DEC PDP-11 Family

MANAGEMENT SUMMARY

Although DEC has perceptibly shifted the emphasis from its 16-bit PDP-11 family to its 32-bit VAX-11 family, and many argue that the end of the line is in sight, the PDP-11 will probably remain with us for several more years as one of the most successful 16-bit machines ever produced. DEC has, however, concentrated on the low-end of the PDP-11 family with the introduction of the Micro/PDP-11 and PDP-11/23S systems, while the top-of-the-line systems have virtually disappeared. Gone from the line is the PDP-11/70, PDP-11/34, PDP-11/23, and PDP-11/03. The current line includes the Micro/PDP-11, PDP-11/23S, PDP-11/23-PLUS, PDP-11/24, and PDP-11/44.

The PDP-11 family offers a range of compatible processors with common hadware architecture supported by a common group of peripherals, operating systems, and application software. One of the keys to the success of PDP-11 processors is the UNIBUS, a single, high-speed data bus through which all system components and peripherals communicate. Other advances include a flexible computer architecture featuring single and double address instructions, general-purpose registers, a hardware vectored priority interrupt system, and an asynchronous and modular organization for easier interfacing and input/output operations. In general, PDP-11 family processors differ in several basic aspects: processor speed, memory system performance, word size, busing structure power, and a variety of special options such as built-in floating point processors, operator console emulators, self-diagnostic features, bootstrap options, and cache memories.

The Micro/PDP-11 is a microcomputer system based on the PDP-11/23-PLUS CPU that combines the CPU, memory, 10.8 megabytes of disk storage, controllers, and power supply in one 5¼ inch high box. The Micro/PDP-11 system is a full-fledged PDP-11 processor with 22-bit addressing capability and runs standard PDP-11 operating systems such as RSX-11M-PLUS, RT-11, RSTS/E, and DSM-11. Designed as a general-purpose system primarily for OEM applications in commercial and technical fields, the Micro/ ▷

The PDP-11 family of 16-bit processors currently includes five systems that may be considered the low-end of the traditional PDP-11 line. The active members are the Micro/PDP-11, PDP-11/23S, PDP-11/23-PLUS, PDP-11/24, and PDP-11/44. PDP-11s are available either as stand-alone products or as parts of packaged systems. Most members of the product line are available for both OEM and end-user sales. Prices range from $10,225 for the Micro/PDP-11 to $47,700 for the PDP-11/44.

MAIN MEMORY: 32KB to 4MB.
DISK CAPACITY: 1MB to 2,048MB.
WORKSTATIONS: Up to 127.
PRINTERS: 30 cps to 900 lpm.
OTHER I/O: Cartridge tape, magnetic tape, card readers, plotters.

CHARACTERISTICS

MANUFACTURER: Digital Equipment Corporation (DEC), 146 Main Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.
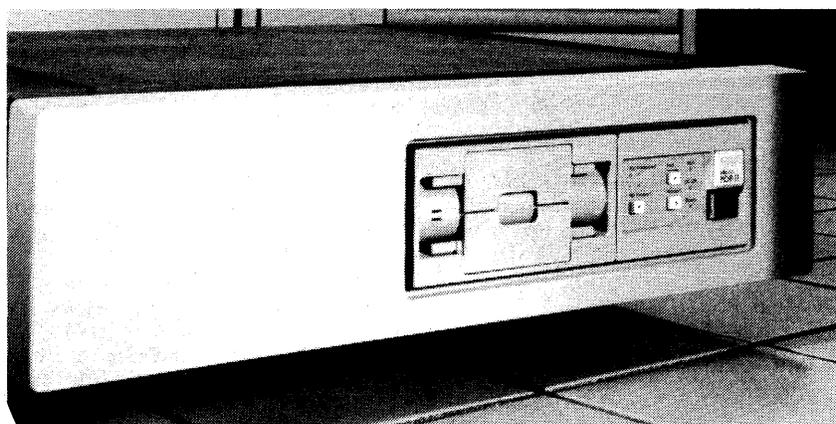
DEC is a worldwide corporation and the world's largest manufacturer of minicomputer systems. The company employs about 44,000 persons and maintains sales and service offices in all major U.S. cities and in major cities throughout Canada and the Western world.

MODELS: PDP-11/23 PLUS, 11/24, 11/44, 11/23S, and Micro/PDP-11.

DATE ANNOUNCED: PDP-11/44, 11/79; 11/24, 3/81; 11/23 PLUS, 11/81; 11/23S, 11/82; Micro/PDP-11, NA.

DATE OF FIRST DELIVERY: PDP-11/44, NA; 11/24, NA; 11/23 PLUS, NA; 11/23S, 1/83; Micro/PDP-11, NA.

NUMBER INSTALLED TO DATE: Over 300,000. ▶

DEC's Micro/PDP-11, based on the PDP-11/23-PLUS, combines CPU, memory, 10.8MB of disk storage, controllers, and power supply in one 5¼ inch high box. The Micro/PDP-11 system is a full-fledged PDP-11 processor with 22-bit addressing capability and runs standard PDP-11 operating systems such as RSX-11M-PLUS, RT-11, and RSTS.

DEC PDP-11 Family

PDP-11 Family Specification Chart

Model	Micro/ PDP-11	PDP-11/23- PLUS	PDP-11/24	PDP-11/44
Word Size (bits)	16	16	16	16
Instruction Set	Std. PDP-11	Std. PDP-11	Std. PDP-11	Std. PDP-11
Number of Instructions	400	400	400	400
Extended Instuction Set	Std.	Std.	Std.	Std.
Maximum Memory Supported	4MB	3MB	4MB	4MB
Memory Management	Std. (22-bit)	Std. (22-bit)	Std. (18-bit) Opt. (22-bit)	Std. (22-bit)
Memory Types	Parity, CMOS	Parity, MOS	MOS, Parity	ECC, MOS
Floating Point Hardware	Opt. FPF-11	Opt. Micro-code, Chip, or Floating Point Processor	Opt.	Opt.
Commercial Instruction Set	Opt.	Opt.	Opt.	Opt.
Cache Memory	NA	NA	NA	Std. 8KB
Number of General Registers	9	9	9	10
Processor Operating Modes	Kernel, User	Kernel, User	Kernel, User	Kernel, User Supervisor
Number of Interrupt Levels	4	4	4	4
Auto Restart	Std.	Std.	Std.	Std.
Battery Backup	NA	NA	Opt.	Opt.
Peripheral Controller	Extended LSI-11	Extended LSI-11	UNIBUS	UNIBUS
Byte Manipulation Capability	Opt. with CIS	Std.	Std.	Std.
Stack Processing	Std.	Std.	Std.	Std.
Operating Systems	RT-11, RSX-11M, RSX-11M-PLUS, RSX-11S, RSTS/E, DSM-11	Same as Micro/PDP-11	Same as Micro/PDP-11	Same as Miro/PDP-11
Languages	Macro, Basic-11, Fortran-IV, Basic-PLUS-2, PDP-11 Cobol, Cobol-81, CORAL 66	Same as Micro/PDP-11	Same as Micro/PDP-11	Same as Micro/PDP-11

▷ PDP-11 system contains an extended LSI-11 bus backplane and supports LSI-11 bus-compatible hardware options. For timesharing, small business, and office applications, it will support two to eight users. The system includes the PDP-11/23-PLUS CPU, two serial I/O ports, 256KB of parity memory, 5¼-inch Winchester disk unit with 10MB of storage, 5¼-inch dual floppy disk drive with a total capacity of 800KB, universal power supply, seven-slot LSI-11 bus backplane, and an I/O connector panel for extended cables.

The PDP-11/23S is a packaged CPU for OEMs that consists of the PDP-11/23-PLUS CPU with two serial lines, boot diagnostic ROMs, line clock, a filter/cable assembly for SLUs, either 32KB of CMOS memory with on-board battery backup or 64KB of RAM memory, and an I/O ▷

▶ DATA FORMATS

BASIC UNIT: 16-bit word plus two parity bits. The processor can also handle 8-bit bytes, and is capable of bit manipulation.

FIXED-POINT OPERANDS: 6-bit words or 8-bit bytes are used as operands in both single- and double-operand instructions. Bit manipulation is provided through Boolean AND/OR instructions.

FLOATING-POINT OPERANDS: 64-bit double-precision operands with an 8-bit exponent and signed 56-bit fraction. Single- and double-precision hardware via a floating-point processor is optionally available. This hardware includes a dedicated set of six 64-bit accumulators. ROM implementation of the extended instruction set (EIS) is also

DEC PDP-11 Family

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION
TERMINALS	
VT100-AA(AB)	VT100 tabletop video display terminal, operates on full duplex asynchronous communications lines, and is equipped with a standard EIA interface; 50 to 19,200 bps baud rate; 24 lines x 80 characters or 14 lines x 132 characters (selectable); 7 x 9 dot matrix, 2-dot descenders; 94-character ASCII and 32-special graphic features
VT101-AA(AB)	VT101 tabletop video display terminal; operates on full-duplex, asynchronous communications lines and is equipped with a standard EIA interface, 50 to 19,200 bps baud rate; 24 lines x 80 characters ASCII with 32 special graphic characters; 83-key detachable unit, standard numeric/function keypad
VT102-AA(AB)	VT102 tabletop video terminal; 50 to 19,200 bps baud rate; 24 lines x 80 characters or 132 characters; 7 x 10 dot matrix with 2 dot descenders; 94-character ASCII set with 32 special graphics characters: U.S. and British character sets standard, others optional; normal or reverse video, blinking, underline, and bold characters on a character-by-character basis; standard numeric/function keypad
VT125-AA(AB)	VT125 tabletop graphics terminal operating with EIA/CCITT interface; 50 to 19,200 bps baud rates; even, odd or none (keyboard selectable parity); 768 x 240 pixel graphics resolution; printer port for graphics mode (for use with LA34-VA); 24 lines x 80 characters or 14 lines x 132 characters; 7 x 10 dot matrix with descenders; 96-ASCII character set (upper/lower case; numeric and punctuation) with 32-character special graphics set; split screen capability
VT131-AA(AB)	VT131 video terminal with full VT102 capability plus local edting and block mode transmission
VT1XX-AA	20mA adapter for the VT100; allows VT100 terminal to convert from an EIA interface to a 20mA current loop interface
VT1XX-AB	Advanced video option for the VT100/VT125
VT1XX-AC	Printer port option; allows connection of a VT100 to a hardcopy printer
VT1XX-CA	20mA interface adapter option for VT100/VT101/VT102/VT125/VT131
VT1XX-CB	Graphics upgrde kit for VT100 to VT125 graphics functionality
VT1XX-CE	Word processing upgrade kit for VT100 and VT125
VT100-AA(AB)	GIGI (General Imaging Generator and Interpreter) VK100 tabletop keyboard terminal, includes graphics, multiple character sets, local intelligence, local ROM Basic, 8 level color support, graphics printer interface, screen control functions and graphics tablet support; operates over full-duplex, asynchronous serial communication lines and on either EIA or 20mA communications interfaces
LA34-RA	DECwriter IV graphics printing terminal, basic printer; 110 to 9,600 bps baud rate, 45 ips print speed (text mode), 320 columns per second or 960 dots per second (graphics mode); 132 print columns; 128-character ASCII set
LA34-VA	Systems graphics printer; same as LA34-RA and also includes roll paper holder, paper low detection option, BC22A-25 cable, ribbon cartridge, and one roll of paper
LA34-WA	Receive only printer; same as LA34-RA and also includes tractors, paper out switch option; BC22A-25 cable; ribbon cartridge and tractor feed paper sample
LA38-GA	Tabletop DECwriter IV printing terminal; 110 or 300 bps baud rates; 30 cps print speed, 7-bit ASCII character set plus ANSI-compatible escape sequences; 10/12/13.2/16.5 characters per inch
LA38-HA	DECwriter IV printing terminal; same as LA38-GA except is the freestanding version
LINE PRINTERS	
LN01-CA(CB)	High-quality nonimpact printer using laser technology; 12 pages per minute printing speed; 188 character set; portrait and landscape print modes; LP11 interface and cable included
LXY11-XX	Lineprinter/plotter; 300/240/170 lpm printing speeds; 16.7 inch per minute plotting speed; 96 ASCII standard character set; 8 inch per second paper slew speed
LXY21-XX	Lineprinter/plotter; 600/465/320 lpm print speeds; 33.3 inch per minute plot speed; 96 ASCII standard character set; 16 inch per second paper slew speed
LP11-AA	Band printer; 300 lpm for 64 ASCII character set
LP11-BA	Band printer; 300 lpm for 64 ASCII set or 215 lpm for 96 ASCII character set
LP11-CA(CD)	Lineprinter; 900 lpm for 64 ASCII character set
LP11-DA(DD)	Lineprinter; 600 lpm for 96 ASCII character set
LP11-EA	Lineprinter; 600 lpm for 64 character set
LP11-EB	Lineprinter; 600 lpm for 64 character set or 445 lpm for 96 character set
LP11-GA	Lineprinter; 905 lpm for 96 character set; requires PDP-11/70
LP11-GB	Lineprinter; 1200 lpm for 64 caracter set; requires PDP-11/70
CARTRIDGE TAPE	
TU58-DA	TU58 cabinet-mountable dual drive cartridge tape subsystem including the necessary hardware for mounting in standard cabinetry; 800 bpi record density; 30 ips read/write speed; 262KB capacity per cartridge

DEC PDP-11 Family

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION
TU58-EB	Same as T58-DA except tabletop version
TU58-K	One 256KB TU58 data cartridge for the TU58-DA and TU58-EB
MAGNETIC TAPE	
TS11-CA(CB)	Nine track TS11 magnetic tape subsystem mounted in a 60.5 inch high H9646 cabinet; 1600 bpi record density; 45 ips read/write speed; requires a PDP-11/24 or PDP-11/44
TJE11-AA(AD)	TE16 magnetic transport and controller to interface with the PDP-11 UNIBUS; includes the controller, a tape formatter, and one nine track TE16 tape transport; 1600 bpi and 800 bpi record densities; 45 ips read/write speed; mounted in 60 inch H9602 cabinet
TE16-AE(AJ)	TE16 magnetic tape transport
TJU77-AB(AD)	TU77 magnetic tape transport and controller to interface to the PDP-11 UNIBUS; includes the controller, a tape formatter and one nine track TU77 tape transport; 1600 bpi and 800 bpi record densities; 125 ips read/write speed
TU77-AF(AJ)	TU77 magnetic tape transport
TU80-AA(AB)	TU80 magnetic tape subsystem; 1600 bpi, 25/100 ips, half-inch magnetic tape subsystem; employs start/stop and streaming tape technology; interfaces to any UNIBUS system; includes tape drive cabinetry
TSV05-BA(BB) (BD)	TSV05 magnetic tape system mounted in a 40 inch H9642 cabinet; microprocessor based one-half inch magnetic tape subsystem incorporates reel-tape technology; 1600 bpi; 25 ips read/write speed; requires a Micro/PDP-11 or PDP-11/23-PLUS
CARD READERS	
CR11(A)	Tabletop card reader and controller; 285 cpm card speed; 550 card capacity; standard 12-row 80-column EIA (Hollerith code) hole punched cards; non-packed and packed data formats
CR11-BC(BD)	Tabletop card reader and controller; 600 cpm card speed; 1000 card capacity; standard 12-row 80-column EIA (Hollerith code) hole punched cards; non-packed and packed data formats
CMS11-KA(KB)	Tabletop card reader and controller; 250 cps card speed; 250 card capacity; standard 12-row 80-column EIA (Hollerith code) hole punched cards; non-packed and packed data formats

▷ patch panel with removable templates. The 3½-inch high box is 19-inch rack mountable and contains a 4 x 4 LSI-11 backplane. The PDP-11/23S is aimed primarily at those applications using the MicroPower/Pascal run-time executive or the RT-11 operating system.

The PDP-11/44 is a midrange minicomputer with features similar to the PDP-11/70 and twice the performance of the PDP-11/34. It offers up to 1 megabyte of memory (expandable to 4MB), standard PDP-11 instruction set and extended instruction set, optional floating point and commercial instruction set, 10 general purpose registers, 4 hardware interrupt levels, a UNIBUS peripheral controller, standard 22-bit memory management, a standard 8K byte cache memory, and byte manipulation and stack processing capabilities. It runs under the RSX-11M, RSX-11M-PLUS, and RSTS/E operating systems.

