

DEC MicroVAX Family

MANAGEMENT SUMMARY

UPDATE: Since the last update of this report, Digital Equipment Corporation has added the MicroVAX 3500 and 3600 to the MicroVAX product line, narrowing the price/performance gap between the MicroVAX II and VAX 8000 product line.

In a full display of technical acumen and networking know-how, not to mention marketing pizzazz, Digital Equipment took over the city of Boston for 10 days in September to host its product showcase, DECworld. Only if he or she were an invited attendee to the show, or a Digital employee, could a visitor to Boston get a room. Those who got rooms, surely were citizens of DECworld and were about to become captive in a networked environment. Digital seemed to be everywhere—exactly the image that the company wanted to portray.

The DECworld extravaganza, hailed as the most lavish trade show ever hosted by a computer vendor, marked a turning point in Digital's marketing strategy. Formerly ➤



The MicroVAX 3500 and 3600 are Digital Equipment Corporation's direct competitive response to IBM's attempt to regain its mid-range systems market share with its 9370. Pictured here, the MicroVAX 3600 is suitable for workgroup, departmental, and small organizational computing in both office and factory environments.

The MicroVAX multiuser supermicrocomputers are designed for use as departmental systems in distributed, networked computing environments for a range of commercial and technical applications. The systems are software compatible with Digital Equipment Corporation's line of VAX 8000 superminis.

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

MEMORY: 2MB to 32MB.

DISK CAPACITY: 31MB to 2.5GB.

WORKSTATIONS: Up to 64.

PRICE: \$7,450 to \$169,500 (base configuration prices).

CHARACTERISTICS

VENDOR: Digital Equipment Corporation, 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 for the MicroVAX 2000 and II is dynamic parity MOS RAM. Main memory cycle time is 400 nanoseconds. Main memory increments are 2M bytes, 4M bytes, and 8M bytes on the MicroVAX II and 2M bytes on the MicroVAX 2000.

The MicroVAX 3500 and 3600 each support a total of four 8M-byte memory modules which use 256K-bit ZIP DRAM-based ECC memory.

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

PROCESSING COMPONENTS

The MicroVAX 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 which 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 3500 and 3600 CPU features a cycle time of 90 nanoseconds. ➤

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CHART A. SYSTEM COMPARISON

MODEL	MicroVAX II	MicroVAX 2000	MicroVAX 3500	MicroVAX 3600
SYSTEM CHARACTERISTICS				
Date of introduction	May 1985	February 1987	September 1987	September 1987
Date of first delivery	June 1985	—	—	—
Microprocessor type	MicroVAX 78032	MicroVAX 78032	CVAX 78034	CVAX 78034
Microprocessor cycle time	200 ns	200 ns	90 ns	90 ns
Operating system	MicroVMS, ULTRIX-32m	MicroVMS, ULTRIX-32m	MicroVMS, ULTRIX-32m	MicroVMS, ULTRIX-32m
Upgradable from	MicroVAX I, MicroPDP-11	Not applicable	Not applicable	Not applicable
Upgradable to	Not applicable	Not applicable	Not applicable	Not applicable
Number of serial/parallel I/O ports	Up to 49 serial	4	40 serial w/modem control, 80 without	40 serial w/modem control, 80 without
Number of expansion slots	7 (BA23); 11 (BA123); 13 (H9642)	0	4	4
MEMORY				
Minimum capacity (bytes)	2M	4M	16M	32M
Maximum capacity (bytes)	16M	6M	32M	32M
DISK STORAGE				
Minimum capacity (bytes)	31M	0 or 42M	280M	622M
Maximum capacity (bytes)	1.8G	142M	560M	2.5G
NUMBER OF WORKSTATIONS	Up to 48	Up to 4	40 to 60	40 to 60
COMMUNICATIONS PROTOCOLS				
	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; 3271; TCP/IP; LU6.2; X.400	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; TCP/IP	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; 3271; TCP/IP; LU6.2; X.400	DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; 3271; TCP/IP; LU6.2; X.400

▷ perceived as a rather straightforward, even straightlaced, supplier of computer systems for engineering and scientific environments, Digital's marketing approach centered around the nuts and bolts of system technology. Now that Digital successfully entered the commercial marketplace, however, and strives to increase its presence there, the company suddenly presents a much more upscale image, complete with the marketing gloss and glitz that impress customers more than technical specifications. It is the kind of marketing that is widely practiced in, and better attuned to, the commercial marketplace. IBM, after all, has been doing it for years. The emphasis is on projecting an image rather than providing information. It's a marketing approach that tries to build customer loyalty. Digital's motto "DEC has it now" could use the addendum "... trust us."

It was in the DECworld limelight that Digital introduced the MicroVAX 3500 and 3600, filling the price/performance gap that has existed between the MicroVAX II and the VAX 8250—the entry-level system in Digital's VAX 8000 line of superminis. According to Digital, performance ratings derived from a variety of benchmark tests (including Linpack, Whetstones, and Drystones) indicate that the 3500 and 3600 systems' CMOS-based CPUs boast processing speeds from 2.6 to 4.2 times faster than those delivered by the MicroVAX II. The systems currently support up to 32 megabytes of memory, twice the amount of memory supported by the MicroVAX II. However, addressable memory on the 3500 and 3600 is 64 megabytes, four times that of the MicroVAX II. Memory boards based on 1-megabit chips are promised, enabling the newer systems to fully use the total addressable memory.

▶ The 3500 and 3600 are reported to feature processing speeds 2.6 to 4.2 times faster than those of the MicroVAX II, for a range of 1.8 to 4.6 MIPS and an average speed of 3.2 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.

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.

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 the MicroVAX II.

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

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▷ The MicroVAX 3500 is suitable for small departments or workgroup environments. The MicroVAX 3600, with its higher disk storage capacity, is suitable as a departmental server.

Because both the MicroVAX 3500 and 3600 are packaged in ruggedized system enclosures, factory floor installation is practical. The ruggedized packaging represents Digital's attempt to make inroads into the manufacturing market, where the company wants to establish more of a presence. The system packaging allows Digital to sell a mainstream system directly into the factory, rather than maintain a separate line of ruggedized MicroVAXs, as it has in the past.

The introduction of the MicroVAX 3500 and 3600 shifts Digital's marketing emphasis away from the MicroVAX II, the industry's leading supermicrocomputer and a mainstay in the Digital product line. Though it is still a popular system, price increases on the MicroVAX II during the past year serve to redirect the focus toward the company's newer systems. In March 1987, one month after the MicroVAX 2000 was announced and at the same time that the VAX 8250, 8350, and 8530 were announced, Digital increased prices on MicroVAX II System Building Blocks (SBBs) and on the MicroVMS operating system licenses. Price increases were most dramatic (up to 40 percent) on large MicroVAX II configurations, narrowing the price/[dh]performance gap between the MicroVAX and the VAX 8000 product lines, and attracting customers to the new low-end VAX 8000 systems. One month before the introduction of the 3500 and 3600, the same pricing strategy was used—prices were raised by 5 percent on all MicroVAX II configurations and MicroVMS operating system licenses for the MicroVAX II, obviously to steer users to the newer machines. (Because MicroVMS is so similar to the VMS operating system used on the VAX 8000s, and to stress the continuity between the product lines, Digital now refers to MicroVMS as VMS.)

