

DEC PDP-11 Family



The PDP-11/70 represents the high end of one of the most extensive minicomputer product lines in existence today. The PDP-11/70 is a high-performance machine with integral cache memory and high-speed 32-bit data paths. The system also has memory management, look-ahead, and internal memory expansion capability up to 4096K bytes.

MANAGEMENT SUMMARY

Although overshadowed recently by its younger cousin, the 32-bit VAX-11 system, the PDP-11 family of processors and packaged systems continue to be important and influential members in the 16-bit marketplace. Much of Digital Equipment Corporation's current success in the computer field can be attributed directly to the PDP-11 family of computers. Introduced in 1970, the PDP-11 product line remains highly viable, due primarily to the continual growth and strengthening of the line with new products and technologies on a timely basis. The current line of PDP-11 processors includes the LSI-11/2, LSI-11/23, PDP-11/03L, PDP-11/23, PDP-11/24, PDP-11/34A, PDP-11/44, PDP-11/70, and PDP-11/23 PLUS.

The PDP-11 family offers a range of compatible processors with common hardware 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

The PDP-11 family of 16-bit processors includes products ranging from the low-priced LSI-11 microcomputer to the powerful PDP-11/70 minicomputer. Eight processors (LSI-11/2, LSI-11/23, PDP-11/03L, PDP-11/23, PDP-11/24, PDP-11/34A, PDP-11/44, and PDP-11/70) are active members of the family at present, and they are available either as stand-alone products or as parts of packaged systems. Most members of the PDP-11 product line are available for both OEM and end-user sales.

MAIN MEMORY: 8KB 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: LSI-11/2, LSI-11/23, PDP-11/03L, PDP-11/23, PDP-11/23 PLUS, PDP-11/24, PDP-11/34A, PDP-11/44, and PDP-11/70.

DATE ANNOUNCED: LSI-11/2, 1/78; PDP-11/03, 12/75; PDP-11/23, 3/79; PDP-11/34A, 2/76; PDP-11/44, 11/79; PDP-11/70, 2/75; PDP-11/24, 3/81; PDP-11/23 PLUS, 11/81.

DATE OF FIRST DELIVERY: LSI-11/2, 3/78; PDP-11/03, Not Available (NA); PDP-11/23, 7/79; PDP-11/34A, 3/76; PDP-11/44, NA; PDP-11/70, 5/75; PDP-11/24, NA; PDP-11/23 PLUS, NA.

NUMBER INSTALLED TO DATE: Over 100,000.

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: 16-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: Optional 32-bit single-precision operands with an 8-bit exponent and signed 24-bit fraction on the LSI-11, LSI-11/2, LSI-11/23, and the 11/34A and larger models; or 64-bit double-precision operands with an 8-bit exponent and signed 56-bit fraction on the 11/34A, 11/44, 11/24, and 11/70.

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PDP-11 TECHNICAL SUMMARY

MODEL	11/03L	11/24	11/23	11/34A	11/44	11/70
STANDARD PROCESSOR FEATURES						
Word size, bits	16	16	16	16	16	16
Number of instructions	66, 8 opt.	400+	400+	400+	400+	400+
Instruction size, bits	16	16	16	16	16	16
Number of general registers	8	9	8	9	10	16
Byte manipulation capability	Yes	Yes	Yes	Yes	Yes	Yes
Stack processing	Yes	Yes	Yes	Yes	Yes	Yes
MEMORY MANAGEMENT HARDWARE						
Bootstrap loader	Yes	Yes	Yes	Yes	Yes	Yes
Line frequency clock	No	Yes	No	No	Yes	Yes
Battery backup	No	Yes	No	No	No	Yes
PROCESSOR OPTIONS						
Extended arithmetic	Yes	Yes	Yes	Yes	Yes	Yes
Real-time clock	No	Yes	No	Yes	No	No
Power fail/auto restart	No	Yes	Yes	No	No	No
Floating point processor	No	Yes	Yes	Yes	Yes	Yes
Cache memory	No	No	No	2KB	8KB	2KB
Commercial Instruction Set processor	No	Yes	No	No	Yes	No
User control store	No	No	No	No	No	No
Extended control store	No	No	No	No	No	No
Diagnostic control store	No	No	No	No	No	No
INPUT/OUTPUT						
I/O word size, bits	16	16	16	16	16	16/32
Direct Memory Access	Yes	Yes	Yes	Yes	Yes	Yes
Maximum DMA transfer rate, bytes/second	1666K	—	1666K	1.7	900K	5.8M
Number of interrupt levels	1	4	4	4	4	4
Maximum I/O transfer rate, bytes/second	180K	—	180K	1.7M	900K	5.8M
Peripheral Controller	LSI-11 Bus	UNIBUS	LSI-11 Bus	UNIBUS	UNIBUS	UNIBUS, MASSBUS
SOFTWARE						
Operating systems	RT-11	RT-11, RSX-11M, RSTS/E	RT-11, RSX-11M	RT-11, RSX-11M, RSTS/E	RSX-11M, RSX-11M-PLUS, RSTS-E	RSTS/E, RSX-11M, RSX-11M-PLUS
High-level languages	Fortran IV, Basic-II, MU Basic	Fortran IV, Basic-II, MU Basic, Basic-PLUS-2, Fortran IV-PLUS, Cobol, CORAL 66	Same as 11/24	Same as 11/24	Same as 11/24	Same as 11/24

▷ 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.

A distinguishing characteristic of the PDP-11 family is its common physical architecture, arising primarily from the UNIBUS, a single high-speed, asynchronous, bi-directional communications path to which all system▷

▶ The sign is the high-order bit in both single- and double-precision operands and precedes the exponent. The exponent is in excess 128 notation, allowing exponent values between -128 and +127. All fractions are assumed to be normalized, so that the high-order fraction bit (which is always 1) is not represented directly. This allows one extra bit of resolution to be achieved.

Single- and double-precision hardware via a floating-point processor is optionally available on the 11/23, 11/34A, 11/44, 11/24, and 11/70. This hardware includes a dedicated set of six 64-bit accumulators. The LSI-11 can have an optional plug-in, ROM-implemented extended instruction set (EIS) for fixed-point arithmetic and a floating-point instruction set (FIS) for single-precision numbers. ROM implementation of EIS is available for the 11/34 and 11/44. Floating-point software subroutines are available for all PDP-11's.

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▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION AND SPEED
TERMINALS	
VT-100-AA(AB)	VT100 tabletop display terminal; 50 to 19,200 bps baud rate, 24 lines x 80 characters or 14 lines x 132 characters (selectable), 7 x 9 dot matrix, 94-character ASCII and 32 special graphic features, double-width/double-size characters, bidirectional smooth scrolling; requires EIA/CCITT serial line interface or equivalent
VT101-AA(AB)	VT101 tabletop video display terminal 50 to 19,200 bps baud rate, 24 lines x 80 characters or 14 lines x 32 characters, 7 x 9 dot matrix, 94-character ASCII set with 32 special graphic characters, 83-key detachable keyboard, standard numeric/function keypad, bidirectional smooth; requires EIA/CCITT serial line interface or equivalent
VT102-AA(AB)	VT102 tabletop video display terminal; 50 to 19,200 bps baud rate, 24 lines x 80 characters or 132 characters, 7 x 10 dot matrix, 94-character ASCII set with 32 special graphics characters, enhanced terminal editing features, up to 132 characters per line, and normal or reverse video, blinking, underline, and bold characters on a character-by-character basis; requires EIA/CCITT serial line interface or equivalent
VT125-AA(AB)	VT125 tabletop graphics terminal operating with EIA/CCITT interface; 50 to 19,200 bps baud rate, 24 lines x 80 characters or 14 lines x 132 characters (keyboard or host selectable), 7 x 10 dot matrix, 96 ASCII character set (upper/lower case, numeric and punctuation) with 32 character special graphics set, 768 x 240 pixel graphics resolution
VK100-AA(AB)	GIGI (General Imaging Generator and Interpreter) VK100 tabletop keyboard terminal 110-9,600 baud rates, 24 lines x 84 character text format, 8 x 10 character dot matrix, 95 ASCII character set, 768 x 240 pixel graphics resolution; requires EIA/CCITT DL11-WB serial line interface or equivalent
LA34-RA/VA/WA	DECwriter IV graphics printing terminal; 110 to 9,600 bps baud rates, 45 cps (text mode) 320 columns per second or 960 dots per second (graphics mode) print speed, 5 inch per second slow speed, 132 print columns, 128-character ASCII set, 9 x 7 dot matrix impact printing in text mode
LA38-GA/HA	DECwriter IV printing terminal; 110 or 300 bps baud rates, 30 cps print speed, 2/3/4/6/8/12 lines per inch, 9 x 7 dot matrix, 7-bit ASCII character set plus ANSI-compatible escape sequences, and 10/12/13.2/16.5 characters per inch
LA120-DA/RA	LA120 DECwriter III freestanding printing terminal; 50 to 9,600 bps baud rates, 180 cps print speed, 2/3/4/6/8/12 lines per inch, 7 x 7 dot matrix, 217 horizontal and 168 vertical tabs, 7-bit ASCII character set plus ANSI-compatible escape sequences, 5/6/6.6/8.25/10/12/13.2/16.5 characters per inch
CARTRIDGE TAPE	
TU58	Cartridge tape subsystem; random access, mass memory storage devices which read and write data on block addressable, preformatted tape cartridges; 800 bpi record density, 30 ips read/write speed, 262KB capacity per cartridge, 3.7KBS maximum data transfer speed; supports 2 transports per controller (only one may operate at a time)
CARD READERS	
CR11	Photoelectric card reader system designed for laboratory and industrial applications, reads hole punched cards and features two data formats (selectable under program control): non-packed (standard Hollerith code); 285 cpm card speed, 500 card capacity, standard 12-row 80-column EIA hole punched cards
CR11-B CMS11-K	Same as CR11 except 600 cpm card speed and 1000 card capacity Photoelectric card reader system designed for educational applications, reads hole punched and mark sense cards and features two data formats (selectable under program control): non-packed and packed; 250 cpm card speed, 250 card capacity, standard 12-row 80-column EIA (Hollerith code hole punched cards)

➤ components (CPU, memories, and I/O controllers) are connected. This common bus structure enables all functional elements to communicate with one another independently of the CPU. This ability reduces the time spent by the CPU in supervising I/O operations and allows it to devote more time to actual data processing.

Since memory and I/O controllers alike are residents of the same bus, they are addressed alike. The result is that the PDP-11's do not employ I/O instructions as a separate class; instead, certain addresses are reserved for I/O devices, and each controller can read and write to memory in the same manner as the CPU. Hence, transfers to and from I/O controllers are accomplished in the same way that data is transferred between general-purpose registers ➤

➤ 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-11/24, 11/44, and 11/23 PLUS. 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, including type, cycle time, and capacity, are covered for the entire family in the Main Storage ➤

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION AND SPEED
PRINTERS	
LXV11-XX	Lineprinter/plotter; 300 lpm, 240 lpm (underlines or upper/lower case characters), 170 lpm (double-height characters) printing speeds; 16.7 inch per minute plotting speed; 96 ASCII standard character set (expansion to 160 characters optional); 8 inch per second paper slew speed; 132 character buffer; requires PDP-11/03, PDP-11/23
LXY11-XX LXY21-XX	Lineprinter/plotter; same as LXV11-XX except for UNIBUS PDP-11s
LPV11-AA LPV11-BA	Band printer operating at 300 lpm for 64 ASCII character set; requires PDP-11/03, PDP-11/23
LP11-AA LP11-BA	Band printer operating at 300 lpm for 64 ASCII character set; requires UNIBUS PDP-11s
LP11-CA(CD) LP11-DA(DD) LP11-YA(YD) LP11-ZA(ZD)	Band printer operating at 300 lpm for 64 ASCII character set or 215 lpm for 96 character set; requires PDP-11/03, PDP-11/23 Drum printer operating at 300 lpm for 64 ASCII character set; requires UNIBUS PDP-11s Drum printer operating at 436 lpm for 96 ASCII character set; requires UNIBUS PDP-11s
MAGNETIC TAPE	
TS11-BA(BB)	TS11 subsystem mounted in 60 inch (152.4 cm) H9602 single width highboy cabinet; 21 inches of peripheral mounting space is available; 9-track, 45 inch per second read/write speed, 72KB/second maximum data transfer speed, 150 inch per second rewind speed; requires UNIBUS PDP-11 system configured in H9600 series cabinets
TS11-DA(DB)	Same as TS11-BA(BB) except mounted in a 72 inch (182.9 cm) high H960 cabinet with 26.25 inches of peripheral mounting space available; requires UNIBUS PDP-11 system configured
TS11-CA(CB)	Same as TS11-BA(BB) except mounted in a 60.5 inch (153.7 cm) high H9646 cabinet with 15.75 inches of peripheral mounting space available; requires PDP-11/24 or PDP-11/44
TJE16/TWE16	Subsystems; include the controller, a tape formatter, and one 9-track TE16 tape transport; uses industry compatible recording densities of 1600 bpi (phase encoded or PE) and 800 bpi (non-return to zero inverted or NRZI) selectable under program control; the subsystem is available with controllers for the PDP-11 UNIBUS or PDP-11/70 MASSBUS; the TE16 tape transport is available mounted in either a 72 inch (182.9 cm) high H960 cabinet, or a 60 inch (152.4 cm) H9602 single width highboy cabinet; supports 8 transports per controller
TJU77/TWU77	Subsystem; includes the controller, a tape formatter, and one nine track TU77 tape transport; the TU77 tape transport uses industry compatible recording densities of 1600 bpi (phase encoded or PE) and 800 bpi (NRZI) selectable under program control; the subsystem is available with controllers for the UNIBUS PDP-11 or the PDP-11/70 MASSBUS; the TU77 transport is available mounted in a 60 inch (152.4 cm) H9602 single width cabinet; supports 4 transports per controller

▷ and memory. More specifically, the highest 4096 memory addresses (8192 bytes) in any PDP-11 system are reserved for use by I/O controllers and cannot be used for memory.

Two small disadvantages arise from this I/O scheme. First, since 4096 addresses are reserved for I/O usage, they cannot be used for memory. Hence, the maximum physical memory that can be incorporated in a particular system is always 4096 words (8192 bytes) less than the *theoretical* maximums.

Secondly, the instructions for the I/O controllers address various controller registers as memory locations. Generally, these must be loaded individually through load-and-store-type commands. While presenting an easy and understandable I/O system, this technique also precludes the implementation of instructions that perform more complex I/O functions, resulting in higher I/O overhead times. ▷

▶ **Characteristics table (page M11-384-305).** The categorized entries in the text that follows emphasize exceptions and noteworthy features. It should be noted that all storage capacities allow for the 8192 bytes (4096 words) that are reserved for use by the I/O system. Non-DEC storage choices are listed in Report M13-100-101, *Minicomputer Add-On Memories*.

STORAGE TYPE: Magnetic core, dynamic MOS, and bipolar are the three types most commonly used within the PDP-11 family. Core is available in a variety of speeds and can be used in every PDP-11 except the LSI-11/2 and 11/23, and the PDP-11/23 and 11/44. Bipolar cache memory is available only for the 11/44 and 11/70. Dynamic MOS is available for all models.

Read-only memories (ROMs) and programmable ROMs (PROMs) are available for dedicated-function processors (e.g., the LSI-11 used in some other machine) or for specific processor functions. These take the form of diode ROM, ultraviolet-programmable ROM, and fusible-link ROM. Much of the ROM usage cannot really be classified as storage (e.g., floating-point ROM in the LSI-11). ▶

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▷ 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 management allowing relocation and protection for multitask 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 users 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 console terminal.

DEC offers a variety of programming languages and communications software products for the PDP-11 line. ▷

▷ multiprogramming by providing a control program state for more efficient and secure system management. A program operating in kernel mode can map users' programs anywhere in memory and thus explicitly protect key areas including the device registers and PSW from the user operating environment. All other PDP-11 family systems operate in basic kernel mode only, i.e., with all available memory (always 64K bytes or less) accessible by all.

Each mode has its own set of active page (address translation) registers and can access up to 8 pages of data and 8 pages of instructions. Each page may be from 64 to 8192 bytes. In the 11/23, 11/34A, and 11/24, there are 8 active page registers per mode. These processors employ 16-bit virtual and 18-bit UNIBUS/physical address spaces. In the 11/44 and 11/70, there are 16 active page registers per mode. The 11/70 and 11/44 employs 16-bit virtual, 18-bit UNIBUS, and 22-bit physical address spaces.

