX 2000				
DH-625N1-A2	MicroVAX 2000 CPU/Floating-Point Unit; 4MB of main memory; RD32 42MB Winchester drive; RX33 1.2MB diskette drive; one-year hardware and software warranty	9,000	*128	**156
DH-625N1-AA(A3)	Same as DH-625N1-A2 but with documentation	9,100	*128	**156
DH-625N2-A2	Same as DH-625N1-A2 but with 6MB of memory	11,000	*128	**156
DH-625N2-AA(A3)	Same as DH-625N1-A2 but with 6MB of memory and documentation	11,100	*128	**156
DH-625N3-A2	MicroVAX 2000 CPU/Floating-Point Unit; 4MB of memory; RD53 71MB Winchester disk; BA40A expansion adapter; one-year hardware/software warranty	11,600	*154	**188
DH-625N3-AA(A3)	Same as DH-625N3-A2 but includes documentation	11,700	*154	**188
DH-625N4-A2	Same as DH-625N3-A2 but with 6MB of memory	13,600	*154	**188
DH-625N4-AA(A3)	Same as DH-625N3-A2 but with 6MB of memory and documentation	13,700	*154	**188
SV-PXXGA-EK(FN)	MicroVAX 2000 CPU/Floating-Point Unit; 6MB of memory; ThinWire Ethernet interface; MicroVMS 4-user license; DECnet end-node and LAVC licenses; documentation	12,900	*115	**140
VAXLAB				
LABVX-AB(AC)	VAXlab/STD; MicroVAX II-based configuration in BA123 enclosure	40,905	306	364
LABVX-DA(DB)	VAXlab/RM; MicroVAX II-based configuration in BA23 rackmount enclosure	34,940	280	333
VAXLAB REALTIME OPTIONS				
ADV11-DA	50KHz, DMA 16-channel, 12-bit resolution analog-to-digital converter	1,995	40	48
AAV11-DA	300KHz, DMA 2-channel, 12-bit resolution digital-to-analog converter	1,995	54	45
AXV11-C	25KHz, 16-channel, analog-to-digital converter with 2-channel digital-to-analog; 12 bits	1,295	32	38
KWV11-C	Programmable realtime clock, 16-bit counter, two Schmitt triggers	895	25	30
DRV11-J	64-bit user-configurable parallel digital interface	490	9	11
DRV11-WA	DMA 16-bit input/output parallel digital interface	990	9	11
MEMORY				
MS630-AA	1MB memory increment	360	18	21
MS630-BA	2MB memory increment	1,500	36	43
MS630-BB	4MB memory increment	1,350	72	86
MS630-CA	8MB parity memory increment	2,650	64	76