The four-digit nomenclature for the newer MicroVAX systems—the MicroVAX 2000, 3500, and 3600—echoing the title of the VAX 8000 line, also indicates that Digital plans to phase out the MicroVAX II. Having been on the market for nearly two and one half years, sales of the MicroVAX II are likely to flatten out (the normal product life cycle for a system of this size is about two years). Digital will surely replace the system with a number of systems that have various processing speeds and mass storage capacities.

Now that the Digital product line constitutes a continuous range of processing capacity, the company must begin replacing its older systems with upgraded versions, to assure customers that it is keeping pace with technology and always has something new to offer. This strategy will keep Digital in the limelight and support the company's image as an active and vibrant contender in the marketplace.

▶ The MicroVAXs feature a 304-instruction set, similar to but differently implemented than 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 3500 and 3600 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 and performs block-mode DMA data transfers on a bandwidth of up to 3M bytes 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 3500, available in the B213 enclosure, includes 16M bytes of main memory (expandable to 32M bytes), a 280M-byte RA70 disk drive, a 296M-byte TK70 cartridge tape drive, an Ethernet controller, operating system software (a 1-to-20 user VMS license or unlimited-user ULTRIX-32m license), a DECnet End-Node or full-function license, and VMS Services for MS-DOS license (with VMS operating system only). One additional RA70 disk drive can be configured on the MicroVAX 3500.

The MicroVAX 3600 is available in a cabinet enclosure and includes 32M bytes of main memory, a 622M-byte RA82 disk drive, a 296M-byte TK70 cartridge tape drive, an Ethernet controller, operating system software (a 1-to-20 user VMS license or unlimited-user ULTRIX-32m license), a DECnet E/DECne or full-function license, and VMS Services for MS-DOS license (with VMS operating system only).

The MicroVAX 3600 Expanded Cabinet System is similar to the standard MicroVAX 3600 configuration, but also includes an additional RA82 disk drive and a TU81-Plus tape drive. The VMS license on the expanded system is for 1 to 40 users. The MicroVAX 3600 supports up to four RA82 disk drives.

The MicroVAX 3500 and 3600 B213 system enclosure backplane supports only quad-height boards, which are wider than the dual-height boards supported by the MicroVAX II backplane. All dual-height boards previously supported by the MicroVAX II are available in quad-height versions for use on the 3500 and 3600; however, not all quad-height boards supported by the 3500 and 3600 are available in dual-height versions for use on the MicroVAX II.

▶ The MicroVAX II comes in a choice of four enclosures: the BA23, a pedestal or rackmount box with 8 module slots ▶

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CHART B. DISK/DISKETTE DEVICES

MODEL	RX33	RX50	RD32	RD52	RD53
Type	Diskette	Dual Diskette	Winchester	Winchester	Winchester
Size (inches)	5.25	5.25 per diskette	5.25	5.25	5.25
Number of surfaces	2	1 per diskette	—	—	—
Formatted capacity per drive (bytes)	1.2M	818K (409K per diskette)	42.8M	31M	71M
Interface/controller	—	RQDX3	ST412/506	RQDX3	RQDX3
Number of drives per interface/controller	—	—	—	—	—
Average access time	—	264 ms	48.3 ms	57.5 ms	38.3 ms
Data transfer rate	500K bps	250K bps	5M bps	625KB/sec	625KB/sec
Sectors/tracks per surface	160	80 tracks/diskette	—	—	—
Bytes per sector/track	512/sector	512/sector	512/sector	512/sector	512/sector

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

➤ All the MicroVAX systems are marketed primarily for departmental applications to be networked as servers or nodes into a corporation-wide computing environment. The systems are also suitable as standalone systems, single-system sales to smaller business have been turned over to Digital's authorized distributors; but they are not the primary marketing focus of Digital's direct sales force.

Digital continues to pursue systems sales to its traditional scientific and engineering markets, such as computer-aided design and manufacturing (CAD/CAM), laboratory research, and process control and factory automation. The company is also marketing the systems for commercial applications like office automation, educational computing, electronic publishing, and general-purpose computing.

Digital's newest targets include the financial industry, and the company can be expected to market stronger online transaction processing (OLTP) products in the next few years. According to a Digital representative, the company plans to enhance the VMS operating systems with transaction processing features such as specialized scheduling. Specialized OLTP systems offerings will include multiprocessor implementations that ensure high availability of system resources. Digital acknowledges that terminal subsystems optimized for transaction processing and faster disk drives are also required if the company is to compete effectively in the OLTP marketplace.

COMPETITIVE POSITION

It is widely understood that IBM plays Goliath to Digital's David. It is sound technology and strategic marketing, rather than size, that has made Digital successful at winning away mid-range systems market share from IBM. As Digital has solidified its position within the mid-range systems market with the MicroVAX, VAX-11, and VAX 8000 product lines, as well as strong connectivity and communications products, the company has also reshaped its practice of coexistence with IBM into one of direct competition in traditional IBM commercial markets. IBM's defensive response to protect its midsection was to announce the 9370—a directed effort to close the gaps in its product line, which had 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

➤ and 2 slots dedicated for 5/4-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 12 basic Standard System packages:

- An Ethernet-node single-user configuration. This system includes 2M bytes of main memory, a single serial line unit, a 31M-byte RD52 Winchester disk subsystem, an 800K-byte 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.
- An Ethernet-node standard system. It is intended for use as a client node in a Local Area VAXcluster (LAVC) and does not function as a standalone system. This configuration includes 5M bytes of memory, a 71M-byte RD53 disk drive, an Ethernet adapter, and a single serial line unit, 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 5M bytes of main memory, a 71M-byte RD53 Winchester disk, a 95M-byte 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 with 71M bytes of disk storage intended for larger workgroups. This configuration includes 9 serial lines (1 console terminal and 8 modem/data); 12 more modem/data serial lines can be added. Also included in this configuration are 5M bytes of main memory, a 71M-byte 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.
- An eight-user system with 318M bytes of disk storage intended for larger workgroups. This configuration includes 9 serial lines (1 console terminal and 8 modem/data); 12 more modem/data serial lines can be added. Also included in this configuration are 9M bytes of mem-

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CHART B. DISK/DISKETTE DEVICES (Continued)

MODEL	RD54	RA60	RA70	RA81	RA82
Type	Winchester	Removable	Winchester	Winchester	Fixed
Size (inches)	5.25	14	5.25	14	14
Number of surfaces	—	6	—	7	—
Formatted capacity per drive (bytes)	159M	205M	280M	456M	622M
Interface/controller	RQDX3	KDA50	KDA50	KDA50	KDA50
Number of drives per interface/controller	—	4	2	4	4
Average access time	38.3 ms	50 ms	27 ms	36.3 ms	32.3 ms
Data transfer rate	625KB/sec	1.98MB/sec	1.4MB/sec	2.2MB/sec	2.4MB/sec
Sectors/tracks per surface	—	1,600 tracks	—	2,496 tracks	—
Bytes per sector/track	512/sector	512/sector	—	512/sector	—

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➤ the mid-range level on IBM's own System/36 and System/38; it also provides System/370 compatibility at the application level.