Two or more sets of length registers are used to delineate the bounds of addressability for individual programs, and these together with associated status registers give memory protection for multiprogramming.

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.

CONTROL STORAGE: The LSI-11, LSI-11/2, and 11/03 are controlled by microcoded read-only memories (MICROM's), among whose functions are provision of PDP-11/35 instruction set emulation and automatic refreshing of any dynamic MOS RAM used. Also, the LSI-11 extended arithmetic option (fixed-point multiply/divide and floating-point arithmetic) is achieved by the use of a plug-in ROM chip. Users can create special LSI-11, LIS-11/2, and 11/03 operations by purchasing fusible-link programmable ROM (PROM) chips. These PROM's are packaged 256 words per chip, two chips to a half-board; the LSI-11 accepts half-boards in its backplane sockets. Other ROM-supplied LSI-11, LSI-11/2, and 11/03 functions are standard. They include resident initialization, power fail/auto restart, bootstrap loading, and debugging routines. ROM and PROM speeds in the LSI-11 are largely irrelevant, since they are at least an ▷

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➤ For a run-down of those currently available, see the PDP-11 Software Availability chart on page M11-384-313.

For data base users, DEC offers DBMS-11, a data base management software system based on Cullinane Corporation's IDMS. This makes two powerful data base management systems available for PDP-11 systems, since Cincom Systems has developed a version of its popular Total system for use on PDP-11s. DEC chose to go with the Cullinane system because it conforms to CODASYL recommendations.

A substantial library of user-generated, but not DEC-supported, software is available from two groups within DEC. DECUS, the DEC USers 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 Application Software (IDEAS), which lists software packages developed by users specifically for educational 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 year terms and 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 updates of software and manuals via a subscription service.

One aspect of the PDP-11 family (as well as other DEC products) that often causes confusion to both prospective and current DEC customers is the many marketing groups within Digital Equipment Corporation. Spokesmen for the manufacturer pictured the company as eight different small companies, each specializing in different application markets that have been carefully delineated to have little or no jurisdictional overlap. Each group has been given the freedom to develop products and markets within its own sphere of responsibility, independently of other groups. All groups, however, draw equipment for their products from the common pool of DEC hardware and, to a lesser degree, develop software from the major DEC operating systems.

PDP-11s are sold by DEC's OEM Marketing Group, Industrial Products Group, Distributed Data Processing Group (responsible for data communications, finance, transportation, and government markets), Telco and Engineering Computation Group, Laboratory Data Products Group, and—in Datasystem 500 and Data- ➤

➤ order of magnitude faster than the 1.2-microsecond overall LSI-11 processor cycle.

REGISTERS: The 11/03 and 11/23 have eight general-purpose registers, while the 11/24 and 11/34 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.

The 11/70 has 16 user-accessible 16-bit registers (two sets of six general-purpose registers, three stack pointers, and a program counter) and a 16-bit processor status register. It should be noted that any one set of general-purpose registers and one stack pointer can be user-accessible at any given time. All user-accessible registers are located in the upper 8K bytes of memory. The FFP's, available with the larger PDP-11 processors, contain a dedicated set of six 64-bit accumulators. Numerous other non-accessible, 16-bit, internal registers are present in various members of the PDP-11 processor family. These include a CPU error register, hit/miss register, maintenance register, control register, memory system error register, high error address register, and low error address register.

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

INSTRUCTION REPERTOIRE: The PDP-11/03 has 66 standard instructions and eight optional instructions. All other 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 OR); 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.** ➤

DEC PDP-11 Family

MAIN STORAGE CHARACTERISTICS

Model	Storage Type	Cycle Time (nanoseconds per word)	Storage Capacity (bytes)	Increment Sizes (bytes)
LSI-11/2	MOS and/or PROM	570 MOS	8K to 64K 1K to 8K	8K, 16K, 32K, 64K 512-bytes x 4-bit PROM chip
LSI-11/23 PDP-11/23	MOS	500MOS	128K to 256K MOS, 64K ROM/PROM	64K MOS, 4K ROM/PROM
PDP-11/03L	MOS	550 MOS 390 MOS	8K to 64K 32K to 64K	8K 32K
PDP-11/24	MOS, parity	450	128K to 1M	128KB or 256KB
PDP-11/34A	MOS, parity, core	510, 700 MOS; 1000 core	32K to 256K	32K to 128K MOS, 32K core
PDP-11/44	ECC MOS	480	256K to 1024K	256K
PDP-11/70	ECC MOS, parity	700 MOS	128K to 4096K	128K

➤ The second salient characteristic of the PDP-11's, software compatibility, is a result of all CPU's, from the LSI-11 up to the PDP-11/70, using the same basic instruction set. It should be noted, however, that the LSI-11 and -23, and PDP-11/03 and PDP-11/23 have "pseudo-UNIBUS" structure in place of the standard UNIBUS and cannot presently use DEC's standard UNIBUS-compatible I/O controllers. Instead, DEC offers two low-to-medium-speed "universal" controllers, one parallel and one serial, that can be adapted to handle most standard peripherals.

Currently DEC offers the LSI-11/2 and LSI-11/23 microcomputers, sold by the Microcomputer Marketing Group, and the PDP-11/03, -11/24, -11/23, (and -11/23 PLUS), -11/34A, -11/44, and -11/70, sold by DEC's other seven market groups.

The LSI-11/2 is a board-level microcomputer product specifically designed for sophisticated users who can incorporate the LSI-11/2 into a product, taking advantage of the PDP-11 family capabilities that were previously unavailable in such packaging. The LSI-11/23 is also a board-level microcomputer that features 256K bytes of memory, four times more than the LSI-11/2. It uses the full instruction set of the 11/34, and software-supported memory segmentation and protection features of the RSX-11M multitasking, multiuser operating system. Depending on configuration, the LSI-11/23 is from 2 to 5 times faster than the LSI-11/2.

The PDP-11/23 is a rack-mountable, packaged version of the LSI-11/23. With a maximum main memory of 256K bytes, the PDP-11/23 features a standard PDP-11 instruction set, standard extended instruction set, optional floating point instruction set, 8 general purpose registers, 4 hardware interrupt levels, an LSI-11 bus peripheral controller, standard 18-bit memory management, and standard byte manipulation capability and stack processing. It runs under the RT-11 and RSX-11M operating systems.

➤ **CYCLE TIME:** Both cycle and access times are listed in the Main Storage Characteristics table on page M11-384-305. Cache memory on the 11/34A (optional) has a 150-nanosecond cycle time; on the 11/44, 275 nanoseconds; on the 11/70, 240 nanoseconds.

In some models, the storage access cycle *rate* (as opposed to the access cycle-time capability of the storage) is a function of the processor, not of the storage; e.g., the constant 1.2-microsecond cycle time of the LSI-11/2 regardless of storage technology. On the 11/70, DEC states that the main storage bandwidth is easily raised from the basic 4 million bytes per second to 5.8 million bytes per second by interleaving. All 11/70's with more than the minimum memory use memory interleaving. The company also states that a 90 to 95 percent cache "hit" rate on the 11/70 yields an effective 11/70 memory cycle time of less than 400 nanoseconds.

CAPACITY: See Main Storage Characteristics table on page M11-384-305. Capacity is a function of packaging and/or marketing, of busing structure (the UNIBUS requires the uppermost 8K bytes to be dedicated as I/O registers, thus limiting direct address space to 56K bytes), and of whether memory mapping is available. Memory mapping is automatic effective address translation that enables a 16-bit computer to address memory in excess of 64K words.

The PDP-11/24 processor memory system provides very rapid transfer to and from the CPU and mass storage peripherals. It can support up to a full megabyte of parity MOS memory. Memory arrays are available in either 128KB or 256KB increments which connect to the central processing unit via a 22-bit memory address bus in the CPU backplane. Since the PDP-11/24 system is designed to accommodate the utilization of either a 5¼ inch or 10½ inch box, depending on the needs and requirements of the customer, the maximum memory subsystem size in the 10½ inch box is one megabyte and up to 768K bytes in the 5¼ inch box.

Memory addressing capability is expanded up to one megabyte of memory by the implementation of the KT24 Physical Address Extension (PAX) and the UNIBUS map option. These two features permit 22 bits of address to be passed to main memory, instead of the standard 18 bits, and map 18-bit UNIBUS addresses onto the 22-bit memory bus. The PDP-11/24 processor battery backup unit (BBU) option is designed to protect the contents of the PDP-11/24 parity MOS memory for as long as 20 minutes in the event of a power outage.

DEC PDP-11 Family

➤ The PDP-11/03 is a complete minicomputer on four integrated circuit chips mounted on a single 8.5 by 10.5 inch board within a rack mountable 19 inch assembly. With a maximum memory capacity of 64K bytes, it features a standard PDP-11 instruction set, optional extended instruction set, 8 general purpose registers, a single interrupt level, LSI-11 bus peripheral controller, standard 16-bit memory management, and byte manipulation and stack processing capabilities. It runs on the RT-11 operating system only.

The PDP-11/34 and 11/44 system computers are used in multiple-task applications where the computer must solve many problems or run multiple programs. The PDP-11/34 features a standard PDP-11 instruction set, standard extended instruction set, optional floating point, 9 general purpose registers, 4 hardware interrupt levels, a UNIBUS peripheral controller, standard 18-bit memory management, 256K byte cache memory and standard byte manipulation capability and stack processing. The 11/34 runs under the RT-11, RSX-11M, and RSTS/E operating systems.

The PDP-11/44 is a midrange minicomputer with features of the PDP-11/70 and twice the performance of the PDP-11/34. It offers up to 1 megabyte of memory, 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.

The multi-function PDP-11/70 can handle simultaneous batch, real-time, and time-sharing applications in its larger configurations, or pairs of these smaller configurations. It incorporates such advances as integral bipolar cache memory and interleaved core memory to reduce effective memory cycle times to below 400 nanoseconds, fast mass storage devices, and a special high-speed 32-bit data bus to accommodate them. The PDP-11/70 offers up to 4 megabytes of main memory, standard PDP-11 instruction set and extended instruction set, optional floating point, 16 general purpose registers, 4 hardware interrupt levels, UNIBUS and MASSBUS peripheral controllers, standard 22-bit memory management, standard 2K byte cache memory, and byte manipulation and stack processing capabilities. The PDP-11/70 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, 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 ➤

➤ **CHECKING:** Parity on the basis of one bit per byte is available with dynamic MOS memory for the LSI-11/2, 11/23, and 11/34A and with core memory for all PDP-11's except the LSI-11/2. Bipolar memory, available for the 11/44, 11/24, and 11/70, also features parity on the basis of one bit per byte. Error correcting and checking (ECC) is a feature of dynamic MOS memory for the 11/44, 11/24, and 11/70. 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 the 11/23, 11/34A, 11/44, 11/24, and 11/70. 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-11's 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 "mainstream," or original, PDP-11 family architecture began with the 11/20 and its closely related, stripped-down 11/15 version, each of which contained about 19 boards and some 600 integrated circuits (ICs). The 11/05 and 11/10 were identical to one another, about 20 percent slower internally than the 11/15 and 11/20, and had improved architectural implementation over their predecessors, using only 2 boards and about 200 IC's. The 11/04 and 11/34A processors use one and two boards, respectively.

Subsequent PDP-11 family models offer design improvements that relate closely to each product's intended market objectives. For example, LSI-11/2 design drops the UNIBUS in order to lower cost, and the 11/44 and larger models augment the UNIBUS for performance gains.

Multiplexer printed-circuit models, which provide cost advantages from a packaging standpoint and speed advantages due to reduced signal path lengths, are now used throughout the PDP-11 family. The 11/34 uses the same technology, backplane, and chassis as the 11/04, differing only in the addition of memory management to extend user addressing capabilities to 248K bytes. Schottky TTL logic appears in the 11/44 and larger models, as does an autonomous Floating-Point Processor; and 32-bit internal data paths and the bipolar cache memory appear in the 11/70.

Mapped memory in any 16-bit machine will limit the address space of any one program to that which is directly addressable within the mapped-to-memory region. Also, the automatic mapping process may add processor overhead. In the 11/34A, this amounts to 120 nanoseconds per address mapped. In the 11/70, however, mapping is concurrent, with no overhead time.

The 11/23 and 11/34A, can access up to 248K bytes of main memory, through memory mapping. In the 11/70, mapping allows up to 4 million bytes to be accessed, and in the 11/44, one million bytes.

With memory management, the 11/23, 11/34A, or 11/24 operates in either a "kernel" or a "user" mode; the user mode prevents programs from modifying key machine state relating to memory mapping and protection. The 11/44 or 11/70 with memory management has three modes: kernel, user, or supervisor. The supervisor mode is intended to facilitate ➤

DEC PDP-11 Family

▷ system 320/350 packaging—by the Business Products Group, Education Products Group, and Graphic Arts (Typeset) Group.

The laboratory was one of DEC's first markets, and is still one of its best application areas. The Lab Data Products Group has the charter of developing and promoting laboratory and scientific systems based mainly on the PDP-11 family.

The Business Products Group is responsible for the development and marketing of special PDP-11-based systems for the business market. DEC's business products have become popular with major users in the insurance, manufacturing, finance, transportation, and wholesale distribution fields to perform such functions as order entry, inventory control, billing, payroll, accounts receivable, and other classic general accounting and information handling applications.

The orientation of the Education Products and Graphic Arts Group is implied in their names. Both are forces with constantly evolving products to offer their respective fields. However, this report does not dwell on their specialized offerings.

The OEM Marketing Group is really composed of two groups, OEM Computer Marketing and Components. OEM (Original Equipment Manufacturers) Marketing sells computers in quantity to industrial and commercial firms who then add value to the computer (e.g., develop a package system for resale) and market it. The Components Group sells the DEC-built minicomputer peripheral line, composed of such products as the LA36 and LA180 DECwriter II, the VT50 and VT52 DECscope CRT terminals, and the LSI-11/2 and PDP-11/03 microcomputers. This group also operates a direct sales facility open to both OEMs and end users who wish to reduce maintenance and repair costs by performing some of this activity through their own qualified personnel. For this purpose, the Components Group has issued a Direct Sales Catalog that permits ordering supplies, modules, chassis, power supplies, terminals, and microcomputers in the same way consumers order merchandise from mail order houses. DEC is one of a few pioneers in this service that allows users to take advantage of the substantial savings that can be realized through this do-it-yourself approach.

The final group, the Industrial Products Group, sells hardware and software solutions for data acquisition and process control applications.

USER REACTION

Datapro has received twenty-one early responses on the DEC PDP-11 computers for the 1982 User Survey. Representing over twenty-five systems, the group includes PDP-11/23s, 11/34s, 11/44s, and 11/70s. Nineteen of the systems were purchased, one was rented or leased from the manufacturer, and one was leased from a third party. The oldest system (a PDP-11/23) was installed in 1976, and the newest (a PDP-11/70) was installed as recently as January ▷

▶ • **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. In the 11/34A, 11/24, 11/44, and 11/70, which have autonomous floating-point processors, the floating point instruction repertoire includes loads/stores for full operands and exponents only, similar compares, floating-point processor condition code operators and set/clear floating-point/integer mode, tests, load/store status, make absolute value, etc.

• **User Control Store**—Extended Function Code appears in one form only.

• **Maintenance**—Maintenance Exam and Dep, Load Microbreak Register, Maintenance Normalization Shift, Maintenance Partial Product, and Maintenance Alignment Shift.

INTERRUPTS: All models except the LSI-11 and 11/03 have four automatic hardware priority level interrupts. The 11/70 can also use any of seven programmable software-supported additional interrupt levels; these have an automatic vectoring instruction held in a reserved main storage location. Each of the interrupt levels can accommodate independently prioritized peripheral devices.

PHYSICAL SPECIFICATIONS: Nominal operating environments for the PDP-11 processors are 50 to 104 degrees Fahrenheit (10 to 40 degrees Centigrade), at 10 to 90 percent relative humidity, and maximum wet bulb of 82 degrees Fahrenheit and minimum dew point of 36 degrees Fahrenheit. These are processor specifications; electro-mechanical peripherals may be more sensitive to their environments. Recommended operating conditions for a typical system are 70 degrees Fahrenheit ± 2 degrees with a noncondensing relative humidity of 45 percent ± 5 percent.

DEC offers a vast array of PDP-11 family equipment, and it is beyond the scope of this report to present more than generalized information regarding the physical specifications of the processors. Please note that all cabinet-mounting components fit in RETMA-standard (19-inch) cabinet interiors, and that the cabinets generally measure 21 inches wide, 30 inches deep, and 72 or 50 inches high.