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DEC MicroVAX II and 2000

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
MASS STORAGE				
RQDX3-AA/BA	RQDX3 controller for RD53 disk; for BA23(AA) or BA123(BA) enclosure; cables and distribution panel (for Model BA) included	2,040	16	19
RQDX3-M	Q-bus controller without cables; for use when replacing existing RQDX2 controllers (cables can be reused)	1,990	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	250	NA	NA
RQDXE-FA	Dual-height disk drive bus extender for use with RQDX2 or RQDX3 controller and disk in BA23-CC expander enclosure	250	NA	NA
RX33-A	1.2MB diskette drive	750	8	10
RX50A-AA/BA	RX50 800KB dual diskette drive with cables for BA23(AA) or BA123(BA) enclosure	1,000	8	10
RX50-AA	RX50 800KB dual diskette drive	1,000	8	10
RX50-D	RX50 800KB dual diskette drive mounted in desktop enclosure with I/O cable	1,800	20	24
RX50-R	RX50 800KB dual diskette drive for mounting in 19-inch standard equipment rack	1,800	20	24
RD32-A	42MB Winchester disk drive	2,300	20	24
RD53-A	RD53 71MB, 5¼-in. Winchester disk drive	3,800	38	45
RD53A-AA/BA	RD53 71MB drive with cables for BA23(AA) or BA123(BA) enclosure	3,800	19	23
RD53-DA/DB	RD53 71MB drive mounted in desktop enclosure with I/O cables	4,400	38	45
RD53-EA	71MB Winchester disk drive for MicroVAX 2000	3,800	38	45
RD53-FA/F3	71MB Winchester disk in expansion box for MicroVAX 2000	5,050	38	45
RD53-RA/RB	RD53 71MB drive in 19-inch standard equipment rack; requires H9302 enclosure	4,650	38	45
RD54-DA/DB/RA/RB	RD54 159MB Winchester disk drive	7,900	63	75
KDA50-QA	Q-bus controller for RA series disk drives	6,500	50	60
RA60-AF	RA60 205MB, 14-in. removable disk; requires 6-ft. cable	18,500	105	125
RQA60-AA/AD	RA60 205MB removable disk drive with KDA50 controller	23,000	155	185
RA60-CA/CD	RA60 205MB removable disk drive in H9642 cabinet	21,400	105	125
RQA60-CA/CD	RA60-CA/CD with KDA50 controller	25,500	155	185
RA81-HA/HD	RA81 456MB, 14-in. rack-mountable Winchester disk drive; requires cable, controller, and cabinet	15,640	95	113
RA81-EA/ED	Three RA81 456MB disk drives mounted in H9642 cabinet; requires KDA50 controller	50,000	284	338
RQA81-AA/AD	RA81 456MB rack-mountable disk drive with KDA50 controller; requires cabinet	22,500	145	173
OPTICAL DISK				
RRD50-QA	600MB Compact Disk Read-Only Memory (CD-ROM) disk drive with MicroVAX II and VAXstation controller	1,200	28	33
RRD50-QC	CD-ROM drive with Q-bus control kit	1,105	28	33
RRD50-A2/A3	600MB CD-ROM add-on disk drive; requires RRD50-QA or QC	1,000	24	29
RRD50-EA	600MB CD-ROM disk drive with controller for IBM PC-compatible products	1,200	28	33
RRD50-EB	600MB CD-ROM disk drive with controller for VAXmate	1,105	24	29
MAGNETIC TAPE				
TQK50-AA	TK50 controller with cables for BA23 enclosure	1,100	8	10
TQK50-AB	Q22 controller for TK50-D/R in BA23 enclosure	1,100	8	10
TQK50-BA	TK50 controller with cables for BA123 enclosure	1,100	8	10
TQK50-BB	Q22 controller for TK50-D/R in BA123 enclosure	1,100	8	10
TK50-AA	TK50 95MB cartridge streaming tape drive	2,800	22	26
TK50-DA/DB	TK50 desktop tape drive	3,400	22	26
TK50-RA/RB	TK50 rackmount tape drive	3,400	22	26
TK50Z-FA/F3	TK50 in expansion box for MicroVAX 2000	4,495	30	36
BA40A-AA	Expansion Adapter for MicroVAX 2000	1,200	NA	NA
TSV05-ZA/ZB	Q-bus TS05 magnetic tape sysem with hardware for rackmounting, control module, cables, and top access cover	9,995	89	106
TU81E-DA(DD)	TU81-Plus 1600/6250 bpi GCR tape drive	27,300	140	167
PRINTERS				
LA50-RA	LA50 50-/100-cps dot matrix tabletop printer with push tractor feed and 110 VAC power supply	795	8	10
LA50-RB/RC	Same as LA50-RA, but with 220 VAC (Model RB) or 240 VAC (Model RC) power supply	715	8	10
LA120-DA	LA120 180-cps dot matrix printer; for 1-to-6 part forms	2,900	34	40
LA210-AA	LA210 40-/80-/240-cps dot matrix printer	1,595	28	33
LA21X-BT	Bidirectional tractor for LA210	245	NA	NA
LA21X-SF	Single-tray sheet feeder for LA210	595	NA	NA