Digital's counterresponse, the MicroVAX 3500 and 3600, continue the attack at IBM's soft—but strengthening—underbelly. These systems were introduced just as IBM began volume shipments of the 9370, taking some of the market attention away from the IBM system and putting it back on Digital. For the first time Digital officially acknowledged that it was pitting its systems directly against computers from IBM. According to Digital, "The MicroVAX family now spans the performance range of IBM's 9370 Models 20, 40, and 60 The [MicroVAX 3500 and 3600] outperform IBM's 9370 Model 60, at prices below the Model 20."

Datapro compared systems and prices to verify Digital's claim. A MicroVAX 3500 configured with 16M bytes of memory, two 280M-byte disk drives, a 296M-byte cartridge tape drive, 20 VT220 terminals, an Ethernet adapter, a VMS operating system license, a DECnet license, and a VMS Services for MS-DOS license—which allows the system to act as a server for a group of VAX-mate PCs—is priced at \$84,660, or \$4,233 per user. A similarly configured 9370 Model 20 with VM/IS operating system (which includes PC support software) is priced at \$166,975, or \$8,349 per user—nearly twice the price, of the Digital system.

In addition to being much less expensive than the IBM 9370, the MicroVAXs have the advantage of being completely software compatible from the low end of the MicroVAX line to the high end of the VAX 8000 product line. The systems also support many of the same peripherals, benefitting users converting to a larger Digital system. Also, Digital's DECnet networking strategy is already in place and embraces more official industry standards than does IBM's Systems Network Architecture (SNA).

Hardware and software compatibility among the MicroVAXs and with the VAX 8000 computers, make the MicroVAX systems attractive to all-Digital users and in mixed Digital/IBM environments where MicroVAX and VAX systems have already been implemented as departmental processors off-loading an IBM mainframe. The new MicroVAXs also benefit from a large base of existing software, while the 9370 software base is just beginning to

➤ ory, two 159M-byte RD54 disk drives, a TK50 streaming tape drive, an Ethernet adapter, and the BA123 cabinet. One RD53 or RD54 may 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), 9M bytes 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), 16M bytes 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 205M-byte removable or RA81 456M-byte Winchester disk as a system device and must also select an operating system license.

This configuration can support up to 1.8G bytes of disk storage. (One option is a 1.368G-byte, 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.

- The LAVC diskless compute server. This system is functional only as an LAVC client node and includes 16M bytes of memory, an Ethernet adapter, one serial line, a VMS two-user license, a DECnet E/DECne license, and an LAVC license. This system will accommodate 12 additional modem control/data lines, an RD53 disk drive for local paging, and networking options.
- The full boot node. This system includes all necessary software and hardware to function as an LAVC server. It includes 16M bytes of memory, a TK50 tape drive, a 456M-byte RA81 disk drive, a TU81 tape drive, and one serial line and eight modem/data serial lines, all in a H9642 cabinet. The system also includes an eight-user VMS license, an LAVC license, and a DECnet full-function license. The system will accommodate three more RA81 disk drives and up to six additional RD disk drives or serial interface adapters. Up to 40 additional modem control/data asynchronous serial lines can be added.
- Compact MicroVAX II Version B. Housed in a 32-inch-high cabinet, this configuration includes 9M bytes of memory, two RD54 159M-byte disk drives, a TSV05

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CHART C. WORKSTATIONS

MODEL	VT220	VT240	VT241	VT320	VT330	VT340
DISPLAY PARAMETERS						
Max. chars./screen	3,168	3,168	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	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	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	P4	White, green, or amber	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	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

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➤ build. Among users who have remained consistently IBM or who have not yet implemented a departmental solution, however, the MicroVAXs will compete with difficulty against an IBM mid-range system that runs IBM mainframe software.

The chief advantage that the 9370 has over the MicroVAXs is IBM's installed base. IBM holds its position as the largest computer company in the world and has a much larger installed base than Digital from which to woo potential sales.

The 9370 supports many more users (up to 64 on the Model 20 and up to 192 users on the Models 40 and 60) and far more disk storage (645G bytes) than the MicroVAXs, which support up to 60 users, depending on application and system configuration, and up to 2.5G bytes of disk storage. Despite the introduction of the 280M-byte RA70 and 622M-byte RA82 disk drives, Digital needs to develop even larger disk drives to keep the MicroVAXs competitive with the 9370. The RA82 is the largest drive available for the MicroVAXs and is overpowered by IBM's 824M-byte 9335 DASD, which allows the 9373-20 to handle up to 6.5G bytes of disk, more than twice that available on the MicroVAX 3600.

IBM has also been concentrating heavily on its communications and networking products for the 9370. SNA will soon be able to deliver the same level of network functionality—such as peer-to-peer communications provided by ACF/VTAM—as Digital's DECnet. Though IBM's connectivity products are not available until well into 1988, the company's move in that direction appeases users and holds the attention of those customers who can afford to wait for the products.

As IBM continues to shore up its mid-range products and connectivity strategy, it will become increasingly difficult ➤

➤ 40M-byte 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 5M bytes 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, 16M bytes of memory, and 318M bytes of storage.

- The Microprocessor Implementation of a Reliable Architecture (MIRA) system. This system is equipped with redundant hardware and dual power supplies to provide high availability of resources. A master and standby system reside in the same cabinet.

Standard systems require the selection of a VMS, 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 the 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 VMS, 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. ➤

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CHART D. PRINTERS

MODEL	LA50	LA75	LA100	LA120	LA210
Type	Dot matrix	Dot matrix	Dot matrix	Dot matrix	Dot matrix
Speed	50/100 cps	32/42/125/250 cps	40/240 cps; 80 cps opt.	180 cps	40/240 cps; 80 cps opt.
Bidirectional printing	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
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.
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
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
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.
Controller/Interface	RS-232-C	RS-423	RS-232-C std.; 20 ma opt.	RS-232-C	RS-232-C std.; Centronics parallel opt.
No. of printers per controller/interface	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
Graphics capability	72 x 180 dpi	180 x 144 dpi	132 x 72 dpi	Not applicable	132 x 72 dpi
Comments		Built-in LA50, LA100, LA210, IBM Proprietary emulation	Keyboard send/receive terminal		Compatible with IBM PC/XT/AT

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

➤ for Digital to use IBM for broadside target practice. That is the reason for Digital's manic pace of new system offerings over the past year—the window of opportunity is still open due to IBM's lack of intersystem connectivity and system compatibility of the type offered by Digital. Digital has concentrated on building up its product line, its marketing image, and its installed base to face an even greater challenge from IBM in the years ahead.

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

ADVANTAGES AND RESTRICTIONS

MicroVAX systems extend numerous advantages to both first-time and current Digital users. The compatibility provided under the VMS environment protects users' software investments, allowing MicroVAX 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 runs unchanged. In addition, the availability of both VMS 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 most obvious advantages of the newest MicroVAXs, the 3500 and 3600, are their processing speeds, ranging from 2.6 to 4.2 times faster than those of the MicroVAX II. Also, the 3500 and 3600 have much more memory support, making the systems more suitable for applications that require large amounts of memory. The current memory capacity of 32M bytes will be expandable to 64M bytes when memory boards composed of 1M-bit chips become available.