DEC recommends that the air distribution system provide cool, well-filtered air with room air pressure kept higher than the pressure of adjacent areas to prevent dust infiltration. Metal walls and partitions are not recommended unless they are insulated on the conditioned surface. For efficient cooling, a minimum 30-inch clearance above the equipment should be employed. To avoid static electricity problems, the floor surface material should have a surface resistance of 0.5 megohms to 20,000 megohms at 40 to 50 percent relative humidity and a temperature of 68 to 72 degrees Fahrenheit.

BTU output per hour varies from 4240 for the 11/03 processor to 5889 for the 11/70 processor. ▶

DEC PDP-11 Family



These disk drives exemplify DEC's vigorous efforts toward vertical integration of its product line. The RL01 (foreground) employs 5-megabyte disks and can be used with all PDP-11 computers, including the microprocessor-based PDP-11/03. The free-standing RK07 drive (left rear) can be used with PDP-11/04 and -11/34 through -11/70 computers; it has a capacity of 28 megabytes. The RM02 drive (right rear) is used with PDP-11/34 through PDP-11/60 computers and has a capacity of 67 megabytes. All these disk units are now available for volume deliveries, and their prices range from \$3,800 to \$23,000.

▷ 1982. The types of industries involved were primarily manufacturing, educational and banking institutions, with the principal applications being accounting/billing, payroll/personnel, manufacturing, education, and order processing/inventory control functions. When asked if they had converted from another computer system, eight users said they had not, and the others had converted or upgraded from such systems as the IBM 360 and System/3, a Basic Four S80, and other DEC systems including the PDP-11/03, 11/40, 11/30, and 11/34.

The number of local workstation/terminals on-site ranged from one to as many as sixty, while remote workstation/terminals ranged from one to, in one case, over sixty. Memory capacity averaged between 582K bytes and 1164K bytes per system while the total disk storage capacity ranged from one megabyte to over 1200 megabytes. When asked if they were using add-in or add-on main memory from another source other than the manufacturer, sixteen users said they did not, while the others employed memory modules from such manufacturers as Mostek, Trident, and Monolithic. The operating

▶ INPUT/OUTPUT CONTROL

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 with the exception of the LSI-II and the 11/03. The 11/70 incorporates a standard UNIBUS and 32-bit internal buses between core memory and cache memory and between high-speed peripheral controllers (e.g., disk and 1600-bpi magnetic tape) and cache memory. The LSI-11 and 11/03 have a "pseudo-UNIBUS" structure that eliminates some lines by doubling-up address and data lines through timesharing them.

The priority of any device connected to the UNIBUS is determined by its physical position; hence, the processor is normally attached so as 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. On the 11/70, the 32-bit bus is fast enough (i.e., 2 million 8-bit bytes per second) to permit overlapped use by the CPU, UNIBUS, and/or several mass storage units, the fastest of which presently operates at 1 million bytes per second. DEC also states that interleaved core memory raises this 32-bit bus bandwidth to 5.8 million bytes per second. Interleaving is done whenever more than minimum memory is purchased.

It should be noted that the 32-bit bus of the 11/70 connects high-speed peripheral controllers to main memory, through cache memory, for data transfer purposes. The priority arbitration logic within the cache memory controls the timing of data transfers. Cache is not affected except that the involved 4-byte block is "flagged" whenever a write hit on an I/O transfer occurs, so as to indicate that the data in the cache is invalid, but that correct data is in core memory. The UNIBUS, meanwhile, handles the interrupt requests and transfer protocols for the high-speed units.

The LSI-11, PDP-11/03, and PDP-11/23 bus has a maximum data transfer rate of 1666K bytes per second.

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). Examples of NPR data transfers are memory to/from main storage and directly between devices (e.g., disk refreshing a CRT display) in an 11/70. 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." (CPU's 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

DEC PDP-11 Family

▷ system used most often was DEC's RSTS/E. Five of the respondents used a data base management system, and of those five, only one was the manufacturer's package. Only seven of the users had integrated word processing functions. The programming language used most often was Basic with Fortran a distant second. When asked if they expected to replace their systems in 1982, eighteen users said no, and two said yes but with the same manufacturer. The twenty-one users rated their DEC PDP-11s as shown in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	13	6	2	0	3.5
Reliability of mainframe	16	5	0	0	3.7
Reliability of peripherals	7	12	2	0	3.2
Maintenance service:					
Responsiveness	12	6	3	0	3.4
Effectiveness	9	9	2	1	3.2
Technical support:					
Trouble-shooting	6	6	5	0	3.0
Education	3	5	8	1	2.5
Documentation	3	8	5	1	2.7
Manufacturer's software:					
Operating system	11	5	1	0	3.5
Compilers and assemblers	7	8	2	0	3.2
Applications programs	3	4	5	0	2.8
Ease of programming	7	6	4	0	3.1
Ease of conversion	2	7	5	2	2.5
Overall satisfaction	8	9	2	0	3.3

*Weighted Average on a scale of 4.0 for Excellent.

When asked to state the significant advantages of the system, thirteen users stated the system was easy to expand/reconfigure, ten users said they were happy with response times, and five users said that productivity aids helped them keep programming costs down, that terminals/peripherals carried over from other systems were compatible as the vendor promised, and that programs/data carried over from other systems were compatible as the vendor promised. When asked to state the significant problems, eight users said that the vendor did not provide all the promised software or support, five users stated that the delivery of required software was late, and only three users stated that the equipment was excessively noisy. When questioned on whether or not the system did what it was expected to do, sixteen users said it did, one user said it did not, and four users were undecided. Similarly, when asked if they would recommend the system to another user, sixteen users said yes, one said no, and four were undecided. □

▶ sockets is a slot. Currently available SU's can accommodate either seven hex and two quad slot modules or two hex and two quad slot modules. Quad slot modules have four connector 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, depending upon the PDP-11 family model.

The basic prewired backplane used in the LSI-11, 11/03, and 11/23 has 16 slots that are grouped in up to eight pairs. Each pair can accommodate one LSI-11-type module. The CPU module, with or without the integral 8K-byte memory,

requires two pairs, leaving six pairs for peripherals and options. Most peripherals require only one pair of slots. Semiconductor memory modules, like the CPU Module, require two pairs of slots. Core memory modules are thicker than semiconductor memory modules and, while requiring only two pairs, preclude the use of the adjacent two pairs of slots. Customers must provide DC power for the LSI-11.

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, RSX-11M-PLUS operating system, and a processor with 512K bytes of memory.

The three PDP-11/24 packaged 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 RT-11, RSX-11M, and RSTS/E operating systems, depending upon which is chosen.

The 11/34A is available in either a small chassis with a 9-slot backplane or a large chassis which can mount backplanes with a total of 9 to 22 slots. Additional system expansion is available via BA11 expansion chassis. Beside the basic processors, numerous packaged configurations are offered. Available SU slots (backplane space) and hex and quad slots to be used for expansion in the basic processors and their packaged systems are specified in the equipment price list.

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 11/70 contains the CPU, KW11-L Line Frequency Clock, hardware memory management, direct memory access, M9301-YC ROM Multidevice Bootstrap Loader, operator's console, prewired slots for up to four high-speed mass storage control units, floating-point processor, 2K-byte cache memory, LA36 DECwriter II console, and two H960 Equipment Cabinets with fans and power supplies. The 11/70 is also available as a packaged system. Available backplane slots and hex and/or quad slots provided with supplied backplanes are all given in the equipment price list.

Slot requirements for memory, special processor interface features, and peripherals include: FP11-A FPP, one hex slot; FP11-C FPP, dedicated 11/44 or 11/70 slots (four); real-time clock for 11/03, double slot; other real-time clocks, one hex slot; memory module for 11/03, single or double slot; cache memory for 11/34A, one hex slot; memory modules for 11/34A, one or two hex slots; bootstrap loaders, double hex or quad slot; floppy disk subsystem, one quad slot or double 11/03 slot; cartridge disk subsystem, one quad slot or double 11/03 slot; cartridge disk subsystem, one or two SU slots or double 11/03 slot; pack disk subsystem, two SU slots or dedicated 11/70 slot; fixed-head disk subsystem, two SU slots; magnetic tape subsystem, either one or two SU slots or 11/70 slot; most communications options, one hex slot, two hex slots, one quad slot, or single 11/03 slot; asynchronous multiplexers (NPR output), two SU slots; auto dial interface, one SU slot; line printer subsystems, one quad slot; punched card subsystems, one SU or quad slot; punched tape subsystems, one quad slot; backplanes, one or two SU slots; and UNIBUS extension hardware, one SU slot. ▶

DEC PDP-11 Family

► **WORKSTATIONS:** From one to sixteen workstations can be configured on PDP-11 systems running under RT-11, 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-11M, and RSX-11M-PLUS-based systems; up to sixteen can be attached to RSTS/E-based systems (PDP-11/70 only) for a total of 2,048 megabytes of storage.

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-11M, and RSX-11M-PLUS-based systems.

MASS STORAGE

RM02 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 settling 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 include an embedded servo, allowing control information to be dispersed on each data track for data integrity. Disk rotational speed is 2400 rpm, and average rotational delay is 12.5 milliseconds. Average head positioning time is 55 milliseconds. Data transfer rate is 512K bytes per second.

RL01 packaged products include the RLV11-AK subsystem for the 11/03 and the RL11-AK subsystem for all PDP-11 systems except the 11/03. All subsystems consist of one drive and a controller for up to four drives. The RL01 and related subsystems are manufactured by DEC.

RL02 10.4-MEGABYTE CARTRIDGE DISK DRIVE: A dual-density version of the RL01, announced in November 1979.

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.

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. RK07 drives may not be used with the PDP-11/03. 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.

RM03 67-MEGABYTE DISK PACK DRIVE: This drive is functionally similar to the RM02 drive. Recording is on five surfaces at 6038 bits per inch and 384 tracks per inch. Data is recorded at 512 bytes per sector and 823 tracks per surface (including 15 spare tracks). Formatted capacity is 67 megabytes. The drives rotate at 3600 rpm, resulting in an average rotational delay of 8.3 milliseconds. Track-to-track, average, and across-all-tracks head positioning times are 6, 30, and 55 milliseconds, respectively. Head positioning is performed by a closed-loop proportional servo system driving a voice-coil actuator. Data transfer rate is 1.2 megabytes per second.

RM03 packaged products include the RWM03-A single-access subsystem and the RWM03-B dual-access subsystem. Both subsystems consist of one drive and a controller for up to eight drives. The RM03 drives are for use in PDP-11/70 systems only. The RM03 is manufactured by Control Data (9762).

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 system. The bottom surface of the pack is dedicated to servo control and tracking. The drive rotates a 360 rpm, resulting in 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, which takes advantage of the higher I/O rate of the PDP-11/70; and the "J" controllers, usable with all current PDP-11's. 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 drive to be converted to the dual-access models. Both the "J" and "W" controller can connect to a dual-ported disk pack drive.

RM05 256-MEGABYTE DISK SUBSYSTEM: For the PDP-11/70 MASSBUS; accommodates I/O-intensive applications by providing high throughput. The subsystem consists of an RM05 256MB top-loading disk drive, disk pack and controller with interconnect cabling. It is packaged in one 36 inch high freestanding disk drive cabinet plus one 36 inch high utility cabinet which houses the RM05 drive adapter and contains space for one additional RM05 drive adapter. Performance specifications include: 256MB formatted capacity per drive; 1200KBS peak transfer rate; 38.3 millisecond average access time; 30 millisecond average seek time; 823 tracks per surface; 512 (16-bit format) bytes per sector; and a 3600 rpm rotational speed.

RM05 packaged products include the RWM05-AA(AB) single-ported disk drive and RWM05-BA(BB) dual-ported drive. The disk drive and drive adapter are packaged in a separate utility cabinet to interface to the PDP-11/70 MASSBUS.

INPUT/OUTPUT UNITS

Please refer to the Peripherals/Terminals Table on page M11-384-303 for information on the DEC peripheral equipment for the PDP-11 computers. Non-DEC peripheral devices that ►

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PDP-11 SOFTWARE AVAILABILITY

MODEL	11/03L	11/23	11/24	11/34A	11/44	11/70
RT-11	■	■	■	■		
RSX-11M		■	■	■	■	■
RSX-11M-PLUS					■	■
RSTS/E			■	■	■	■
Fortran-IV	■	■	■	■	■	■
Basic-II	■	■	■	■	■	■
MU Basic	■	■	■	■		
DECnet	■	■	■	■	■	■
2780/3780	■	■	■	■	■	■
FMS-11	■	■	■	■	■	■
DATATRIEVE-11		■	■	■	■	■
Basic-PLUS-2		■	■	■	■	■
Fortran-IV-PLUS		■	■	■	■	■
PDP-11 Cobol		■	■	■	■	■
RMS-11		■	■	■	■	■
SORT-11		■	■	■	■	■
CORAL 66		■	■	■	■	■
DBMS-11		■	■	■	■	■
3271		■	■	■	■	■
RJE/HASP		■	■	■	■	■
SNA				■	■	■
DLX-11		■	■	■	■	■
2780			■	■	■	■
Fortran-77		■	■	■	■	■
Cobol-81			■		■	■
MUX200/RSX-IAS		■	■	■	■	■
UN1004/RSX-UNIVAC		■	■	■	■	■

► 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 market are greater than those of many 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, ranging from the PDP-11/03 to the PDP-11/70. DEC states that it has placed much emphasis on giving all the PDP-11's 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 communications interfaces follow standard PDP-11 configuration rules. Special chassis and/or backplanes for communications options are not required, as is the case with some other vendors' equipment.

Data communications control for all PDP-11's is supplied by numerous interface controllers. However, each of these has a number of variants and options so that PDP-11's can be ►

DEC PDP-11 Family

► 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. The characteristics of the available interface controllers are summarized in the Communications Hardware Interfaces table on page M11-384-318 through 320.

COMMUNICATIONS CONTROL

A variety of communications-oriented software packages is available from DEC.

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 non-switched 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 RSX-11M 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 RSX-11M 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 DUP11's. 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).

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 off-loading 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-11M is a software package that provides communications with a CDC 6000 CYBER series or other ►

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► 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/RXS-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/RXS 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/RXS 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.

For all DEC computer networks, there is *DECnet*, which is actually a number of specific products aimed at several broad markets. Announced in April 1975 as a series of hardware and software extensions to standard systems, DECnet permits users to create communications networks merely by adding appropriate software and hardware to existing computer systems.

DECnet is not a turnkey solution. At the very least, customers must purchase communications links such as a telephone line or private wire, one or more of DEC's communications interfaces for each computer in the network, and often a modem for each end of every link. Some of the more complicated applications will require considerable programming, as well.

DECnet allows customers to:

- Transmit data files across a room or around the world, with less expense and greater speed than is generally possible through other media.
- Share expensive peripherals among several CPU's, some of which may be remote.
- Use another tool in the creation of high-availability (super-reliable) systems, adding to the UNIBUS links and multi-port options that Digital already supplies.
- Make more extensive use of memory-only systems.

DECnet is also the collective name for the set of software products which extend various DEC operating systems so they can be interconnected with each other to form computer networks. The DECnet user can configure a variety of networks by choosing the appropriate CPU's, line interfaces (and speeds), and operating systems software. Such networks typically fall into one of three classes: 1) those that move data from one physical location to another; 2) file-oriented networks, often the case for remote job entry systems; or 3) line-oriented networks, as occurs with the concentration of interactive terminal data.

DECnet includes a set of network protocols, each designed to fulfill specific functions within the network. Collectively, these protocols are known as the Digital Network Architecture, or DNA. The major protocols, and their functions, are as follows. Digital Data Communications Message Protocol (DDCMP) handles the link traffic control and error recovery within DECnet (physical link between the line and the processor). DDCMP has been designed to operate over

full- and half-duplex facilities, using synchronous, asynchronous, and parallel facilities. Network Services Protocol (NSP) handles network management functions within DECnet (logical link between the physical line and the user programs) including the routing of messages between systems and within any given system. Data Access Protocol (DAP) enables programs on one node of the network to utilize the I/O services available on other network nodes. Each operating system in DECnet provides facilities for translating its own unique I/O calls into the DAP standard, and vice versa. DAP thus allows remote file access, including OPEN, READ, WRITE, CLOSE and DELETE for sequential and random files, and remote device access for unit record devices.

