

DEC MicroVAX II

MANAGEMENT SUMMARY

Digital Equipment Corporation's MicroVAX supermicro product line nominally comprises two models: I and II. The newer MicroVAX II, however, is the focus of the company's future plans and current marketing efforts for the low-end MicroVAX subgroup within the VAX family. While the MicroVAX I is still available, the company is not actively marketing it; thus, it is not covered in detail in this report.

Digital is focusing on the MicroVAX II with good reason. The system represents Digital's much-discussed implementation of the VAX architecture on a fully proprietary chip. The MicroVAX II features a single-board CPU centered around the ZMOS MicroVAX 78032. The 78032 features 32-bit internal and external data paths and its own 20MHz clock generator. The chip provides a 200-nanosecond cycle time, two-stage pipelined architecture, 4GB of virtual address space, and demand-paged virtual memory management.

Also on the CPU board is the MicroVAX 78132, a chip-level floating-point unit (FPU). Digital officials contend that this unit outperforms commodity floating-point units from merchant chip manufacturers by a factor of 2 or 3. In addition to the central processor and FPU, the CPU board includes 1MB of integral main memory. Also included is a Q-bus interface; like the older MicroVAX I and Digital's MicroPDP-11 computers, the MicroVAX II employs the 22-bit Q-bus for I/O control.

The MicroVAX II uses a full set of 304 VAX instructions, implemented both in the 78032 and 78132 and in software macrocode. Digital claims that, depending upon the appli- ➤

Digital Equipment Corporation's MicroVAX II is intended for a range of technical and commercial applications in office and departmental computing environments. This supermicro system, which supports Digital's Q-bus peripherals as well as two Unibus disk drives, is software-compatible with the company's line of VAX superminis.

MODELS: MicroVAX II.
MEMORY: 512KB to 9MB.
DISK CAPACITY: 31MB to 1.8GB.
WORKSTATIONS: Up to 33.
PRICE: \$11,150 to \$61,145 (base system prices).

CHARACTERISTICS

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

CANADIAN ADDRESS: Digital Equipment of Canada, Ltd., P.O. Box 13000, 100 Herzberg Road, Kanata, Ontario, K2K 2A6, Canada.

DATA FORMAT

BASIC UNIT: 32-bit word.

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

MAIN STORAGE

Memory is dynamic MOS RAM. Main memory cycle time is 400 nanoseconds. Main memory increments are 1MB, ➤



Digital Equipment Corporation's MicroVAX II delivers between 70 and 110 percent of the performance of a VAX-11/780 supermini. It is based on Digital's proprietary MicroVAX 78032, a full 32-bit microprocessor. Available in a variety of packaged configurations and building blocks, the MicroVAX II can accommodate up to 9MB of main memory, 1.8GB of Winchester disk storage, and 33 workstations.

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CHART A. SYSTEM COMPARISON

MODEL	Micro VAX II
SYSTEM CHARACTERISTICS	
Date of introduction	May 1985
Date of first delivery	July 1985
Microprocessor type	MicroVAX 78032
Microprocessor cycle time	200 ns
Operating system	MicroVMS, Ultrix-32m
Upgradable from	MicroVAX I
Upgradable to	Not applicable
Number of serial/parallel I/O ports	33
Number of expansion slots	7 (BA23); 11 (BA 123); 13 (H9642)
MEMORY	
Minimum capacity (bytes)	1M
Maximum capacity (bytes)	9M
DISK STORAGE	
Minimum capacity (bytes)	31M
Maximum capacity (bytes)	1.8G
NUMBER OF WORKSTATIONS	
33	
COMMUNICATIONS PROTOCOLS	
async; sync; DDCMP (DECnet); Ethernet; SNA; X.25; 2780/3780; 3271; TCP/IP; LU6.2	

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

► cation, the 78032 and 78132 in conjunction deliver between 70 and 110 percent of the performance of the much larger VAX-11/780 supermini, with an average of 90 percent.

Additional memory is available in 1MB, 2MB, and 4MB increments. Up to two boards can be added, for a main memory capacity of 9MB. The MicroVAX II supports Q-bus disk drives and two Unibus drives: the 205MB RA60 removable disk drive and the 456MB RA81 Winchester drive; maximum disk capacity is 1.8GB.

Digital is targeting the MicroVAX II toward a range of technical and commercial applications, including CAD/CAM, laboratory research, process control and factory automation, office automation, educational computing, electronic publishing, and general-purpose computing. The company views the system as installable in a range of office- or department-level computing environments. For example, it intends entry-level systems to be used for such tasks as realtime data acquisition or process control in Ethernet environments. Slightly larger (four- to eight-user) configurations can be used by work groups or teams in small businesses or branch offices, or in distributed data processing/LAN environments by small groups within larger organizations. Larger configurations supporting up to 33 users can be employed as departmental systems. A high-end configuration, supporting up to 1.8GB of disk, can be employed for both computation- and storage-intensive applications like CAD and seismic analysis.