DEC expanded the PDP-11 line in March of 1981 with the introduction of the PDP-11/24. With a memory capacity of 1 megabyte (expandable to 4MB), the PDP-11/24 has 90 percent of the integer performance of the PDP-11/34 minicomputer and complements the upper-midrange PDP-11/44. It features custom MOS/LSI technology, UNIBUS architecture, full PDP-11 family hardware and software, and a broad scope of maintenance and support. The PDP-11/24 was designed for multitask and dedicated applications. It contains a single HEX module processor which features an optional extended 22-bit memory address capability. Other features of the PDP-11/24 include: basic PDP-11 instruction set and extended instruction set; memory ▷

▶ available. Floating-point software subroutines are available for all PDP-11s.

INSTRUCTIONS: PDP-11 instructions are 16 bits long. If program counter addressing is employed, then an additional 16 bits are added to the instruction length. Instruction formats are numerous, varying from one PDP-11 model to another. Common formats throughout the PDP-11 line occur in instructions of the single operand group, the double operand group, branch group, subroutine return, and condition code operators group. Operation codes vary from 4 bits to 16 bits in length. A Commercial Instruction Set (CIS) is available on the PDP-11. The CIS is a CPU microcode extension that implements a set of commercial instructions on a variety of data types, including character-string, packed decimal, and numeric formats. The firmware implementation yields much faster program execution times than a similar software implementation.

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

MAIN STORAGE

General aspects are covered for the entire family in the PDP-11 Specification chart (page M11-384-305).

STORAGE TYPE: Storage types include Parity, CMOS (Micro/PDP-11); MOS, Parity (PDP-11/23-PLUS); CMOS (PDP-11/23S); MOS, Parity (PDP-11/24); and ECC, MOS (PDP-11/44).

CYCLE TIME: The cycle time on a PDP-11/44 with an 8KB standard cache memory is 275 nanoseconds. ▶

DEC PDP-11 Family

management allowing relocation and protection for multi-task environments; real-time clock; optional floating point unit to increase Fortran and Basic program execution speeds: ASCII console functionality; power/fail automatic restart; self-diagnostic bootstrap loader; error logging to provide diagnostic information to the user and field service; optional built-in voltage monitoring; and optional battery backup (BBU).

DEC followed up the announcement of the PDP-11/24 with the introduction of the PDP-11/23 PLUS in November 1981. The PDP-11/23 PLUS is a high-end version of the PDP-11/23 microcomputer featuring up to 1 megabyte of memory and extended addressing capabilities not found on the standard PDP-11/23.

There are four basic operating systems offered for the PDP-11. *RT-11*, one of the oldest and smallest, is a single-user system for interactive program development. It can support both single-job and foreground/background modes of operation. The single-job version requires a 16K-byte system, and the two-partition version requires 32K bytes. RT-11 supports both the Fortran IV and Basic languages for program development.

RSX-11 is a real-time operating system available in two versions that vary widely in functionality and in system requirements. *RSX-11M*, a disk-based real-time operating system, can be run on any PDP-11 except the LSI-11/2 and PDP-11/03. RSX-11M requires a minimum of 32K bytes of main memory and one hard disk plus one other disk (which can be a floppy). To perform concurrent program development and real-time processing, at least 48K bytes of memory are required. In April 1979, DEC announced RSX-11M-PLUS, an extended version of RSX-11M. With appropriate hardware, RSX-11M-PLUS will support twice the uses and tasks of RSX-11M.

RSTS/E is DEC's resource-sharing, time-sharing system that supports up to 63 simultaneous users performing either interactive data processing using the Basic-PLUS language or batch-mode operations using Cobol. RSTS/E also has a more sophisticated file system than RSX-11 supporting both random and sequential files. In addition, the newly announced RMS-11 adds multi-keyed indexed sequential (ISAM) files to the list. RMS-11 enhances the RSTS/E file capabilities with multi-level privacy control and allows both generic and approximate key searches. RSTS/E requires an 11/34 or larger with a minimum of 64K bytes of memory, hard disk, magnetic tape, and a cosole terminal.

A substantial library of user-generated, but not DEC-supported, software is available from two groups within DEC. DECUS, the DECUSers Society, offers a catalog of software packages that includes languages, editors, numerical functions, utilities, display routines, and various other types of applications software. Also, the Educational Products Group publishes the Index and Description of Educational Applicational Software (IDEAS), which lists software packages developed by users specifically for edu-

CAPACITY: See the PDP-11 Specification Chart on page M11-384-302.

CHECKING: Parity on the basis of one bit per byte is available with dynamic MOS memory for the Micro/PDP-11, PDP-11/23-PLUS and PDP-11/24 and with core memory for all PDP-11s. Error correcting and checking (ECC) is a feature of dynamic MOS memory for the 11/44. ECC corrects all single-bit errors and detects all double-bit errors and most multiple-bit errors.

STORAGE PROTECTION: Via the memory management function on all PDP-11s. Mapping automatically provides hardware storage protection.

RESERVED STORAGE: The uppermost 8192 bytes on all models with a UNIBUS are reserved for I/O registers. This apparent "waste" of storage is more than compensated for by the resulting I/O programming flexibility.

All PDP-11s reserve at most 511 locations (168 in the 11/03) at the low end of memory for interrupt vectors, trap vectors, and floating vectors (not in the 11/03). Floating vectors are assigned for communications and other devices that interface with the PDP-11.

CENTRAL PROCESSORS

The *PDP-11/23-PLUS* CPU is a 16-bit, microprogrammed processor based on the extended LSI-11 bus with extended addressing capability. Integral to the CPU is the NMOS microprocessor chip set also used on the PDP-11/24. The CPU module itself contains the CPU, a memory management unit, a line frequency clock, a bootstrap/diagnostic ROM, and two serial line units. The PDP-11/23-PLUS CPU, in conjunction with its memory management unit, executes instructions in either kernel or user mode.

Both the *PDP-11/23S* and *Micro/PDP-11* contain a PDP-11/23-PLUS module with bootstrap ROM and diagnostics.

The PDP-11/23-PLUS processor offers a standard instruction set of 91 instructions. This instruction set includes both single and double operand instructions that operate with bit, byte, 16-bit word, and multiple-word data types. A variety of addressing modes extends the standard instruction set to over 400 instructions common to all PDP-11 processors. In addition to the standard instruction set, an optional microcoded floating point chip provides 46 instructions for single-precision (32-bit) and double-precision (64-bit) floating point data. For applications requiring floating point performance beyond that of the KEF11-A microcoded chip, the optional floating point processor provides additional instructions for faster execution of Fortran programs. A commercial instruction set (CIS) microcoded chip is also available for business applications requiring fast Cobol program execution.

The PDP-11/23-PLUS microcomputer features high-density, parity MOS memory based on advanced 64K RAM chip technology. A single quad-height memory module contains 512K bytes of memory, while a 256K byte memory management facility allows the processor to extend memory addresses to a full megabyte, in conjunction with the Extended LSI-11 bus and address relocation mapping.

The PDP-11/44 CPU also contains fixed point arithmetic with hardware multiply and divide, extensive test and branch operations, and other control operations as well as room for the addition of the floating point processor, commercial instruction set, and UNIBUS options. The CPU ►

DEC PDP-11 Family

cational purposes. Some of the programs listed in the IDEAS catalog are from the DECUS catalog. Users can obtain copies of these programs on various media for a nominal charge by contacting either of these organizations.

Although DEC sells most of its products on a purchase basis, leasing arrangements are available through DEC's Customer Finance Department. Available are full payout leases with 3 to 5 years conditional sales agreements.

Hardware and software maintenance are offered through several levels of optional service. Hardware maintenance options vary from several off-site plans to on-call service and guaranteed four-hour service. Software maintenance is offered through several levels of optional service ranging from a periodic software newsletter to automatic udpates of software and manuals via a subscription service.

COMPETITIVE POSITION

As the granddaddy of the 16-bit minicomputer, almost any other 16-bit machine in existance (except, perhaps, some specific small business 16-bit minis) are direct competitors with DEC's PDP-11. This line-up includes, among many others, Data General's Eclipse line, Hewlett-Packard's HP 1000 Series, Wang's VS Series, Honeywell's DPS 6, Modcomp's Classic II Series, and Sperry Univac's V77.

ADVANTAGES AND RESTRICTIONS

Perhaps the most significant restriction on the PDP-11 family rests in the current trends surfacing within the computer industry itself. That trend is toward more powerful 32-bit systems (like DEC's own VAX-11 family) that offer significant increases in processing power for the kind of price currently found in 16-bit machines. The move toward the 32-bit supermini can be seen in DEC's own emphasis on the VAX-11 over the past few years. However, the life of the PDP-11 line is far from over. With more software available for the PDP-11 than any other system, more than 400 companies selling peripherals and add-on equipment for the series, a unique bus structure that fosters the production of add-ons, and DEC's own unique position in the distributed processing market (another obvious trend), the PDP-11 will be with us for a long time to come.

USER REACTION

Two-hundred and thirty-one users representing 346 PDP-11 minicomputers responded to Datapro's 1983 User Survey. The average life of the systems represented in the survey was approximately 48 months. Two-hundred and five users purchased their systems, 23 leased from a third party, and 3 rented or leased from the manufacturer. One-hundred and forty-two respondents were first-time computer users. The types of industries represented most in the survey were Education, Manufacturing, Retail/Wholesale, Engineering/Scientific, and Government. The principal applications performed on these PDP-11s were accounting/billing, engineering/scientific, order processing/inventory control, payroll/personnel, and sales distribution. The

contains 10 general registers which can be used as accumulators, index registers, or as stack pointers. Stacks are useful for nesting programs, creating re-entrant coding, and as temporary storage where a Last-In/First-Out structure is desirable. One of the general registers is used as the PDP-11/44S program counter. Three others are used as processor stack pointers, and for each operational mode. The PDP-11/44 processor acts as the arbitration unit for UNIBUS control by regulating bus requests and transferring control of the bus to the requesting device with the highest priority.

The PDP-11/44 cache memory is integrated to the 11/44 processor and is designed to increase the CPU performance by decreasing the CPU-to-memory read access time. It is an 8,192-byte high speed RAM memory, organized as a direct mapped cache with write-through features.

All PDP-11 family processors have an instruction stack capability to facilitate the implementation of sharable (re-entrant) routines. The size of the pushdown stacks is limited only by the size of available memory.

The CPU of the *PDP-11/24* is a microprogrammed processor which executes a wide range of arithmetic and control logic operations to produce fixed point arithmetic, and hardware multiply and divide, and extensive test and branch instructions. Additional microcode, available as an option, allows the execution of single and double precision (32 and 64-bit) floating-point instructions, giving the user faster Fortran and Basic execution speeds. The floating point unit provides 46 additional instructions for high-speed floating point computation. The PDP-11/24 also contains standard PDP-11 instructions, plus the extended instruction set, memory management, power/fail automatic restart, six general purpose registers, two stack pointers, and one program counter. An additional register, the CPU error register, permits system software error logging.

Integral memory management provides additional capabilities and protection in a multiprogramming environment. It assigns memory pages to user programs and prevents users from unauthorized access to pages outside their own area. This gives users the necessary protection required in large multiuser, multiprogramming environments. Memory management also permits kernel and user modes to relocate individually anywhere in physical memory, thus allowing expeditious context switching to occur. Additionally, pages of memory may be constrained for either read-only access or non-access operations. Also, 16-bit, 18-bit, or optional 22-bit translation is offered to ensure compatibility with other members of the PDP-11 family.

REGISTERS: The Micro/PDP-11, PDP-11/2-PLUS, and PDP-11/24 have nine general purpose registers.

The 11/44 has 10 general registers which can be used as accumulators, index registers, or as stack pointers. One of the general registers is used as 11/44's program counter, and three others are used as the processor stack pointers, one for each operational mode.

ADDRESSING: Eight address modes are provided, with each operand address consisting of three bits to specify address mode and three bits that specify the register used to calculate the address. The modes consist of Register (operand in register), Register Indirect (operand address in register), Auto Increment/Decrement (self-incrementing/decrementing operand address in register), Auto Increment/Decrement Indirect (self-incrementing/decrementing register which points to an address in memory), Indexed, and Indexed Indirect. The eight modes can allow a specific operation code (e.g., MOV, for move) to accomplish regis-

DEC PDP-11 Family

▷ main source of application programs came from in-house personnel (71 percent).

Ninety-six percent of the users surveyed employed local workstation/terminals. Only 63 percent, however, used remote workstation/terminals. Memory capacities ranged from a low of 32KB (five users) to over 8,192KB (two users). Among the 231 users, total disk storage ranged anywhere from 1MB to over 1,200MB. Seventy-five users employed a data base management system while another 28 planned to install one in 1983. The programming languages used most were Basic (87 users) and Fortran (42 users). One-hundred users had a disaster recovery plan while 26 more planned to install one in 1983. When asked if they expected to replace their systems in 1983, 184 users said no, 30 said yes with the same manufacturer, and 7 said yes with a different manufacturer. The 231 users rated their PDP-11s as shown in the chart below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	109	109	6	4	3.4
Reliability of mainframe	141	75	9	1	3.6
Reliability of peripherals	96	100	24	4	3.3
Maintenance service:					
Responsiveness	110	86	22	4	3.2
Effectiveness	83	103	28	6	3.1
Technical Support:					
Trouble-shooting	43	108	46	15	2.7
Education	29	115	47	17	2.7
Documentation	37	107	57	16	2.7
Manufacturer's software:					
Operating system	92	102	20	4	3.2
Compilers and assem- blers	68	112	26	3	3.2
Applications programs	34	83	32	6	2.9
Ease of programming	69	119	25	2	3.1
Ease of conversion	40	84	36	10	2.9
Overall satisfaction	86	118	14	5	3.2

*Weighted Average based on a scale of 4.0 for Excellent.

When asked to state the significant advantages of their systems, 62 percent stated that the system was easy to expand/reconfigure, 54 percent said they were happy with the response time, 30 percent said that terminals/peripherals carried over from other systems are compatible as the vendor promised, and 27 percent stated that programs/data carried over from other systems are compatible as the vendor promised. On the other hand, when asked to state the significant problems with their systems, only 14 percent said that system costs (for hardware, vendor-supplied software, support) exceeded the expected total, 12 percent stated that the computer proposed by the vendor was too small, and 11 percent claimed that the delivery of required software was late and that the equipment was excessively noisy. When asked if their PDP-11s did what they were expected to do, 202 said yes and 15 were undecided. When asked if they would recommend the system to another user, 188 said yes but 26 were undecided.□

► ter/register, register/memory, memory/memory, memory/ stack, and register/stack manipulation.

INSTRUCTION REPERTOIRE: All PDP-11 models have in excess of 400 instructions. The instruction classes are listed below.

- Single Operand—General (e.g., clear, increment, decrement, complement, negate, .test); Shifts; Multiple Precision (e.g., add and subtract with carry, extend sign); and Rotate. Many of these instructions have word and byte operand versions.

- Double Operand—General (e.g., storage-to-storage move, add, subtract, compare); Register Destination (e.g., multiply, divide. Exclusive O); and Logical. Move and Compare can have word and byte versions; logical instructions can have bit and byte versions.

- Memory Management—Move From Previous Data Space, Move From Previous Instruction Space, Move to Previous Data Space and Move to Previous Instruction Space.

- Branches—Unconditional; Simple Conditional Branches; Signed Conditional Branches (for testing values of 2's complement arithmetic); and Unsigned Conditional Branches for testing results of comparing unsigned operands).

- Subroutine—e.g., Jump to Subroutine, Mark, and Return from Subroutine.

- Program Control—e.g., Jump, Subtract One and Branch, and, in some models, Set Priority Level.

- Traps—these are calls to emulators, I/O monitors, debuggers, and user-defined interpreters.

- Miscellaneous—e.g., Halt, Wait, Reset, and in various models, No Op, Move to/from Previous Instruction/Data Space.

- Condition Code Operators—Set/Clear conditionally or unconditionally all of each of the four PDP-11 condition code bits.

- Floating Point—the four arithmetic functions for floating-point arithmetic. In models with both single- and double-precision floating-point arithmetic, these instructions have single- and double-precision versions.

- User Control Store—Maintenance Exam and Dep, Load Microbreak Register, Maintenance Normalization Shift, Maintenance Partial Product, and Maintenance Alignment Shift.