The 3500 and 3600 system ruggedized cabinets make the systems more versatile—they're suitable for both the office and the factory—but, the new packaging is a disadvantage to users who wish to upgrade or convert their MicroVAX IIs to one of the newer systems. First of all, Digital has not made it clear if and when CPU upgrade kits will be available. Secondly, the 3500 and 3600 use

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-32m 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 E/DECnet, and LAVC software licenses.

The MicroVAX 2000 supports 4 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 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.

DEC MicroVAX Family

CHART D. PRINTERS (Continued)

MODEL	LQP02	LQP03	LN03	LN03 Plus
Type	Daisywheel	Daisywheel	Laser	Laser
Speed	32 cps	25/34 cps	8 ppm	8 ppm
Bidirectional printing	Yes	—	Not applicable	Not applicable
Paper size	Up to 15 in wide	8.5 x 11 in	8.5 x 11 in	8.5 x 11 in
Character formation	Full	Full	300 x 300 dpi	300 x 300 dpi
Horizontal character spacing (char./inch)	Variable	Variable	Variable	Variable
Vertical line spacing (lines/inch)	Variable (includes proportional)	Variable (includes proportional)	Variable	Variable
Character set	ASCII	ASCII	ASCII; 16 resident Courier/Elite fonts	ASCII, technical; 17 resident fonts
Controller/Interface	RS-232-C	RS-232-C	RS-232-C	RS-232-C
No. of printers per controller/ interface	1	1	1	1
Printer dimensions, in. (h x w x d)	7 x 25 x 16	7.75 x 20.75 x 15.25	15 x 21 x 23.5	15 x 21 x 23.5
Graphics capability	Yes; opt.	Yes; opt.	Not applicable	300 x 300 dpi
Comments		Prints in landscape and portrait modes	Prints in landscape and portrait modes	Provides bit-mapped, Tektronix 4010/ 4014-compatible graphics

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

➤ quad-height boards, which are wider than the dual-height boards used on the MicroVAX II. Though the MicroVAX II boards can be modified to fit in the 3500 or 3600 system cabinet, it entails some added cost and inconvenience.

The older MicroVAX II has upgradability advantages for MicroPDP-11 users, though. 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.

At the low end of the MicroVAX product line, the chief advantage of the MicroVAX 2000 is recognized when the system is added to an existing Local Area VAXcluster (LAVC), which interconnects up to 28 MicroVAX systems, allowing them to share centralized software and hardware resources. Adding a single MicroVAX 2000 to an LAVC supports up to 16 more users through the system’s Ethernet connection. The system’s small size and low price, however, 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.

The new Q-bus-based MicroVAX 3500 and 3600 support Q-bus peripherals, benefitting users who already have an

➤ Also available are four VAXserver systems, based on the MicroVAX systems but configured to function as resource servers in an LAVC. The current VAXserver product line includes the VAXservers 100, 3500, 3600, and 3602.

The VAXserver 100 includes 16M bytes of memory, a 462M-byte disk drive, a 95M-byte streaming tape drive, an Ethernet interface, and the ULTRIX-32m or VMS operating system. Under VMS, full-function DECnet and LAVC licenses are also included. Under ULTRIX-32m, a Network File System (NFS) license is included.

The VAXserver 3500 and 3600 are housed and configured the same as the MicroVAX 3500 and 3600, respectively, but include a one-to-two user ULTRIX or single-user VMS license. Also, a VAXserver 3600 includes only 16M bytes of memory. The VAXserver 3602, housed in two H9644 cabinets, includes two CPUs (each with 16M bytes of memory), two FPUs, two disk controllers, two Ethernet interfaces, one RA82 dual-ported disk drive, one TK70 cartridge tape drive, a one-to-two user ULTRIX-32m or single-user VMS license, and a DECnet E/DECne or full-function license for each CPU. The VMS-based system also includes LAVC licenses for each CPU.

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 3500 and 3600 and has a 5/4-inch form factor. It is optional for the MicroVAX II. The TK70 uses 296M-byte CompacTape-II tape cartridges (developed by Digital in conjunction with 3M Company) which hold the entire contents of the 280M-byte RA70 disk drive. The TK70 transfers data at 90K bytes per second and features ECC, CRC, and a read-after-write procedure to verify data.

The TK50 streaming tape drive is a 1/2-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

DEC MicroVAX Family

CHART D. PRINTERS (Continued)

MODEL	LG01/LG02	LXY12/22	LPS40	LJ250/LJ252
Type	Matrix	Dot matrix printer/plotter	Laser	—
Speed	280/600 lpm	300/600 lpm	40 ppm	167 cps black, 55 cps color
Bidirectional printing	—	No	Not applicable	—
Paper size	4-16 in wide; 3-20 in long	—	7.5-11 in wide; 10.5-17 in long	—
Character formation	120 x 144/60 x 72 dots/in.	Variable	Electrophotographic	—
Horizontal character spacing (char./inch)	Variable	Variable	Variable	—
Vertical line spacing (char./inch)	—	—	Variable	—
Character set	Multiple	96 ASCII; 192 opt.	29 resident typefaces	DEC technical, NRC, ISO-Latin, line drawing
Controller/Interface	LP11 or RS-232-C	RS-232-C	—	RS-232-C (250), parallel (252)
No. of printers per controller/interface	—	—	—	—
Printer dimensions, in. (h x w x d)	38 x 33.5 x 22.3	46.5 x 30 x 24.3	40.4 x 60 x 28.4	—
Graphics capability	LG02 only	Yes	300 x 300 dpi	180 x 180 (7 colors), 90 x 90 (255 colors)
Comments	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	LJ252 supports HP-PCL for PC applications

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

investment in such devices. The new systems do not support UNIBUS peripherals, indicating that Digital is moving even further away from that bus architecture. Also, no enhancements made to the 3500/3600 Q-bus architecture to keep pace with the much greater processing capacity of the CPU indicates that Digital plans to phase out that open-bus architecture in favor of future systems based on the closed VAX 8000 VAXBI bus. This would be completely in line with Digital's recent closed-bus strategy and the company's attempts to keep third-party peripheral vendors out of Digital territory by strictly limiting licensing of the VAXBI.

Dual porting of the new RA70 and RA82 disk drives allows two systems or network servers access to each of the disks, offering some data security in the event of a failure on one of the systems or networks. The dual porting of the disks indicates that Digital is emphasizing the high availability of system resources—a necessity in the OLTP market that the company is newly targeting.

Unlike Digital's defensive position against third-party peripheral vendors, the company 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, re-

rate of 62.5K bytes per second (45K bytes per second for user data). Recording density is 6667 bpi. The TK50 also features read-after-write operation and 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. The TS05 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 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 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.

The 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 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.

DEC MicroVAX Family

➤ relieving the customer of the responsibility for building a specialized system.

Digital's Volume Software Pricing and VAX Software Portfolio programs are also advantageous. The former allows 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 were the license for each product purchased individually.