Several single-user graphics workstations based on the MicroVAX II are also offered: the VAXstation II monochrome station and the VAXstation 520, VS550, VS555, and VS565 color stations.

► 2MB, and 4MB. Like all VAX systems, the MicroVAX II provides up to 4GB of virtual memory space.

PROCESSING COMPONENTS

The MicroVAX II features 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-nano-second cycle time, two-stage pipelined architecture, and instruction prefetch. The chip also includes its own 20MHz clock generator and demand-paged virtual memory management. The 78032 provides sixteen 32-bit general registers, 31 interrupt levels, and 1GB of physical address space. The 78032 has a TTL-compatible interface.

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

Like larger VAX systems, the MicroVAX II features a 304-instruction set, although differently implemented. On the MicroVAX II, 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.

In addition to the CPU and FPU, the MicroVAX II CPU board includes 1MB of integral main memory, memory expansion control, console serial line unit, 64KB of ROM containing power-up diagnostics and bootstrap program, and a Q-bus interface containing an 8,000-entry map for virtual-to-physical I/O address translation. The older MicroVAX I can be field-upgraded to the MicroVAX II.

INPUT/OUTPUT CONTROL

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

CONFIGURATION RULES

The MicroVAX II comes in a choice of three enclosures: the BA23, a pedestal or rackmount box with eight module slots and two slots dedicated for 5/4-inch mass storage devices; the BA123, a floorstanding enclosure with 12 module slots and five slots for mass storage; and a cabinet system employing a modified H9642 cabinet (the type used for larger VAX computers) containing two BA23 enclosures and providing space for two RA-class disks.

The MicroVAX II is available in the following five basic system packages:

- A single-user configuration, constituting an entry-level Ethernet node and featuring 2MB of main memory, a single serial line unit, a 31MB RD52 Winchester disk subsystem, an 800KB RX50 dual floppy disk subsystem, and an Ethernet adapter, all housed in the BA23 pedestal enclosure.
- A four-user standalone configuration, intended for team or work-group computing. It features 2MB of main memory, a 71MB RD53 Winchester disk, a 95MB TK50 streaming cartridge tape drive, five serial lines, and a BA23 pedestal enclosure.

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CHART B. DISK/DISKETTE DEVICES

MODEL	RX50	RD52	RD53	RC25	RA60	RA81
Type	Dual diskette	Winchester	Winchester	Winchester/ removable	Removable	Winchester
Size (inches)	5.25 per diskette	5.25	5.25	5.25	14	14
Number of surfaces	1 per diskette	—	—	—	6	7
Formatted capacity per drive (bytes)	818K (409K per diskette)	31M	71M	26M/26M	205	456
Interface/controller	RQDX2	RQDX2	RQDX3	Integrated	KDA50	KDA50
Average access time	264 ms	57.5 ms	38.3 ms	45.5 ms	50 ms	36.3 ms
Data transfer rate	250K bps	625KB/sec.	625KB/sec.	1.25MB/sec.	1.98MB/sec.	2.2MB/sec.
Sectors/tracks per surface	80 tracks/ diskette	—	—	—	1600 tracks	2496 tracks
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.

➤ The MicroVAX II runs Digital's proprietary MicroVMS operating system and supports the VMS programming languages, development tools and utilities, and data management tools available for the VAX supermini line. The MicroVAX II can run programs written on larger VAX computers without recompilation or relinking. The supermicro also runs Ultrix-32m, Digital's enhanced version of the University of California at Berkeley's 4.2 BSD Unix implementation, and VAXELN, a layered product for development of realtime applications. Applications software is available both directly from Digital and through the company's EAS (External Applications Software) library, which acquires applications from third-party vendors and makes them available through corporate distribution channels.

For communications, the MicroVAX II employs DECnet-VAX software under MicroVMS for Ethernet local area communications, as well as for various types of wide-area communications. For Ultrix-32m-based systems, DECnet-Ultrix provides communications with non-Digital systems using TCP/IP protocols and with VMS-based systems. Digital's Internet products allow the MicroVAX II to communicate through gateways with IBM and compatible systems running in SNA and DISOSS environments and to use the LU6.2 protocol for peer-to-peer communication; VMS/SNA software allows communications with SNA and DISOSS systems without a gateway.

COMPETITIVE POSITION

The MicroVAX II has a significant, one might even say critical, impact on the price/performance curve available within Digital's VAX line and, thus, on the very shape of that product family; the MicroVAX II also enhances Digital's ability to compete in the rapidly heating market for departmental systems.