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DEC MicroVAX II and 2000

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
LQP02-AA(AD)	LQP02 32-cps daisywheel printer with Courier-10 font	2,800	37	44
LQPX2-AA	Bidirectional forms tractor for LQP02	250	NC	NC
LQPX2-SF	Dual-tray cut-sheet feeder with envelope tray for LQP02	1,800	19	23
LQP03-A	LQP03 25-/34-cps daisywheel printer with 130-character wheel and power cord	1,395	23	27
LQPX3-FT	Bidirectional forms tractor for LQP03	245	NC	NC
LQPX3-SF	Single-tray sheet feeder for LQP03	695	8	10
LG01-BA	Q-bus text printer; requires cabinet kit	12,900	127	151
LG02-BA	Q-bus text and graphics printer; requires cabinet kit	15,900	127	151
LG01-UG	Upgrade kit to convert LG01 text printer to LG02 text and graphics printer	3,500	NA	NA
LXY12-DA/DB	300-lpm dot matrix printer/plotter; includes RS-232-C interface cable, pedestal with basket, and paper guide	12,700	104	124
LXY22-DA/DB	600-lpm dot matrix printer/plotter; same components as LXY12-DA/DB	17,700	135	161
LCG01-AA	LCG01 ink jet color printer with graphics processor	15,900	125	149
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	3,495	49	58
LN03S-AA	LN03 Plus 8-ppm desktop graphics laser printer; includes 1MB RAM, Modern Gothic typeface, two toner cartridges, organic photoreceptor cartridge, AC power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation	4,995	56	67
LN03S-UA	Graphics board to upgrade LN03 to LN03 Plus	1,595	7	8
LPS40-AA	Print Server 40, 40-ppm Ethernet printer with power cord	47,900	775	923
LVP16-AA	Graphics pen plotter with documentation and supplier	2,095	10	12
WORKSTATIONS/TERMINALS				
VT220-D2(D3)	VT220 terminal with white phosphor nonglare screen; with VT22K-AA data processing or VT22K-BA word processing keyboard	580	12	14
VT220-E2(E3)	Same as VT220-A2(A3), but with green screen	580	12	14
VT220-F2(F3)	Same as VT220-A2(A3), but with amber screen	580	12	14
VT22X-AA	Integral 300/1200 baud modem for VT220	395	6	7
VT240-A2(A3)	VT240 terminal with white phosphor nonglare screen	1,980	19	23
VT240-B2(B3)	VT240 with green screen	1,980	19	23
VT240-C2(C3)	VT240 with amber screen	1,980	19	23
VT241-AA	VT241 color terminal	2,980	26	31
VT24K-AA	VT240/241 data processing country kit/keyboard	215	NC	NC
VT24K-BA	VT240/241 word processing country kit/keyboard	215	NC	NC
VT24X-AA	Integral modem for VT240/241	495	6	7
VT330-AA/A2	Graphics video terminal without keyboard	1,695	19	23
VT330-B2/C2	Graphics video terminal with USA keyboard	1,895	19	23
VT340-A3	Color graphics terminal without keyboard	2,595	26	31
VT340-AA	Color graphics terminal with USA keyboard	2,795	26	31
LA100-BA	LA100 30-/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	2,395	27	32
LA100-BB	Same as LA100-BA, but with Courier-10 font, international overlay, and VT100 line drawing set	2,395	27	32
LA100-CA	LA100 with keyboard, tractors, cable, ribbon cartridge, package of paper, Courier-10/Orator-10 fonts, and multiple font option	2,495	27	32
LA100-CB	Same as LA100-CA, but with Courier-10 font, international overlay, and VT100 line drawing set	2,495	27	32
LA120-DA	LA120 180-cps keyboard send/receive terminal for use with 1-to-6 part forms	2,900	34	40
VOICE SYNTHESIS MODULE				
DTC01-AA	Single-line DECtalk text-to-speech unit; includes cables	4,000	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				
DHV11-M	DHV11 eight-line asynchronous DMA multiplexer; requires cable	1,520	15	18
DZQ11-M	DZQ11 four-line asynchronous multiplexer; requires cable	760	11	13
DPV11-M	DPV11 single-line synchronous interface; requires cable	719	14	17
DMV11-M	DMV11 single-line synchronous interface; requires cable	2,125	41	49
DMV11-N	Integral modem interface	1,800	41	49
H4005	Ethernet/IEEE 802.3 transceiver	300	4	5
DESTA-AA	ThinWire Ethernet station adapter	275	4	5
DSRVB-AA	8-line DECserver 200	3,625	28	33
DSRVA-AA	8-line DECserver 100	3,537	30	36
DEQNA-M	DEQNA Ethernet-to-Q-bus high-performance synchronous communications controller; requires cable	2,500	15	18