INTERRUPTS: All models have four automatic hardware priority level interrupts.

PHYSICAL SPECIFICATIONS: The PDP-11/23S is a 3½ inch high, 19 inch rack-mountable microcomputer that contains a 4 x 4 LSI-11 backplane.

The Micro/PDP-11 is available as a rack-mountable, floor stand or table top model. It is 24.5 inches high, 6 inches wide, 27 inches deep, and weighs 70 pounds.

The PDP-11/23-PLUS is 41.75 inches high, 21.25 inches wide, 30 inches deep, and weighs 375 pounds.

The PDP-11/24 is either 5.25 inches high, 19 inches wide, 25 inches deep and weighs 45 pounds or 10.35 inches high, 16.62 inches wide, 26 inches deep and weigh 70 pounds.

PDP-11/44 is 10.38 inches high, 16.22 inches wide, 26 ► inches deep and weighs 90 pounds.

DEC PDP-11 Family

UNIBUS: The UNIBUS, a single common data path that treats all components or modules of a PDP–11 family system as equal-level devices for data access and transfers, including the processor, memory modules, and peripheral controllers, is part of all PDP–11 family members. The priority of any device connected to the UNIBUS is determined by its physical position; hence, the processor is normally attached to give it the highest priority. There is no logical limit to the number of devices that can be attached to the UNIBUS, with bus access and control handled by the interrupt system. The theoretical maximum UNIBUS data transfer rate is 5 million bytes per second, and attached components communicate in a master/slave manner.

Simultaneous operations: While I/O using the programmed interrupt structure cannot be simultaneous with processing or other I/O, NPR (non-processor data transfers) can. These are DMA (direct memory access) data transfers via the UNIBUS (or other buses in the large processors). NPR is available to all PDP–11 family members.

CONFIGURATION RULES

In general, all PDP–11 devices that tie into the UNIBUS impose a single "bus load." (CPUs and the multi-device bulk storage bootstrap loader impose two bus loads each.) The UNIBUS can support 20 bus loads before a Bus Repeater must be added. A UNIBUS repeater allows an additional 18 unit loads and an additional 50 feet of UNIBUS cable to be added to a system.

In order to physically attach devices to a PDP–11, sufficient mounting hardware must be present. Free-standing and cabinet-mounted devices do not tie up space on the system's chassis.

Each PDP–11 has a basic chassis with a unique number of "system unit" positions in it. Each system unit (SU) is a space for mounting a backplane (backpanel mounting unit). The backplane is a printed circuit board with sockets. Each row of sockets is a slot. Currently available SUs can accommodate either seven hex and two quad slot modules or two hex and two quad slot modules. Quad slot modules have four consecutive fingers, while hex slot modules have six connector fingers. Each finger fits in its corresponding socket.

In order to expand memory and/or peripherals beyond the space limits permitted by the basic chassis, certain kinds of expander boxes must be used, expending upon the PDP–11 family model.

The PDP–11/23 PLUS systems, designed for technical OEMs, are available in two basic configurations. The entry-level configuration has twin 10.4 megabyte disk drives, VT100-family terminal, RSX–11M operating system software, and a processor with 256K bytes of memory. The other configuration has dual 10.4 megabyte drives, VT100-family terminal, TSX–11M-PLUS operating system, and a processor with 512K bytes of memory.

The three PDP–11/24 systems are available in these configurations: one has 128K bytes of memory, dual RX02 floppy disk drives, and a choice of a DECwriter IV hard-copy or VT100 video terminal. The second has 256K bytes of memory, dual RL02 10.4 megabyte disks, and a choice of VT100 or DECwriter III terminal. The third has 256K bytes of memory, dual 28MB RK07 disk drives, and a DECwriter III terminal. The configurations run under the RSTS/E operating systems, depending upon which is chosen.

The basic 11/44 is available in a 10.5 inch box with a 14-slot backplane, power supply, CPU, 256K bytes of memory, and

two cabinets. The backplane contains prewired areas for expansion of optional equipment.

The PDP–11/23S package consists of the PDP–11/23–PLUS CPU with two serial lines, boot diagnostic ROMs, line clock, a filter/cable assembly for SLUs, either 32KB of CMOS memory with on-board battery backup or 64KB of RAM memory, and an I/O patch panel with removable templates. The 3½ inch high box is 19 inch rack mountable and contains a 4 x 4 LSI–11 backplane.

The Micro/PDP–11 includes the PDP–11/23–PLUS CPU, two serial I/O ports, 256K bytes of parity memory, 5¼ inch Winchester disk unit with 10MB of storage, 5¼ inch dual floppy disk drive with a total capacity of 800KB, universal power supply, seven-slot LSI–11 bus backplane, and an I/O connector panel for extended cables.

WORKSTATIONS: From one to sixteen workstations can be configured on PDP–11 systems running under RT–11, RSX–11S, RSX–11M, and RSX–11M-PLUS operating systems. Up to 127 terminals can be configured on RSTS/E-based systems.

DISK STORAGE: Up to eight disk drives can be attached to RT–11, RSX–11S, RSX–11M, and RSX–11M-PLUS-based systems; up to sixteen can be attached to RSTS/E-based systems.

MAGNETIC TAPE: Up to eight magnetic tape subsystems can be attached to PDP–11 systems.

PRINTERS: Up to eight printers can be attached to RSTS/E-based systems. Only one printer can be attached to RT–11, RSX–11S, RSX–11M, and RSX–11M-PLUS-based systems.

MASS STORAGE

RX02 FLOPPY DISK: A floppy disk subsystem consisting of a controller and two drives. Each drive has a capacity of 512K bytes, for a capacity of 1024K bytes per subsystem. Data is recorded on 77 tracks on one side of the diskette. Each track is formatted into 26 sectors of 128 bytes each. Head movement time is 10 milliseconds per track plus 20 milliseconds head setting time. Rotational speed is 360 rpm, giving an average rotational delay of 83 milliseconds. Average access time is 357 milliseconds. The data transfer rate is 61,000 bytes per second. Track capacity is 3328 bytes, and the total capacity of one diskette is 256,256 bytes. The subsystem is manufactured by DEC.

RL01 5.2-MEGABYTE CARTRIDGE DISK DRIVE: This is a top-loading drive employing a removable cartridge. Features provided in the RL01 includes an embedded servo, allowing control information to be dispersed on each data track for data integrity. Disk rotational speed is 2400 rpm, and average rotation delay is 12.5 milliseconds. Average head positioning time is 55 milliseconds. Data transfer rate is 512K bytes per second.

RK07 28-MEGABYTE CARTRIDGE DISK DRIVE: This drive accepts a top-loading, dual-platter disk cartridge employing a technology similar to that of the IBM 3330 through the use of a track-following servo system. With this system, the bottom surface of one platter is dedicated to servo control and tracking information. Disk rotational speed is 2400 rpm, and average rotational delay is 12.5 microseconds. The data transfer rate is 538K bytes per second (3.72 microseconds per 16-bit word). Average access time is 49 milliseconds.

DEC PDP-11 Family

OPERATING SYSTEMS COMPARISON TABLE

	RT-11	RSTS/E	RSX-11M	RSX-11M-PLUS
Hardware utilization:				
LSI-11/2	Yes	No	No	No
LSI-11/23	Yes	No	No	No
PDP-11/03L	Yes	No	No	No
PDP-11/23	Yes	No	Yes	No
PDP-11/34A	Yes	Yes	Yes	No
PDP-11/24	Yes	Yes	Yes	No
PDP-11/44	No	Yes	Yes	Yes
PDP-11/70	No	Yes	Yes	Yes
Programming language support:				
Basic	Yes	No	Yes	Yes
Basic-Plus-Two	No	Yes	Yes	Yes
Cobol	No	Yes	Yes	Yes
CORAL 66	No	No	Yes	No
Fortran IV	Yes	Yes	Yes	Yes
Fortran IV Plus	No	Yes	Yes	Yes
MU Basic	Yes	No	No	No
Type of operating system:				
Single-user	Yes	No	No	No
Multi-user	No	Yes	Yes	Yes
Single-job	Yes	No	No	No
Foreground/Background	Yes	Yes	Yes	Yes
Multiprogramming	No	No	Yes	Yes
Time-sharing	No	Yes	Yes (quasi)	Yes
Multi-user data base mgmt.	No	No	No	No
Libraries:				
System subroutine	Yes	No	—	Yes
Object	Yes	Yes	Yes	Yes
Task checkpointing	No	Yes	Yes	Yes
Dynamic memory allocation	—	Yes	Optional	Yes
Memory mgmt. support (swapping)	Yes	Yes	Yes	Yes
Min./max. nonmapped memory (bytes)**	16K/56K	96K/—	32K/56K	—
Min./max. mapped memory (bytes)**	62K/248K	—/1920K	48K/3840K	—
Overlays	Yes	Yes	Yes	Yes
Mapped segments per process	—	2	8	8
Program scheduling:				
By operator	Yes	Yes	Yes	Yes
By event interrupt	Yes	No	Yes	Yes
By another program/task	Yes	Yes	Yes	Yes
By time of day	Yes	No	Yes	Yes
No. of on-line terminals allowed	16	127	32	50
No. of terminals in use simultaneously	16	63	16	—
Number of concurrent jobs	2	63	NSL*	—
Min. memory required for monitor (bytes)	4K	48K	16K	—
Monitor completely memory-resident	No	No	No	—
DBMS-11 support	No	No	Yes	Yes
Re-entrant I/O	—	—	Yes	—

*NSL (no software limitation); limited by hardware configuration or performance.
**The upper 8K bytes of memory are reserved for system use. Min./max. represents the smallest/largest processor requirements will vary.

► RK07 packaged products include the RK711-EA subsystem for the UNIBUS PDP-11 and the RK711-PA For the PDP-11/44. Both subsystems consist of one drive and a controller for up to eight drives. The RK07 drives are manufactured by DEC.

RM02 67-MEGABYTE DISK PACK DRIVE: This drive, like other disk pack drives offered by DEC for the PDP-11, employs a technology similar to that of the IBM 3330 through the use of a track-following servo system. In this system, one disk surface of each pack is dedicated to servo control and tracking information. The pack contains five platters, with the top and bottom platters employed for protection. Data is recorded on five surfaces. The drives

rotate at 2400 rpm, resulting in an average rotational delay of 12.5 milliseconds. Average head positioning time is 30 milliseconds, and data transfer rate is 806K bytes per second.

RM02 packaged products include the RJM02–AA single-access subsystem and the RJM02-BA dual-access subsystem. Both subsystems consist of one drive and a controller for up to eight drives.

RP06 176-MEGABYTE DISK PACK DRIVES: Employs a 12-platter disk pack and utilizes a technology similar to that of the IBM 3330, through the use of a track-following servo ►

DEC PDP-11 Family

OPERATING SYSTEMS COMPARISON TABLE (Continued)

	RT-11	RSTS/E	RSX-11M	RSX-11M-PLUS
I/O spooling	—	Yes	Yes	Yes
Line printer	—	Yes	Yes	Yes
Multiple copies	No	Yes	No	Yes
Specific priority, forms type	No	Yes	No	—
Time of day, generic queues	No	Yes	No	—
Card reader	—	No	No	—
Output buffering	—	Yes	Yes	Yes
Concurrent batch & I/O spooling	Yes (batch)	Yes	Yes	Yes
Disk file support	Yes	Yes	Yes	Yes
Linked	No	Yes	No	No
Contiguous	Yes	Yes	Yes	Yes
Mapped	No	No	Yes	Yes
Fixed & variable-length records	No	Yes	Yes	Yes
File access methods:				
Sequential	Yes	Yes	Yes	Yes
Index sequential	No	Optional	Yes	Yes
Direct access	Yes	Yes	Yes	Yes
Multi-keyed index sequential	No	Optional	Optional	Yes
Hierarchical	No	No	No	No
Device allocation control	No	Yes	Yes	Yes
Usage accounting	No	Yes	No	No
Intertask communications	Yes	Yes	Yes	Yes
Sharable data files	Yes	Yes	Yes	Yes
Sharable libraries	No	No	Yes	Yes
Sharable data areas	No	Yes	Yes	Yes
Task size (bytes) with/without mgmt.	—	56K/—	2000K/20K	—
Program priority levels	2	255	250	250
Disk/memory program swapping	No	Yes	Yes	Yes
System generation on target equip,	Optional	Yes	Yes	Yes

system. The bottom surface of the pack is dedicated to servo control and tracking. The drive rotates at 360 rpm, resulting an average delay of 8.3 milliseconds. The peak data transfer rate is 806K bytes per second (2.5 microseconds per 16-bit word). Average access time is 38.3 milliseconds.

Each subsystem includes a controller for up to 8 drives. Two types of controllers are offered: the "W" controller, and the "J" controllers, usable with all current PDP-11s. The "W" subsystems include either a single-access or dual-access disk drive and controller. A dual-port kit is optional, permitting single-access disk drives to be converted to the dual-access models. Both the "J" and "W" controller can connect to a dual-ported disk pack drive.

RUA80 121MB FIXED-DISK SUBSYSTEM: The RUA80 provides 121MB of storage in a 10.5 inch high package. It can combine with the RL02 removable disk cartridge to provide a low-cost, complete mass storage solution in a single cabinet. The RUA80 features a 1.2MB per second peak transfer rate, 33.3 msec average seek time, 8.33 msec average latency time, standard dual port option, 546 tracks per surface, 512 bytes per sector, and 3600 rpm rotational speed. Up to three RA80 drive units can be mounted in the 42 inch high H9642 cabinet. The RUA80 requires a PDP-11/24 and PDP-11/44.

RUA81 456MB FIXED DISK SUBSYSTEM: The RUA81 features a high-performance Winchester technology disk drive and an intelligent controller, the UDA50, that accelerates I/O throughput, performs expanded error recovery, and contains a twelve-sector data buffer to match the disk's 2.2MB burst data rate to the host system. The RUA81 features a 2.2MB per second peak transfer rate, 36.3 msec average access time, 28 msec average seek time, 8.33 msec average latency time, standard dual port option, 1248 tracks per surface, and 3600 rpm rotational speed. The

URA81 is offered in a single drive configuration (456MB) or in a 3-drive configuration (1.4GB) that takes only 5 square feet of floor space. The prerequisite for RUA81 subsystems is the PDP-11/44.

RUA60 205MB REMOVABLE-MEDIA DISK SUBSYS-TEMS: The RUA60 subsystem includes the UDA50 controller which provides several levels of performance optimization to improve disk throughput. A seek-ordering algorithm will reorder up to twelve I/O requests in the UDA50S command queue to minimize seek time, in single- or multidrive subsystems. The use of the UDA50 controller allows the user to mix RA60 disk drives with RA80 or RA81 disk drives. The RUA60 features 1.989MB per second peak transfer rate, 41.7 msec average seek time, 8/33 msec average latency time, standard dual-port option, 6 data media surfaces, 1600 tracks per surface, 43 sectors per track, and 3600 rpm rotational speed. Up to three RA60 drive units may be mounted in the 42 inch high H9642-AP(AR) deep cabinet. The RUA60 requires a PDP-11/44.

RL211 10.4MB CARTRIDGE DISK SUBSYSTEM: A single-drive buffered subsystem that features an embedded closed-loop servo positioning system that improves data integrity by continuously sampling servo information with the same head that reads and writes the data. The RL211 features a 512KB per second peak transfer rate, 55 msec average seek time, 12.5 msec average latency time, no dual-port option, 2 data surface, 40 sectors per track, 256 bytes per sector, and 2400 rpm rotational speed. It also features 4 drives per controller and a maximum 2 controllers per CPU.

INPUT/OUTPUT UNITS

DEC PDP-11 Family

▶ ment for the PDP-11 computers. Non-DEC peripheral devices that can be used with these and other popular minicomputers are summarized in Reports M13-100-301 through M13-100-601.

DATA COMMUNICATIONS

A discussion of data communications capabilities for the PDP-11 family involves more than a collection of hardware interfaces and a few software packages. Rather, it involves a marketing and engineering group—the Distributed Systems Group—which is chartered to develop, market, and generally further DEC's position in data communications. This group has taken its assigned tasks quite seriously and has developed hardware components, systems, and software packages in great numbers—so great, in fact, that the offerings of this *group* to the *companies* dedicated entirely to data communications.