DDCMP performs the physical line control only for the interfaces noted in the Communications Hardware Interfaces table as DECnet-supported. DDCMP performs line scanning, error detection and error recovery. On half-duplex lines, DDCMP controls the direction of traffic, while on full-duplex lines, DDCMP controls bidirectional traffic; on multi-point lines DDCMP performs the polling function. Outgoing transmissions are enveloped with control characters mainly to enable the receiving device to perform error detection. The CRC-16 polynomial checking technique is employed in creating an error detection code. Incoming transmissions are stripped of control characters after passing error detection checks. To accommodate the relatively long transit times for satellite-destined messages, DDCMP can support the transmitting of up to 255 messages before halting transmission to await acknowledgements for the previously transmitted messages.

DECnet software to handle the DDCMP protocol line handling is intended for use with low- or medium-speed communications systems. The software will perform the function for both the program-interrupt and the DMA types of communications hardware interfaces. When volume increases substantially and begins to consume too much central processor overhead, or when high-speed communications lines are used, the DMC11 interface can be employed. Containing a dedicated microprocessor, the DMC11 will perform, via firmware, the line handling function, thus relieving the central processor's DECnet software of this time-costly burden. With the DMC11, a user could employ the DDCMP protocol without using the other functions of DECnet.

When NSP receives a message for transmission from a program, NSP affixes the receiving program's identifier and sends it to the appropriate physical link for DDCMP protocol line handling. Incoming messages are stripped of their envelope characters and given to the appropriate program. When two remotely located programs must talk to each other by passing a high volume of a particular type of data (as in remote program loading), NSP can establish a Dynamic Logical Link between the programs and will pass only the specified type of data through the link.

When a remotely located program wants access to a file, NSP does not supply the request to a user program, but to the DAP DECnet module. This module goes through the same steps a local user program would take to get at data from mass storage. Namely, it issues an open and a read/write command to the File Management System. If the remote command was a Read, DAP would obtain the data and pass it to NSP for transmission. NSP will treat data as just another outgoing message from just another user. DAP will also interface with the Device Handler software that controls unit record equipment and locally attached terminals.

A goal for the set of DEC products has been to provide as general an interconnection mechanism between specific products as possible, limited only by the technology and cost considerations which constrain each individual member of DECnet. Those latter constraints make totally general inter- ►

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► connectability impractical. The individual DEC Software Product Descriptions for each product should be consulted in order to ascertain whether any particular configuration violates the guidelines for the individual product.

DEC has extended the range of its DECnet communications software to include networking among most DEC operating systems and processors ranging from the LSI-11 micro-computer to the 32-bit VAX-11/780 and 11/750.

In 1978, DEC made changes to the Network Service Protocol (NSP) Data Access Protocol (DAP), and Digital Data Communications Message Protocols (DDCMP) within DEC's Digital Network Architecture. Among the changes are improved support for various systems under DAP and the ability to prevent network overloads under NSP.

Basically, the revised DECnet programs were designed to simplify network configuration and generation and to provide computing networks for industrial, commercial, scientific, and educational markets. The programs allow "dynamic reconfiguration," the ability to switch lines without interrupting service in case of malfunction. A full point-to-point interconnect capability allows disk-to-task communications by which programs running on separate networks can exchange data. Remote resource access for use of peripherals at another node and remote sequential I/O files are also supported.

While DECnet represents a generalized approach to computer networks within the DEC family, the company is continuing development of a series of remote terminal emulators for other manufacturers' host mainframes. In the PDP-11 family, the IBM 2780 emulator is available under RSX-11M, RSTS/E, RSX-11M-PLUS, and RT-11. Multi-leaving HASP emulation is available under RSX-11M and RSX-11M-PLUS, as well as in a standalone version. Direct channel interfaces to IBM computers via the DX11 have also been sold in custom situations under RSX-11M. Remote job entry to Control Data and Univac mainframes is also available under RSX-11M and RSX-11M-PLUS. DEC's RJE emulators offer sophisticated replacements for the Control Data 200 User Terminal and the Univac 1004.

In February 1980, DEC opened DECnet, Phase III, by introducing DECnet-11M-PLUS, and DECnet-11M, for PDP-11 computers using the RSX-11 family of operating systems. In addition to the above, DEC also announced a new communications interface giving PDP-11 systems interactive access to IBM Systems Network Architecture (SNA) host machines, and a commitment to support of X.25 packet-switching network technology.

The major new features of DECnet Phase III products include:

Adaptive path routing. One DECnet network node may send messages to another through intermediate nodes. Each node maintains a routing table for the entire network, and where more than one path exists between source and destination nodes, the network automatically selects the least-cost path according to line values assigned by the network manager. Routing tables are updated whenever changes in line or system status occur; if service is interrupted on any line, the network automatically reroutes the message across the next-least-cost path.

DECnet Phase III networks comprise both routing nodes, which can send, receive, and forward messages, and end nodes, which only send and receive. Multitasking, mapped systems running under RSX-11M or RSX-11M-PLUS can function as either routing or end nodes, while small, unmapped RSX-11M systems participate as end nodes only.

Multipoint. Also called multidrop, this feature allows up to six remote (or "slave") systems to communicate over a single line with a host (or "master") system, which controls communication and polls each slave system in turn. Slaves can communicate with each other through the host. Multipoint configurations can exist as subgroups within larger networks, enabling both master and slave systems to participate in message routing, file transfer and resource access with other systems.

Multipoint networks are designed as low-cost installations for applications with low intersystem communication requirements.

Network command terminals. Terminal users at one DECnet node can perform standard terminal functions on any other node utilizing the same operating software (e.g., any RSX-11 system). Interaction proceeds as if the terminal were local to the remote system, and the network interface is user-transparent. Network command terminals provide users direct access to programs and devices on remote systems anywhere in the network.

Network management. Management functions can be either centralized or fully distributed across all nodes for efficient monitoring of communication loads, error rates, line condition and node status at all points in the network. Management software enables network managers to evaluate overall network efficiency and to optimize traffic flow by dynamic adjustment of line values. Managers can perform system, interface and line testing while network operation continues.

DECnet-RT allows a suitably configured RT-11 system to participate as a Phase II DECnet mode in point-to-point computer networks. DECnet-RT uses the Digital Network Architecture (DNA) protocols and offers task-to-task communications, network file transfer, and network resource-sharing capabilities. DECnet-RT communicates with adjacent modes over synchronous and asynchronous communication lines. Using DECnet-RT utilities, a user can transfer sequential ASCII files between DECnet modes. Files can be transferred in both directions between a locally supported RT-11 file system device and the file system of an adjacent DECnet mode. In addition, other types of files can be transferred where formats are compatible between the DECnet modes. DECnet-RT permits system command files or batch files to be submitted to a remote mode where the list of commands is in the format expected by the mode responsible for the execution.

DECnet-11M allows a suitably configured RSX-11M system to participate as a routing or non-routing (end) mode in DECnet computer networks. DECnet-11M offers task-to-task communications; utilities for network file transfer; homogeneous network resource-sharing capabilities, using the Digital Network Architecture (DNA) protocols. DECnet-11M communicates with adjacent modes over synchronous and asynchronous communications lines and parallel interfaces. Access to DECnet-11M is supported for RSX-11M user programs written in MACRO-11, Fortran IV, Basic-Plus-2, and Cobol.

DECnet-11M-PLUS offers virtually the same features as DECnet-11M. Access to DECnet-11M-PLUS is supported, however, for RSX-11M-PLUS user programs written in MACRO-11, Fortran IV, Fortran IV-PLUS, and Basic-Plus-2.

DECnet/E allows a suitably configured RSTS/E system to participate as a Phase II DECnet mode in point-to-point computer networks. DECnet/E offers task-to-task communications and utilities for network file transfer using the Digital Network Architecture (DNA) protocols. DECnet/E communicates with adjacent modes over synchronous and asynchronous communications lines interfaced with DMC11 ►

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- microprogrammed controllers. Access to DECnet/E is supported for RSTS/E user programs written in MACRO-11, Fortran IV, Basic-Plus-2, and Cobol.

SOFTWARE

OPERATING SYSTEMS: The major operating systems for the PDP-11 include: 1) the single-user RT-11 disk-based system; 2) the RSTS/E resource-sharing time-sharing system; and 3) the RSX-11 real-time multiprogramming systems: RSX-11M and RSX-11M-PLUS.

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. BASIC-PLUS-2, PDP-11 Cobol, Cobol 81, FMS-11/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, user-definable 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.

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, PDP-11/44, and PDP-11/70 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

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COMMUNICATIONS HARDWARE INTERFACES (Synchronous Transmission Mode)

MODEL	NO. OF LINES	DUPLEX MODE	MAX. LINE SPEED (bps)	LINE ¹ INTERFACE	BUS SUPPORT	CRC PROCESSING	PROTOCOL PROCESSING	EXT. CABLING INCLUDED	DIRECT MEMORY ACCESS
DUP11-DA	1	H/F	9,600	EIA/CCITT	UNIBUS	Yes	No	BC05C-25	No
DMC11-AR/DA	1	H/F	19,200	EIA/CCITT	UNIBUS	Yes	Yes	Not included	Yes
DMC11-AR/FA	1	H/F	250,000	CCITT V.35/DDS	UNIBUS	Yes	Yes	Not included	Yes
DMR11-AA	1	H/F	19,200	EIA/CCITT	UNIBUS	Yes	Yes	Not included	Yes
			56,000	EIA RS-423-A	UNIBUS	Yes	Yes	Not included	Yes
			20,000	EIA RS-449	UNIBUS	Yes	Yes	Not included	Yes
			9,600	150 490Z	UNIBUS	Yes	Yes	Not included	Yes
DMR11-AB	1	H/F	1,000,000 ²	150 2593 CCITT V.35	UNIBUS	Yes	Yes	Not included	Yes
DMR11-AC	1	H/F	1,000,000 ²	Integral modem	UNIBUS	Yes	Yes	BC05Z-25	Yes
DMR11-AE	1	H/F	1,000,000 ²	EIA RS-422-A	UNIBUS	Yes	Yes	Not included	Yes
DUV11-DA	1	H/F	9,600	EIA/CCITT	LSI-11 Bus	No	No	BC05C-25	No
DPV11-DB	1	H/F	56,000	EIA	LSI-11 Bus	Yes	No	BC26L-25	No

¹Unless otherwise specified, EIA/CCITT indicates conformance to EIA RS-232C/CCITT V.24

²Speed is dependent upon externally supplied modem

► 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 FMS-11/RXS, 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.

LANGUAGES: DEC offers several major programming languages for the PDP-11 family of computers. For an overview of which programming language is supported on any specific PDP-11 system, refer to the PDP-11 Software Availability chart.

Fortran IV/RT-11 is an extended superset of the ANSI Fortran X3.9-1966 standard. Its features include fast, one-pass compilation, optimized code generation, and support for virtual arrays on systems with memory management directives. Fortran IV provides a set of object modules (Object Time System or OTS) that are selectively linked with compiler-produced object modules to produce an executable program. Fortran programs may be developed under RT-11 and output in absolute binary format for execution on a standalone PDP-11 system with minimal peripherals, or for loading into ROM or PROM memory. Using SYSLIB, the RT-11 Fortran system subroutine library, all features of the RT-11 monitor are available to Fortran programs. Additionally, SYSLIB provides subroutines which support extensive character string manipulations. Other features include general expressions in all meaningful contexts; mixed-mode arithmetic; BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output.

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

MU Basic/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 interpreter running under the RT-11 operating system Foreground/Background monitor with multiterminal (up to eight) capability and features a variety of program manipulation commands; support for real (single or double precision) integer and string data types; sequential data storage using the RT-11 file system; program chaining and overlaying with COMMON to accommodate large programs; ability to run in either the foreground or background under the RT-11 Foreground/Background monitor concurrently with another job; immediate mode execution for desk calculator operation and program debugging; and virtual arrays on disk.

Basic-11/IAS-RSX is an incremental, interactive, interpretive compiler that uses simple English language-like statements and familiar mathematical notations to describe procedures. Features include a variety of program manipulation commands; support for single precision, real, integer, and string data types; immediate mode statements for debugging and desk calculator use; sequential storage; strings; chaining; virtual arrays; CALL facility for assembly language subroutines interfacing; and Basic interpreter's pure code, shareable by multiple users. This language can be supported by any RSX-11M system with an additional 30KB partition.

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 ►

DEC PDP-11 Family

COMMUNICATIONS HARDWARE INTERFACES (Continued)
(Asynchronous Transmission Mode—Single Line Options)

MODEL	NO. OF LINES	DUPLEX MODE	MAX. LINE SPEED (bps)	LINE ¹ INTERFACE	BUS SUPPORT	CRC PROCESSING	PROTOCOL PROCESSING	EXT. CABLING INCLUDED	DIRECT MEMORY ACCESS
DL11-E	1	H/F	9,600	EIA/CCITT	UNIBUS	No	No	BCZZA	No
DL11-WA	1	H/F	9,600	20mA	UNIBUS	No	No	BC05M-04	No
DL11-WB	1	H/F	9,600	EIA/CCITT	UNIBUS	No	No	BC05C-25	No
DL11-WC	1	H/F	9,600	EIA/CCITT	UNIBUS	No	No	BC03L-10	No
DLV11	1	H/F	9,600	20mA EIA/CCITT	LSI-11 Bus	No	No	Not included	No
DLV11-EB	1	H/F	19,200	EIA	LSI-11 Bus	No	No	BC01V-25	No
DLV11-E	1	H/F	19,200	EIA	LSI-11 Bus	No	No	Not included	No
DLV11-FB	1	H/F	19,200	EIA/CCITT	LSI-11 Bus	No	No	BC03L-05	No
DLV11-FA	1	H/F	19,200	20mA	LSI-11 Bus	No	No	BC05M-04	No
DLV11-F	1	H/F	19,200	20mA EIA/CCITT	LSI-11 Bus	No	No	Not included	No

► 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.

Fortran IV/IAS-RSX is an extended superset of the ANSI Fortran X3.9-1966 standard. Systems with memory management directives provide support for virtual arrays. PDP-11 Fortran IV provides fast, one-pass compilation, and compiler optimizations include common subexpression elimination; local code tailoring; array vectoring; and optional in-line code generation for integer and logical operations. Fortran IV provides a set of object modules (Object Time System or OTS) that are selectively linked with compiler-produced object modules to produce an executable program. Other features include general expressions in all meaningful contexts; mixed-mode arithmetic; BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output.

PDP-11 Fortran IV-Plus/RXS is an extended superset of the ANSI Fortran X3.9-1966 standard. Extensions to the ANSI standard include general expressions in all meaningful contexts; mixed-mode arithmetic; BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output. Systems with memory management directives provide support for virtual arrays. Two Object Time Systems are available with Fortran IV-plus: the File Control Services-based OTS or the RMS-based OTS. The Fortran IV-Plus compiler produces direct PDP-11 machine code optimized for execution time efficiency on a PDP-11 with a floating point processor.

PDP-11 Cobol is a language designed for business data processing and is based on ANSI Cobol X3.23-1974. The PDP-11 Cobol language processor is composed of a compiler and an Object Time System/Library. The compiler produces an object module from a source program and, following program line checks and compilation, an object module can be linked and executed at the operating system command level. File I/O operations are controlled through the RMS data management software which supports sequential,

relative, and indexed file organization. Other features include an interactive debugger that allows a user to set and remove breakpoints and examine and change program variables; support for the Commercial Instruction Set (CIS); and CALL statements for writing subprograms in both Cobol or MACRO-11 assembly languages. Any configuration must include a user area of at least 56KB of memory, and at least 4000 free blocks of on-line disk storage on the public disk structure.

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; re-entrant 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.

Fortran IV/RSTS/E is an extended superset of the ANSI Fortran X3.9-1966 standard. PDP-11 Fortran IV/RSTS/E provides fast, one-pass compilation, and compiler optimizations include common subexpression elimination; local code tailoring; array vectoring; and optional in-line code generation for integer and logical operations. This language provides a set of object modules that are selectively linked with compiler-produced object modules to produce an executable program. Other features include general expressions in all meaningful contexts; mixed-mode arithmetic; BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output. Fortran programs may be developed under RSTS/E and output in absolute binary format for execution on a stand-alone PDP-11 system with minimal peripherals or for loading into ROM or PROM memory.