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SOFTWARE PRICES

		License Fee ($)
OPERATING SYSTEM		
QZ001-CZ	MicroVMS 2-user license for MicroVAX II	2,000
Q3001-C3	MicroVMS 4-user license on RX50 media for MicroVAX 2000	2,000
Q3001-C5	MicroVMS 4-user license on TK50 media for MicroVAX 2000	2,000
QZ002-C3	MicroVMS 8-user license and key on RX50 media for MicroVAX II	6,000
Q3002-C3	MicroVMS 8-user license and key on RX50 media for MicroVAX 2000	4,000
Q3002-C5	MicroVMS 8-user license and key on TK50 media for MicroVAX 2000	4,000
QZ002-C5	MicroVMS 8-user license and key on TK50 media for MicroVAX II	6,000
QZ003-C3	MicroVMS 16-user license and key on RX50 media for MicroVAX II	13,000
Q3003-C3	MicroVMS 16-user license and key on RX50 media for MicroVAX 2000	6,000
QZ003-C5	MicroVMS 16-user license and key on TK50 media for MicroVAX II	13,000
Q3003-C5	MicroVMS 16-user license and key on TK50 media for MicroVAX 2000	6,000
QZ004-C3	MicroVMS unlimited-user license and key on RX50 media for MicroVAX II	18,000
QZ004-C5	MicroVMS unlimited-user license and key on TK50 media for MicroVAX II	18,000
QZ376-DZ	VAXELN runtime license only, for MicroVAX II	18,000
QZ832-UZ	Ultrix-32m 2-user license for MicroVAX II	1,000
QZ833-UZ	Ultrix-32m 8-user license for MicroVAX II	2,000
QZ837-UZ	Ultrix-32m 16-user license for MicroVAX II	3,000
QZAAF-UZ	Ultrix-32m 32-user license for MicroVAX II	4,000
COMMUNICATIONS		
QZD04-UZ	DECnet end-node license for MicroVAX II	1,010
Q3D04-UZ	DECnet end-node license for MicroVAX 2000	680
QZD05-UZ	DECnet full license for MicroVAX 2000	2,535
Q3D05-UZ	DECnet full license for MicroVAX II	1,710
QZD09-UZ	DECnet end node to full license upgrade for MicroVAX II	1,525
Q3D09-UZ	DECnet end node to full license upgrade for MicroVAX 2000	1,235
QZ363-UZ	DECnet/SNA 3270 for MicroVAX II	1,500
Q3363-UZ	DECnet/SNA 3270 for MicroVAX 2000	750
QZ455-UZ	DECnet/SNA Application Programming Interface (API) for MicroVAX II	1,200
Q3455-UZ	DECnet/SNA Application Programming Interface (API) for MicroVAX 2000	600
QZ022-UZ	DECnet/SNA Advanced Program-to-Program Communications (APPC) for MicroVAX II	1,500
Q3022-UZ	DECnet/SNA Application Programming Interface (API) for MicroVAX 2000	900
QZ454-UZ	DECnet/SNA Terminal Emulator (TE) for MicroVAX II	600
Q3454-UZ	DECnet/SNA Terminal Emulator (TE) for MicroVAX 2000	300
QZ453-UZ	DECnet/SNA RJE for MicroVAX II	600
Q3454-UZ	DECnet/SNA RJE for MicroVAX 2000	300
QZ452-UZ	DECnet/SNA Gateway Management for MicroVAX II	300
Q3452-UZ	DECnet/SNA Gateway Management for MicroVAX 2000	150
QZ042-UZ	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for MicroVAX II	900
QZ044-UZ	DECnet/SNA Printer Emulator (PrE) for MicroVAX II	600
Q3042-UZ	DECnet/SNA Gateway Management for MicroVAX 2000	450
Q3044-UZ	DECnet/SNA Gateway Management for MicroVAX 2000	300
QZ111-UZ	DECnet/SNA 2780/3780 Protocol Emulator for MicroVAX II	2,900
QZ112-UZ	DECnet/SNA 3271 Protocol Emulator for MicroVAX II	2,900
Q3B12-UZ	DECnet/SNA VAX VIDA for MicroVAX 2000	5,250
QZ362-UZ	VMS/SNA for MicroVAX II	1,125
QZB12-UZ	VAX VIDA for MicroVAX II	10,500
Q3ZCE-UZ	Local Area VAXcluster for MicroVAX 2000	650
QZZCE-UZ	Local Area VAXcluster for MicroVAX II	1,900
DATA BASE MANAGEMENT		
QZ898-UZ	Datatrieve for MicroVAX II	4,920
Q3898-UZ	Datatrieve for MicroVAX 2000	2,460
QZ897-UZ	Common Data Dictionary (CDD) for MicroVAX II	1,365
Q3897-UZ	Common Data Dictionary (CDD) for MicroVAX 2000	683
QZ800-UZ	Forms Management System (FMS) for MicroVAX II	2,480
Q3800-UZ	Forms Management System (FMS) for MicroVAX 2000	1,239
QZD07-UZ	Rdb/ELN Development License for MicroVAX II	4,500
Q3D07-UZ	Rdb/ELN Development License for MicroVAX 2000	2,250
QZD08-UZ	Rdb/ELN Run Time Option (RTO) for MicroVAX II	750
QZ354-UZ	Rdb/MicroVMS for MicroVAX II	7,080
Q3354-UZ	Rdb/Micro VMS for MicroVAX 2000	3,540
QZ357-UZ	Rdb/MicroVMS Remote for MicroVAX II	819
Q3357-UZ	Rdb/MicroVMS Remote for MicroVAX 2000	410
Q3358-UZ	Rdb/MicroVMS Run Time Option (RTO) for MicroVAX 2000	1,365
QZ358-UZ	Rdb/MicroVMS Run Time Option (RTO) for MicroVAX II	2,730