USER REACTION

Datapro spoke with several MicroVAX II users who responded to our 1987 Computer Users Survey. The first user with whom we spoke is the systems manager at an engineering/scientific firm in Washington, DC. Before purchasing the MicroVAX II, the company also looked at a Xerox 860, a Wang OAS 140 and 145, an IBM System/36, and an NBI OAS 64. The primary application is word processing, and the MicroVAX II was selected because it is the best system to run the word processing software (Microsystem Engineering Corp. MASS-11) the company wanted to use. Also the company discovered that the Digital system allowed it to use its twisted-pair wiring scheme rather than go to the additional expense of installing coax cable.

The DP manager finds the MicroVAX II to be very reliable and the MicroVMS operating system easy to operate. She could think of neither major drawbacks to the system nor problems encountered. The company is currently planning to add another system for scientific research. Clustering a second MicroVAX to the existing system is an option being considered.

The second user interviewed is the DP coordinator of a New York-based architectural engineering firm. This company uses the MicroVAX II for accounting, project control, cost control, and general ledger activities. Before purchasing the MicroVAX II, the company looked at systems from Prime and IBM. The primary reason for selecting the MicroVAX II was that the purchaser's third-party service company, which services Prime and Digital systems, uses a VAX. Thus the user believed that the service reps would be more familiar with the MicroVAX than with the other vendors' systems.

The second user likes the compatibility throughout the Digital product lines and says the company plans to upgrade to a VAX 8000 system. He thinks that the MicroVAX II is a bit slow and would like the vendor to add facilities to increase the system's speed. He had not yet looked into the increased performance of the faster MicroVAX 3500 and 3600. He would also like Digital to offer an Uninterruptible Power Supply (UPS) for the MicroVAX II. In our opinion, however, because a UPS is hardware independent, a UPS from a number of suppliers could be used with the MicroVAX II.

The third user interviewed is the DP manager of an Illinois manufacturing firm which uses its MicroVAX II to run accounting, manufacturing, order processing, inventory, payroll, personnel, and purchasing applications. The

➤ 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.

COMMUNICATIONS

The MicroVAX systems can also participate in LAVCs as either boot or satellite members. Up to 26 MicroVAX and VAXstation family members (satellites) can be interconnected through ThinWire Ethernet to two central MicroVAXs, VAXservers, or other VAX systems acting as servers (boot nodes). A single MicroVAX or VAXserver acting as an LAVC server supports up to 13 satellite members. The dual-CPU VAXserver 3602 supports 26 satellite systems. 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 DHV11 asynchronous interfaces, the DPV11 and DMV11 synchronous interfaces, and the DEQNA 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 *DHV11* is an eight-line asynchronous, direct memory access (DMA) multiplexer that provides local or remote interconnection between MicroVAX II, 3500, and 3600 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, 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.

The *DEQNA* is an Ethernet synchronous communications controller which connects MicroVAX 2000, II, 3500, and 3600 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.

DEC MicroVAX Family

➤ MicroVAX II was selected as part of a decision to use Digital products throughout the corporation.

This user finds that the MicroVAX II is easier to operate than the IBM 8100 from which the company converted. It has also been easy to add peripherals through the company's ROLM network. He said that the only major drawback encountered so far are bug checks in MicroVMS which cause a buffer to fill up without clearing, causing the system to go down. Digital is currently trying to fix the problem.

The company's current plans for the MicroVAX include interfacing the system, via Ethernet, with factory equipment from other vendors to gather online statistical data from the machines.

The final interview was with a professor in the Electrical Engineering department of a North Dakota university, where the MicroVAX II is being used for engineering/scientific applications. The MicroVAX II had been selected over the IBM System/36 and minicomputers from Prime and Control Data because of its price/performance ratio. The user likes the ease of use of the operating system, but finds the system's strong point to be its capability to communicate with systems throughout the university via DECnet. He would like to see Digital provide larger disk drives for the system; the recently announced larger capacity RA70 and RA82 disk drives are not supported on the MicroVAX II.

The department is planning to cluster the MicroVAX II with VAXstation 2000s, using the MicroVAX II to drive the technical workstations. The user's final comment was that he wished the university could afford more of the systems. "Everyone should have one in their office," he said.

The following chart shows how the 12 MicroVAX II users who replied to our Computer Users Survey rate the MicroVAX II. (The MicroVAX 2000, 3500, and 3600 were not available at the time the survey was conducted.)

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	6	1	0	3.3
Reliability of system	6	4	1	1	3.5
Reliability of peripherals	4	8	0	0	3.3
Maintenance service:					
Responsiveness	4	7	0	0	3.4
Effectiveness	4	5	2	0	3.2
Technical support:					
Troubleshooting	2	4	4	0	2.8
Education	2	5	2	1	2.8
Documentation	1	7	2	0	2.9
Manufacturer's software:					
Operating system	6	6	0	0	3.5
Compilers & assemblers	4	8	0	0	3.3
Application programs	2	8	1	0	3.1
Ease of programming	3	8	1	0	3.2
Ease of conversion	3	7	2	0	3.1
Overall satisfaction	4	8	0	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

Complete results of this survey are available in the "U.S. User Ratings of Minicomputers and Supermicros" report in *Datapro Reports on Minicomputers*. □

➤ Also configurable on the MicroVAX II, 3500, and 3600 is the *H4005 Ethernet Transceiver*, detailed in the "VAX 8000 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 CYX08 provides an RS-423-A eight-line asynchronous interface with modem control.
- The DFA01 is a two-line asynchronous interface with integral modems.
- 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 yards) 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 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 *Unshielded Twisted-Pair Ethernet Adapter (UTPEA)* is a passive adapter that allows a single Ethernet station to connect to unshielded twisted pair wiring (telephone wiring) from an office to a wiring closet or satellite equipment room.

The DECconnect Office Communications Cabinet is an H9646 cabinet that holds enough networking equipment to support 32 Ethernet (high speed) and 128 terminal (low speed) users.

SOFTWARE

The VMS operating system for the MicroVAX systems (formerly called MicroVMS) 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 de- ➤

DEC MicroVAX Family

► tails on VAX and MicroVAX software can be found in the *Datapro Directory of Software* and the *Datapro Directory of Microcomputer Software*.

OPERATING SYSTEM: *VMS* for the MicroVAXs 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 and batch applications. Digital formerly referred to *VMS* for the MicroVAXs as MicroVMS, but with the introduction of the MicroVAX 3500 and 3600, Digital has begun to refer to MicroVMS as *VMS* to emphasize the continuity between the MicroVAX and VAX 8000 product lines.

MicroVAX *VMS* allows an absolute limit of 8,192 concurrent processes. It requires a minimum of 1M bytes of physical memory. *VMS* includes routines found in VAX/VMS for backup, copy, rename, delete, and edit functions. Programming aids include macro and object libraries, assemblers, debuggers, 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.

Recent enhancements to *ULTRIX-32m* include support for Digital and Sun Microsystems diskless workstations, as well as for all VAX, MicroVAX, and VAXstation servers. Also, *ULTRIX-32m* provides Ethernet support using the TCP/IP network protocols, UDP/IP protocols, ThinWire, baseband, and optionally the Digital Network Services Protocol (NSP) if DECnet-*ULTRIX* is present. Support for the UNIX-to-UNIX copy (UUCP) permits communication among systems running *ULTRIX-11* or *-32*, and systems running AT&T's UNIX System V operating system.