The *PDP-11 Fortran IV/Plus/RSTS/E* compiler produces direct PDP-11 machine code optimized for execution time efficiency on a PDP-11 with a floating point processor. Fortran-IV-Plus provides the compatibility of creating either or both of the following object time systems: File Control ►

DEC PDP-11 Family

COMMUNICATIONS HARDWARE INTERFACES (Continued) (Asynchronous Transmission Mode—Multi-Line Options)

MODEL	NO. OF LINES	DUPLEX MODE	MAX. LINE SPEED (bps)	LINE ¹ INTERFACE	BUS SUPPORT	CRC PROCESSING	PROTOCOL PROCESSING	EXT. CABLING INCLUDED	DIRECT MEMORY ACCESS
DH11-AD	16	H/F	9,600	EIA/CCITT	UNIBUS	No	No	Not included	No
DH11-AE	16	H/F	9,600	EIA/CCITT	UNIBUS	No	No	Not included	No
DZ11-A	8	F	9,600	EIA/CCITT	UNIBUS	No	No	Not included	No
DZ11-A/B	16	F	9,600	EIA/CCITT	UNIBUS	No	No	Not included	No
DZ11-C	8	F	9,600	20mA	UNIBUS	No	No	Not included	—
DZ11-C/D	16	F	9,600	20mA	UNIBUS	No	No	Not included	No
DZ11-E	16	F	9,600	EIA/CCITT	UNIBUS	No	No	Not included	No
DZ11-F	16	F	96,000	20mA	UNIBUS	No	No	Not included	No
KMC11 ³⁺ DZ11-A	8	F	9,600	EIA/CCITT	UNIBUS	Yes	No	Not included	Yes
KMC11 ³⁺ DZ11-A+ DZ11-B	16	F	9,600	EIA/CCITT	UNIBUS	Yes	No	Not included	Yes
KMC11 ³⁺ DZ11-C	8	F	9,600	20mA	UNIBUS	Yes	No	Not included	Yes
KMC11 ³⁺ DZ11-C+ DZ11-D	16	F	9,600	20mA	UNIBUS	Yes	No	Not included	Yes
DZ11-B	4	H/F	9,600	EIA/CCITT	LSI-11 Bus	No	No	BC11U	No
DLV11-J	4	H/F	38,400	EIA/CCITT	LSI-11 Bus	No	No	Not included	No

³The KMC11 is a microprocessor and requires a communication option to function as an input/output device.

► Services (FCS; allows sequential and random access to sequentially organized files) and Record Management Services (RMS; provides access to sequential, relative, and indexed organization files). Other features include general expressions in all meaningful contexts; mixed-mode arithmetic; BYTE data type for character manipulation; commenting at the end of each source line; and list-directed input/output.

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 packed-decimal 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 construct

including IF...THEN, ELSE IF, ELSE, and END IF statements, for conditional execution of blocks of statements.

UTILITIES: The paragraphs following are generalized descriptions of some of the PDP-11 family utility programs.

FMS-11/RT-11 is a set of utilities and subroutines that provide a multiterminal video forms capability for programs written in Fortran IV/RT-11, Basic-11/RT-11, or MACRO-11. Forms defined using FMS-11 utilize the following features of a VT100 video terminal: reverse video characters; bold characters; underline characters; blinking characters; 132-column lines; jump and smooth scrolling; split screen; and reverse screen. Software components include: Form Editor for creating and modifying video forms by typing them on a VT100 screen; Form Utility for manipulating FMS/RT-11 forms descriptions; Form Driver for performing screen processing; and Application Run-Time Supervisor for running application programs independently of the programs on other terminals.

FMS-11/RSX is a forms-oriented, video I/O management system which functions as an independent, software front-end that logically off-loads the complexities of interactive video I/O management from the application program. Forms defined using FMS-11/RSX utilize the following features of a VT100 video terminal: reverse video characters; bold characters; underline characters; blinking characters; 132-column lines; jump and smooth scrolling; split screen; and reverse screen. Software components include: Form Editor for creating and modifying video forms by typing them on a VT100 screen; Form Utility for manipulating FMS//RT-11 forms descriptions; Form Driver for controlling screen processing; and Video Keypad Editor for general purpose text editing of standard ASCII files.

FMS-11/RSX Upgrade option permits currently licensed users of FMS-11/RT to purchase the license to a FMS-►

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- 11/RXS upgrade kit for use on the same CPU as their previous license. This option includes binaries, license, and full support services.

RMS-11K provides keyed access record management services for the RSX-11M operating system. RMS-11K comprises a set of run-time service routines and utility programs that enable keyed access data files to be defined, populated, updated, and maintained on random access storage devices. Application programs retrieve, modify, or store logical data records by using key field reference value once established by interactive utility program functions. The RMS-11K run-time service routines provide an interface between PDP-11 multi-programmed operating systems and user developed applications programs and also provide all necessary access control, data buffering, record blocking/deblocking, and file structure maintenance. This language can be supported by any valid RSX-11M system with memory management that meets the minimum memory requirements for the operating system and language processors, plus an additional 8KB.

SORT-11 is a optional utility that can accept as input any RMS-11 format file and output a reordered RMS-11 format file. Input files can contain data stocked 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).

DBMS-11 is DEC's adaptation of Cullinane Corporation's IDMS data base management system. IDMS was originally developed by a *Fortune 500* company in 1970 and 1971, and was put into production in early 1972. In 1973 Cullinane was awarded complete responsibility for the system, including all technical developments, enhancements, field support, and marketing. Enhancements have generally followed the CODASYL guidelines, with emphasis on performance and usability, making DEC the first minicomputer vendor to offer a data base management system consistent with the CODASYL recommendations.

DBMS-11 encompasses a data base design methodology; a language to describe the physical and logical data base (DDL); a data manipulation language (DML); compilers for Cobol and Fortran; and a data base manager that provides record storage, control, space management, security, and backup and recovery functions. Also included is a data base dictionary subsystem.

The basic unit of physical space under DBMS-11 is the page, a fixed-length block between 512 and 4096 bytes long. Data bases can be divided into physical areas made up of any number of pages and also into logical files. The entire data base can be assigned to one file, and many logical files can be assigned to a physical area.

DBMS-11 uses the concept of sets. Within a set, one record type functions as the "owner" and one or more record types functions as "members." Using the set concept, hierarchical, network, partially inverted, indexed, and bill of material data bases can easily be defined. Set characteristics are defined by the system designer and consists of independent choices of set order, set membership, and set linkage.

The designer can select one of five logical orders for each set:

- SORTED—members are stored under control of a logical sort field.

- FIRST—members are stored LIFO (last-in, first out).
- LAST—members are stored FIFO (first-in, first-out).
- NEXT—members are stored in a descending sequence under control of the application program.
- PRIOR—members are stored in ascending sequence under control of the application program.

The same member record may be in a different sequence in each set in which it participates.

The designer can select one of four membership specifications for each set. The choices are:

- Mandatory Automatic—members are automatically inserted into a set at the time they are stored and remain in the set until erased from the data base.
- Mandatory Manual—members are inserted into a set under program control but remain in the set until erased from the data base.
- Optional Automatic—members are automatically inserted into a set when stored but may be disconnected from one set and connected to another under program control.
- Optional Manual—members are inserted into sets under program control but must remain in that set until erased from the data base.

A member record may have different linkage specifications in each set in which it participates. Four linkage options are available for each set.

- NEXT—the system maintains unidirectional pointers for processing in the forward direction only.
- NEXT and PRIOR—the system maintains bidirectional pointers for processing in forward as well as reverse order.
- NEXT and OWNER—the system maintains pointers back to the respective owner in each member record as well as pointers in the forward direction.
- NEXT, PRIOR, and OWNER—a combination of the second and third options noted above.

Records are stored into the DBMS-11 data base by one of the following three techniques:

- CALC—provides for record storage based on a symbolic key within the data record which the data base management system uses to calculate a relative storage address. CALC is used to define entry points into the data base and is often used for "master" type data. Duplicate keys may be accepted or rejected based on design criteria.
- VIA—provides for storage of member records physically near the owner record to which they are related within the set. VIA is often used for "transaction" type data and provides for more efficient processing because all the associated data are brought into main memory with a single access.
- DIRECT—the application program directs the data base management system to store a record at a given relative location. This technique is useful when the application program desires to establish a custom addressing scheme.

In all cases, actual record storage, space management, buffering, and control are the responsibility of the data base management system. ►

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► The subschema provides for a logical subset of the data base and defines the rules by which the individual application system may access the data base. Data independence and data security features are implemented in the subschema, and the users can define additional privacy control through the use of passwords, special keys, or data range analysis. DBMS-11 also provides special routines for data compression and decompression, variable-length records, editing and validation, record substitution, auditing, statistical analysis, and encoding/decoding through the use of special DBA procedures.

Application programs access the data base through use of the DML, which provides the interface to the data base system. DML commands such as STORE, ERASE, CONNECT, DISCONNECT, MODIFY, and OBTAIN minimize the need for CALL statements. The DML commands and the host-language statements, which may be Cobol or Fortran, are read into a DML compiler which checks the syntax of the DML command, checks its logical consistency with the data base, and inspects the security and privacy locks associated with the application subschema. In addition, the DML compiler builds the user data work areas, data base communication areas, and data base declarative statements.

DBMS-11/RXS-11M is an implementation of CODASYL Database Language specifications. It is designed to provide database facilities for Cobol-11 programs and any other host language which supports a CALL statement such as Fortran IV/IAS-RSX, Basic-Plus-2, and MACRO-11. DBMS-11 provides separate language facilities for the description of data and the manipulation of data. The minimum hardware required for DBMS-11/RXS-11M includes any valid RXS-11M operating system configurations that includes a PDP-11/70 with 256K words of memory; sufficient mass storage for database areas; a line printer; and a magnetic tape drive.

DBMS-11/RXS-11M-PLUS provides many capabilities to enhance and extend productivity including: multiple database support (allows up to five databases to be active concurrently); variable-sized data dictionaries (permits basing dictionary size on the number of records and sets defined and number of subschemes); improved journaling (ability to restrict the kinds of page images journaled); and utility enhancements (improved command formats and documentation).

DBMS-11/RXS-11M-PLUS Upgrade is available to upgrade DBMS installations from RXS-11M to RXS-11M-PLUS.

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 RXS-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 RXS-11M configuration including memory management hardware, 64K bytes of user memory, and hardware multiply/divide.

DATATRIEVE-11/RXS-11M Upgrade is an option available as an upgrade kit for RXS-11M users who need RMS-11K.

WORD PROCESSING: *DECword* and *DECword/DP* are designed for use with the family of PDP-11 computer systems and RSTS/E operating software. Available from the

Commercial Products Group and Government Systems Group, *DECword/DP* is a layered application software product for data processing customers who want word and data processing capabilities on a single system. *DECword* is a packaged, shared-resource system targeted to large, dedicated word processing users such as corporate departments. It is available from the Word Processing/Small Systems Product Group. Both *DECword* and *DECword/DP* products feature an interactive Computer Based Training (CBT) module that allows users to train at their own pace while using the *DECword* software.

DECword/DP is Digital's first RSTS/E-based timesharing word processing application. *DECword/DP* software handles more than 30 concurrent word and data processing users. The software is available as an add-on application to existing RSTS/E installations, an add-on application with packaged terminals, or as part of new RSTS/E-based data processing systems ranging from the PDP-11/24 to the PDP-11/70. Minimum hardware requirements for *DECword/DP* software are 128K words of main memory, 3500 blocks of free disk space (of which 300 must be contiguous), and at least one VT52-W or VT100-W terminal operating on any valid RSTS/E version 7.0 configuration.

DECword is a hard-disk based, packaged system capable of supporting from four to eight concurrent users and up to 40 megabytes of storage. It is built around the PDP-11/34 central processor and is designed to be compatible with *DECword/DP* as well as Digital's other word processors, including the *DECmate* Word Processor system and *WS200* shared office system. The base configuration includes the *DECword* software and documentation set, central processor with 256KB of main memory, four VT100 video display terminals, 400 word-per-minute letter quality printer, and two RL02 hard disk drives.

PRICING

POLICY: DEC generally provides the PDP-11 mini-computers 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

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.

► 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-11 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 PDP-11, Introduction to Minicomputers, and Introduction to Data

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

► **Communications Concepts.** DEC's Special Systems group offers training in both hardware and software areas on-site and in DEC training centers.

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.

The newest field engineering service is Remote Diagnosis for the PDP-11/70. This process consists of an electronic console, the Digital Diagnosis Center (DDC) with its host computer, and the Service Response Hot-Line/Remote Diagnosis. The electronic console replaces the regular PDP-11/70 front panel and permits initiation of operating commands through the system terminal. Both the DDC and the response group operate 24 hours per day and 7 days a week, and are responsible for decisions on the use of remote diagnosis and analysis of results.

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

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
LSI-11/2 AND LSI-11/23 PROCESSORS			
KD11-HA	LSI-11/2 Central Processor Unit (CPU); one module; minimum order of 50	\$ 555*	\$ —
KD11-HF	LSI-11/2 CPU with 8KB of RAM; two modules	693	—
KD11-HC	LSI-11/2 CPU with 32KB of RAM; two modules	917	—
DK11-HD	LSI-11/2 CPU with 64KB of RAM; two modules	1,115	—
KD11-HU	LSI-11/2 CPU with UV PROM/RAM memory board; two modules	693	—
KUV11-UH	Writable Control Store (WCS) field upgrade kit	1,980	—
KD11-GF	LSI-11/2 CPU with 8KB Multifunction Option Module; two modules	653	—
KD11-GC	LSI-11/2 CPU with 32KB Multifunction Option Module; two modules	917	—
KD11-GD	LSI-11/2 CPU with 32KB Multifunction Option Module plus additional 32KB or RAM; three modules; 64KB total RAM	1,386	—
KDF11-HD	LSI-11/23 CPU with 64KB of RAM; CPU permits addressing to 64KB maximum; Memory Management Unit (MMU) not included; two modules	1,980	—
KDF11-HG	LSI-11/23 CPU with MMU and 128KB of RAM; three modules	2,970	—
KDF11-HH	LSI-11/23 CPU with MMU and 192KB of RAM; four modules	3,498	—
KDF11-HK	LSI-11/23 CPU with MMU and 256KB of RAM; five modules	3,993	—
KDF11-GD	LSI-11/23 CPU with 32KB Multifunction Option plus additional 32KB of RAM; CPU permits addressing to 64KB maximum; MMU not included; three modules, 64KB total RAM	2,310	—
KDF11-SE	LSI-11/23 CPU with MMU plus 32KB Multifunction Option and additional 64KB of RAM; includes license to copy RSX-11S for use on a single CPU; three modules, 96KB total RAM	3,904	—
KDF11-SG	LSI-11/23 CPU with MMU plus 32KB Multifunction Option and additional 128KB of RAM; includes license to copy RSX-11S for use on a single CPU; four modules, 160KB total RAM	3,432	—
KDF11-SJ	LSI-11/23 CPU with MMU plus 32KB Multifunction Option and additional 192KB of RAM; includes license to copy RSX-11S for use on a single CPU; five modules, 224KB total RAM	3,927	—
KDF11-RE	LSI-11/23 CPU with MMU plus 32KB Multifunction Option and additional 64KB of RAM; includes license to copy RT for use on single CPU; three modules, 96KB total RAM	2,904	—
KDF11-RG	LSI-11/23 CPU with MMU plus additional 32KB Multifunction Option and additional 128KB of RAM; includes license to copy RT for use on a single CPU; four modules, 160KB of RAM	3,432	—
KDF11-RJ	LSI-11/23 CPU with MMU plus 32KB Multifunction Option and additional 192KB of RAM; includes license to copy RT for use on a single CPU; five modules, 224KB total RAM	3,927	—

PDP-11/03L SYSTEMS

PDP-11/03L RX02-based systems include CPU; RT-11 operating system; 64KB MOS memory; Floating point instruction set (FIS); bootstrap module with diagnostics; 4-line asynchronous EIA/CCITT interface; one RXV21 floppy disk subsystem that includes one controller, one 0.5MB RX02 floppy disk as system device and one 0.5MB RX02 as backup; one 31 inch high H9610 cabinet; and 4 LSI-11 Quad slots for expansion.

SR-VXSSB-CA (CD)	With LA120 DECwriter III	15,400	144
SR-VXSSB-BA (BD)	With VT100 Video Display	14,700	134
SR-VXSSB-AA (AD)	With LA38 DECwriter IV	14,500	130

PDP-11/03L RLO1-based systems include CPU; RT-11 operating system; 64KB MOS memory; FIS; bootstrap module with diagnostics; 4-line asynchronous EIA/CCITT interface; one RLV11 disk subsystem with one controller and one 5.2MB RLO1 removable cartridge disk drive as system device; one 5.2MB RLO1 as the backup; one 41 inch high H9612 cabinet; and 3 LSI-11 Quad slots for expansion.