Comparing the prices just of base VAX processor complexes to those of base MicroVAX II systems, one finds that the supermicro consistently delivers a far lower price per MIPS (measured in the VMS environment) than Digital's superminis. The VAX-11/780, rated at 1.06 MIPS, costs about \$136,800 per MIPS. Depending upon the system box purchased, the 0.9-MIPS MicroVAX II costs about \$12,400 or ➤

- • An eight-user departmental system, intended for larger work groups and offering nine serial lines. This configuration includes 3MB of main memory, an RD53 disk, an RX50 dual floppy subsystem, a TK50 streaming tape drive, and the BA123 cabinet.
- A 16-user departmental system featuring 17 communications lines, 5MB of main memory, three RD53 disks, a TK50 streaming tape drive, and the BA123 cabinet.
- A departmental system for storage-intensive applications. Housed in the 40-inch modified H9642 cabinet, this configuration includes nine serial lines, 5MB of main memory, a KDA50 disk controller (for RA60 and RA81 disks), a TK50 streaming tape drive, and a DECnet/Ethernet interface. Purchasers must choose either an RA60 205MB removable or RA81 456MB Winchester disk as a system device, and must also select an operating system license. This configuration can support up to 1.8GB of disk storage. The basic system cabinet can accommodate two RA81 disks or one RA81 and one RA60; a standard disk cabinet can be added with space for two more disks. Up to 33 serial lines can be supported.

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

Digital also offers several single-user workstations based on the MicroVAX II: the VAXstation II monochrome station, and the VAXstation 520 and VS550, VS555, and VS565 color stations.

VAXstation II is a multiwindow, multiprocessing, monochrome graphics station. The CPU and other components are housed in the BA23 pedestal box. The VAXstation II includes a graphics subsystem and 19-inch, 60 Hz monochrome monitor with 864 vertical by 1024 horizontal pixel resolution. It can support up to 9MB of main memory and 102MB of disk storage; a DECnet/Ethernet LAN interface is standard. Special packages for artificial intelligence work and Ada programming are available.

VAXstation 520 includes a color monitor with 1280-by-1024 pixel resolution. Its Tektronix 4125 color graphics subsystem features 256KB of display-list memory and two bit planes of frame-buffer memory. An Ethernet interface is standard.

The VS550, VS555, and VS565 workstations feature a direct memory access (DMA) interface between the MicroVAX II CPU and the Tektronix 4125 graphics subsystem. The VS550 is housed in the BA23 pedestal enclosure ➤

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CHART C. WORKSTATIONS

MODEL	VT220	VT240	VT241
DISPLAY PARAMETERS			
Max. chars./screen	3168	3168	3168
Buffer capacity	—	—	—
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132
Tilt/swivel screen	Tilt standard	Standard	Standard
Symbol formation	7 x 10 dot-matrix	8 x 10 dot-matrix	8 x 10 dot-matrix
Character phosphor	White, green, or amber	White, green, or amber	P4
Total colors/no. simult. displayed	Not applicable	Not applicable	—
KEYBOARD PARAMETERS			
Style	Typewriter	Typewriter	Typewriter
Character/code set	ASCII, Digital Special Graphics, and Supplemental	ASCII, Digital Special Graphics, and Supplemental	ASCII, Digital Special Graphics, and Supplemental
Detachable	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.
COMMENTS	—	800 x 240 pixel graphics array	800 x 240 pixel graphics array; includes color monitor

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➤ \$15,800 per MIPS. The VAX 11/750, delivering 70 percent the power of an 11/780, costs \$75,000 per MIPS. The 11/730, at 30 percent of the 11/780's power, prices out at \$59,700 per MIPS. The low-end VAX-11/725, available in a package with minimal storage, costs approximately \$83,200 per MIPS; a basic packaged MicroVAX II costs about \$24,000 per MIPS.

Because of the vast improvement in price/performance offered by the MicroVAX II and its support for large Unibus disk drives, the supermicro will undoubtedly kill off the more expensive and less expandable low-end VAX-11/725 and 11/730 superminis. It will encroach on the territory of the mid-range 11/750 as well, at least for smaller departmental applications.

By supplanting the "underpowered" MicroVAX I (a term aptly used by International Data Corporation) as Digital's principal supermicro offering, the MicroVAX II gives the company a formidable competitor in the low-end computing area, where it comes up against a variety of departmentally oriented minis, superminis, and supermicros.

According to Digital, IBM's System/36—that company's principal office/departmental system—provides the principal competition for the MicroVAX II. The Digital contender can certainly compete effectively with the high-end IBM Model 5360 in overall configurability. The 5360 provides only 1.75MB of main memory and 800MB of disk, versus the 9MB of memory and 1.8GB of disk storage offered by the MicroVAX II. The System/36 model has a slight edge only in workstation support, accommodating 36 local stations, only three more than the MicroVAX II accommodates.

The MicroVAX II also provides stiff competition for low-end departmental systems from Digital's traditional supermini rivals—systems like Data General's Eclipse MV/4000 DC. Other competitors include the burgeoning number of supermicros based on full 32-bit microprocessors, whether proprietary or available in the merchant

➤ sure and features, among other components, 3MB of memory, an RD53 disk, a TK50 streaming tape drive, and an Ethernet interface. The VS555 and VS565 are housed in the larger BA123 enclosure. The VS565 has eight bit planes and 3D wire frame and color shading hardware as standard features; the hardware is optional on the VS550 and VS555. The 3D hardware reportedly makes the graphics subsystem equivalent to Tektronix 4128 and 4129 subsystems. The two larger stations can support up to 9MB of main memory and 213MB of disk.