Members of the PDP-11 line were selected for data communications use because of the wide spectrum of models with varying capabilities. DEC states that it has placed much emphasis on giving all the PDP-11s considerable data communications capabilities, pointing to their byte-handling capabilities and the UNIBUS architecture, which does not require additional multiplexing hardware for multiple communications channels or for DMA transfers. Also, all PDP-11 communicatons interfaces follow standard PDP-11 configuration rules. Special chassis and/or backplanes for communications options are not required, as is the case with some oher vendors' equipment.

Data communications control for all PDP-11s is supplied by numerous interface controllers. However, each of these has a number of variants and options so that PDP-11s can be connected to almost any type of communication channel (private phone, dial-up phone, 20-ma line, telegraph line), almost any type of terminal, or almost any type of modem. Supplementing these interfaces is additional data communications hardware to provide flexibility in unique situations. Please refer to the PDP-11 Equipment Price list in this report for a complete listing of PDP-11 Communication and Realtime I/O devices.

COMMUNICATIONS CONTROL

The interconnection of Digital systems with computers built by other manufacturers is supported by a family of products called *Internets*. DEC's protocol emulator (PE) products provide a way for DEC computers and terminals to communicate with computers and terminals built by IBM, CDC, and UNIVAC by emulating those manufacturers terminal and line products. Internet products include:

The *RT-11 2780/3780 Protocol Emulator (PE)* runs under the RT-11 Foreground/Background (FB) or Extended Memory (XM) monitor on a suitably equipped RT-11 system, providing emulation of an IBM 2780 or 3780 remote batch terminal. Any block addressable storage device supported by RT-11 can be used as a source of transmission files and any block addressable storage device or line printer supported by RT-11 can be used to receive files. Features supported by the RT-11 2780/3780 include commands for unattended operation, 2780 multiple record transmission option, transparent mode, 3780 space compression, variable horizontal forms control, and print and punch component selection on receive. A DU1, DUV11, OR DUP11 synchronous communications interface is required.

The *RSX-11 2780/3780 Emulator* emulates the communications protocol of an IBM 2780/3780 device while running as a user job under a suitably equipped RSX-11M or RSX-11M-PLUS system. It appears as an IBM 2780 or 3780 data transmission terminal on a point-to-point switched or nonswitched synchronous data link operating with standard 2780/2780 protocol, and can transmit and receive data and/or job control files with an IBM System/370, including 303X processor systems. On a mapped system, the RSX-11 2780/3780 Emulator also supports a spooling feature which allows users to queue one or more files for subsequent transmission or printing. Features include transmission from disk storage devices; transmission of queuing requests during unattended operation; binary or EBCDIC transmission; support of line speeds up to 9600 bps; automatic retry of unattended mode transmissions; error log recording and loopback facilities; and vertical and horizontal print format control.

The *RSX-11/3271 Protocol Emulator (PE)* permits user tasks running on a PDP-11 to communicate interactively with user jobs running on an IBM 360, 370 or 303X host system. The user task presents itself to the IBM system as an IBM 3277 display unit attached to an IBM 3271 control unit operating in slave mode. The protocol emulator operates as a device driver under RSX-11M, maintaining the synchronous line discipline on one side and interfacing with the user tasks on the other. The Protocol Emulator module supports up to six synchronous lines, each of which can be viewed by the 360 or 370 as a 3271 controller. The maximum number of RSX11M user tasks that can be supported by each pseudo controller is 32. The maximum number of supported lines and user tasks is a function of application requirements and buffer constraints.

RSX-11M/IAS RJE/HASP is a software package for performing the standard functions of an IBM HASP Remote Job Entry Workstation. RJE/HASP provides multileaved (pseudosimultaneous, bidirectional) communication of up to seven input and seven output data streams. Standard HASP protocol features include data compression of repeated sequential characters including blanks; full EBCDIC transparency; multileaving; and support of printer vertical forms to skip to channel 1 (top of form). Communications line control is performed directly by one of the RJE/HASP task. Concurrent use of the communications device by other RSX-11M or RSX-11M-PLUS tasks is precluded. Any mass storage or unit record device supported by RSX-11M or RSX-11M-PLUS can be used as a source or destination of data from a HASP data stream.

The *RSX-11M/SNA Protocol Emulator* provides an RSX11M system with the ability to participate in an IBM Systems Network Architecture (SNA) network. RSX-11M/SNA enables the RSX-11M user application programs to communicate with IBM application programs or system services on a task-to-task basis. Three modes of application programming support are offered to fit varied customer expertise and requirements: Emulator Control (EC), Extended Emulator Control (XEC) and Application Control (AC). RSX-11M/SNA supports up to 4 half-duplex or full-duplex synchronous lines at speeds up to a maximum of 61 user sessions. The supported communications devices are DUP11 or KMC11 with DUP11s. Co-residency with DECnet-11M or with RSX-11/3271 is not supported.

RSX DLX-11 is a low-overhead software communications line interface which provides users of Digital microcomputers access to Phase III DECnet networks. The product is available on the RSX-11M system for interfacing with a DECnet-11M or DECnet-11M-PLUS Phase III mode. RSX DLX-11 supports a single physical line in a point-to-point or multi-point connection. A user-written MACRO-11 program at each end of the line controls the communication line directly. The integrity and sequentiality of data sent over the line are maintained by the use of DECnet Digital Data Communication Message Protocol (DDCMP). ▶

DEC PDP-11 Family

> *RSTS/E-2780 Emulator* software emulates the communications protocol of an IBM 2780 device while running as user job under a suitably configured RSTS/E system. It will transmit files stored on any input medium (video or hardcopy terminals, lineprinter and card readers) and store files on any output medium supported by RSTS/E except DECtape. Files can print on any lineprinter supported by an RSTS/E operating system, excluding the LS11 printer.

The *RSTS/E High Performance 2780/3780 Emulator* emulates the communications protocol of an IBM 2780/3780 device while running as a user job under a suitably equipped RSTS/E system. It appears as an IBM 2780 or 3780 transmission terminal on a point-to-point switched or non-switched synchronous data link operating with standard 2780/3780 protocol, and can transmit and receive data and/or job control files with an IBM System/370, including 303X processor systems. Features include multiple record transmission; automatic retransmission and retry; CPU offloading of modem/line control and BSC protocol; short record (EM) detection for received files; and vertical and horizontal print format control. The RSTS/E/2780/3780 Emulator uses the KMC11 microprocessor to lower significantly the CPU overhead normally associated with bisynch communications. This option requires a DUP11-DA and a KMC11-A.

The *RSTS/E 3271 Protocol Emulator* permits user jobs running under the RSTS/E operating system to communicate interactively with user tasks running on an IBM 370 or 303X host system. The RSTS/E user program can be written in either Basic-Plus, Basic-Plus-2, Cobol, or Dibol. The IBM application program must run under either the IMS/VS or CICS/VS DB/DC systems. The package makes it possible for users to have remote, on-line access to IBM data bases, for the purposes of information entry, retrieval, update, or file transfer. Other features include line discipline; user job interface; and CPU off-loading. This option requires a DUP11-DA synchronous line interface and a KMC11-A communications processor.

MUX200/RSX-IAS is a software package that provides communications with a CDC 6000 CYBER series or other system using the 200 UT Mode 4A communications protocol. The PDP-11 user can communicate at command level with a host system, submitting jobs for batch processing and receiving results from the host. The software package can be configured to support either ASCII or external BCD versions of the communications protocol. MUX200/RSX-IAS enables several users to communicate simultaneously with a host system over a single line. The PDP-11 system, while using a single physical drop, appears to the host as a number of multidrops and terminals on the circuit.

UN1004/RSX is a software package which provides communication between a UNIBUS-based RSX-11M system and a UNIVAC 1100 series, or other system using the UNIVAC 1004 RMS-1 communications protocol. The software provides remote job entry (RJE) terminal emulation through which the user can send data in 80-column card format and receive data in line or card format. UN1004/RSX supports one synchronous communications circuit to a host computer, a single switched or dedicated lease line, 2-wire or 4-wire common carrier facility at transmission rates up to 4800 bpi, and ASCII line communications code. Only full duplex console terminals may act as emulator terminals.

RSX-11 PSI (Packetnet System Interface): RSX-11 PSI/M and RSX-11 PSI/M-PLUS allow suitably configured RSX-11M and RSX-11M-PLUS operating systems to connect to public packet-switching networks (PPSNs) conforming to the CCITT recommendation of June 1980. These PSI products support task-to-task communication via the network and remote terminal communication through a packet assembler/disassembler (PAD) facility provided by the network. Terminals connected to a host RSX-11M or RSX-11M-PLUS system cannot act as network terminals to other systems connected to the network. Access to RSX-11 PSI/M or RSX-11 PSI/M-PLUS is supported for RSX-11M user programs written in Macro-11, Fortran-IV, and Fortran-77. The communications discipline used is the CCITT V.24 (EIA-RS-232) at the hardware level, and symmetric LAPB varient of the X.25 frame level protocol and the X.25 packet level protocol.

RSX-11 PSI/M and RSX-11 PSI/M-PLUS can coexist with, or operate as a layered product under DECnet-11M or DECnet-11M-PLUS, allowing the use of DECnet facilities over PPSNs as well as private leased-lines or switched telephone networks. The Packetnet System Interface supports a subset of Digital's Network Architecture's management features including loading and unloading software, defining lines, and providing access to error counters and other maintenance functions. RSX-11 PSI/M and RSX-11 PSI/M-PLUS have been certified and are warranted on the following networks: Transpac (France), Datex-P (Germany), PSS (United Kingdom), and Telenet (U.S.A.).

DECNet: DECnet is a Phase III network product that allows a suitably configured system to participate as a routing or non-routing (end) mode in DECnet computer networks. DECnet offers task-to-task communications, utilities for network file transfer, homogeneous network command terminal support, and network resource capabilities, using the DEC Network Architecture (DNA) protocols. DECnet communicates with adjacent nodes over synchronous and asynchronous communications lines and parallel interfaces. Communication using X.25 circuits over selected public packet-switching networks is also possible when configured with the appropriate PSI product.

DECnet offers a wide range of networking functions over and above the data communications protocol which support a wide range of applications strategies: occasional update of remote files using remote resource sharing facilities and transfers of entire files from one system to another for intensive modifications are just two of the features which may be selected to help optimize productivity. Following is a summary of DECnet's features:

- Task-to-task communication—enables two programs to exchange information. These two programs can be running under different operating systems, and can be written in different languages.

- File transfer—exchange of sequential ASCII or binary files; DECnet handles compatibility issues among operating systems. The transfer of file types other than sequential ASCII and binary may also be supported between particular operating systems.

- Remote command file submission and execution—one system can direct another to execute a specified program, either resident on the remote system, or sent to the remote system as part of the request.

- Down-line loading—programs or whole software systems can be developed on a mode with appropriate peripherals and shipped to another.

- Network command terminal—a terminal user at one system may be logically connectd to another on the network running the same operating system and act as if directly connected to that route around line or system failures.

- Network management—DECnet products include the tools for monitoring and controlling network operation. >

► These include facilities for tuning network parameters, for logging events, and for testing nodes, lines modems, and communication interfaces. For monitoring network operation or for testing a new network application, DECnet, provides statistical traffic and error information. Access to such a network performance information allows potential problems to be solved before they degrade network performance.

A DECnet network may be configured so that each network member is fully connected with every other member, or may communicate with other network nodes through intermediate or routing network communicate via a user-defined "least cost" path but have the ability to detect and route around line or system failures.

DECnet nodes may communicate with adjacent nodes over synchronous and asynchronous communications lines and parallel interfaces. DECnet nodes may share a communications link in a multipoint configuration thereby reducing the high cost of multiple, directly connected communications lines. Microwave and satellite link (neither is available from DEC) are also used to connect DECnet nodes. DECnet-11M and DECnet-11M-PLUS nodes may communicate with each other with full DECnet functionality across a public packet switching network when used with the Packetnet System Interface (PSI).

RSX DLX-11 is a low-overhead software communications line interface which provides users of DEC's microcomputers access to Phase III DECnet networks. The product is available on the RSX-11M operating system for interfacing with a DECnet-11M or DECnet-11M-PLUS Phase III node. RSX-DLX-11 supports a single physical line in a point-to-point or multipoint connection. A user-written Macro-11 program at each end of the line control the communication line directly. The integrity and sequentiality of data sent over the line are maintained by the use of the DECnet Digital Data Communication Message Protocol (DDCMP).

SOFTWARE

OPERATING SYSTEMS: The major operating systems for the PDP-11 include the single-user RT-11 disk-based system; the RSTS/E resource-sharing time-sharing system; and the RSX-11 real-time multiprogramming systems: RSX-11M and RSX-11M-PLUS; RSX-11S; and DSM-11.

RT-11 is a compact, single-user, real-time operating system designed for interactive program development and/or online applications. Standard with all RT-11 systems are the MACRO-11 assembly language, the KED keypad editor, and the EDIT text editor. Optional software supported by RT-11 includes Fortran IV/RT-11, Basic-11/RT-11, MU Basic-11/RT-11 V2.1, DECnet-RT, and FMS-11/RT-11, Digital's Forms Management System.

RT-11 supports both single-job and foreground/background processing modes. In foreground/background mode, memory for user programs is divided into two separate regions. Two independent programs, therefore, can reside in memory and effectively share the resources of the system. The foreground program is given priority and executes until it relinquishes control to the background program. The background program then executes until the foreground program again requires control.

RT-11 supports indirect command files which further simplify system interaction. Users can construct indirect command files that contain strings of commonly issued keyboard monitor commands. By executing only the indirect file, users can invoke the stream of commands. Indirect command files

provide capabilities similar to batch processing, yet do not require users to learn the complicated job control language. RT-11 does include a batch facility, should it be required.

RT-11 offers program development tools including a choice of three text editors, file and device maintenance utilities, an online debugger, and a number of patch utilities. With DECnet RT, RT-11 systems can be linked with other Digital operating systems for network operation. Using Internet protocol emulators, RT-11 can communicate with IBM mainframe systems or other systems that support Binary Synchronous Communication (BSC) protocols.

RSTS/E, Resource Sharing Timesharing System/Extended, is a highly interactive, multiuser, multitasking, general purpose operating system. Standard with all RSTS/E systems are BASIC-PLUS and some features of BASIC-PLUS including the BASIC-PLUS editor, MACRO-11 assembly language, RMS (Record Management Services) data management subsystem, and the SORT-11 utility; it supports BASIC-PLUS-2, PDP-11 Cobol, Cobol 81, FMS11/RSTS/E, Fortran IV, Fortran 77, DATATRIEVE-11 data inquiry and report writing package, DECnet/E Phase III, DECword/DP and the RSTS/E-2780, RSTS/E/3271, and RSTS/E High Performance 2780/3780 Protocol Emulators for IBM interconnects. RSTS/E systems support concurrent interactive timesharing, transaction processing, batch processing, and program development.

RSTS/E dynamically allocates system resources such as processor time, memory space, file space, and peripherals on a best fit/best throughput basis to continually keep processing efficient. Shared common code, shareable data, and intertask communication save memory space and increase performance, while disk data cache, overlapped seeks, and file placement control speed up disk access times and operating system throughput.

RSTS/E application development tools include a wide range of high-level languages, data management and file processing facilities, program development aids, and communications capabilities. RMS and SORT-11 provide extensive file processing and data management services, i.e. sequential, relative, and multikey ISAM support, file sharing, and protection mechanisms. Using facilities that support multiple job terminals, some RSTS/E systems may be able to support up to 127 concurrent terminal users, despite the fact that the maximum number of simultaneous jobs per RSTS/E system is limited to 63.

Additional features of the RSTS/E operating system include disk file and device backup and restore utilities, system management operations and access control utilities, userdefinable terminal commands, multistream batch processing facilities, lineprinter spooling, and extensive system maintenance tools, including automatic device error logging.