SR-VXLLB-CA (CD)	With LA120 DECwriter III	23,700	210
SR-VXLLB-BA (BD)	With VT100 Video Display	23,000	200
SR-VXLLB-AA (AD)	With LA38 DECwriter IV	22,800	196

PDP-11/23 SYSTEMS

PDP-11/23 RX02-based systems include CPU; RT-11 operating system; 128KB MOS memory; memory management; bootstrap module with diagnostics; 4-line asynchronous EIA/CCITT interface; one RXV21 floppy disk subsystem including one controller, one 0.5MB RX02 floppy disk as a system device and one 0.5MB RX02 as backup; one 31 inch H9610 cabinet; and 3 LSI-11 Quad slots for expansion.

SR-WXSSA-CA (CD)	With LA120 DECwriter III	16,600	171
SR-WXSSA-BA (BD)	With VT100 Video Display	15,900	160
SR-WXSSA-AA (AD)	With LA38DECwriter IV	15,700	156

PDP-11/23 RLO1-based systems include CPU; RT-11 operating system; 128KB MOS memory; memory management; bootstrap module with diagnostics; 4-line asynchronous EIA/CCITT interface; one RLV11 disk subsystem including one controller and one 5.2MB RLO1 removable cartridge disk drive as a system device; one 5.2MB RLO1 as a backup; one 41 inch H9612 cabinet; and 2 LSI-11 Quad slots for expansion.

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
PDP-11/23 SYSTEMS (Continued)			
SR-WXLLA-CA (CD)	With LA120 DECwriter III	26,200	237
SR-WXLLA-BA (BD)	With VT100 Video Display	25,500	226
SR-WXLLA-AA (AD)	With LA38 DECwriter IV	25,300	222
	PDP-11/23 RLO2-based system; same as SR-WXLLA except with one RLV21 disk subsystem including one controller, one 10.5MB RLO2 removable cartridge disk as system device, one 10.4MB RLO2 as backup; and one 41 inch H9612 cabinet.		
SR-WXMMA-CA (CD)	With LA120 DECwriter III	27,200	245
SR-WXMMA-BA (BD)	With VT100 Video Display	26,500	235
SR-WXMMA-AA (AD)	With LA38 DECwriter IV	26,300	231
	PDP-11/23 RLO1-based systems running under RSX-11M include CPU; RSX-11M operating system; 128KB MOS memory; memory management; bootstrap module with diagnostics; 4-line asynchronous EIA/CCITT interface; one RLV11 disk subsystem including one controller and one 5.2MB RLO1 removable cartridge disk drive as system device; one 5.2MB RLO1 as backup; one 41 inch H9612 cabinet; and 2 LSI-11 Quad slots for expansion.		
SM-WXLLA-CA (CD)	With LA120 DECwriter III	30,300	237
SM-WXLLA-BA (BD)	With VT100 Video Display	29,600	226
SM-WXLLA-AA (AD)	With LA38 DECwriter IV	29,400	222
	PDP-11/23 RLO2-based system running under RSX-11M; same as SM-WXLLA except includes one RLV21 disk subsystem including one controller and one 10.4MB removable cartridge disk drive as system device; and one 10.4MB as a backup.		
SM-WXMMA-CA (CD)	With LA120 DECwriter III	30,800	245
SM-WXMMA-BA (BD)	With VT100 Video Display	30,100	235
SM-WXMMA-AA (AD)	With LA38 DECwriter IV	29,900	231
PDP-11/24 SYSTEMS			
	PDP-11/24 RX02-based system running under RT-11 includes CPU; RT-11 operating system; 128KB parity MOS memory; memory management; ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interface: one for the console terminal and one available for expansion; one RX211 floppy disk subsystem including one controller and one 0.5MB RX02 floppy disk drive as system backup; one 0.5MB RX02 as the backup; one 41.75 inch H9642 CPU cabinet; and 5 Hex slots and 1 Quad slot for expansion.		
SR-FXSSA-BA (BD)	With VT100 Video Display	20,000	150
SR-FXSSA-AA (AD)	With LA38 DECwriter IV	19,800	146
	PDP-11/24 RLO2-based system running under RT-11; same as SR-FXSSA except with 256KB parity MOS memory; one RL211 disk subsystem including one controller and one 10.4MB RLO2 removable cartridge disk drive as the system device; and one 10.4MB RLO2 as the backup.		
SR-FXMMB-BA (BD)	With VT100 Video Display	30,000	260
	PDP-11/24 RLO2-based system running under RSX-11M includes CPU; RSX-11M operating system; 256KB parity MOS memory; memory management; ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interfaces: one for the console terminal and one available for expansion; one RL211 disk subsystem including one controller and one 10.4MB RLO2 removable cartridge disk drive as the system device; one 10.5MB RLO2 as the backup; one 41.75 inch H9645 CPU cabinet; and 5 Hex slots and 1 Quad slot for expansion.		
SM-FXMMA-BA (BD)	With VT100 Video Display	35,000	260
	PDP-11/24 RK07-based system running under RSX-11M; same as SM-FXMMA with one RK711 disk subsystem including one controller and one 28MB RK07 disk drive as the system device; one 28MB RK07 as the backup; and one 41.75 inch H9642 cabinet with one 41.75 inch H9642 bolt-on RK07 disk drive and one freestanding H9642 RK07 disk drive.		
SM-FXHHA-CA (CD)	With LA120 DECwriter III	55,700	426
	PDP-11/24 RLO2-based system running under RSTS/E includes CPU; RSTS/E operating system; 256KB parity MOS memory; memory management; ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interfaces: one for the console terminal and one available for expansion; one RL211 disk subsystem including one controller and one 10.4MB RLO2 removable cartridge disk drive for use as the system device; one 10.4MB RLO2 removable cartridge as the backup; one 41.75 inch H9645 CPU cabinet; and 5 Hex slots and 1 Quad slot for expansion.		

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
PDP-11/24 SYSTEMS (Continued)			
SE-FXMMMA-CA (CD)	With LA120 DECwriter III	43,700	270
	PDP-11/24 RK07-based system running under RSTS/E; same as SE-FXMMMA except includes one RK711 disk subsystem with one controller and one 28MB RK07 disk drive as the system device; one 28MB RK07 as the backup; and one 41.75 inch H9642 cabinet with one 41.75 inch H9642 bolt-on RK07 disk drive and one freestanding H9642 RK07 disk drive.		
SE-FXHHA-CA (CD)	With LA120 DECwriter III	62,700	426
PDP-11/34A SYSTEMS			
	PDP-11/34A RX02-based system running under RT-11 includes CPU; RT-11 operating system; 128KB parity MOS memory; memory management; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; programmer's console interface; one RX211 floppy disk subsystem including one controller and one 0.5MB RX02 floppy disk drive as the system device; one 0.5MB RX02 as the backup; one 72 inch H960 CPU cabinet; and 4 Hex slots and 1 Quad slot or 7 Hex slots for expansion.		
SR-30SSB-CA (CD)	With LA120 DECwriter III	27,900	175
SR-30SSB-BA (BD)	With VT100 Video Display	27,200	164
SR-30SSB-AA (AD)	With LA38 DECwriter IV	27,000	160
	PDP-11/34A RL01-based system running under RT-11; same as SR-30SSB except with one RL11 disk subsystem including one controller and one 5.2MB RL01 removable cartridge disk drive as the system device; one 5.2MB RL01 as the backup; and 4 Hex slots and 1 Quad slot or 6 Hex slots and 1 Quad slot for expansion.		
SR-30LLB-CA (CD)	With LA120 DECwriter III	33,800	241
SR-30LLB-BA (BD)	With VT100 Video Display	33,100	230
SR-30LLB-AA (AD)	With LA38 DECwriter IV	32,900	226
	PDP-11/34A RL01-based system running under RSX-11M includes CPU; RSX-11M operating system; 128KB parity MOS memory; memory management; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; programmer's console interface; one RL11 disk subsystem including one controller and one 5.2MB RL01 removable cartridge disk as the system device; one 5.2MB RL01 as the backup; one 72 inch H960 CPU cabinet; and 4 Hex slots and 1 Quad slot or 6 Hex slots, 1 Quad slot, and 1 SU for expansion.		
SM-30LLB-CA (CD)	With LA120 DECwriter III	38,300	241
SM-30LLB-BA (BD)	With VT100 Video Display	37,600	230
SM-30LLB-AA (AD)	With LA38 DECwriter IV	37,400	226
	PDP-11/34A RL01-based system running under RSX-11M; same as SM-30LLB except with 256KB parity MOS memory.		
SM-30LLC-CA (CD)	With LA120 DECwriter III	39,300	281
SM-30LLC-BA (BD)	With VT100 Video Display	38,600	270
SM-30LLC-AA (AD)	With LA38 DECwriter IV	38,400	266
	PDP-11/34A RL02-based system running under RSX-11M; same as SM-30LLC except with one RL211 disk subsystem including one controller and one 10.4MB RL02 removable cartridge disk drive as the system device; and one 10.4MB RL02 as backup.		
SM-30MMA-CA (CD)	With LA120 DECwriter III	40,300	287
SM-30MMA-BA (BD)	With VT100 Video Display	39,600	277
SM-30MMA-AA (AD)	With LA38 DECwriter IV	39,400	273
	PDP-11/34A RL02-based system running under RSTS/E includes CPU; RSTS/E operating system; 256KB parity MOS memory; memory management; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; programmer's console interface; one disk RL211 subsystem including one controller and one 10.4MB RL02 removable cartridge disk drive as the system device; one 10.4MB RL02 as backup; one 72 inch H960 CPU cabinet; and 4 Hex slots and 1 Quad slot or 6 Hex slots, 1 Quad slot, and 1 SU for expansion.		
SE-30MMA-CA (CD)	With LA120 DECwriter III	48,300	287
	PDP-11/34A RK07-based system running under RSTS/E includes CPU; RSTS/E operating system; 256KB parity MOS memory; memory management; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; programmer's console interface; one RK711 disk subsystem including one controller and one 28MB RK07 disk drive as the system device; one 28MB RK07 as the backup; one 72 inch H960 CPU cabinet and two 39 inch freestanding RK07 disk drives; and 4 Hex slots and 1 Quad slot or 2 Hex slots and 1 SU for expansion.		
SE-30HHA-CA (CD)	With LA120 DECwriter III	69,500	440

*CPU quantity level of 50-99.

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DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
PDP-11/44 SYSTEMS			
	PDP-11/44 RL02-based system running under RSX-11M includes CPU; RSX-11M operating system; 512KB ECC MOS memory; 8KB cache parity memory; memory management with physical address extension; microprocessor-controlled ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interfaces: one for the LA120 console terminal and the other for the TU58 cartridge tape subsystem; dual TU58 cartridge tape subsystem (256KB per cartridge); one RL211 disk subsystem including one controller and one 10.4MB RL02 removable cartridge disk drive as the system device; one 10.4MB RL02 as the backup; one 41.75 inch H9642 CPU cabinet and one 41.75 H9642 bolt-on RL02 disk cabinet; and 1 Quad slot and 3 SUs for expansion.		
SM-40MMC-CA (CD)	With LA120 DECwriter III	57,000	358
	PDP-11/44 RL02-based system running under RSX-11M; same as SM-40MMC except also includes Fortran IV-PLUS and floating point processor.		
SM-40MMDQCA (CD)	With LA120 DECwriter III	64,000	375
	PDP-11/44 RK07-based system running under RSX-11M; same as SM-40MMC except includes one 28MB RK07 disk subsystem including one controller and one 28MB RK07 disk drive as the system device; one 28MB RK07 as the backup; and 3 Hex slots, 2 Quad slots, and 1 SU for expansion.		
SM-40HHB-CA (CD)	With LA120 DECwriter III	77,200	504
	PDP-11/44 RM02-based system running under RSX-11M includes CPU; RSX-11M operating system; 512KB ECC MOS memory; 8KB parity cache memory; memory management with physical address extension; microprocessor-controlled ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interfaces: one for the LA120 console terminal and the other for the TU58 cartridge tape subsystem; dual TU58 cartridge tape subsystem (256KB per cartridge); one RJM02 disk subsystem including one controller and one 67MB RM02 disk drive as the system device; one TS11 magtape subsystem including one controller and one TS11 magtape transport as the backup; 41.75 inch high H9642 CPU cabinet, one 60.5 inch H9646 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM02 disk drive; 1 Quad slot and 1 SU for expansion.		
SM-40UAB-CA (CD)	With LA120 DECwriter III	94,200	484
	PDP-11/44 RM02-based system running under RSX-11M-PLUS includes CPU; RSX-11M-PLUS operating system; 512KB ECC MOS memory; 8KB parity cache memory; memory management with physical address extension; microprocessor-controlled ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interface: one for the LA120 console terminal and the other for the TU58 cartridge tape subsystem; dual TU58 cartridge tape subsystem (256KB per cartridge); one RJM02 disk subsystem including one controller and one 67MB RM02 disk drive as the system device; one TS11 magtape subsystem including one controller and one TS11 magtape transport as the backup; one 41.75 inch H9642 CPU cabinet; one 60.5 inch H9646 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM02 disk drive; and 1 Quad slot and 1 SU for expansion.		
SN-40UAB-CA (CD)	With LA120 DECwriter III	98,200	484
	PDP-11/44 RL02-based system running under RSTS/E includes CPU; RSTS/E operating system; 512KB ECC MOS memory; 8KB parity cache memory; memory management with physical address extension; microprocessor-controlled ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interfaces: one for the LA120 console terminal and the other for the TU58 cartridge tape subsystem; dual TU58 cartridge tape subsystem (256KB per cartridge); one RL211 disk subsystem including one controller and one 10.4MB RL02 removable cartridge disk drive as the system device; one 10.4MB RL02 as the backup; one 41.75 inch H9642 CPU cabinet and one 41.75 inch H9642 bolt-on RL02 disk cabinet; 1 Quad slot and 3 SUs for expansion.		
SE-40MMB-CA (CD)	With LA120 DECwriter III	65,000	358
	PDP-11/44 RK07-based system running under RSTS/E; same as SE-40MMB except with one RK711 disk subsystem including one controller and one 28MB RK07 disk drives as system device; one 28MB RK07 as the backup; one 41.75 inch H9642 CPU cabinet, one 41.75 inch H9642 bolt-on RK07, and one 41.75 inch H9642 free-standing RK07; 3 Hex slots, 2 Quad slots, and 1 SU for expansion.		