INPUT/OUTPUT UNITS

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

OTHER PERIPHERALS: The TK50 streaming tape drive is a ½-inch cartridge unit that uses CompacTape cartridges, developed by DEC in conjunction with 3M Company; a single cartridge can back up any of the Winchester disks used on a MicroVAX II. This Q-bus drive, which uses a microprocessor-based controller, has a maximum storage capacity of 95MB and achieves read/write speed of 75 ips in streaming mode. The TK50 has a peak data transfer rate of 62.5KB per second (45 KB/second for user data). Recoding density is 6667 bpi. The TK50 also features read-after-write operation and emulation of reel-to-reel tape drive operation.

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

The LA12 DECwriter Correspondent is an interactive printing terminal that prints at up to 150 cps in draft mode. The LA100 is a keyboard send/receive hardcopy terminal that prints at 30 or 240 cps, with an 80-cps print option. The LA12 or LA100 can be used as a MicroVAX II console.

The LCP01 color printer is an inkjet color graphics device that provides output on paper and transparencies. It provides print resolution of 154 dots per inch, a print rate of approximately two minutes per copy, and up to 216 shades.

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 database with a standard Touch-tone telephone.

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CHART D. PRINTERS

MODEL	LA50	LA120	LA210	LQP02	LQP03	LN03
Type	Dot-matrix	Dot-matrix	Dot-matrix	Daisywheel	Daisywheel	Laser
Speed	50/100 cps	180 cps	40/240 cps; 80 cps opt.	32 cps	25/34 cps	8 ppm
Bidirectional printing	Yes	Yes	Yes	Yes	—	Not applicable
Paper size	4.5 to 10 in. wide	3 to 15 in. wide	3.5 to 15 in. wide	Up to 15 in. wide	8.5 x 11 in.	8.5 x 11 in.
Character formation	13 x 9/7 x 9 dot-matrix	7 x 7 dot-matrix	33 x 18/7 x 9 dot-matrix; 33 x 9/80 cps	Full	Full	300 x 300 dots/sq. in.
Horizontal character spacing (char./inch)	10, 12, 16.5 or 5, 6, 8.25	5, 6, 6.6, 8.25, 10, 12, 13.2, 16.5	Variable	Variable	Variable	Variable
Vertical line spacing (char./inch)	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	2, 3, 4, 6, 8, 12	Variable (includes proportional)	Variable (includes proportional)	Variable
Character set	96 ASCII	94 ASCII, APL	94 ASCII	94 ASCII	ASCII	ASCII; 16 resi- dent Courier/Elite fonts
Controller/Interface	RS-232-C	RS-232-C	RS-232-C	RS-232-C	RS-232-C	RS-232-C
No. of printers per controller/ interface	1	1	1	1	1	1
Printer dimensions, in. (h x w x d)	5 x 15.7 x 11.2	33.5 x 27.5 x 21.7	12.5 x 53.75 x 33.75	7 x 25 x 16	7.75 x 20.75 x 15.25	15 x 21 x 23.5
Graphics capability, dots per inch	72 x 180	Not applicable	74-330 x 72	Not applicable	Not applicable	150 (average)
Comments					Prints in land- scape and por- trait modes	Prints in land- scape and por- trait modes

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market. Examples of the former group are AT&T's 3B2/300 and 3B2/400 systems, based on that company's WE 32000 and WE 32100 MPUs, respectively. Competitors from the latter category include Charles River Data Systems' Universe 32, Altos' 3068, and NCR's Tower/32, which all implement Motorola's MC68020 processor.

The VAXstation II is also a significant addition to the Digital product line, bringing almost full 11/780 power to the desktop, single-user environment. The company is targeting the station beyond the engineering applications typically associated with 32-bit workstations, intending it to provide the high-productivity worker—whether engineer, financial analyst, software developer, or commercial artist—with dedicated high-end VAX functionality and tools. The VAXstation II gives Digital greater leverage against Apollo Computer, Sun Microsystems, and other competitors in the market for dedicated technical applications; the availability of the color VAXstation 520, VS550, VS555, and VS565 workstations enhances the company's position in that market even more.

ADVANTAGES AND RESTRICTIONS

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

COMMUNICATIONS

Like the larger VAX systems, the MicroVAX II supports 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 "Communications Control" section of the "DEC VAX Family" report in this volume of DATAPRO REPORTS ON MINICOMPUTERS.)

The MicroVAX II supports the DZQ11, DHV11, DPV11, DLVJ1, DMV11, and DEQNA interfaces. Details on these Q-bus communications devices, which are also supported by Q-bus-based DEC PDP-11 systems, are provided in the "Communications Control" section of the "DEC PDP-11 Family" report in this volume of DATAPRO REPORTS ON MINICOMPUTERS.

An intelligent hardware device, *LAN Bridge 100*, enables users to link together multiple Ethernet local area networks. LAN Bridge 100 can reportedly support several thousand computers on baseband, broadband, and fiber optic Ethernet connections. It operates at the data link level and is protocol-independent, supporting any Ethernet/IEEE 802.3 protocol. LAN Bridge 100 comes in two versions: for baseband-to-baseband, baseband-to-broadband, and broadband-to-broadband connection; and for baseband- or broadband-to-fiber optic connection.