RSX-11M is a multiuser, multiprogramming, realtime operating system designed to serve a broad range of realtime applications. Standard on all RSX-11M systems are the MACRO-11 assembly language, the FILES-11 data management services file system that provides volume structuring and protection, FCS (File Control Services), a basic file handling system, RMS-11, a superset of FCS, and the EDI and EDT editors. Optional software includes Basic 11/IAS-RSX, Basic-PLUS-2, CORAL 66, Fortran IV/IAS-RSX, Fortran IV-PLUS, PDP-11 Cobol, DECnet-11M Phase III, and the SORT-11 utility. Optional data management services include FMS-11/RSX, a forms management system, RMS-11K, record management services, DATATRIEVE-11, a record management services query language, and DBMS-11, a data base management system. RSX-11M systems support up to 32 simultaneous users. ►

DEC PDP-11 Family

► RMS (Record Management Services) is a superset of FCS (File Control Services), the basic file handling system for RSX-11M/RSX-11M-PLUS systems, and is compatible with FCS written files. RMS has two variations: RMS-11, which comes with the RSX-11M operating system, and RMS-11K, which is optional and provides the additional capability of multikey indexed sequential file organization. RMS permits relative, sequential, and single-key indexed sequential file organizations, and sequential, random, and record's file address access modes.

RSX-11M is designed to support factory automation, laboratory data acquisition and control, graphics, process monitoring and control, communications, and other applications that demand immediate response. In addition, because of its multiprogramming capabilities, RSX-11M permits realtime activities to execute concurrently with less time-critical activities such as program development, text editing, and data management. RSX-11M provides the environment for development and execution of multiple realtime tasks with a priority structured event-driven scheduling mechanism. Program development and realtime tasks can execute concurrently in systems with at least 48KB of memory.

The *RSX-11M-PLUS* operating system is a superset of the RSX-11M operating system. It takes advantage of the expanded addressing capability of the PDP-11/24 and PDP11/44 while maintaining the reliability and architecture of the RSX-11M operating system. RSX-11M-PLUS supports up to 50 simultaneous users and provides facilities for batch job execution, interactive program development and execution, and timesharing.

Standard on all RSX-11M-PLUS systems are the MACRO-11 assembly language and the FILES-11 data management services file system that provides volume structuring and protection, FCS, RMS-1K, and the EDI and EDT editors. Optional software includes Basic/11/IAS-RSX, Basic-PLUS-2, Fortran IV/IAS-RSX, Fortran IV-PLUS, PDP-11 Cobol, DECnet-11M-PLUS Phase III, and the SORT 11 utility. Optional data management services include FMS11/RSX, DATATRIEVE-11, and DBMS-11. In addition, RSX-11M-PLUS supports DCL (Digital's standard command language), multistream batch processing, accounting, dynamic dual-ported disks, additional memory management capability, and more simultaneous tasks and terminals than RSX-11M.

RSX-11S is a memory-based subset of the RXS-11M operating systems. RSX-11S provides a runtime environment for execution of tasks on a memory-based processor. Memory resident application programs require the support of a disk-based host system like RSX-11M or RSX-11M-PLUS for program development. RSX-11S has most of the RSX-11M features and generation capability, and supports all of the peripheral devices that are supported under RSX-11M. Other features included on RSX-11S are a monitor console routine, on-line task loader, system image preservation program, and file control services for record devices.

The *DSM-11* operating system is a multiuser, data management system that consists of an interactive high-level programming language, Digital Standard MUMPS (Massachusetts General Hospital Multiprogramming System), a data management facility, and a timesharing executive. Many users can access DSM-11 simultaneously and be relatively unaffected by the activities of other users. Digital Standard MUMPS, an extension of the American National Standard Specification, is a high-level language oriented towards solving database problems. It can be used by programmers with relatively little programming experience. Implementation of the Digital Standard MUMPS language as an interpreter facilitates program development by eliminating the need to load editors, assemblers, and linkers. The

languages text-handling capabilities allow the inspection of any data item for content or for format. These capabilities are useful for online data entry checking and correction. Other text-handling capabilities include the ability to concatenate text strings and to segment text.

The DSM-11 hierarchical file structure allows users to design data file strategies to suit the needs of a particular processing environment. Dynamic file storage with variable length string subscripts allows for easy modification or expansion of the database. Other features of the DSM-11 operating system are: high-performance database handler using memory-resident cache or disk data for data sharing among users; distributed database management implemented using DMS11/DMR11 high speed data links; online, high-speed, database backup, disk media preparation and bad-block management, and tape-to-tape copying; automatic powerfail restart capability; and hardware device error reporting, system patching utility, and executive debugger for system maintenance.

LANGUAGES: DEC offers several major programming languages for the PDP-11 family of computers.

Fortran IV is an extended superset of the ANSI X3.9-1966 standards for this scientific and engineering programming language. Its high-speed, one-pass optimizing compiler works efficiently in small memory environments, making Fortran program development possible on smaller PDP-11 systems. Because it can produce absolute binary code suitable for standalone PDP-11 systems or for loading into ROM or PROM memory, Digital's Fortran IV is especially useful for industrial applications such as control programs for automated equipment. Other features of Fortran IV include the ability to use general expressions in all meaningful contexts; mixed-mode arithmetic; the BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output.

DIBOL-11, DEC's Business-Oriented Language, is a high-level language for commercial applications programming. It is similar to Cobol in that it has a DATA DIVISION, a PROCEDURE DIVISION, and uses English-like procedural statements (although more concise than those of Cobol). Unlike Cobol, DIBOL-11 is designed specifically for creating interactive applications programs. DECFORM is an easy-to-use data entry and file inquiry package, included with DIBOL-11 for designing screen formats for data entry. Using interactive video terminals, programmers can produce forms on the terminal screen that closely resemble traditional printed forms. Thus, DIBOL-11 and DECFORM work together for programmers designing applications in data entry and retrieval (such as accounting).

Both DIBOL-11 and DECFORM have their own interactive debugging utilities to speed program development. DIBOL-11 performs data manipulation; arithmetic expression evaluation; table subscripting; record redefinition; external calls to other programs, and both sequential and random access to files. DECFORM features facilities for defining data entry field protection, autoduplication, alphabetic or decimal checking, range checking, field totaling, crossfield validation, and auto-increment of counters.

Basic-11/RT-11, based on Basic developed at Dartmouth College, is a conversational programming language utilizing simple English language-like statements and familiar mathematical notations to perform operations. It is an incremental, interactive, interpretive compiler and features support for real, integer, double precision and string data types; immediate mode statements for debugging and desk calculator usage; sequential data storage using the RT-11 file system; string capability, including string arrays and functions; disk virtual arrays for string, integer and real data types; chaining with COMMON to accommodate large ►

DEC PDP-11 Family

▶ programs; CALL facility for invoking assembly language subroutines using a PDP-11 Fortran-compatible call interface; and formatted output using the PRINT USING statement.

PDP-11 Basic-Plus-2 is a superset of the Basic-Plus and Dartmouth Basic languages which use simple English language-like statements and familiar mathematical notations to perform operations. The language processor is composed of a compiler and an Object-Time System/Library that contains the following run-time routines: performing library and arithmetic functions; handling dynamic allocation of string storage and I/O buffers; handling I/O operations; and processing errors in arithmetic, I/O, and system operations. Other features include extensive string manipulation functions; terminal-format files; virtual arrays; matrix package handling operations; RMS I/O; and external subprograms such as SUB, CALL, CHAIN and COMMON; and other user-defined functions.

CORAL 66 is a high-level block-structured programming language. It is the standard general purpose language prescribed by the British Government for real-time and process control applications. This language is designed to replace assembly level programming in modern industrial and commercial applications. It is used for long-life products where ease of maintenance and flexibility are required. Features of Coral 66 include BYTE, LONG (32-bit integer) and DOUBLE (64-bit floating point) numeric types; reentrant code at the procedure level; executable generated code; switchable options to select target PDP-11 computer instruction sets, optimize generated code, check the bounds of array-type variables, control listing output, or read card format; and conditional compilation of defined parts of source code.

Cobol-81 is a highly efficient Cobol compiler for small RSTS/E systems. Cobol-81 can compile at 500 lpm on a PDP-11/44 and is upward compatible with VAX-11 Cobol. Cobol-81 is designed for small systems where compactness, speed, ease of use, and the ability to migrate to VAX-11 Cobol are more important than an extensive list of high-level Cobol features. Cobol-81 supports numeric COMP-3 packeddecimal data; numeric COMPUTATIONAL (COMP) binary data; alphanumeric DISPLAY data (ASCII); and NUMERIC DISPLAY data (ASCII). The compiler's sequential I/O and multikey indexed I/O modules meet the full ANSI-74 Level 1 standards. Additional I/O features include variable-length records through extensions to the RECORD SIZE clause and the ability to designate indexed input files as OPTIONAL. Cobol-81 runs on any PDP-11 system with an extended instruction set.

PDP-11 Fortran-77 is an optimizing, high-performance compiler for the RSX and RSTS/E operating systems. It is an extended implementation of the subset Fortran language defined by the ANSI standard. It is both a compatible superset of PDP-11 Fortran IV-Plus and a subset of VAX-11 Fortran. PDP-11 Fortran-77 programs can be recompiled for use on a VAX system without changes to the source code. Fortran applications using any subset ANSI 77 features will run on this compiler. If programs use only ANSI 77 features, they should run with little or no modifications. Among the major features defined by the ANSI subset are a CHARACTER data type and a BLOCK IF contruct including 'IF...THEN, ELSE IF, ELSE, and END IF statements, for conditional execution of blocks of statements.

DATA MANAGEMENT: The paragraphs following are generalized descriptions of some of the PDP-11 data management packages.

FMS-11 (Forms Management System) is a software package used by applications programmers to build interactive screen-oriented data entry capabilities into their application programs. Used in conjunction with a standard programming language such as Fortran, Cobol-81, or PDP-11 Basic-PLUS-2, FMS-11 can be used for any data entry application in which paper forms were traditionally used—inventory, payroll, bookkeeping, patient admittance, etc. Components of the FMS-11 package are: the Form Editor for layout and modification of video forms on a VT100 screen; the Video Keypad Editor for general-purpose text editing of standard ASCII files; the Form Utility for manipulation of FMS forms descriptions during debugging; the Form Driver for performing screen processing at application run-time; and on RT-11, the Application Run-Time Supervisor for running application programs independently of programs running on other system terminals.

FMS-11/RSX Upgrade option permits currently licensed users of FMS-11/RT to purchase the license to a FMS11/RSX upgrade kit for use on the same CPU as their previous license. This option includes binaries, license, and full support services.

SORT-11 is an optional data sorting utility that can accept as input any RMS-11 format file and output a reordered RMS-11 format file. Input files can contain data stored in binary, EBCDIC, or ASCII format, and the file organization can be sequential, relative, or indexed sequential. Records can be sequenced by key fields in ascending and descending order. SORT-11 cannot be used to merge two separate files. SORT-11 provides four different user-selectable, sorting processes: Record Sort (manipulates records in their entirety); Tag Sort (produces a reordered file by manipulating only the key position of each record); Address Routing Sort (produces a file for the date and multiple address files that are used to access the data in the desired sequences); and Index Sort (produces a separate index file that contains the record SORT key field and a pointer to the record's location in the data file).

DATATRIEVE-11 is an inquiry and report writing system that allows interactive data retrieval, sorting, and updating; report generation and creation; and maintenance and accessing of data dictionary entries that define RMS-11K records. Like RMS-11K, DATATRIEVE-11 runs under RSTS/E or RSX-11M. The system has capabilities to handle RMS-11K files created by Cobol, Basic-PLUS II, DIBOL, and macro assembler programs. DATATRIEVE-11 provides 10 query commands, 6 parameters for report writing, 5 commands for report writing, 5 statistical functions, and a process for storing often-used statements in the data dictionary as procedures. DATATRIEVE-11 requires an RSTS/E or RSX-11M configuration including memory management hardware, 64K bytes of user memory, and hardware multiply/divide.

WORD PROCESSING: *DECword/DP* is a software package that puts fully-featured word processing in the RSTS/E timesharing environment. It can be run from any VT100 terminal used to access a RSTS/E system, and gives end-users the type of text-manipulation features usually associated with standalone word processor equipment. DECword/DP is suitable for regular RSTS/E end-users who need to prepare occasional memos and short reports. DECword/DP provides industry-standard features such as menu-driven function selection, cut and paste, forward and reverse scrolling, global search and replace, and automatic word wrap. It also offers a variety of advanced features including footnoting, spelling error detection, list processing, and computer-aided instruction in using its software.

GRAPHICS: *PLXY-11* is a software package designed to provide RT-11, RSX-11M, RSX-11M-PLUS, and RSTS/E applications programmers with access to the plotting capabilities of Digital's LXY11/LXY21 lineprinter/plotters. Using the PLXY-11 graphics subroutines, pro- ▶

DEC PDP-11 Family

▶ grammers can create software that prints out representations of data in graphs and charts with clear alphanumeric labeling. This makes PLXY–11 useful in equipping scientific, engineering, statistical, and econometric application programs with graphics.

The *BCP Bar Code/Block Character* software package lets RSX–11M users print out industry-standard Code 39 bar codes on Digital's LXY11/LXY21 printer/plotters. The package provides quick and easy production of labels for warehouse, stockroom, and other inventory tracking operations. The package's interactive user program lets users enter data to be coded for immediate printout of bar codes and block-lettered labels. A library of graphics routines are also provided that may be combined with applications programs written in PDP-11 Fortran-77, for fully automated label generation. Both parts of the package require that the RSX–11M system on which they run have Fortran–77 plus a minimum 40K words of memory.

The *Professional Tool Kit* lets programmers use PDP-11 RSX–11M and RSX–11M–PLUS systems to develop application programs for Digital's Professional 300 Series Personal Computers. Using the software and optional hardware in the package, applications programmers can create and debug applications compatible with the Professional's P/OS menu-driven environment using their current PDP–11 system. The Tool Kit includes the Macro–11/Professional, Basic-PLUS–2/Professional, and Fortran–77/Professional programming languages; the RMS/Professional Record Management System; FMS/Professional for forms-oriented video I/O management; the SORT/Professional record sorting utility; the Professional Graphics Package for over 20 device-independent graphics commands; the Professional Diskette Builder for end-user media distribution; and the Professional Debugger for use with Basic-PLUS–2/Professional. Applications are developed on the host PDP–11 system and then transferred to a Professional 350 system for debugging.

ADE (Applications Development Environment) is a programming tool specifically designed for non-programmers to use in developing and running small, simple applications for use in small businesses. It allows users with little or no computer experience to preform record keeping and bookkeeping tasks such as maintaining and printing mailing lists, inventory lists, time sheets, and budgets. ADE runs in the RSTS/E timesharing environment.

ADE presents electronic worksheets made up of rows and columns on a user's video terminal. Users work with these worksheets by writing procedures—simple programs using English verbs. Procedures can store information from worksheets in tables kept in disk files, or retrieve such information; manipulate the entries in a worksheet; or print out reports. An interactive HELP command, continuous display of messages and available commands and messages at the bottom of the terminal screen, and interactive command prompting help users step by step.

MENU–11 is a software package that allows application programmers to design customized interface between an RSTS/E system and its users. It allows for RSTS/E's DCL command language environment to be sealed off from novice or infrequent users and replaced with a set of interactive menus backed by help texts, giving users access to just those procedures and utilities needed in their work. MENU–11 consists of a set of programs that interact with RSTS/E and control the display of menus to users according to command files prepared by programmers. The command files specify the format and content of menus; help text associated with each menu option; actions to be taken when an option is chosen (including conditional execution of actions); transfers between different menus; and interactions with the user

to gather more information. Menu options can execute system commands, run application programs, and generally perform action or series of actions possible under RSTS/E.

PRICING

POLICY: DEC generally provides the PDP-11 minicomputers on a purchase basis, with separately priced maintenance agreements. DEC's Customer Finance Department is organized to enable customers to acquire a system using a lease, conditional sale, or similar financing agreement rather than outright purchase. CFD's function is to write full payout financing agreements for credit worthy DEC customers who seek financing. Available are full payout leases with 3 to 5 year terms, non-cancellable 3 to 5 year conditional sales agreements, and 3 to 5 year U.S. government lease to ownership agreements.

Software maintenance is offered through several levels of optional service, ranging from a periodic software newsletter to automatic updates of software and manuals (software subscription service). In addition, software components, including documents and updates, can be purchased separately from Digital's Software Distribution Center.

In September 1979, DEC announced a new and expanded warranty policy and contract services for software products including operating systems, programming languages and utility packages. The new services include a toll-free telephone support line for immediate response to questions on software usage and performance. Warranty service was expanded to include more than 150 products. New warranty services covering Digital-supported products include automatic delivery of Software Product Updates released during the 90 day warranty period and use of the Telephone Support Center for selected products. DEC will continue to provide installation service, on-site support, technical newsletters and a performance reporting service. Software product services extending beyond the warranty period range from comprehensive "DECsupport," which provides continuation of warranty-level support with visits for preventive maintenance, to a Software Product and Documentation Update service for self-maintenance customers. Service contracts carry monthly charges according to product and level of service.