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
PDP-11/44 SYSTEMS (Continued)			
SE-40HHB-CA (CD)	With LA120 DECwriter III PDP-11/44 RMOS-based system running under RSTS/E; same as SE-40HHB except with one RM02 disk subsystem including one controller and one 67MB RM02 disk drive as the system device; one TS11 magtape subsystem including one controller and one TS11 magtape transport as the backup; one 41.75 inch H9642 CPU cabinet, one 60.5 inch H9646 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM02 disk drive; 1 Quad slot and 1 SU for expansion.	84,200	504
SE-40HHB-CA (CD)	With LA120 DECwriter III PDP-11/44 RM02-based system running under RSTS/E; same as SE-40HHB except with one RM02 disk subsystem including one controller and one 67MB RM02 disk drive as the system device; one TS11 magtape subsystem including one controller and one TS11 magtape transport as the backup; one 41.75 inch H9642 CPU cabinet, one 60.5 inch H9646 bolt-on S11 magtape cabinet, and one 39 inch freestanding RM02 disk drive; 1 Quad slot and 1 SU for expansion.	84,200	504
SE-40VAC-CA (CD)	With LA120 DECwriter III PDP-11/44 RM02-based system running under RSTS/E includes CPU; RSTS/E operating system; 512KB ECC MOS memory; 8KB parity cache memory; memory management with physical address extension; PDP-11 Cobol; commercial instruction set (CIS) processor; microprocessor-controlled ASCII console; bootstrap module with diagnostics; line frequency clock; two single line asynchronous EIA/CCITT interface: one for the LA120 console terminal and the other for the TU58 cartridge tape subsystem; dual TU58 cartridge tape subsystem (256KB per cartridge); one RJM02 disk subsystem including one controller and one 67MB RM02 disk drive as the system device; one TS11 magtape subsystem as the backup; one 41.75 inch H9642 CPU cabinet, one 60.5 inch H9646 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM02 disk drive; 1 Quad slot and 1 SU for expansion.	102,200	484
SE-40VAB-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system running under RSX-11M includes CPU; RSX-11M operating system; 512KB interleaved ECC MOS memory with battery backup; 2KB parity cache memory; memory management with physical address extension; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; one RWMO3 disk subsystem including one controller and one 67MB RM03 disk drive as the system device; one TS11 magtape subsystem as the backup; one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM03 disk drive; and 2 Hex slots, 1 Quad slot, and 3 MASSBUS ports for expansion.	115,100	498
PDP-11/70 SYSTEMS			
SM-70TAA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system running under RSX-11; same as SM-70TAA except includes one TWE16 magtape subsystem as backup; one 72 inch H960 CPU cabinet, one 72 inch H960 memory cabinet, one 72 inch H960 bolt-on TE16 magtape cabinet, and one 39 inch freestanding RM03 disk drive; and 3 Hex slots, 1 Quad slot and 2 MASSBUS ports for expansion.	139,000	614
SM-70TYB-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system running under RSX-11M; same as SM-70TVB except includes one 60 inch H9600 CPU/memory cabinet, one 60 inch H9602 high bolt-on TE16 magtape cabinet, and one 39 inch freestanding RM03 disk drive	148,000	693
SM-70TVC-CA (CD)	With LA120 DECwriter III PDP-11/70 RP06-based system running under RSX-11M includes CPU; RSX-11M operating system; 512KB interleaved ECC MOS memory with battery backup; 2KB cache memory; memory management with physical address extension; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; one RWPO6 disk subsystem including one controller and one 176MB RP06 disk drive as the system device; one TWE16 magtape subsystem as the backup; one 72 inch H960 CPU cabinet, one 72 inch H960 bolt-on TE16 magtape cabinet, and one 47 inch freestanding RP06 disk drive; 3 Hex slots, 1 Quad slot, 2 MASSBUS ports	148,000	693
SM-70CVD-CA (CD)	With LA120 DECwriter III PDP-11/70 RP06-based system running under RSX-11M; same as SM-70CVD except includes one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 bolt-on TE16 magtape cabinet, and one 47 inch freestanding RP06 disk drive	164,000	746

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
PDP-11/70 SYSTEMS (Continued)			
SM-70CVE-CA (CD)	With LA120 DECwriter III PDP-11/70 RPO6-based system running under RSX-11M; same as SM-70CVD except with 1024KB interleaved ECC MOS memory with battery backup	164,000	746
SM-70CVB-CA (CD)	With LA120 DECwriter III PDP-11/70 RPO6-based system running under RSX-11M; same as SM-70CVB except includes one TWU77 magtape subsystem as the backup; one 60 inch H9600 double width highboy CPU/memory, one 60 inch H9602 TU77 magtape cabinet, and one 47 inch freestanding RPO6 disk drive	170,000	872
SM-70CBA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system running under RSX-11M-PLUS includes CPU; RSX-11M-PLUS operating system; 512KB interleaved ECC MOS memory with battery backup; 2KB parity cache memory; memory management with physical address extension; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; one RWM03 disk subsystem including one controller and one 67MB RM03 disk drive as the system device; one TS11 magtape subsystem as the backup; one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM03 disk drive; 2 Hex slots, 1 Quad slot, and 3 MASSBUS ports for expansion	183,700	964
SN-70TAA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system running under RSX-11M; same as SN-70TAA-CA (CD) except includes one TWE16 magtape subsystem as backup; one 60 inch H9602 bolt-on TE16 magtape cabinet; 3 Hex slots, 1 Quad, and 2 MASSBUS ports for expansion	143,000	614
SN-70TVA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM05-based system running under RSX-11M-PLUS; same as SN-70TAA except includes one RWM05 disk subsystem including one controller and one 256MB RM05 disk drive as the system device; one TWU77 magtape subsystem as the backup; one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 TU77 magtape cabinet, one 36 inch freestanding RM05 disk drive, and one 36 inch utility cabinet; and 3 Hex slots, 1 Quad slot, and 2 MASSBUS ports for expansion	152,000	693
SN-70DBA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system running under RSTS/E includes CPU; RSTS/E operating system; 512KB interleaved ECC MOS memory with battery backup; 2KB parity cache memory; memory management with physical address extension; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; one RWM03 disk subsystem including one controller and one 67MB RM03 disk drive as the system device; one TS11 magtape subsystem as backup; one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM03 disk drive; 2 Hex slots, 1 Quad slot, and 3 MASSBUS ports for expansion	174,000	888
SE-70TAA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system; same as SE-70TAA except includes one TWE16 magtape subsystem extension; bootstrap module with diagnostics; single line asynchronous EIA/CCITT interface and line frequency clock; one RWM03 disk subsystem including one controller and one 67MB RM03 disk drive as the system device; one TS11 magtape subsystem as backup; one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 bolt-on TS11 magtape cabinet, and one 39 inch freestanding RM03 disk drive; 2 Hex slots, 1 Quad slot, and 3 MASSBUS ports for expansion	147,300	614
SE-70TAA-CA (CD)	With LA120 DECwriter III PDP-11/70 RM03-based system; same as SE-70TAA except includes one TWE16 magtape subsystem as the backup; one 72 inch H960 CPU cabinet, one 72 inch H960 memory cabinet, one 72 inch H960 bolt-on TE16 magtape cabinet, and one 39 inch freestanding RM03 disk drive; 3 Hex slots, 1 Quad slot, and 2 MASSBUS ports for expansion	147,300	614

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
PDP-11/70 SYSTEMS (Continued)			
SE-70TVB-CA (CD)	With LA120 DECwriter III	156,000	693
	PDP-11/70 RMO5-based system running under RSTS/E; same as SE-70TAA; same as SE-70TAA except includes one RWM05 disk subsystem including one controller and one 256MB RMO5 disk drive as the system device; one TWU77 magtape subsystem for use as the backup; one 60 inch H9600 double width highboy CPU/memory cabinet, one 60 inch H9602 TU77 magtape cabinet, one 36 inch freestanding RMO5 disk drive, and one 36 inch utility cabinet; 3 Hex slots, 1 Quad slot, and 2 MASSBUS ports for expansion		
SE-70DBA-CA (CD)	With LA120 DECwriter III	178,300	888
PDP-11/23-PLUS SYSTEMS			
	PDP-11/23-PLUS RL02-based system running under RSX-11M includes 11/23-PLUS CPU, including bootstrap with diagnostics; 256KB MOS memory; memory management; two single line asynchronous EIA/CCITT interfaces; system distribution panel for serial line and options interconnect; one RLV22 disk subsystem (one controller and one 10.4MB RL02 disk drive) as system device; one 10.4MB RL02 disk drive for backup and load; and one 41.75 inch high H9642 cabinet; system has 768KB of MOS memory for expansion to 1MB		
SM-RXMMB-CA (CD)	With LA120 DECwriter III	32,400	247
SM-RXMMB-BA (BD)	With VT100 Video Display	31,700	237
	PDP-11/23-PLUS RL02-based system running under RSX-11M-PLUS includes 11/23-PLUS CPU, including bootstrap with diagnostics; 512KB MOS memory; memory management; two single line asynchronous EIA/CCITT interfaces; system distribution panel for serial line and options interconnect; one RLV22 disk subsystem (one controller and one 10.4MB RL02 disk drive) as system device; one 10.4MB RL02 disk drive for backup and load; one 41.75 inch high H9642 cabinet; system has 512KB memory expansion available to a total of 1MB		
SN-RXMMC-CA (CD)	With LA120 DECwriter III	35,400	274
SN-RXMMC-BA (BD)	With VT100 Video Display	34,700	264
	PDP-11/23-PLUS RL02-based system running under RSTS/E includes 11/23-PLUS CPU, including bootstrap with diagnostics; 256KB MOS memory; memory management; two single line asynchronous EIA/CCITT interfaces; system distribution panel for serial line and options interconnect; one RLV22 disk subsystem (one controller and one 10.4MB RL02 disk drive) as system device; one 10.4MB RL02 as the backup and load device; one 41.75 inch high cabinet; system has 768KB of MOS memory expansion available for a maximum total of 1MB		
SE-RXMMB-CA (CD)	With LA120 DECwriter III	37,600	247
PROCESSOR OPTIONS			
	PDP-11/23, PDP-11/03 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; mounts on KDF11 CPU board	420	NC
MSV11-DC	32KB dynamic Random Access Memory (RAM)	500	16
MSV11-DD	64KB dynamic RAM	750	27
MRV11-BA	256 x 16-bit memory module that contains 8 sockets for MRV11-BC UV PROM chips; no memory chips are included	390	NA
MRV11-BC	1K x 8-bit UV PROM chip; unprogrammed for use with MRV11-BA	110	NA
MRV11-AA	32 IC socket PROM/ROM memory module, accepts 256 x 4-bit or 512 x 4-bit chips, masked ROM devices and MRV11-AC PROM chips; maximum capacity of 8KB	210	NA
MRV11-AC	512 x 4-bit PROM chip for use with MRV11; mounts on MRV11-AA board	45	NA
	PDP-11/24 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 and mounts on a KDF11 CPU board	420	NC
MS11-LB	128KB parity MOS memory	2,400	42
MS11-LD	256KB parity MOS memory	2,800	79
H775-A	Battery backup; requires 5.25 inch PDP-11/24 CPU	700	8
H7750-BA (BD)	Battery backup; requires 10.5 inch PDP-11/24 CPU	1,600	15
KT 24	Physical Address Extension (PAX) module allows memory expansion up to 768 bytes with a 5.25 inch CPU box and up to 1MB with a 10.5 inch CPU box	1,500	15
	PDP-11/23 PLUS Processor Options		
KEF11-AA	Single and double precision floating point option for use with PDP-11/23-PLUS; 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	420	NC

*CPU quantity level of 50-99.

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DEC PDP-11 Family

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSOR OPTIONS (Continued)			
FPF11	Single and double precision floating point option for use with PDP-11/23-PLUS; micro-code to implement this option resides on one quad module mounted adjacent to the CPU; 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; executes instructions approximately six times faster than the KEF11-AA	2,900	25
KEF11-BB	Commercial Instruction Set (CIS) for the PDP-11/23-PLUS; implements a set of 27 commercial instructions on a variety of data types, including character strings, packed decimal and numeric formats	4,000	24
MSV11-PK	256KB dynamic Random Access Memory with parity	2,900	28
MSV11-PL	512KB dynamic Random Access Memory with parity	4,900	55
PDP-11/34A Processor Options			
FP11-A	Floating point processor for the PDP-11/34A; 46 instruction set; performs hardware operations on 32-bit and 64-bit floating point numbers as well as integer to floating point conversions	3,400	25
KK11-A	2KB high-speed cache memory	4,400	18
MS11-LB	128KB parity MOS memory	2,400	42
MS11-LD	256KB parity MOS memory	2,800	79
H775-CA (CB)	Battery backup; requires 10.5 inch PDP-11/34A CPU	1,600	8
PDP-11/44 Processor Options			
KE44-A	Commercial Instruction Set (CIS) processor; implements a set of 27 new commercial instructions on a variety of data types, including character strings, packed decimal and numeric	7,900	17
FP11-F	Floating point processor; forty-six 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	3,100	17
MS11-MB	256KB ECC MOS memory	5,600	48
MS11-MC	512KB ECC MOS memory	8,900	95
MS11-MD	768KB ECC MOS memory	13,200	142
H7750-BA (BD)	Battery backup for PDP-11/44 CPU	1,600	15
PDP-11/70 Processor Options			
FP11-C	Floating point processor; 46 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	6,600	34
MS11-CE	512KB ECC MOS expansion memory	10,200	126
MK11-CF	1024KB ECC MOS expansion memory	13,800	252
MASS STORAGE			
RXV21-BA (BD)	RXV21 dual floppy disk drive and controller to interface to the LSI-11 bus; includes two 0.5MB RX02 drives; 61KBS peak transfer rate; 262 msec. average access time; requires PDP-11/03L, 11/23	4,150	48
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; requires UNIBUS PDP-11	4,150	48
RLV11-AK	RLV11 cartridge disk drive and controller to interface to the LSI-11 bus; includes an RLO1 5.2MB disk drive; 512KBS peak transfer rate; 67.5 msec average access time; requires PDP-11/03, 11/23	6,400	61
RL11-AK	RL11 cartridge disk drive and controller to interface to the PDP-11 UNIBUS; includes an RLO1 5.2MB disk drive; 512KBS peak transfer rate; 67.5 msec. average access time; requires PDP-11 UNIBUS	6,400	61
RLO1-AK	Add-on cartridge disk; requires RL11-AK, RLV11-AK, RL211-AK or RLV21-AK	5,100	53
RLV21-AK	Top loading removable cartridge disk drive and controller to interface to the LSI-11 bus; includes an RLO2 10.4MB disk drive; 512KBS peak transfer rate; 67.5 msec average access time; requires PDP-11/03, 11/23	6,900	68
RL211-AK	Top-loading removable cartridge disk drive and controller to interface to the PDP-11 UNIBUS; includes an RLO2 10.4MB disk drive; 512KBS peak transfer rate; 67.5 msec. average access time; there is a maximum of two RL211-AK controllers per CPU; requires UNIBUS PDO-11	6,900	68
RLO2-AK	Add-on cartridge disk; RL211-AK, RLV21-AK, RL11-AK or RLV11-AK	5,600	60
RLO2K-DC	10.4MB disk cartridge for the RLO2	199	NA
RK711-EA (ED)	RK711 disk drive and controller to interface to the PDP-11 UNIBUS; includes an RK07 28MB top-loading disk drive; mounts in a 39 inch H969 freestanding cabinet; requires UNIBUS PDP-11 system configured in H960 or H9600 series cabinets	18,500	153
RK711-PA (PD)	RK711 disk drive and controller mounted in a 41.75 inch high freestanding cabinet; includes an RK07 28MB top-loading disk drive; requires a UNIBUS PDP-11 system configured in an H9640 series cabinet	18,500	153
RK07-EA (ED)	RK07 28MB top-loading cartridge disk drive with disk cartridge mounted in a 39 inch high freestanding H969 cabinet; requires RK711-EA (ED)	13,000	121
RK07-PA (PD)	RK07 28MB top-loading cartridge disk drive with disk cartridge mounted in a 41.75 inch high freestanding H9642 cabinet; requires RK711-PA (PD)	13,000	121