SOFTWARE

The MicroVMS operating system is based on the same architecture as VAX/VMS, which runs on the VAX superminis. Consequently, the MicroVAX computers run the same system and applications software as the larger VAX computers, 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 "Software" section of the "DEC VAX Family" report in this volume of DATAPRO REPORTS ON MINICOMPUTERS. Further details on VAX and MicroVAX software can be found in the DATAPRO DIRECTORY OF SOFTWARE and the DATAPRO DIRECTORY OF MICRO-COMPUTER SOFTWARE.

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➤ The ability of the MicroVAX II to support Q-bus peripherals provides a boon for MicroPDP-11 users who want to upgrade to VAX power; they can transfer their peripherals without making additional hardware outlays. Similarly, the supermicro's support for the Unibus RA60 and RA81 disk drives benefits Unibus PDP-11 mini and low-end VAX supermini users who may wish to substitute a MicroVAX II configuration with Unibus disk support.

Although the MicroVAX I is no longer a significant factor in the MicroVAX grouping, users can take comfort in the knowledge that Digital is not abandoning the installed community of MicroVAX I users; the company provides upgrade kits to convert the less powerful supermicro to a MicroVAX II.

USER REACTION

Digital Equipment Corporation declined to provide us with a list of MicroVAX II users we could contact for system evaluations. Because MicroVAX II systems have only been shipped for a few months, the company felt it was better to wait until a sufficient number had been installed and used, so that a full spectrum of responses to MicroVAX II system performance could be obtained. □

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

MicroVMS allows an absolute limit of 8,192 concurrent processes. It requires a minimum of 1MB of physical memory. MicroVMS includes routines found in VAX/VMS for backup, copy, rename, delete, and edit functions. Programming aids include macro and object libraries, assembler, debugger, and system programming utilities. MicroVMS is unbundled from MicroVAX II system packages and is licensed according to the number of users on the system.

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

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

VAXELN, which is not so much an operating system as a development tool and specialized runtime environment, acts as a compatible subsystem to the MicroVMS operating system for development of applications in realtime control and distributed computing environments. It consists of development utilities for creating target applications and a

runtime kernel of device drivers and service code that becomes a part of each application. After development, VAXELN applications run standalone on MicroVAX target systems without the host operating system. VAXELN applications are written in an optimizing version of Pascal or C.

DATA BASE MANAGEMENT: The MicroVAX II employs the VAX data base management or information management architecture, which is arranged in layers above the operating system. On the top layer, the MicroVAX II 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 database management systems. *Rdb/ELN* is used in dedicated or distributed VAXELN environments; *Rdb/MicroVMS* runs on purely MicroVMS-based systems.

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

COMMUNICATIONS: *DECnet-VAX* permits suitably configured MicroVMS- and VMS-based systems to participate as routing or end nodes in DECnet computer networks. It offers task-to-task communications, file transfer, down-line system and task loading, network command terminals, and network resource-sharing capabilities through DNA protocols.

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

The MicroVAX II supports Digital's *Internet* products, which provide interconnection of MicroVMS-based Digital computers and Digital networks to systems built by IBM and other manufacturers. Members of the Internet group, prefixed DECnet/SNA, are: Gateway; DISOSS Document Exchange Facility (DDXF); Advanced Program-to-Program Communications/LU6.2 Programming Interface (APPC); Application Programming Interface (API); Printer Emulator (PrE); 2780/3780 Protocol Emulator; and 3271 Protocol Emulator. Also available are two other access products: *DECnet/SNA RJE Facility*, which allows a MicroVAX II 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 and VAXstations 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 or VAXstation II system appears to the SNA network as a Physical Type 2 cluster controller. Among other functions, a Digital system can exchange documents and electronic mail messages between the MicroVMS operating system and DISOSS, and can implement distributed application programs that run between MicroVMS and IBM systems. According to Digital, VMS/SNA complements the DECnet/SNA Gateway, supporting many of the same access routines and user interfaces; applications written for

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► VMS/SNA can be migrated to the Gateway with no change to software.

Remote Network Bridge Management (RBMS) software allows users to remotely control bridges among networks, monitoring performance and characteristics, modifying parameters, and initiating self tests.

APPLICATIONS: A range of applications and special-purpose products is available directly from Digital for the MicroVAX II. *WPS-Plus* and *ALL-IN-1* are principal office automation systems. 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)*, *DECcalc*, and *VAX GKS/0b* (for graphics).

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

Digital also offers third-party applications packages for VAX systems. The company's External Applications Software (EAS) Library service acquires software from third parties and makes it available through the company's software distribution channels. Software is tested by Digital for operation, documentation, and ease of installation prior to being included in the EAS Library. Software products from the EAS Library are sold on an "as is" unsupported basis, although the author of the software may offer a separate maintenance agreement.