The Digital Equipment Computer Users Society (DECUS) is a voluntary, non-profit users' group supported by DEC. DECUS provides an extensive program library, users' groups, special interest groups, and workshops/symposia. Technical symposia are sponsored twice a year in the United States and once a year in Europe, Canada, and Australia. In terms of documentation, the society has the responsibility of maintaining the DECUS program library and publishing a library catalog, the proceedings of symposia, and a periodic newsletter, DECUSCOPE.

Training credits are issued with many of the PDP-ll systems, allowing the customer to obtain free training in programming techniques and systems operation and applications. Each individual student week of instruction or fraction thereof requires one training credit. Training is offered in 17 DEC facilities found in Japan, Australia, Great Britain, Germany, France, The Netherlands, Sweden, Italy, Canada, and throughout the United States. At present, over 100 courses are offered. Digital also offers on-site instruction in both standard and customized courses and self-paced audio/visual (A/V) courses. A/V courses are presented through mixed media of audio/film-strip cartridges, video cassettes, and workbooks. A/V courses include Introduction to the PDP11, Introduction to Minicomputers, and Introduction to Data Communications Concepts. DEC's Special Systems group offers training in both hardware and software areas on-site and in DEC training centers. ▶

DEC PDP-11 Family

▶ Field service is offered on several levels to meet varying customer needs. For customers with in-house troubleshooting and self-maintenance capabilities, DEC offers the off-site facilities of its Product Repair Center (PRC), with 17 locations throughout the world. Services provided by PRC include return-to-PRC agreements which cover all repairs (user performs troubleshooting) on a specific CPU, peripheral, or system for one year; exchange service providing teletypewriters, punches, and selected disk drive exchange at a flat rate; a fixed quote service, which provides a quote on equipment repair before any work is performed; and a loose piece module repair plan for modules and subassemblies. Under the repair plan, DEC estimates a typical turn-around repair time of 20 working days after receipt at the customer returns area (CRA). PRC also offers a module exchange service on a yearly contract basis, allowing a customer to replace a defective module within seven working days from the time it is received at the CRA. DEC supplies special mailers for both the loose piece module repair plan and the module exchange service. Also available for this class of customer is a customer spares program, which includes component and subassembly spares, engineer-designed spares kit, memory stack spares, maintenance test equipment, maintenance documentation service, and emergency parts service.

On-site field service is offered worldwide through a network of 300 offices, 190 of which are located in North America. These offices provide both field service and spare parts inventory. Over 4000 service representatives are assigned to these offices.

Per Call On Site Service is offered to customers for whom downtime may not be critical and who have sufficient expertise to perform first-line maintenance, or as a supplementary program for standard service agreement customers if remedial maintenance is required outside their normal hours of coverage. Labor rate charges are portal-to-portal; parts and travel expenses are rated separately.

The basic field service agreement includes remedial maintenance; preventive maintenance; an assigned service representative; all parts, material, and labor; engineering modifications; and documentation. Hours of coverage are 8 a.m. to 5 p.m. Monday through Friday. (Preventive maintenance time is extended by 3 hours to 8 p.m. on weekdays.)

Extensions are available to allow coverage up to 24 hours a day, 7 days a week.

The DECservice agreement is the same as the basic field service agreement except for these additions: response time of four hours or less if a call is made during coverage hours; continuous service until system level repairs are complete; and no extra charge for service continued after coverage hours.

EQUIPMENT: A large number of packaged PDP-11 systems appear in the Equipment Price List which follows.

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
LSI-1 SINGLE BOARD PROCESSORS			
KD11-HA	LSI-1/2 Central Processor Unit (CPU); 64KB addressing modes	840	22
KDF11-AC	LSI-11/23 CPU with 64KB addressing ranges; 46 optional floating point instructions; two modules	1,140	22
KDF11-AA	LSI-11/23 CPU with Memory Management Unit (MMU); physical address range to 4MB	1,340	22
KDF11-BA	PDP-11/23-PLUS CPU with all KDF11-AA features; two serial lines; diagnostics; boot; program controlled line clock	1,690	39
KDF11-BE	KDF-BA with boot ROM for MICRO/PDP-11	1,690	39
KDF11-BP	KDF11-E with cable and filter attachments for the two serial line units	1,790	39
PDP-11 COMPUTER BOXES AND KERNAL SYSTEMS			
11/23-BC (BD)	PDP-11/23-PLUS computer box with 11/23-PLUS Central Processor Unit (CPU); 256KB memory; two serial line units; line frequency clock; boot and diagnostics ROMS: nine slot backplane (seven open slots)	5,690	82
PDP-11/24-AA(AB)	PDP-11/24 small box computer with CPU; 128KB MOS memory; bootstrap terminator module; rack-mountable 5.25 in BA11-L chassis; line frequency clock	10,000	84
PDP-11/24/AC(AD)	Same as PDP-11/24-AA(AB) but with 256KB MOS memory	11,000	116
PDP-11/24-BC (BD)	PDP-11/24 large box computer with CPU; 256KB MOS memory; line frequency clock; bootstrap terminator module; rack-mountable 10.5 inch BA11-A chassis (includes a nine-slot backplane)	12,500	126
PDP-11X24-BC(BD)	PDP-11/24 kernal system with CPU; 256KB MOS memory; 10.5 inch chassis (BA11-L) mounted in a 41.75 inch H9642 cabinet; sufficient space in the cabinet for the H7750 battery backup and two 5.25 inch communications distribution panels	14,000	126
PDP-11/44-CA(CB)	PDP-11/44 computer with CPU; 256KB MOS memory; bootstrap terminator module; cabinet-mountable in BA11-A chassis; line frequency clock; two serial lines	29,300	168
PDP-11/44-DA(DB)	PDP-11/44 computer with CPU; 1MB MOS memory; bootstrap terminator module; cabinet-mountable in BA11-A chassis; line frequency clock; two serial lines	—	—
PDP-11X44-CA(CD)	PDP-11/44 kernal system with CPU; 256KB MOS memory; 10.5 inch chassis (BA11-L) mounted in a 41.75 inch H9642 cabinet; sufficient space in the cabinet for the BBU and two 5.25 inch communications distribution panels; TU58 cartridge tape used to load system diagnostics and software updates	31,800	158
PDP-11X44-DA(DB)	PDP-11/44 kernal system with CPU; 1MB MOS memory; 10.5 inch chassis (BA11-L) mounted in a 41.75 inch H9642 cabinet; sufficient space in the cabinet for the BBU and two 5.25 inch communications distribution panels; TU58 cartridge tape used to load system diagnostics and software updates	33,000	154

▶

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MICRO/PDP-11 SYSTEMS			
SX-RA500-FA	Micro/PDP-11 microcomputers include 11/23 PLUS CPU module with bootstrap ROM and diagnostics; RT-11, RSX-11M, RSX-11M-PLUS, RSX-11S or RSTS/E operating system; 256KB MOS memory; 22-bit memory management; 2-line asynchronous EIA/CCITT Interface, one for console terminal and one for expansion; DZV11-C 4-line asynchronous multiplexor; one 5.25 inch 10MB Winchester disk subsystem for use as backup and load device; one 5.25-inch 800KB diskette subsystem for use as the backup and load device; one System Distribution Panel for I/O connection; one 24.5-inch upright cabinet; and PDP-11 Operating System Generator License	10,225	109
PDP-11/23-PLUS SYSTEMS			
SX-RXMMA-EK(EN)	PDP-11/23 PLUS RLO2-based systems include CPU; RT-11, RSX-11M, RSX-11M-PLUS, RSX-11S, or RSTS/E operating system; bootstrap module with diagnostics; 512KB MOS memory; 22-bit memory addressing; 2-line asynchronous EIA/CCITT interfaces; system distribution panel for serial line and options interconnect; one RLV22 disk subsystem with one controller and one 10.4MB RLO2 removable cartridge disk drive, one 10.4MB RLO2 removable cartridge dis drive for use as the backup and load device; one 41.75 inch high H9642 cabinet and one BC22A-25 cable for console terminal (console terminal not included)	20,750	245
PDP-11/23S SYSTEMS			
—	PDP-11/23S microcomputer systems include PDP-11/23 PLUS CPU; 2 serial lines; boot diagnostic ROMs; line clock; filter/cable assembly for SLUs; either 32KB CMOS memory with on-board battery back-up or 64KB RAM memory; I/O patch panel with removable templates; one 3.5 inch high box which is 19 inch rack mountable; and a 4 x 4 LSI-11 backplane	3,740	—
PDP-11/24 SYSTEMS			
SX-FXMMA-EK(EN)	PDP-11/24 RLO2-based systems include CPU; RT-11, RSX-11M, RSX-11M-PLUS, RSX-11S or RSTS/E operating system; KT24 Physical Address Extension (PAX) module; 256KB ECC MOS memory; 22-bit memory addressing; microprocessor- controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; 41.8 inch H9642 CPU cabinet; one RL211 disk subsystem, with one controller and one 10.4MB RLO2 removable cartridge disk drive, one 10.4MB RLO2 removable cartridge disk for use as the backup and load device; one H9642 bolt-on RLO2 disk drive cabinet; 1 Quad slot, 4 Hex slots and 4 System Units of expansion space; and one BC22A-25 cable included for console terminal (console terminal not included)	27,200	276
SX-FXHHA-EK(EN)	PDP-11/24 RK07-based systems include CPU; RT-11, RSX-11M, RSX-11M-PLUS, RSX-11S or RSTS/E operating system; KT24 Physical Access Extension (PAX) module; 256KB ECC MOS memory; 22-bit memory addressing; micorprocessor controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; one H9642 48.1 inch CPU cabinet; one RK711 disk subsystem: one controller and one 28MB RK07 disk drive; one 28MB RK07 disk for use as the backup and load device; one H9642 bolt-on RK07 disk cabinet and one freestanding H9642 cabinet; 2 Quad slots, 3 Hex slots and 1 System Unit of expansion space; and one BC22A-2S cable included for console terminal (console terminal not included); BC22A-2S cable included for console terminal (console terminal not included)	32,300	430
SX-FXGMA-EK(EN)	PDP-11/24 RA80-based systems include CPU; RT, RSX-11M, RSX-11M-PLUS, RSX-11S or RSTS/E operating system; KT24 Physical Address Extension (PAX) module; 512KB ECC MOS memory; 22-bit memory addressing; microprocessor-controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; one H9645 41.8 inch CPU cabinet; one RUA80 disk subsystem: one controller and one 121MB RA80 disk drive; one RL211 disk subsystem: one controller and one 10.4MB RLO2 removeable cartridge disk drive; 1 Quad slot, 1 Hex slot and 4 System Units of expansion space; and one C22A-25 cable included for console terminal (console terminal not included)	42,000	407
PDP-11/44 SYSTEMS			
SX-40MMA-EK(EN)	PDP-11/44 RLO2-based systems include CPU; RT-11, RSX-11M, RSX-11M, RSX-11M-PLUS, RSTS/E or IAS operating system; 512KB ECC MOS Memory; 8KB parity cache memory; 22-bit memory adressing; microprocessor-controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; H9642 41.8 inch CPU cabinet; one RL211 disk subsystem: one controller and one 10.4MB RLO2 removable cartridge disk for use as the backup and load device; dual TU58 cartridge tape subsystem (256KB per cartridge); one H9642 bolt-on RLO2 disk cabinet; 1 Quad slot and 3 System Units of expansion space; and BC22A-25 cable for console terminal (console terminal not included)	47,700	342

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
SX-40HHA-EK(EN)	PDP-11/44 RK07-based systems include CPU; RT-11, RSX-11M, RSX-11S, RSX-11M-PLUS, RSTS/E or IAS operating system; 512KB ECC MOS memory; 8KB parity cache memory; 22-bit memory addressing; microprocessor-controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; H9642 CPU cabinet; one RK711 disk drive; one 28MB RK07 disk for use as the backup and load device; dual TU58 cartridge tape subsystem (256KB per cartridge); one H9642 bolt-on RK07 disk cabinet and one freestanding H9642 RK07 cabinet; 2 Quad slots, 3 Hex slots, and 1 System Unit of expansion space; and one BC22A-25 cable for console terminal (console terminal not included)	51,800	496
SX-40GZA-EK(EN)	PDP-11/44 RA80-based system building blocks include CPU; RT-11, RSX-11M, RSX-11S, RSX-11M-PLUS, RSTS/E or IAS operating system; 1MB ECC MOS memory; 8KB parity cache memory; 22-bit memory addressing; microprocessor-controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; CPU cabinet; one RUA80 disk subsystem: one controller and one 121MB RA80 disk drive; dual TU58 cartridge tape subsystem (256KB per cartridge); one H9642 bolt-on RA80 disk cabinet; 3 Quad slots, 6 Hex slots and 1 System Unit of expansion space; and one BC22A-25 cable included for console terminal (console terminal not included)	53,900	265
SX-40GMA-EK(EN)	PDP-11/44 RA80-based system includes CPU; RT-11, RSX-11M, RSX-11S, RSX-11M-PLUS, RSTS/E and IAS operating system; 1MB ECC MOS memory; 8KB parity cache memory; 22-bit memory addressing; microprocessor-controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; H9645 CPU cabinet; dual TU58 cartridge tape subsystem; one RUA80 disk subsystem: one controller and one 121MB RA80 disk drive; one RL211 disk subsystem: one controller and one 10.4MB RL02 removable cartridge disk drive; 3 Quad slots, 5 Hex slots, and 1 System Unit of expansion space; and one BC22A-25 cable included for console terminal (console terminal not included)	60,300	377
SX-40PZA-EK(EN)	PDP-11/44 RA60 System Building Blocks include CPU; RT-11, RSX-11M, RSX-11S, RSX-11M-PLUS, RSTS/E or IAS operating system; 1MB ECC MOS memory; 8KB parity cache memory; 22-bit memory addressing; microprocessor-controlled ASCII console; bootstrap module with diagnostics; 2-line asynchronous EIA/CCITT interfaces: one for the console and one for expansion; CPU cabinet; dual TU58 tape cartridge subsystem (256KB per cartridge); one RUA60 removable disk subsystem: one controller and one 202MB RA60 removable disk drive; one 42 inch high H9642-AP(AQ) bolt-on RA60 disk cabinet; 3 Quad slots, 6 Hex slots, and 1 System Unit of expansion space; and one BC22A-25 cable included for console terminal (console terminal not included)	54,900	264

PROCESSOR OPTIONS

MICRO/PDP-11 and PDP-11-PLUS Processor Options

KEF11-AA	Single and double precision floating point option; the microcode to implement this option resides in two chips on one 40-pin package; performs hardware options on 32-bit and 64-bit floating point numbers; provides up to 17 digits of precision, as well as integer to floating point conversions; mounts on CPU board	225	NC
FPF11	Single and double precision floating point option; microcode to implement this option resides on one quad module mounted adjacent to CPU; performs hardware operations on 32-bit and 64-bit floating point numbers; provides up to 17 digits of precision, as well as integer to floating point conversions; executes instructions approximately six times faster than the KEF11-AA	2,000	25
KEF11-BB	Commercial Instruction Set (CIS); implements a set of 27 commercial instructions on a variety of data types, including character strings, packed decimal and numeric formats	495	NA
MSV11-PK	256KB dynamic Random Access Memory with parity	1,900	28
MSV11-PL	512KB dynamic Random Access Memory with parity	3,000	55
MCV11-DA	8KB MOS dynamic Random Access Memory with on-board battery backup	625	9
MCV11-DC	32KB MOS dynamic Random Access Memory with on-board battery backup	990	18