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LANGUAGES

		License Fee ($)
QZ018-UZ	Dibol for MicroVAX II	2,490
Q3018-UZ	Dibol for MicroVAX 2000	1,245
QZ130-UZ	DSM (Digital Standard Mumps) for MicroVAX II	5,400
Q3130-UZ	DSM (Digital Standard Mumps) for MicroVAX 2000	2,700
QZ100-UZ	Fortran for MicroVAX II	3,100
Q3100-UZ	Fortran for MicroVAX 2000	1,551
QZ917-UZ	Lisp for MicroVAX II	4,800
Q3917-UZ	Lisp for MicroVAX 2000	2,400
QZ126-UZ	Pascal for MicroVAX II	2,835
Q32126-UZ	Pascal for MicroVAX 2000	1,418
QZ114-UZ	PL/1 for MicroVAX II	4,780
Q3114-UZ	PL/1 for MicroVAX 2000	2,391
QZ631-UZ	RPG II for MicroVAX II	1,890
Q363I-UZ	RPG II for MicroVAX 2000	945
QZ056-UZ	Ada for MicroVAX II	14,940
Q3056-UZ	Ada for MicroVAX 2000	7,470
QZ020-UZ	APL for MicroVAX II	4,780
Q3020-UZ	APL for MicroVAX 2000	2,391
QZ095-UZ	Basic for MicroVAX II	3,180
Q3095-UZ	Basic for MicroVAX 2000	1,590
QZ106-UZ	Bliss-32 for MicroVAX II	3,465
Q3106-UZ	Bliss-32 for MicroVAX 2000	1,372
QZ015-UZ	C for MicroVAX II	2,835
Q3015-UZ	C for MicroVAX 2000	1,418
QZ099-UZ	Cobol for MicroVAX II	4,780
Q3099-UZ	Cobol for MicroVAX 2000	2,391
QZ913-UZ	OPS5 for MicroVAX II	3,000
Q3913-UZ	OPS5 for MicroVAX 2000	2,250

UTILITIES AND TOOLS

QZ425-UZ	Application Development Environment (ADE) for MicroVAX II	1,620
Q3425-UZ	Application Development Environment (ADE) for MicroVAX 2000	810
QZ451-UZ	DECor for MicroVAX II	3,600
Q3451-UZ	DECor for MicroVAX 2000	1,800
QZ310-UZ	DECalc for MicroVAX II	1,400
Q3310-UZ	DECalc for MicroVAX 2000	1,020
QZ360-UZ	DECgraph for MicroVAX II	1,500
Q3360-UZ	DECgraph for MicroVAX 2000	750
QZ361-UZ	DECslide for MicroVAX II	1,500
Q3361-UZ	DECslide for MicroVAX 2000	750
QZ038-UZ	DECtype for MicroVAX II	1,200
Q3038-UZ	DECtype for MicroVAX 2000	600
QZ007-UZ	DEC/CMS (Code Management System) for MicroVAX II	5,205
Q3007-UZ	DEC/CMS (Code Management System) for MicroVAX 2000	2,602
QZ500-UZ	DEC/MMS (Module Management System) for MicroVAX II	1,260
Q3500-UZ	DEC/MMS (Module Management System) for MicroVAX 2000	630
QZ143-UZ	DECshell for MicroVAX II	2,850
Q3143-UZ	DECshell for MicroVAX 2000	1,425
QZ810-UZ	GKS/Ob for MicroVAX II	3,600
Q3810-UZ	GKS/Ob for MicroVAX 2000	1,800
QZ706-UZ	TDMS for MicroVAX II	2,478
Q3706-UZ	TDMS for MicroVAX 2000	1,239
QZ375-UZ	VAXELN Toolkit for MicroVAX II	4,000
Q3375-UZ	VAXELN Toolkit for MicroVAX 2000	2,000
QZ382-UZ	VAX-11 RSX for MicroVAX II	2,400
Q3382-UZ	VAX-11 RSX for MicroVAX 2000	1,200 ■

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