OPERATING ENVIRONMENT

The BA123 enclosure of the MicroVAX II measures 24.5 inches high by 13 inches wide by 27.5 inches deep (62.2 by 33 by 70 cm). The BA23 box measures 24.5 by 10 by 28.5 inches (62.2 by 25.4 by 72.4 cm). The modified H9642 is a 40-inch cabinet. Power requirements are 120 VAC, single-phase, 60 Hz, 88 to 128 VRMS, 47 to 63 Hz. Maximum running current is 12 amp for the BA123 and 6 amp for the BA23; maximum power consumption is 690 watts for the BA123 and 345 watts for the BA23. MicroVAX II operating temperatures range from 59 to 90 degrees Fahrenheit (15 to

32 degrees Celsius), at 20 to 80 percent humidity, noncondensing.

SUPPORT SERVICES

DOCUMENTATION: Owner and Technical Manuals are included with the MicroVAX II System Building Blocks. Documentation Kits are optionally available for selected software packages; the kits include Reference Manuals, User's Guides, and other instructional materials.

TRAINING/EDUCATION: Digital maintains over 25 training centers worldwide. Courses covering both Digital equipment-related and nonproduct-related topics are offered. A variety of instructional methods are used, including instructor-led courses and self-paced instruction. Digital's Educational Services division publishes a digest listing available courses four times a year. On-site training at the customer's installation can also be provided.

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

PRICING

POLICY: Digital provides VAX systems on a purchase basis, with separately priced maintenance agreements. Leasing arrangements are available through Digital's U.S. Customer Finance Group.

Digital software is licensed rather than sold. Users purchase licenses and distribution rights separately. Customers ordering Ultrix-32m receive a Unix binary license directly from Digital.

EQUIPMENT PRICES

	Purchase Price (\$)	Monthly Maint. (\$)
SYSTEM PACKAGES		
DH-630Q1-AA (A2, A3) MicroVAX II CPU; 2MB of main memory; 31MB RD52 disk; 800KB RX50 dual diskette; DEQNA Ethernet adapter; BA23 pedestal enclosure	18,840	155
DH-630Q2-AA (A2, A3) MicroVAX II CPU; 2MB of main memory; 71MB RD53 disk; 95MB TK50 streaming cartridge tape drive; five serial line units; BA23 pedestal enclosure	21,580	193
DH-630Q3-AA (A2, A3) MicroVAX II CPU; 3MB of main memory; RD53 disk; TK50 streaming tape; RX50 dual diskette drive; nine serial line units; BA123 enclosure	29,430	233
DH-630Q4-AA (A2, A3) MicroVAX II CPU; 5MB of main memory; three RD53 disk drives; TK50 streaming tape; 17 serial line units; BA123 enclosure	43,780	351
DH-630Q5-AA (A2, A3) MicroVAX II CPU; 5MB of main memory; KDA50 disk controller; TK50 streaming tape; 8-line asynchronous multiplexer; DECnet/Ethernet interface; modified H9642 cabinet	42,505	283
SYSTEM BUILDING BLOCKS (SBBs)		
630QY-A2 (A3) MicroVAX II CPU; 1MB of main memory; BA23 pedestal enclosure	11,150	84
630QZ-A2 (A3) MicroVAX II CPU; 1MB of main memory; BA23 rackmount enclosure	11,000	84
630QB-A2 (A3) MicroVAX II CPU; 1MB of main memory; BA123 enclosure	14,200	95
CPU UPGRADES		
630XR-AB MicroVAX I to MicroVAX II upgrade; MicroVMS license	9,700	NA
630XR-AC MicroVAX I to MicroVAX II upgrade; Ultrix-32m license	9,700	NA
630XR-AD MicroVAX I to MicroVAX II upgrade; VAXELN license	9,700	NA

NA—Not applicable.

A dash (—) for an order number or price indicates that the information was not available from the vendor.

NC—No charge.