PDP-11/24 Processor Options

KEF11-AA	Single and double precision floating point option for use with PDP-11/24; microcode to implement this option resides in two chips on one 40-pin package; performs hardware options on 32-bit and 64-bit floating point numbers; provides up to 17 digits of precision as well as integer to floating point conversions; mounts on the CPU board	225	NC
FPF11	Single and double precision floating point option for use with PDP-11/24; microcode to implement this option resides on one quad module mounted adjacent to the CPU; performs hardware operations on 32-bit and 64-bit floating point numbers; provides up to 17 digits of precision as well as integer to floating point conversions; executes instructions approximately six times faster than the KEF11-AA	2,000	25
KEF11-BB	Commercial Instruction Set (CIS) for the PDP-11/24; implements a set of 27 commercial instructions on a variety of data types, including character strings, packed decimal and numeric formats	495	NA
MS11-LB	128KB parity MOS memory	1,190	44
MS11-LD	256K parity MOS memory with the KT24 Physical Address Extention (PAX) module	1,700	83
MS11-PB	1MB ECC MOS memory	4,900	46
KT24	Physical Address Extension (PAX) module allows memory expansion up to 4MB with a 5.25 inch CPU box and up to 1MB with a 10.5 inch CPU box	800	16
H775-A	Battery backup for 5.25 inch PDP-11/24 CPU	700	8
H7750-BA(BD)	Battery backup for 10.5 inch PDP-11/24 CPU	1,600	16

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
► PDP-11/44 Processor Options			
KE44-A	Commercial Instruction Set (CIS) processor for the PDP-11/44; implements a set of 27 commercial instructions on a variety of data types, including character strings, packed decimal and numeric formats	7,900	18
FP11-F	Floating point processor for the PDP-11/44 with 46 floating point instruction set; performs hardware operations on 32-bit and 64-bit floating point numbers providing up to 17 digits of precision as well as integer to floating point conversions.	2,000	25
MS11-MB	256K ECC MOS memory	2,500	50
MS11-PB	1MB ECC MOS memory; backwards compatible with MS11-MB memory	4,900	46
H7750-BA(BD)	Battery backup	1,600	16
MASS STORAGE			
RUA80-CA(CD)	RUA80 fixed disk subsystem with 121MB storage; contains RA80 cabinet-mounted disk drive and UDA50 controller; 1.2MBS peak transfer rate; 33.3 msec average access time; requires PDP-11/24, 11/44	21,000	111
RUA80-AA(AD)	Same as RUA80-CA(CD) except with RA80 rack-mounted disk drive (no cabinet) and UDA50 controller	19,000	111
RA80-CA(CD)	RA80 H9642 cabinet-mounted add-on disk drive; requires RUA80-AA(AD)	16,000	81
RA80-AA(AD)	RA80 rack-mounted disk drive (no cabinet); requires RUA80-CA(CD)	14,000	81
RUA81-CA(CD)	RUA81 fixed disk subsystem with 456MB formatted capacity per drive; contains RA81 cabinet-mounted disk drive and UDA50 controller; 2.2MBS peak transfer rate; 36.3 msec average access time; requires PDP-11/44	26,000	120
RA81-CA(CD)	RA81 H9642 cabinet-mounted add-on disk drive	21,000	90
RA81-AA(AD)	RA81 disk drive; no cabinet	19,000	90
RUA60-CA(CD)	RUA60 removable-media disk subsystem with 205MB-formatted capacity per drive; contains RA60-AA cabinet-mounted disk drive and UDA50 controller; 1.98MBS peak transfer rate; 50 msec average access time; requires PDP-11/44	22,000	110
RUA60-JA(JD)	Same as RUA60-CA(CD) except with RA60-AA cabinet-mounted disk drive and two UDA50 controllers	27,000	140
RA60-CA(CD)	RA60-AA H9642-AP(AR) cabinet-mounted add-on disk drive	17,000	80
RA60-AA	RA60 rack-mounted disk drive; no cabinet	15,000	80
RL211-AK	RL211 cartridge disk subsystem; top-loading removable cartridge disk drive and controller to interface to the PDP-11 UNIBUS; 10.4MB RL02 disk drive; 512KBS peak transfer rate; 67.5 msec average access time	6,900	71
RLV22-AP	RL211 cartridge disk subsystem; LSI-11 BUS	6,900	73
RL02-AK	Add-on cartridge disk; requires RL211-AK	3,000	63
RL02K-DC	10.4MB disk cartridge for the RL02	199	NA
RK711-PA(PD)	RK711 disk drive and controller; subsystem consists of an RK07 28MB top-loading disk drive with disk carridge and controller mounted in a 41.75 inch high freestanding cabinet; 538KBS peak transfer rate; 49 msec average access time	18,500	161
RK07-PA(PD)	RK07 28MB top-loading add-on cartridge disk with disk cartridge mounted in a 41.75 inch high freestanding H9642 cabinet; requires RK711-PA(PD)	13,000	127
RK07K-DC	28MB disk cartridge for the RK07 disk drive	430	NC
RK07K-AC	28MB alignment disk cartridge for the RK07 disk drive	1,483	NC
RK07K-EF	Error-free 28MB disk cartridge for the RK07 disk drive	650	NC
RX211-BA(BD)	RX211 dual floppy disk drive and controller to interface to the PDP-11 UNIBUS includes two RX02 0.5MB drives; 61KBS peak transfer rate; 262 msec average access time	4,150	50
RSV21-EA(ED)	Table-top RX421 dual floppy disk drive and controller to interface to the LSI-11 bus; requires PDP-11/23 PLUS	4,500	50
CARTRIDGE TAPE			
TU58-DA	TU58 cabinet-mountable dual drive cartridge tape subsystem including the necessary hardware for mounting in standard cabinetry; 800 bpi record density; 30 ips read/write speed; 262KB capacity per cartridge	1,850	17
TU58-EB	Same as TU58-DA except tabletop version	1,750	17
TU58-K	One 256KB TU58 data cartridge for the TU58-DA and TU58-EB	23	NA
MAGNETIC TAPE			
TS11-CA(CB)	Nine track TS11 magnetic tape subsystem mounted in a 60.5 inch high H9646 cabinet; 1600 bpi record density; 45 ips read/write speed; requires a PDP-11/24 or PDP-11/44	16,400	79
TJE11-AA(AD)	TE16 magnetic transport and controller to interface with the PDP-11 UNIBUS; includes the controller, a tape formatter, and one nine track TE16 tape transport; 1600 bpi and 800 bpi record densities; 45 ips read/write speed; mounted in 60 inch H9602 cabinet	27,000	163
TE16-AE(AJ)	TU77 magnetic tape transport	15,900	97
TJU77-AB(AD)	TU77 magnetic tape transport and controller to interface to the PDP-11 UNIBUS: includes the controller, a tape formatter and one nine track TU77 tape transport; 1600 bpi and 800 bpi record densities; 125 ips read/write speed	36,800	259
TU77-AF(AJ)	TU77 magnetic tape transport	23,800	193
TU80-AA(AB)	TU80 magnetic tpae subsystem; 1600 bpi, 25/100 ips, half-inch magnetic tape subsystem; employs start/stop and streaming tape technology; interfaces to any UNIBUS system; includes tape drive cabinetry	9,900	63
TSV05-BA(BB) (BD)	TSV05 magnetic tape system mounted in a 40 inch H9642 cabinet; microprocessor based one-half inch magnetic tape subsystem incorporates reel-tape technology; 1600 bpi; 25 ips read/write speed; requires a MICRO/PDP-11 or PDP-11/23-PLUS	9,995	85

►

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
▶ TERMINALS			
VT100-AA(AB)	VT100 tabletop video display terminal; operates on full duplex asynchronous communications lines, and is equipped with a standard EIA interface; 50 to 19,200 bps baud rate; 24 lines x 80 characters or 14 lines x 132 characters (selectable); 7 x 9 dot matrix, 2-dot descenders; 94-character ASCII and 32 special graphic features	1,945	18
VT101-AA(AB)	VT101 tabletop video display terminal; operates on full-duplex, asynchronous communications lines and is equipped with a standard EIA interface; 50 to 19,200 bps baud rate; 24 lines x 80 characters ASCII set with 32 special graphic characters; 83-key detachable unit; standard numeric/function keypad	1,350	15
VT102-AA(AB)	VT102 tabletop video terminal; 50 to 19,200 bps baud rate; 24 lines x 80 characters or 132 characters; 7 x 10 dot matrix with 2 dot descenders; 94-character ASCII set with 32 special graphics characters; U.S. and British character sets standard, others optional; normal or reverse video, blinking, underline, and bold characters on a character-by-character basis; standard numeric/function keypad	1,710	22
VT125-AA(AB)	VT125 tabletop graphics terminal operating with EIA/CCITT Interface; 50 to 19,200 bps baud rates; even, odd or none (keyboard selectable parity; 768 x 240 pixel graphics resolution; printer port for graphics mode (for use with LA34-VA); 24 lines x 80 characters or 14 lines x 132 characters; 7 x 10 dot matrix with descenders; 96-ASCII character set (upper/lower case, numeric and punctuation) with 32-character special graphics set, split screen capability	3,800	29
VT131-AA(AB)	VT131 video terminal with full VT102 capability plus local editing and block mode transmission	1,825	23
VT1XX-AA	20mA adapter for the VT100; allows VT100 terminal to convert from an EIA interface to a 20mA current loop interface	140	4
VT1XX-AB	Advanced video option for the VT100/VT125	180	4
VT1XX-AC	Printer port option; allows connection of a VT100 to a hardcopy printer	350	7
VT1XX-CA	20mA interface adapter option for VT100/VT101/VT102/VT125/VT131	140	4
VT1XX-CB	Graphics upgrade kit for VT100 to VT125 graphics functionality	1,800	11
VT1XX-CE	Word processing upgrade kit for VT100 and VT125	395	NA
VK100-AA(AB)	GIGI (General Imaging Generator and Interpreter) VK100 tabletop keyboard terminal; includes graphics, multiple character sets, local intelligence, local ROM Basic, 8 level color support, graphics printer interface, screen control functions and graphics tablet support; operates over full-duplex, asynchronous serial communication lines and on either EIA or 20mA communications interfaces	2,500	23
LA34-RA	DECwriter IV graphics printing terminal, basic printer; 110 to 9,600 bps baud rate; 45 ips print speed (text mode); 320 columns per second or 960 dots per second (graphics mode); 132 print columns; 128-character ASCII set	1,230	21
LA34-VA	Systems graphics printer; same as LA34-RA and also includes roll paper holder, paper low detection option; BC22A-25 cable, ribbon cartirdge, and one roll of paper	1,340	21
LA34-WA	Receive only printer; same as LA34-RA and also includes tractors, paper out switch option; BC221-25 cable, ribbon cartridge and tractor feed paper sample	1,400	21
LA38-GA	Tabletop DECwriter IV printing terminal; 110 or 300 bps buad rates; 30 cps print speed; 7-bit ASCII character set plus ANSI-compatible escape sequences; 10/12/13.2/16.5 character per inch	1,550	18
LA38-HA	DECwriter IV printing terminal; same as LA38-GA except is the freestanding version	1,660	18
LINEPRINTERS			
LN01-CA(CB)	High-quality nonimpact printer using laser technology; 12 pages per minute printing speed; 188 character set; portrait and landscape print modes; LP11 interface and cable included	19,995	320
LXY11-XX	Line printer/plotter; 300/240/170 lpm printing speeds; 16.7 inch per minute plotting speed; 96 ASCII standard character set; 8 inch per second paper slew speed	11,250	141
LXY21-XX	Line printer/plotter; 600/465/320 lpm print speeds; 33.3 inch per minute plot speed; 96 ASCII standard character set; 16 inch per second paper slew speed	15,800	163
LP11-AA	Band printer; 300 lpm for 64 ASCII character set	8,350	100
LP11-BA	Band printer; 300 lpm for 64 ASCII set or 215 lpm for 96 ASCII character set	8,950	100
LP11-CA(CD)	Line printer; 900 lpm for 64 ASCII character set	32,500	205
LP11-DA(DD)	Line printer; 600 lpm for 96 ASCII character set	34,500	205
LP11-EA	Line printer; 600 lpm for 64 character set	13,600	143
LP11-EB	Line printer; 600 lpm for 64 character set or 445 lpm for 96 character set	14,400	143
LP11-GA	Line printer; 905 lpm for 96 character set; requires PDP-11/70	45,000	400
LP11-GB	Line printer; 1200 lpm for 64 character set; requires PDP-11/70	45,000	400
CARD READERS			
CR11(A)	Tabletop card reader and controller; 285 cpm card speed; 550 card capacity; standard 12-row 80-column EIA (Hollerith code) hole punched cards; non-packed and packed data formats	9,495	74
CR11-BC(BD)	Tabletop card reader and controller; 600 cpm card speed; 1000 card capacity; standard 12-row 80-column EIA (Hollerith code) hole punched cards; non-packed and packed data formats	13,455	76
CMS11-KA(KB)	Tabletop card reader and controller; 250 cps card speed; 250 card capacity; standard 12-row 80-column EIA (Hollerith code) hole punched cards; non-packed and packed data formats	5,695	96

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
► EXPANSION HARDWARE			
DD11-CK	Four slot expansion backplane for use in BA11-K and BA11-L expander boxes; also mounts in the PDP-11/24 and PDP-11/44 CPU boxes; accommodates two hex and two quad modules	470	NC
DD11-DK	Nine slot expansion backplane for use in BA11-K and BA11-L expander boxes; also mounts in PDP-11/24 an PDP-11/44 CPU boxes; accommodates seven hex and two quad modules	940	NC
BA11-K(KX)	UNIBUS expansion box; cabinet mountable expander box with bezel and slides for use in H9642-DB(DC) cabinets	3,500	20
BA11-LE(LF)	UNIBUS expansion box; cabinet mountable expander box with bezel for use in PDP-11/24 and PDP-11/44 systems	2,700	14
BA11-SE(SF)	Extended LSI-11 bus expansion box; cabinet mountable expander box with bezel required for 22-bit expansion or use in PDP-11/24-PLUS system	2,000	15

LSI COMMUNICATIONS OPTIONS

DLV11 and DZV11 Asynchronous Interfaces

DLV11	Asynchronous, EIA RS-232-C, or 20mA line interface LSI-11 bus to several types of serial communications lines; module receives serial data from peripheral device, assembles into parallel data streams and transfers to LSI-11 bus; accepts data from LSI-11 bus and converts it into serial data for transmission to peripheral lines; supports a variety of data rates, in addition to selectable stop data bits, even, odd, or no parity, and may be run in full- or half-duplex mode		
DLV11-E	Single-line EIA interface with full modem control; data rates from 50 to 19,200 bps; compatible with Bell 103, 113, 202C, 202D and 212 modems; cable not included; for use on LSI bus system	440	8
DLV11-ED	Same as DLV11-E; for use on PDP-11/23-PLUS system	490	8
DLV11-EP	Same as DLV11-E; for use on MICRO/PDP-11 system	490	8
DLV11-JA	Four-line EIA/CCITT asynchronous interface without modem control; data rates from 150 to 38,400 bps; external cable not included; for use on PDP-11/23- PLUS system	650	10
DLV11-KA	EIA to 20mA converted with BC21A-03 cable for connection to the DLV11-J; cable not included	190	7
DZV11	Asynchronous 4-line multiplexer provides an interface beween LSI-11 processor and up to 4 asynchronous serial data communications channels, either terminal or modem; data rates up to 9600 bps; can be used with LSI-11 processor in a variety of applications that include data concentration, realtime processing, and cluster controlling; provides EIA interface levels and enough data set control to permit dial-up (auto-answer) operation with modems using full-duplex operation such as Bell models 103, 1113, or equivalent; does not support half-duplex operations	900	10
DZV11-C	Four-line asynchronous multiplexer; cable not included; for use on PDP-11/23- PLUS system	900	10
DZV11-CP	Four-line asynchronous multiplexer; cable not included; for use on MICRO/ PDP-11 system	900	10