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 operations similar to UNIX for systems running under VAX/VMS. *ULTRIX-32m* is also syntax compatible with the C Shell script on *ULTRIX-32* and *ULTRIX-11* systems. *ULTRIX-32m* is also compatible with the IEEE 1003 Portable Operating System for Computer Environments (POSIX).

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. 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 MicroVAX *VMS*-based systems.

LANGUAGES: Programming languages available for the MicroVAXs include Ada, APL, Basic, Bliss-32, C, Cobol, Dibase, 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 implementations. (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 Standardization Organization (ISO) Open System Interconnect (OSI) model.

DECnet-VAX permits suitably configured MicroVAX *VMS*- and VAX/*VMS*-based systems to participate as routing or e/DECnes 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 e/DECne 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 the TCP/IP protocols. *DECnet-ULTRIX* 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 26 MicroVAX and VAXstation satellite systems with two central MicroVAXs or VAXservers or with a single dual-CPU VAXserver 3602. 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 ►

DEC MicroVAX Family

► 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, 3500, or 3600, or a VAX 8000 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 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 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 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 VMS operating system and DISOSS and can implement distributed application programs that run between VMS 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-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 is composed of 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 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 facilitate 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 MicroVAX VMS or VAX/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.

APPLICATIONS: Applications and special-purpose products for the MicroVAX are available directly from Digital. The *WPS-Plus* document processing system and the *ALL-* ►

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► *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*.

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 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, 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 MicroVAX 3500 B213 chassis measures 27 inches high by 21 inches wide by 17.8 inches deep (60 cm. by 53 cm. by 45 cm.). The MicroVAX 3600 H9644 chassis

(which incorporates the B213) measures 41.6 inches high by 21 inches wide by 32.5 inches deep (106.8 cm. by 54 cm. by 80 cm.).

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 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.

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 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 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. 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 equipment-related and non-product-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 MicroVAXs, 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 ►

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► **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 8000 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. Custom-

ers ordering ULTRIX-32m 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.

EQUIPMENT PRICES

		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
MICROVAX 3000 SYSTEMS				
DU-350T1-A2/A3	MicroVAX 3500 CPU/Floating-Point Unit; 16MB of memory; BA213 enclosure; 280MB RA70 disk drive; 296MB TK70 tape drive; Ethernet adapter; unlimited-user ULTRIX and DECnet End Node licenses; one-year on-site hardware and software warranty	74,500	—	—
DU-350T1-AA	Same as DU-350T1-A2/A3 but includes documentation, diagnostics, and U.S. power cord	74,800	—	—
DV-350T1-A2/A3	Same as DU350T1-A2/A3 but with 1-to-20 user VMS, DECnet End Node, and VMS services for MS-DOS licenses	74,500	—	—
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	74,800	—	—
DU-360T1-A2/A3	MicroVAX 3600 CPU/Floating Point Unit; 32MB of memory; B213 enclosure; 622MB RA82 disk drive; 296MB TK70 tape drive; Ethernet adapter; unlimited-user ULTRIX and DECnet End Node licenses; one-year on-site hardware and software warranty	99,500	—	—
DU-360T1-AA	Same as the DU-360T1-A2/A3 but also includes documentation, diagnostics, and U.S. power cord	99,800	—	—
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	99,500	—	—
DV-360T1-AA	Same as the DV-360T1-A2/A3 but also includes documentation, diagnostics, and U.S. power cord	99,800	—	—
DU-360T2-A2/A3	Same as DU-360T1-A2/A3 but also includes expanded cabinet containing a second 622MB RA82 disk drive and TU81-Plus tape drive	149,500	—	—
DU-360T2-AA	Same as DU-360T2-A2/A3 but also includes documentation, diagnostics, and U.S. power cord	149,800	—	—
DV-360T2-A2/A3	Same as DU-3602-A2/A3 but with 1-to-40 user VMS, DECnet e/DECne, and VMS services for MS-DOS licenses	169,500	—	—
DV-360T2-AA	Same as DV-360T2-A2/A3 but also includes documentation, diagnostics, and U.S. power cord	169,800	—	—

F/S—Contact Digital Field Service.
 NA—Not applicable.
 NC—No charge.

DEC MicroVAX Family



Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
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MICROVAX II SYSTEM BUILDING BLOCKS (SBBs)

630QB-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; BA123 enclosure	19,320	163	194
630QE-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; H9642 enclosure	23,835	169	201
630QY-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; BA23 pedestal enclosure	15,540	153	182
630QZ-A2(A3)	MicroVAX II CPU/Floating-Point Unit; 1MB of main memory; BA23 rack-mount enclosure	15,383	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	24,691	211	251
DH-630Q1-DA	Same as DH-630Q1-D2(D3), but with documentation/diagnostics software kit	25,006	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)	22,344	248	295
DH-630Q2-FA	Same as DH-630Q2-F2(F3), but with documentation/diagnostics software kit	22,659	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	30,587	277	330
DH-630Q3-FA	Same as DH-630Q3-F2(F3), but with documentation/diagnostics software kit	30,902	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-BBs; also includes DEQNA Ethernet/Q-bus adapter	44,520	353	420
DH-630Q4-FA	Same as DH-630Q4-F2(F3), but with documentation/diagnostics software kit	44,835	353	420
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	47,335	365	435
DH-630Q4-HA	Same as DH-630Q4-H2(H3), but with documentation/diagnostics software kit	47,670	365	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	44,315	279	332

F/S—Contact Digital Field Service.

NA—Not applicable.

NC—No charge.



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		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
DH-630Q5-FA	Same as DH-630Q5-F2(F3), but with documentation/diagnostics software kit	44,630	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, DEQNA Ethernet interface, 2-user MicroVMS and LAVC licenses	25,620	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	99,598	514	612

COMPACT MICROVAX II

SS-630Q6-B2/B3/ B4/B5	Compact MicroVAX II with 9MB of memory, two 159 RD54 disk drives, TK50 tape drive	62,895	456	543
SS-630Q6-E2/E3/ E4/E5	Compact MicroVAX II with 5MB of memory, one RD53 disk drive, one TK50 tape drive	44,415	361	430

MICROVAX 2000

DH-625N1-B2	MicroVAX 2000 CPU/Floating-Point Unit; 4MB of main memory; RD32 42MB Winchester drive; RX33 1.2MB diskette drive; expansion adapter; and one-year hardware/software warranty	7,450	F/S	F/S
DH-625N1-BA(B3)	Same as DH-625N1-B2 but with documentation	7,550	F/S	F/S
DH-625N2-B2	Same as DH-625N1-B2 but with 6MB of memory	9,450	F/S	F/S
DH-625N2-AA	Same as DH-625N1-B2 but 6MB of memory and documentation	11,655	*	*
DH-625N3-A2	MicroVAX 2000 CPU/Floating-Point Unit; 4MB of memory; RD53 71MB Winchester disk; BA40A expansion adapter; one-year hardware/software warranty	7,200	*	*
DH-625N3-AA(A3)	Same as DH-625N3-A2 but includes documentation	7,300	*	*
DH-625N4-A2	Same as DH-625N3-A2 but with 6MB of memory	9,200	*	*
DH-625N4-AA(A3)	Same as DH-625N3-A2 but with 6MB of memory and documentation	9,300	F/S	F/S
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	12,080	F/S	F/S