DEC MicroVAX II

EQUIPMENT PRICES

		Purchase Price (\$)	Monthly Maint. (\$)
VAXstations			
SV-LV52A-EK (EN)	VAXstation II; includes MicroVAX II CPU; 2MB of main memory; graphics subsystem and 19-inch monochrome monitor; DECnet/Ethernet interface; RX50 dual diskette; RD52 disk; three-button mouse; MicroVMS operating system and workstation licenses; Graphics Kernel System (GKS) license; BA23 pedestal box	26,500	—
SV-LV55A-EK (EN)	Same as SV-LV52A-EK (EN), but substituting RD53 disk and TK50 streaming tape for RD52 and RX50	29,640	—
—	VAXstation 520; includes MicroVAX II CPU; 2MB of main memory; MicroVMS operating system license; Tektronix 4125 color graphics subsystem; RS52 disk; RX50 dual floppy disk; color monitor and keyboard; Ethernet interface; BA23 enclosure	40,790	320
—	VAXstation 550; includes MicroVAX II CPU; 3MB of main memory; Ethernet interface; RD53 disk; TK50 streaming tape; MicroVMS operating system license; DMA interface and drives; Tektronix 4125 graphics subsystem; BA23 enclosure	55,030	—
—	VAXstation 555; same as VS550, but with additional backplane and storage slots	58,080	—
—	VAXstation 565; same as VS555, but BA 123 enclosure	73,130	—
VS5XX-UC	Upgrade to Tektronix 4128/4129 graphics subsystem	15,050	—
MEMORY			
MS630-AA	1MB memory increment	3,500	18
MS630-BA	2MB memory increment	7,000	36
MS630-BB	4MB memory increment	14,000	72
MASS STORAGE			
RQDX2-AA/BA	RQDX2 controller for RD52 disk and RX50 dual diskette; for BA23 (AA) or BA 123 (BA) enclosure	1,340	12
RQDX3-AA/BA	RQDX3 controller for RD53 disk; for BA23 (AA) or BA 123 (BA) enclosure	1,840	16
RX50A-AA/BA	RX50 800KB dual diskette drive with cables for BA23 (AA) or BA 123 (BA) enclosure	700	8
RD52A-AA/BA	RD52 31MB Winchester disk drive with cables for BA23 (AA) or BA 123 (BA) enclosure	3,000	19
RD53-A	RD53 71MB, 5¼-in. Winchester disk drive	3,350	—
RD53A-AA/BA	RD53 drive with cables for BA23 (AA) or BA 123 (BA) enclosure	3,350	—
RA60-AF	RA60 205MB, 14-in. removable disk; requires 6-ft. cable	17,140	—
RA81-HA (HD)	RA81 456MB, 14-in. Winchester disk drive; requires 6-ft. cable	18,640	95
OPTICAL DISK			
RRD50-A2 (A3)	600MB read only disk drive	1,350	—
RRD50-QA (QC)	RRD50-A2 (A3) with Q-bus controller kit	2,195	—
RRD50-KA	U.S. country kit; RRD50 power cord and documentation	95	NA
MAGNETIC TAPE			
TQK50-AA	TK50 controller with cables for BA23 enclosure	995	8
TQK50-AB	Q22 controller for TK50-D/R in BA23 enclosure	995	8
TQK50-BA	TK50 controller with cables for BA 123 enclosure	995	8
TQK50-BB	Q22 controller for TK50-D/R in BA 123 enclosure	995	8
TK50-AA	TK50 95MB cartridge streaming tape drive	2,495	22
TK50-DA (DB)	TK50 desktop tape drive	3,095	22
TK50-RA (RB)	TK50 rackmount tape drive	3,095	22
PRINTERS			
LA50-RA (RB)	LA 50 50-/100-cps dot-matrix tabletop printer with push tractor feed and power supply	695	8
LA120-RA	LA 120 180-cps dot-matrix printer; for 1- to 6-part forms	2,420	39
LA120-RB	Same as LA120-RA, but for 4- to 9-part forms	2,600	39
LA210-AA	LA210 40-/80-/240-cps dot-matrix printer	1,595	28
LQP02-AA (AD)	LQP02 32-cps daisywheel printer with Courier-10 font	2,800	29
LQPX2-AA	Bidirectional forms tractor for LQP02	250	NC
LQPX2-SF	Dual-tray cutsheet feeder with envelope tray for LQP02	1,800	19
LQP03-A	LQP03 25-/34-cps daisywheel printer with 130-character wheel and power cord	1,395	23
LQP03-AA	Same as LQP03-A, but includes documentation	1,395	23
LN03-AA	LN03 8-ppm laser printer; includes two toner cartridges, organic photo receptor cartridge, power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation	4,195	49
LCPO1-AA	LCPO1 ink-jet color printer with graphics processor	14,595	125
WORKSTATIONS/TERMINALS			
VT220-A2 (A3)	VT220 terminal with white phosphor nonglare screen	880	9
VT220-B2 (B3)	Same as VT220-A2 (A3), but with green screen	880	9

NA—Not applicable.

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NC—No charge.

DEC MicroVAX II

		Purchase Price (\$)	Monthly Maint. (\$)
WORKSTATIONS/TERMINALS (Continued)			
VT220-C2 (C3)	Same as VT220-A2 (A3), but with amber screen	880	9
VT22X-AA	Integral 300-/1200-baud modem for VT220	595	6
VT22K-AA	VT220 data processing keyboard	215	NC
VT22K-BA	VT220 word processing keyboard	215	NC
VT240-A2 (A3)	VT240 terminal with white phosphor nonglare screen	1,980	19
VT240-B2 (B3)	VT240 with green screen	1,980	19
VT240-C2 (C3)	VT240 with amber screen	1,980	19
VT241-AA	VT241 color terminal	2,980	26
VT24K-AA	VT240/241 data processing country kit/keyboard	215	NC
VT24K-BA	VT240/241 word processing country kit/keyboard	215	NC
VT24X-AA	Integral modem for VT240/241	495	6
LA12-AB	LA12 DECwriter correspondent 80-/150-cps printing terminal; 1200-baud modem, 300-baud coupler, EIA interface, and carrying case	2,195	21
LA12-CB	LA12 with 300-baud acoustic coupler, EIA interface, and carrying case	1,595	21
LA12-DB	LA12 tabletop and console model with EIA interface only	1,495	21
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	2,195	27
LA100-BB	Same as LA100-BA, but with Courier-10 font, international overlay, and VT100 line drawing set	2,195	27
LA100-CA	LA100 with keyboard, tractors, cable, ribbon cartridge, package of paper, Courier-10/Orator-10 fonts, and multiple font option	2,295	27
LA100-CB	Same as LA100-CA, but with Courier-10 font, international overlay, and VT100 line drawing set	2,295	27
LA120-DA	LA120 180-cps keyboard send/receive terminal for use with 1- to 6-part forms	2,800	34