DUV11, DPV11, and DMV11 Synchronous Interfaces

DUV11	Single-line, double-buffered, program-controlled communications interface used to establish a data communications link between any LSI-11 bus and a Bell 201 synchronous modem or equivalent; fully programmable with respect to sync characters and parity selection; provides serial-to-parallel and parallel-to-serial data communications, buffers TTL-EIA voltage levels, and controls modem for half- or full-duplex operation; also interfaces synchronous and isochronous communications data; transmits EIA CCITT data at rates up to 9600 bps		
DUV1-DE	Synchronous single-line interface; includes EIA modem cable; for use on PDP-11/23-PLUS system	990	8
DUV11-DP	Synchronous single-line interface, includes EIA modem cable; for use on MICRO/PDP-11 systems	990	8
DPV11	Single-line program-controlled, double-buffered communications device interfaces the LSI-11-based processor to a serial synchronous line; suited for interfacing to medium-speed synchronous lines for packet switching, remote batch, remote data collection, remote concentration and network application; capable of handling, under program control, a wide variety of protocols, including byte-oriented protocols such as DDMP and BISYNC and bit-oriented protocols such as HDLC and ADCCP		
DPV11-DC	Single-line synchronous interface; includes modem cable, for use on PDP-11- PLUS system	770	13
DMV11	Multipoint, multidrop intelligent microprocessor-bases synchronous line controller supports full- or half-duplex Direct Memory Access (DMA) data transfer in either point-to-point or multipoint operation; depending on operating system and layered software implementation, will support up to 12 multipoint tributaries; controller microcode handles all DDCMP protocol processing, thereby offloading the central processor; point-to-point operation can communicate with a DMC11, DUP11, DPV11, DMR11, DMP11, or DMV11 device operating in the same mode; in multipoint operation the complementary devices must be DMP11s or DMV11s	770	13
DMV11-AA	Supports EIA RS-423-A operation up to 56K bps, and EIA RS-232-C CCITT V.24, or CCITT V.28 operation at 19.2K bps; external cables not included; for use on PDP-11/23-PLUS system; cable for RS-423-A operation not available from Digital	2,200	39

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
DMV11-AP	Supports EIA RS-232-C, CCITT V.24, or CCITT V.24 or V.28 operation at 19.2K bps; for use on PDP-11/23-PLUS and MICRO/PDP-11 systems; external cables not included	2,200	39
DMV11-FP	Supports EIA RS-423-A operation up to 56K bps; for use on MICRO/PDP-11 system; external cable not available for Digital	2,300	39
DMV11-AB	Supports CCITT V.35/DDS operation up to 56K bps; for use on PDP/11-23-PLUS system; external cables not included	2,300	39
DMV11-BP	Supports CCITT V.35/DDS operation up to 56K bps; for use on PDP-11/23-PLUS system; external cables not included	2,300	39
DMV11-AC	Includes integral modem; supports fixed data rate of 56K bps; for use on PDP-11/23-PLUS system; external cables not included	2,000	39
DMV11-CP	Includes integral modem; supports fixed data rate of 56K bps; for use on MICRO-PDP-11 system; external cable not included	2,000	39

UNIBUS COMMUNICATION OPTIONS

DL11 Single-Line Asynchronous Interfaces

DL11	Single-line asynchronous interfaces provide local and remote intercommunication of the UNIBUS to terminals and other computer systems; selectable character size, parity stop bit(s), and speed of operation; operate in full-duplex or half-duplex mode	—	—
DL11-E	EIA/CCITT serial line interface with modem control; jumper selectable options; compatible with Bell 103, 113, or 202 modem; data rates from 50-9600 bps; cable included	1,170	8
DL11-WA	20mA serial line interface and line frequency realtime clock; switch-selectable options; data rates from 110-9600 bps; character formats are switch-selectable; cable for terminal connection is included	990	7
DL11-WB	EIA/CCITT RS-32-C serial line interface and line frequency realtime clock; switch-selectable options; includes BCO5C-25 cable; data rates from 110-9600 bps; character formats are switch-selectable	950	7
DL11-WC	Same as DI1-WB; includes BCO3L-10 cable	950	7

DZ11 Asynchronous Multiplexers

DZ11	Asynchronous serial communications interfaces can be used for local or remote connection of UNIBUS systems for up to 16 terminals or to another system; programmable speeds up to 9600 bps and format on a per-line basis, operating at full-duplex	—	—
DZ11-A	Eight-line multiplexer for EIA/CCITT terminals; can be expanded to 16 lines with the addition of a DZ11-B; includes modem control for use with Bell 103 or 113 modems or equivalent; cable not included	2,700	33
DZ11-B	Eight-line EIA/CCITT expansion multiplexer for the DZ11-A; cables not included	2,150	28
DZ11-C	Eight-line multiplexer for 20mA current loop terminal; can be expanded to 16 lines with the addition of a DZ11-D; cable not included	3,000	33
DZ11-D	20mA current loop expansion multiplexer for the DZ11-C; cables not included	2,310	28
DZ11-E	16-line multiplexer for EIA/CCITT terminals or lines; includes data set control for use with Bell 103 or 113 modems or equivalent; cables not included	4,350	56
DZ11-F	16-line multiplexer fo 20mA current loop terminals; cables not included	5,000	56
DH11	16-line asynchronous NPR multiplexers for local or remote connection of UNIBUS to EIA/CCITT terminals; operating in full- or half-duplex mode; they support per-line program control for data rates up to 9600 bps, character size, stop bit, and transmission mode; split-speed transmit and receive rates are supported	—	—
DH11-AD	Includes modem control; cables not included	8,950	68
DH11-AE	Does not include modem control; cables not included	7,950	57

DUP11 and DMR11 Single-Line Synchronous Interface

DUP11	Full- or half-duplex synchronous interface can be programmed to handle 8-bit character-oriented protocols such as DDCMP and Bisync and bit-oriented protocols such as SDLC and HDLC; hardware calculates CRC-16 when using DDCMP, and CRC/CCITT when using bit-oriented protocols	—	—
DUP11-DA	Interfaces to Bell 200 series modems or equivalent at speeds up to 9600 bps; includes data set control and cable for modem connection	1,575	12
DMR11	High-performance DDCMP-based microprocessor and synchronous line unit interface are used in local system interconnection or for connection to external modems for remote networking; can be used to communicate with another DMR11, DMV11, or other DDCMP microprocessor-based interface, or to some other synchronous interface with software implementation of DDCMP V3.1 or 4.0; half- and full-duplex operation are supported		
DMR11-AA	Interfaces to EIA RS-232-C synchronous modems (Bell series compatible) at speeds up to 19.2K bps, or EIA RS423/CCITT V.24 synchronous modems at speeds up to 56K bps; includes data set control; cable not included	4,400	39
DMR11-AB	Interfaces CCITT V3.5/DDS synchronous modems (Bell 500A LI/5 or equivalent) at speeds up to 1M bps; includes data set control and cable for modem connection	4,400	39
DMR11-AC	Includes integral modem for local interconnection; cables not included	4,400	39
DMR11-AE	Interfaces to EIA RS422/CCITT V.24 synchronous modems; supports speeds up to 1M bps; includes data set control for switched network operation; cable not included (cable is not available through Digital)	4,400	39

DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
DMP11 Multipoint Synchronous Interfaces			
DMP11	Microprocessors and synchronous line units provide multipoint or point to point network links using DDCMP protocol for local and remote communications; operate in full- or half-duplex mode; will support up to 32 tributaries; multipoint operation; the complementary devices must be DMP11s DMV11s or VAX systems DMF32s (as tributaries only); point to point communication, the DMP11 can be used to communicate with another synchronous interface having software implementation of DDCMP Version 3.1 or 4.0		
DMP11-AA	Interfaces to EIA RS-232-C synchronous modems (Bell series 200 compatible) at speeds up to 19.2K bps or EIA RS423/CCITT V.24 synchronous modems at speeds up to 56K bps; includes data set control; cable not included	6,900	74
DMP11-AB	Interfaces to CCITT V.35/DDS synchronous modems (Bell 500A LI/5 or equivalent) at speeds up to 56K bps, includes data set control cable and cable for modem connection	6,900	74
DMP11-AC	Includes integral modem; for local interconnection; cable not included	6,900	74
DMP11-AE	Interfaces to EIA RS422/CCITT V.24 synchronous modems, supports up to 1M bps (HDX) or 500K bps (FDX); includes data set control for switched network operation; cable not inlcuded	6,900	74
Multipoint Parallel Interface			
PCL11-B	Multidrop communications link that connects up to 16 processors in a local distributed processing network; data is transmitted in block mode with Direct Memory Access (DMA) via a time division multiplexed (TDM) 16-bit parallel bus; total TDM bus bandwidth ranges up to 1M bps; total bandwidth between any transmitter and receiver can be as high as 500K bps depending on the percentage of bandwidth that is allocated to the transmitter; data is transmitted at full duplex; CRC and word parity error detection supported by hardware, maximum TDM bus length is 300 ft; additional intermode cables may be purchased separately	7,750	66
Auxiliary Communications Microprocessors			
KMC11-A	High-speed general purpose microprocessor that logically interfaces between synchronous and asynchronous I/O options and the central processor	2,580	24
KMS11-BD(BE)	Intelligent front-end processor used to implement PSI or custom networking applications; high speed (up to 5600 bps) operation using DMS transfers or support up to 8 full-duplex synchronous lines; the DMC11-B, an integral part of the KMS11-BD(BE), offers 4K words of Writable Control Storage and 4K words of RAM storage; modem control is supported on switched and unswitched lines using Bell 201, 208, 209, or equivalent modems; interface signals supported are EIA RS-232-C and RS423-C CCITT V.24 and MIL 1880-114 unvalanced	12,500	97
Statistical Multiplexer			
	The DZ Statistical Multiplexer is the term used to describe a statistical multiplexer network comprised of one DZS11-EA and any combination of one or two VT1XX-EB remotely located asynchronous terminals to share a common composite communications link		
DZS11-EA	A single module containing a DZ11-A asynchronous multiplexer emulator and a statistical multiplexer; program-compatible with the DZ11-A and therefore interfaces to the operating system via standard device drivers; to VAX/VMS, A DZ Statistical Multiplexer network consisting of a DZS11-EA and one or two VT1XX-EBs appears as eight asynchronous terminals connected via a standard DZ11-A multiplexer; DZS11 can replace up to sixteen modems and eight separate telephone lines with two modems and one synchronous line; for connections less than one kilometer apart, all modems can be eliminated by using one RS422 long line cable	4,050	38
VT1XX-EB	An eight-channel statistical multiplexer enabling eight asynchronous terminals to be statistically multiplexed to a DZS11-EA via the composite communication link; VT1XX-EB has two composite communications ports, the main and the route-through; the main composite communication port interfaces to a primary device (a DZS11-EA or another VT1XX-EB is the second cluster controller) via the main composite link; the route-through port is implemented; both composite ports operate independently at baud rates from 1200 to 19,200 bps from an internal or external timing source.	4,050	28
Communications Arithmetic Option			
KG11-A	Communications arithmetic option; computers cyclic redundancy check (CRC), longitudinal redundancy check (LRC), and block check characters (BCC)	1350	7
Auto Dial Interfaces			
DN11-AA	Frame for up to 4 DN11-DA module sets	1,320	7
DN11-DA	Module set interface to Bell 801 ACU; includes 25 foot cable	825	7
Modems (Available in U.S. only)			
DF02-AA	Direct connect, full-duplex, asynchronous modem operating at speeds up to 300 bps; allows terminals and processors to communicate over unconditioned, dial-up lines	450	12

DEC PDP-11 Family

		Purchase Price	Monthly Maint.
DF02-AC	DF02 modem with serial Automatic Call Unit (ACU); uses asynchronous ASC11 input format at switch-selectable data rates of 110 or 300 bps; stores up 16 digits for dialing/redialing	650	14
DF03-AA	Direct connect, full-duplex, synchronous/asynchronous modem operating at speeds of 0-300 bps or 1200 bps; allows terminals and processors to communicate over unconditioned, dial-up lines	895	14
DF03-AC	DF03 modem with serial Automatic Call Unit (ACU); switch-selectable data rates of 110, 300, or 1200 bps; stores up to 16 digits for dialing/redialing	1,095	15

REALTIME I/O OPTIONS

LSI-11 Realtime I/O Options

DRV11-LP	General purpose program-controlled parallel line interface unit; permits program-controlled data transfers at rates up to 40K words per second; cables not inlcuded; requires MICRO/PDP-11	400	6
DRV11-BP	General purpose direct memory access (DMA) parallel line interface unit; permits data transfers at rates up to 250K words per second in a single cycle mode and up to 500K words per second in burst mode; cables not inlcuded; requires MICRO/PDP-11	740	9
DRV11-JP	General purpose program controlled parallel line interface; contains 64 bidirectional input/output lines as configured as four 16-bit ports; bit interruptable up to 16 lines; interrupt vectors may have fixed or rotating priorities; cables not inlcuded; requires MICRO/PDP-11, PDP-11/23-PLUS	520	9
DRV11-JA	Same as DRV11-JP	520	9

UNIBUS Realtime I/O Options

AA11-KT	Package of AA11-K, 12-bit 4-channel digital-to-analog converter and CRT control, distribution panel, and BCO8R cable	1,650	8
AD11-K	12-bit, 16-channel single-ended/8-channel true differential analog-to-analog converter with self-test and softwre-controlled vernier offset	2,850	37
ADK11-KT	Package of AD11-K analog-to-digital converter, KW11-K realtime clock, distribution panel, and two BCO9R cables	3,950	56
AM11-K	48-channel single-ended or 24-channel differential expander switch gain multiplexer; 6 gain levels per 16 channels; requires AD11-KT	1,550	17
AR11-KT	Package of AR11 analog realtime subsystem, which inlcudes 10-bit analog-to-digital, 16-channel multiplexer, smaple hold, two 10-bit digital-to-analog converter, CRT control, and crystal clock with programmable frequencies; includes distribution panel and BCO8R cables	2,500	22
DR11-C	General purpose digital interface; permits bi-directional 16-bit parallel transfers between the user's device and the UNIBUS; includes all necessary interrupt, address, and control signals and all required cable connectors	640	7
DR11-KT	Dr11-K general purpose digital interface packge; this general purpose digital interface permits bidirectional 16-bit parallel transfers between the user's device and the UNIBUS; features include recoverable over-voltage protection; can accommodate both pulse and buffered data input; each line can generate an interrupt	1,360	8
DR11-W	General purpose direct memory access (DMA) controller which interfaces user devices to the PDP-11 UNIBUS	1,650	11
JW11-K	Dual programmable realtime clock; one 16-bit clock and one 8-bit clock, 5 crystal-controlled frequencies, 1 external, 1 line frequency, and 1 special frequency, 3 Schmitt triggers and 4 modes of operation	1,150	20
KW11-P	Programmable realtime clock; program-selectable interrupts of 100 Khz, line frequency or external signal	880	9

SOFTWARE PRICES

		License Fee ($)
QS813	Fortran IV/RT-11	1,250
QS813	Basic-11/RT-11	1,450
QJD59	RT-11 280/3780 Protocol Emulator	3,500
QJ713	FMS-11/RT-11	3,110
QJ718	FMS-11/RSX Upgrade	1,550
QP301	DATATRIEVE/RSX	7,000
QJ918	PDP-11 Basic-Plus-2/RSX	6,400
QSD82	RSX-11 2780/3780 Emulator	6,400
QP230	Fortran IV/RSX	1,250
QS668	PDP-11 Fortran IV-PlusRSX	6,670
QP602	SORT-11/RSX	950
QJ684	DECnet-11M	6,000
QP066	CORAL 66/RSX	7,600
WJD76	RSX-11/3271 Protocol Emulator (PE)	6,700
WJS60	RSX-11M/IAS RJE/HASP	9,900

DEC PDP-11 Family

SOFTWARE PRICES

		License Fee
QJ715	FMS-11/RSX	3,110
QJD69	RSX-11M/SNA Protocol Emulator	10,000
QJ716	FMS-11/RSTS/E	3,110
QJ689	RSX DLX-11	800
QR580	DECnet-11M-PLUS	6,000
QR435	Fortran IV/RSTS/E	3,870
QR100	PDP-11 Fortran IV/PLUS/RSTS/E	6,670
QPD10	RSTS/E-2780	7,000
QRD06	RSTS/E High Performance 2780/3780 Emulator	7,400
QRD05	RSTS/E 3271 Protocol Emulator	8,000
QJ070	MUX200/RSX-IAS Multiterminal Emulator	7,600
QJ170	UN1004/RSX Uivac 1004 Terminal Emulator	4,100
QJ916	PDP-11 Basic-PLUS-2/RSTS/E	6,400
QR106	PDP-11 Fortran-77/RSTS/E	—
QJ993	Cobol-81/RSTS/E	6,540
QJ994	Cobol-81/RSX	—
QP528	Dibol-11/DECFORM/RSTS/E	8,400
QP300	Datatrieve/RSB/E	7,000
QR480	DECword-DP/RT-11	8,500
QJ071	Professional Tool Kit/RSX	4,000
QR530	ADE/RSTS/E	3,500
QR690	Menu-11/RSTS/E	—
QJ505	BCP Graphics/RSX	— ∎