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	2,095	40	48
AAV11-DA	300KHz, DMA 2-channel, 12-bit resolution digital-to-analog converter	2,095	45	54
AXV11-C	25KHz, 16-channel, analog-to-digital converter with 2-channel digital-to-analog; 12 bits	1,360	32	38
KWV11-C	Programmable realtime clock, 16-bit counter, two Schmitt triggers	940	25	30
DRV11-J	64-bit user-configurable parallel digital interface	515	9	11
DRV11-WA	DMA 16-bit input/output parallel digital interface	1,040	9	11

MEMORY

MS630-AA	1MB memory increment	378	*	*
MS630-BA	2MB memory increment	1,575	*	*
MS630-BB	4MB memory increment	1,418	*	*
MS630-CA	8MB parity memory increment	2,783	*	*

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	2,142	16	19
RQDX3-M	Q-bus controller without cables; for use when replacing existing RQDX2 controllers (cables can be reused)	2,090	16	19

F/S—Contact Digital Field Service.

NA—Not applicable.

NC—No charge.



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RQDXE-AA	Dual-height disk drive bus extender for use with RQDX2 or RQDX3 controller in a BA23 enclosure and for external disk	263	NA	NA
RQDXE-FA	Dual-height disk drive bus extender for use with RQDX2 or RQDX3 controller and disk in BA23-CC expander enclosure	263	NA	NA
RX33-A	1.2MB diskette drive	788	8	10
RX50A-AA/BA	RX50 800KB dual diskette drive with cables for BA23(AA) or BA123(BA) enclosure	1,050	8	10
RX50-AA	RX50 800KB dual diskette drive	1,050	8	10
RX50-D	RX50 800KB dual diskette drive mounted in desktop enclosure with I/O cable	1,890	20	24
RX50-R	RX50 800KB dual diskette drive for mounting in 19-inch standard equipment rack	1,890	20	24
RD32-A	42MB Winchester disk drive	2,415	20	24
RD53-A	RD53 71MB, 5¼-in. Winchester disk drive	3,990	38	45
RD53A-AA/BA	RD53 71MB drive with cables for BA23(AA) or BA123(BA) enclosure	3,990	19	23
RD53-DA/DB	RD53 71MB drive mounted in desktop enclosure with I/O cables	4,620	38	45
RD53-EA	71MB Winchester disk drive for MicroVAX 2000	3,990	38	45
RD53-FA/F3	71MB Winchester disk in expansion box for MicroVAX 2000	5,303	38	45
RD53-RA/RB	RD53 71MB drive in 19-inch standard equipment rack; requires H9302 enclosure	4,620	38	45
RD54-DA/DB/RA/RB	RD54 159MB Winchester disk drive	8,295	63	75
KDA50-QA	Q-bus controller for RA series disk drives	6,825	50	60
RA60-AF	RA60 205MB, 14-in. removable disk; requires 6-ft. cable	19,425	105	125
RQA60-AA/AD	RA60 205MB removable disk drive with KDA50 controller	26,670	155	185
RA60-CA	RA60 205MB removable disk drive in H9642 cabinet	22,470	105	125
RQA60-CA/CD	RA60-CA with KDA50 controller; for H9642	29,295	155	185
RA70	280MB RA70 disk drive for MicroVAX 3500 and 3600	9,000	—	—
RA81-HA/HD	RA81 456MB, 14-in. rack-mountable Winchester disk drive; requires cable, controller, and cabinet	16,422	95	113
RA81-EA/ED	Three RA81 456MB disk drives mounted in H9642 cabinet; requires KDA50 controller	52,500	285	339
RQA81-AA/AD	RA81 456MB rack-mountable disk drive with KDA50 controller; requires cabinet	23,625	145	173
RA82-EA/ED	Three 622MB disk drives	65,625	—	—

OPTICAL DISK

RRD50-QA	600MB Compact Disk Read-Only Memory (CD-ROM) disk drive with MicroVAX II and VAXstation controller	1,260	28	33
RRD50-QC	CD-ROM drive with Q-bus control kit	1,160	28	33
RRD50-A2/A3	600MB CD-ROM add-on disk drive; requires RRD50-QA or QC	1,050	24	29
RRD50-EA	600MB CD-ROM disk drive with controller for IBM PC-compatible products	1,260	28	33
RRD50-EB	600MB CD-ROM disk drive with controller for VAXmate	1,160	24	29

MAGNETIC TAPE

TQK50-AA	TK50 controller with cables for BA23 enclosure	1,155	8	10
TQK50-AB	Q22 controller for TK50-D/R in BA23 enclosure	1,155	8	10
TQK50-BA	TK50 controller with cables for BA123 enclosure	1,045	8	10
TQK50-BB	Q22 controller for TK50-D/R in BA123 enclosure	1,155	8	10
TK50-AA	TK50 95MB cartridge streaming tape drive	2,940	22	26
TK50-DA/DB	TK50 desktop tape drive	3,570	22	26
TK50-RA/RB	TK50 rackmount tape drive	3,570	22	26
TK50Z-FA/F3	TK50 in expansion box for MicroVAX 2000	4,720	30	36
TK70	296MB TK70 tape drive	7,300	—	—
BA40A-AA	Expansion Adapter for MicroVAX 2000	1,200	NA	NA
TSV05-ZA/ZB	Q-bus TS05 magnetic tape system with hardware for rackmounting, control module, cables, and top-access cover	11,760	89	106
TU81E-DA(DD)	TU81-Plus 1600/6250 bpi GCR tape drive	28,665	140	167

PRINTERS

LA50-RA	LA50 50/100 cps dot matrix tabletop printer with push tractor feed and 110 V AC power supply	795	8	10
LA50-RB/RC	Same as LA50-RA, but with 220 V AC (Model RB) or 240 V AC (Model RC) power supply	715	8	10
LA120-DA	LA120 180 cps dot matrix printer; for 1-to-6 part forms	3,045	34	40
LA210-AA	LA210 40/80/240 cps dot matrix printer	1,675	28	33
LA21X-BT	Bidirectional tractor for LA210	257	NA	NA
LA21X-SF	Single-tray sheet feeder for LA210	105	NA	NA

F/S—Contact Digital Field Service.
 NA—Not applicable.
 NC—No charge.