VOICE SYNTHESIS MODULE

DTC01-AA	DECTalk text-to-speech board, speech analog, and telephone output	4,000	22
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COMMUNICATIONS/NETWORKING

DHV11-M	DHV11 eight-line asynchronous DMA multiplexer; requires cable	1,320	15
DZQ11-M	DZQ11 four-line asynchronous multiplexer; requires cable	650	11
DLVJ1-M	DLVJ1 EIA RS-232-C/CCITT V.28 or RS-442/CCITT V.11 interface; requires cable	610	12
DEQNA-M	DEQNA Ethernet-to-Q-bus high-performance synchronous communications controller; requires cable	1,350	15
—	LAN Bridge 100; for baseband-to-baseband, baseband-to-broadband, and broadband-to-broadband connection	8,000	—
—	LAN Bridge 100; for baseband- or broadband-to-fiber-optic connection	8,500	—

NA—Not applicable.

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SOFTWARE PRICES

		License Fee (\$)
COMMUNICATIONS		
QZD04-UZ	DECnet end license	630
QZD05-UZ	DECnet full license	1,950
QZD09-UZ	DECnet upgrade	1,320
QZ363-UZ	DECnet/SNA 3270	1,500
QZ455-UZ	DECnet/SNA Application Programming Interface (APPI)	900
QZ022-UZ	DECnet/SNA Advanced Program-to-Program Communications (APPC)	1,500
QZ454-UZ	DECnet/SNA Terminal Emulator (TE)	600
QZ453-UZ	DECnet/SNA RJE	600
QZ452-UZ	DECnet/SNA Gateway	270
QZ042-UZ	DECnet/SNA DISOSS Document Exchange Facility (DDXF)	900
QZ044-UZ	DECnet/SNA Printer Emulator (PrE)	600
QZ111-UZ	DECnet/SNA 2780/3780 Protocol Emulator	3,696
QZ112-UZ	DECnet/SNA 3271 Protocol Emulator	3,380
—	Remote Bridge Management Software (RBMS)	600
—	VMS/SNA	2,500
DATA BASE MANAGEMENT		
QZ898-UZ	Datatrieve	3,960
QZ897-UZ	Common Data Dictionary (CDD)	790
QZ800-UZ	Forms Management System (FMS)	1,575
QZ801-UZ	FMS Driver	150
QZ802-UZ	FMS Language Translator	750

DEC MicroVAX II

SOFTWARE PRICES

		License Fee (\$)
QZD07-UZ	Rdb/ELN	4,500
QZD08-UZ	Rdb/ELN RTO	750
QZ354-UZ	Rdb/MicroVMS	5,400
QZ357-UZ	Rdb/MicroVMS REM	600
QZ358-UZ	Rdb/MicroVMS RTO	1,800
LANGUAGES		
QZO18-UZ	Dibol	2,490
QZ130-UZ	DMS (Digital Standard Mumps)	5,400
QZ100-UZ	Fortran	3,100
QZ917-UZ	Lisp	4,800
QZ126-UZ	Pascal	2,835
QZ114-UZ	PL/1	4,780
QZ631-UZ	RPG II	1,890
QZO56-UZ	Ada	14,940
QZO20-UZ	APL	4,780
QZO95-UZ	Basic	3,180
QZ106-UZ	Bliss-32	3,465
QZO15-UZ	C	2,835
QZO99-UZ	Cobol	4,780
UTILITIES AND TOOLS		
QZ425-UZ	Application Development Environment (ADE)	1,485
QZ451-UZ	DeCor	3,600
QZ310-UZ	DECalc	2,040
QZ360-UZ	DECgraph	1,500
QZ361-UZ	DECslide	1,500
QZO38-UZ	DECtype	1,200
QZO07-UZ	DEC/CMS (Code Management System)	5,205
QZ500-UZ	DEC/MMS (Module Management System)	1,260
QZ143-UZ	DECshell	2,850
QZ810-UZ	GKS/Ob	1,260
QZ706-UZ	TDMS	1,650
QZ713-UZ	TDMS upgrade	130
QZ375-UZ	VAXELN Toolkit	4,000
QZ907-UZ	WPS-Plus/VMS	5,700
—	WPS-Plus/VMS American Legal Lexicon	600 ■