DEC MicroVAX Family



		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	13,545	127	151
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	3,675	NA	NA
LXY12-DA/DB	300-lpm dot matrix printer/plotter; includes RS-232-C interface cable, pedestal with basket, and paper guide	13,335	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	16,695	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	3,670	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	5,245	56	67
LN03S-UA	Graphics board to upgrade LN03 to LN03 Plus	1,675	7	8
LPS40-AA	Print Server 40, 40-ppm Ethernet printer with power cord	60,795	775	923
LVP16-AA	Graphics pen plotter with documentation and supplier	2,200	10	12

WORKSTATIONS/TERMINALS

VT220-D2(D3)	VT220 terminal with white phosphor nonglare screen; with VT22K-AA data processing or VT22K-BA word processing keyboard	609	12	14
VT220-E2(E3)	Same as VT220-A2(A3), but with green screen	609	12	14
VT220-F2(F3)	Same as VT220-A2(A3), but with amber screen	609	12	14
VT22X-AA	Integral 300/1200 baud modem for VT220	415	6	7
VT240-A2(A3)	VT240 terminal with white phosphor nonglare screen	2,079	19	23
VT240-B2(B3)	VT240 with green screen	2,079	19	23
VT240-C2(C3)	VT240 with amber screen	2,079	19	23
VT241-AA	VT241 color terminal	3,129	26	31
VT24K-AA	VT240/241 data processing country kit/keyboard	226	NC	NC
VT24K-BA	VT240/241 word processing country kit/keyboard	226	NC	NC
VT24X-AA	Integral modem for VT240/241	520	6	7
VT330-A2	Graphics video terminal without keyboard	1,780	19	23
VT330-B2/C2	Graphics video terminal without keyboard	1,780	19	23
VT340-A3	Color graphics terminal without keyboard	2,725	26	31
VT340-AA	Color graphics terminal with USA keyboard	2,935	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	2,515	27	32
LA100-BB	Same as LA100-BA, but with Courier-10 font, international overlay, and VT100 line drawing set	2,515	27	32
LA100-CA	LA100 with keyboard, tractors, cable, ribbon cartridge, package of paper, Courier-10/Orator-10 fonts, and multiple-font option	2,620	27	32
LA100-CB	Same as LA100-CA, but with Courier-10 font, international overlay, and VT100 line drawing set	2,620	27	32
LA120-DA	LA120 180 cps keyboard send/receive terminal for use with 1-to-6 part forms	3,045	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

DHV11-M	DHV11 eight-line asynchronous DMA multiplexer; requires cable	1,596	15	18
DZQ11-M	DZQ11 four-line asynchronous multiplexer; requires cable	798	11	13
DPV11-M	DPV11 single-line synchronous interface; requires cable	755	14	17

F/S—Contact Digital Field Service.

NA—Not applicable.

NC—No charge.



DEC MicroVAX Family



		Purchase Price (\$)	Basic Service (Monthly) (\$)	DECserv. (Monthly) (\$)
DMV11-M	DMV11 single-line synchronous interface; requires cable	2,231	41	49
DMV11-N	Integral modem interface	1,890	41	49
H4005	Ethernet/IEEE 802.3 transceiver	315	4	5
DESTA-AA	ThinWire Ethernet station adapter	289	4	5
DSRVB-AA	8-line DECserver 200	3,806	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	2,625	15	18

F/S—Contact Digital Field Service.

NA—Not applicable.

NC—No charge.

SOFTWARE PRICES

		License Fee (\$)
OPERATING SYSTEM		
QZ001-CZ	MicroVMS 2-user license for MicroVAX II	2,100
Q3001-C3	MicroVMS 4-user license on RX50 media for MicroVAX 2000	3,000
Q3001-C5	MicroVMS 4-user license on TK50 media for MicroVAX 2000	3,000
QZ002-C3	MicroVMS 8-user license and key on RX50 media for MicroVAX II	6,300
Q3002-C3	MicroVMS 8-user license and key on RX50 media for MicroVAX 2000	6,000
Q3002-C5	MicroVMS 8-user license and key on TK50 media for MicroVAX 2000	6,000
QZ002-C5	MicroVMS 8-user license and key on TK50 media for MicroVAX II	6,300
QZ003-C3	MicroVMS 16-user license and key on RX50 media for MicroVAX II	13,650
Q3003-C3	MicroVMS 16-user license and key on RX50 media for MicroVAX 2000	13,000
QZ003-C5	MicroVMS 16-user license and key on TK50 media for MicroVAX II	13,650
Q3003-C5	MicroVMS 16-user license and key on TK50 media for MicroVAX 2000	13,000
QZ004-C3	MicroVMS unlimited-user license and key on RX50 media for MicroVAX II	18,900
QZ004-C5	MicroVMS unlimited-user license and key on TK50 media for MicroVAX II	420
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	1,061
Q3D04-UZ	DECnet End Node license for MicroVAX 2000	714
QZD05-UZ	DECnet full license for MicroVAX 2000	2,662
Q3D05-UZ	DECnet full license for MicroVAX II	1,796
QZD09-UZ	DECnet End Node to full license upgrade for MicroVAX II	1,601
Q3D09-UZ	DECnet End Node to full license upgrade for MicroVAX 2000	1,297
QZ363-UZ	DECnet/SNA 3270 for MicroVAX II	1,575
Q3363-UZ	DECnet/SNA 3270 for MicroVAX 2000	788
QZ455-UZ	DECnet/SNA Application Programming Interface (API) for MicroVAX II	1,260
Q3455-UZ	DECnet/SNA Application Programming Interface (API) for MicroVAX 2000	630
QZ022-UZ	DECnet/SNA Advanced Program-to-Program Communications (APPC) for MicroVAX II	1,890
Q3022-UZ	DECnet/SNA Application Programming Interface (API) for MicroVAX 2000	945
QZ454-UZ	DECnet/SNA 3270 Terminal Emulator (TE) for MicroVAX II	630
Q3454-UZ	DECnet/SNA 3270 Terminal Emulator (TE) for MicroVAX 2000	315
QZ453-UZ	DECnet/SNA RJE for MicroVAX II	630
Q3454-UZ	DECnet/SNA RJE for MicroVAX 2000	315
QZ452-UZ	DECnet/SNA Gateway Management for MicroVAX II	315
Q3452-UZ	DECnet/SNA Gateway Management for MicroVAX 2000	158
QZ042-UZ	DECnet/SNA DISOSS Document Exchange Facility (DDXF) for MicroVAX II	945
QZ044-UZ	DECnet/SNA Printer Emulator (PrE) for MicroVAX II	630
Q3042-UZ	DECnet/SNA Gateway Management for MicroVAX 2000	473
Q3044-UZ	DECnet/SNA Gateway Management for MicroVAX 2000	315
QZ111-UZ	DECnet/SNA 2780/3780 Protocol Emulator for MicroVAX II	3,045
QZ112-UZ	DECnet/SNA 3271 Protocol Emulator for MicroVAX II	3,045
Q3B12-UZ	DECnet/SNA VAX VIDA for MicroVAX 2000	5,513
QZ362-UZ	VMS/SNA for MicroVAX II	2,625
QZB12-UZ	VAX VIDA for MicroVAX II	11,025
Q3ZCE-UZ	Local Area VAXcluster for MicroVAX 2000	683
QZZCE-UZ	Local Area VAXcluster for MicroVAX II	1,995

NA—Not applicable.

NC—No charge.

*Basic System Service.



DEC MicroVAX Family

License
 Fee
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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

LANGUAGES

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
Q3631-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	DECcor for MicroVAX II	3,600
Q3451-UZ	DECcor for MicroVAX 2000	1,800
QZ310-UZ	DECcalc for MicroVAX II	1,400
Q3310-UZ	DECcalc 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 ■

NA—Not applicable.

NC—No charge.

*Basic System Service.