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
MASS STORAGE (Continued)			
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
RJM02-AA (AD)	RM02 disk drive and controller to interface to the PDP-11 UNIBUS; includes an RM02 67MB top-loading disk drive, disk pack and controller; 806KBS peak transfer rate; 42.5 msec average access time; requires UNIBUS PDP-11	32,300	179
RM02-AA (AD)	RM02 disk drive; requires a RJM02-A	20,300	147
RM03-P	67MB disk pack for either the RM02 or RM03 disk drives	635	NA
RWM03-AA (AD)	Single-ported RM03 disk drive and controller to interface to the PDP-11/70 MASSBUS; includes an RM03 67MB top-loading disk drive, disk cartridge and controller; 1200 KBS peak transfer rate; 38.3 msec average access time; requires a PDP-11/70	32,300	179
RWM03-BA (BD)	Dual-ported RM03 disk drive and two controllers to interface to two PDP-11/70 systems; includes an RM03 67MB top-loading disk drive; 1200KBS peak transfer rate; 38.3 msec average access time; requires one or two PDP-11/70s	43,900	226
RM03-AA (AD)	Single-ported RM03 disk drive; requires RWM03-A	20,300	147
RM03-BA (BD)	Dual-ported RM03 disk drive; requires RWM03-B	22,500	163
RWM03-C	RM03 dual-port kit containing drive logic, cables and second controller to convert RWM03-A to RWM03-B; requires two PDP-11/70s	13,700	48
RM03-C	RM03 dual-port kit containing drive logic and cables to convert RM03-A to RM03-B	2,150	16
RM03-P	67MB disk pack for either the RM02 or RM03 disk drives	635	NA
RJP06-AA (AB)	Single-ported RPO6 disk drive and controller to interface to the PDP-11 UNIBUS; includes an RPO6 176MB top-loading disk drive, disk pack and controller; 806KBS peak transfer rate; 38.3 msec average access time; requires a UNIBUS PDP-11	46,000	231
RWP06-AA (AB)	Single-ported RPO6 disk drive and controller to interface to the PDP-11/70 MASSBUS; includes an RPO6 176MB top-loading disk drive, disk pack and controller; 806KBS peak transfer rate; 38.3 msec average access time; requires a PDP-11/70	46,000	231
RWP06-BA (BB)	Dual-ported disk drive and two controllers to interface to two PDP-11/70 systems	60,600	284
RPO6-AA (AB)	Single-ported RPO6 disk drive; requires RJP06-A subsystem	34,000	200
RPO6-BA (BB)	Dual-ported RPO6 disk drive; requires RWP06-B subsystem	39,140	221
RWP06-C	RPO6 dual-port kit containing drive logic, cables and second controller to convert RWP06-A to RWP06-B; requires two PDP-11/70s with RWP06-A subsystem	16,700	53
RPO6-C	RPO6 dual-port kit containing drive logic, hardware, and cables to convert RPO6-A to RPO6-B	5,150	21
RPO6-P	176MB disk pack for RPO6	950	NA
RWM05-AA (AB)	Single-ported RM05 disk drive and drive adapter packaged in separate utility cabinet to interface to the PDP-11/70 MASSBUS; includes an RM05 256MB top-loading disk drive, disk pack and controller with interconnect cabling; 1200KBS peak transfer rate; 38.3 msec average access time; require a PDP-11/70	46,000	310
RMW05-BA (BB)	Dual-ported RM05 disk drive and drive adapter; same as RWM05-AA except interfaces to two PDP-11/70 systems	60,600	395
RM05-AA (AB)	Add-on single-ported 256MB RM05 disk drive and adapter; packaged in one 36 inch high freestanding disk drive cabinet and one 36 inch high utility cabinet which houses the RM05 drive adapter and contains space for one additional drive adapter	34,000	240
RM05-BA (BB)	Same as RM05-AA except dual-ported	39,140	255
RM05-AC (AD)	Add-on single-ported 256MB RM05 disk drive and drive adapter; packaged in one 36 inch high freestanding disk drive cabinet only	34,000	240
RM05-BC (BD)	Same as RM05-AC except dual-ported	39,140	255
RWM05-C	RM05 dual-port upgrade kit containing drive logic, cables, and second controller to convert RWM05-A to RWM05-B	16,700	85
RM05-C	RM05 dual-port kit containing drive logic and cables to convert RM05-A to RM05-B	5,150	15
RM05-P	256MB removable disk pack for RM05	1,500	NA
RM05-PX	256MB hard error-free removable disk pack for RM05	1,650	NA
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	16
TU58-EB	Same as TU58-DA except tabletop version	1,750	16
TU58-K	One 256KB TU58 data cartridge for the TU58-DA and TU58-EB	18	NA
MAGNETIC TAPE			
TS11-BA (BB)	Nine track TS11 magnetic tape subsystem mounted in a 60 inch H9602 single width highboy cabinet; 1600 bpi record density; 45 ips read/write speed; requires UNIBUS PDP-11 system configured in H9600 series cabinets	16,400	75
TS11-DA (DB)	Same as TS11-BA except mounted in a 72 inch high H960 cabinet; requires UNIBUS PDP-11 system configured in H960 series cabinets	16,400	75
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	75
TJE16-AA (AD)	TE16 magnetic tape transport and controller to interface to 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 a 60 inch H9602 cabinet	27,000	155
TWE16-AA (AD)	Same as TJE16-AA except interfaces to the PDP-11/70	27,000	155
TJE17-EA (ED)	Same as TJE16-AA except mounts in a 72 inch high H960 cabinet	27,000	155

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
MAGNETIC TAPE (Continued)			
TWE16-EA (ED)	Same as TWE16-AA except mounted in a 72 inch high H960 cabinet	27,000	155
TE16-AE (AJ)	TE16 magnetic tape transport mounted in a 60 inch H9602 single width highboy cabinet	15,900	92
TE16-EE (EJ)	TE16 magnetic tape transport mounted in a 72 inch high H960 cabinet	15,900	92
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	247
TWU77-AB (AD)	Same as TJU77-AB except interfaces to the PDP-11/70 MASSBUS	36,800	247
TU77-AF (AJ)	TU77 magnetic tape transport	23,800	184
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	2,150	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	2,150	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	2,400	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
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	150	4
VT1XX-AC	Printer port option; allows connection of a VT100 to a hardcopy printer	225	7
VT1XX-CA	20mA interface adapter option for VT101/VT102/VT125	140	4
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	1,550	21
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	1,650	21
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	1,700	21
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	1,750	18
LA38-HA	DECwriter IV printing terminal; same as LA38-GA except is the freestanding version	1,850	18
LA120-DA	Freestanding DECwriter III hardcopy terminal; 50 to 9600 bps baud rates; 180 cps print speed; 7 x 7 dot matrix; 7-bit ASCII character set plus ANSI-compatible escape sequences	2,800	32
LA120-RA	Freestanding DECprinter III receive-only version of the LA120-DA hardcopy terminal	2,700	37
LINEPRINTERS			
LXV11-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 slow speed; requires a PDP-11/03 or 11/23	9,950	134
LXY11-XX	Lineprinter/plotter; same as LXV11-XX except requires a UNIBUS PDP-11	11,250	134
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 slow speed; requires UNIBUS PDP-11	15,800	155
LPV11-AA	Band printer; 300 lpm for 64 ASCII character set; requires PDP-11/03, 11/23	8,350	95
LPV11-BA	Band printer; 300 lpm for 64 ASCII character set or 215 lpm for 96 ASCII character set; requires PDP-11/03, 11/23	8,950	95
LP11-AA	Band printer; 300 lpm for 64 ASCII character set; requires UNIBUS PDP-11	8,350	95
LP11-BA	Band printer; 300 lpm for 64 ASCII set or 215 lpm for 96 ASCII character set	8,950	95
LP11-CA(CD)	Lineprinter; 900 lpm for 64 ASCII character set; requires UNIBUS PDP-11	32,500	195
LP11-DA(DD)	Lineprinter; 600 lpm for 96 ASCII character set; requires UNIBUS PDP-11	34,500	195
LP11-YA(YD)	Lineprinter; 660 lpm for 64 ASCII character set; requires UNIBUS PDP-11	24,240	158
LP11-ZA(ZD)	Lineprinter; 436 lpm for 96 ASCII character set; requires UNIBUS PDP-11	26,280	158

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
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	8,250	70
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	11,700	72
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	4,950	91
EXPANSION HARDWARE			
DD11-CK	Four slot expansion backplane for use in BA11-K and BA11-L expander boxes; also mounts in the PDP-11/04, 11/24, 11/34A, 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-11/04, 11/24, 11/34A, and 11/44 CPU boxes; accommodates seven hex and two quad modules	940	NC
BA11-KE(KF)	UNIBUS expansion box; cabinet mountable expander box with bezel and slides for use in H960 series cabinets	3,500	19
BA11-KW(KX)	UNIBUS expansion box; cabinet mountable expander box with bezel and slides for use in H9642-DB(DC) or H9602-CC(CD) cabinets	3,500	19
BA11-LE(LF)	UNIBUS expansion box; cabinet mountable expander box with bezel for use in PDP-11/24, 11/34A, and 11/44 systems	2,700	13
BA11-NE(NF)	LSI-11 Bus expansion box; cabinet mountable expander box with bezel for use with PDP-11/03L and PDP-11/23 systems; includes one nine slot LSI-11 backplane that provides seven LSI-11 quad slots of mounting space	2,000	9
DB11-A	UNIBUS repeater; adds 19 unit busloads and allows up to 50 feet of additional UNIBUS length to be added to the system	2,240	7
CABINETS			
H9610 Series Cabinets			
The H9610 series cabinet is a small system cabinet styled for the office environment. Features include a front to rear cooling system; rigid mounting casters and levelers for suspension; and a plated frame for optimum grounding continuity			
H9610-AA(AB)	Cabinet frame with top; front loading with 24.5 inch panel space	1,590	NA
H9612-AA(AB)	Cabinet frame without top; 10.5 inch top-loading with 24.5 inch panel space	1,890	NA
H9613-AA(AB)	Cabinet frame with top; 10.5 inch top-loading with 24.5 inch panel space	1,890	NA
H9640 Series Cabinets			
H9640 series cabinets meet the requirements of systems designed primarily for the office environment. They include front to rear cooling; fixed mounted wheel assemblies for suspension; an all-steel frame coated with zinc-chromate to ensure optimal grounding continuity; and locking front and rear doors. These cabinets can be configured as either front loading or top-loading			
H9642-DB(DC)	Expansion cabinet without end panels; provides 31.5 inch vertical mounting space	1,490	NC
H9642-BD(BE)	Top-loading expansion cabinet for RL01/RL02; provides 21 inch mounting space beneath RL01/RL02	1,570	NC
H9642-BK(BL)	Expansion cabinet for RX02; provides 21 inch mounting space beneath RX02	1,570	NC
H960 Series Cabinets			
The H960 series cabinets are medium to large system cabinets suited for expanding existing systems. They include a cooling mechanism which operates top to bottom; rigid mounting casters and levelers for suspension; extension feet; front bezel panels; and locking devices for all doors and covers			
H960-CF(CG)	Standard PDP-11 expansion cabinet without end panels	1,990	NC
H9600 Series Cabinets			
The H9600 series cabinets are for use with PDP-11/70 systems. They include an improved grounding mechanism; a cooling system which operates from front to bottom (lower); an automatic integral lock system to prevent any device from sliding out until the stabilizer legs are extended; an integral shock isolation wheel assembly which eliminates any special handling equipment; and lock devices for all doors and covers			
H9602-CC(CD)	Single width, highboy expansion cabinet; includes slide mounts to accept 19 inch or 25 inch cabinet mountable devices	3,140	NC

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
LSI-11 COMMUNICATIONS OPTIONS			
	DLV11 Single Line Asynchronous Interfaces		
DLV11	Serial interface unit; operates at full- or half-duplex; optically-isolated 20mA current loop or EIA/CCITT interface levels; selectable stop and data bits, data rates from 50 to 9600 bps; does not provide modem control; requires PDP-11/03, 11/23	525	6
DLV11-EB	Asynchronous line interface module with EIA interface levels; selectable stop and data bits; even, odd or no parity; operates at full- or half-duplex; data rates from 50 to 19,200 bps; compatible with Bell 103, 113, 202C, 202D, 212; provides full modem control; includes BCOIV-25 cable; requires PDP-11/03, 11/23	550	8
DLV11-E	Asynchronous line interface module; same as DLV11-EB except does not include cable	440	8
DLV11-FB	EIA/CCITT asynchronous line interface module; operates at full- or half-duplex; selectable stop and data bits; data rates from 50 to 19,200 bps; does not provide modem control; includes BCO3L-05 cable; requires PDP-11/03, 11/23	670	8
DLV11-FA	20mA asynchronous line interface module; operates at full- or half-duplex; selectable stop and data bits; data rates from 50 to 19,200 bps; does not provide modem control; includes BCO5M-04 cable; requires PDP-11/03, 11/23	550	8
DLV11-F	Asynchronous line interface module; operates at full- or half-duplex; supports 20mA current loop or EIA/CCITT interface levels; selectable stop and data bits; data rates from 50 to 19,200 bps; does not provide modem control; cable not included; requires PDP-11/03, 11/23	370	8
	Four Channel Asynchronous Serial Line Unit		
DLV11-J	Four-line asynchronous EIA/CCITT serial line unit; character formats of 7 or 8 data bits, 1 or 2 stop bits, parity or no parity, and even or odd parity; operates full- or half-duplex; data rates from 150 to 38,400 bps; bi-directional data input/output lines, up to 16 bit interrupts; does not provide modem control; cables not included; requires PDP-11/03, /23	580	10
DLV11-KA	EIA to 20mA converter with BC21A-03 cable for connection to the DLV11-J	190	7
DZV11	Asynchronous Multiplexer (Programmed I/O)	1,100	10
DZV11-B	Asynchronous 4 line multiplexer for EIA/CCITT terminals or lines; features programmable speeds (up to 9600 bps) and formats on a per line basis; includes data set control for use with Bell 103 or 113 modems or equivalent; requires PDP-11/03, 11/23	1,100	10
DUV11/DPV11	Single Line Synchronous Interfaces		
DPV11-DB	Single line synchronous interface for connecting LSI-11s to synchronous modems; full modem control for half- or full-duplex operation; it is also capable of transmitting data at speeds up to 56,000 bps; includes BC26L-25 cable	770	12
UNIBUS COMMUNICATIONS OPTIONS			
KMC11-A	Auxiliary Communications Processor		
KMC11-A	High-speed general purpose processor that interfaces between synchronous or asynchronous I/O options and the PDP-11 UNIBUS; it uses a 72-bit microcode and operates on 8-bit data paths; the KMC11 includes 1024 16-bit word write operation control memory, and 1024 16-bit data memory; NPR UNIBUS interface provides 8- or 16-bit direct memory access to data buffers or control blocks located in PDP-11 memory under microprogram control	2,580	23
DL11	Single Line Asynchronous Interfaces		
DL11-WC/WB	EIA/CCITT serial line interface and line frequency realtime clock; switch-selectable character size, parity, stop bits, and speed of operation; operates at full- or half-duplex the line frequency clock is used when this option is the console interface on a PDP-11/04 or PDP-11/34; the DL11-WB or DL11-WC require a null modem with local devices	950	7
DL11-WA	20mA serial line interface and line frequency realtime clock; switch-selectable character size, parity, stop bits, and speed of operation; operates at full- or half-duplex; switch-selectable active or passive transmitter and receiver	990	7
DL11-E	Modem controlling EIA/CCITT serial line interface with jumper-selectable speed, character size, parity and stop bit size; operates at full- or half-duplex; compatible with Bell 103, 113, 202 or equivalent	1,170	8
DZ11	Asynchronous Multiplexer (Programmed I/O)		
DZ11-A	Asynchronous eight-line multiplexer for EIA/CCITT terminals or lines; features programmable speeds (up to 9600 bps) and formats on a per-line basis; operates at full-duplex; can expand to 16 lines with the addition of a DZ11-B and includes 16-line Distribution Pair; includes data set control for use with Bell 103 or 113 modems or equivalent	2,700	31
DZ11-B	Eight-line EIA/CCITT expansion multiplexer for the DZ11-A		
DZ11-C	Asynchronous 8-line multiplexer for 20mA current loop terminals; features programmable speeds (up to 9600 bps) and formats on a per-line basis; operates at full-duplex; can expand to 16 lines with the addition of a DZ11-D; includes 16-bit Distribution Pan	2,150	27
DZ11-D	8-line current loop expansion multiplexer for the DZ11-C		
DZ11-E	Asynchronous 16-line multiplexer for EIA/CCITT terminals or lines; features programmable speeds (up to 9600 bps) and formats on a per-line basis; operates at full-duplex; includes 16-line Distribution Pan; includes data set control for use with Bell 103 and 113 modems or equivalent	4,350	53
DZ11-F	Asynchronous 16-line multiplexer for 20mA current loop terminals; features programmable speeds (up to 9600 bps) and formats on a per-line basis; operates at full-duplex	5,000	53
DH11	Asynchronous Multiplexer (NPR Output)		

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
UNIBUS COMMUNICATIONS OPTIONS (Continued)			
DH11-AD	Complete programmable asynchronous EIA/CCITT 16-line multiplexer; operates full- or half-duplex; includes modem control	8,950	65
DH11-AE	Complete programmable EIA/CCITT asynchronous 16-line multiplexer; operates full- or half-duplex; does not include modem control	7,950	54
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 protocol (not Bisync) and CRC/CCITT when using bit-oriented protocols; interfaces to Bell 200 series modems or equivalent at speeds up to 9600 bps	1,575	11
DMC11/DMR11 Network Link Modules			
DMR11-AC	Network link DDCMP microprocessor and line unit modules for operation support; provides high-speed connection to another DMR11 or DMC11 using twinaxial, coaxial, or triaxial cables up to 18,000 ft.; operates full-duplex with two cables and half-duplex with a single cable	4,400	37
DMC11-AR	Network link DDCMP microprocessor module (remote); DDCMP protocol implemented in hardware for remote operation; operates full- or half-duplex; NPR input and output transfers; includes firmware for unattended operation (remote load detect)	2,130	20
DMC11-DA	Network link unit module (remote); interfaces to EIA/CCITT synchronous modems (Bell series 200 compatible) at speeds up to 19,200 bps; operates full- or half-duplex; includes data set control for switched network operations; can be used to communicate over common carrier facilities to another DMC11 or to a synchronous interface with software implementation of DDCMP version 3.2	1,500	7
DMC11-FA	Network link line module (remote); interfaces to CCITT V.35/DDS synchronous modems (Bell 500A LI/5 or equivalent) at speeds up to 250,000 bps; includes data set control for full- or half-duplex, private wire operation; can be used to communicate over common carrier facilities to another DMC11 or to a synchronous interface with software implementation of DDCMP version 3.2	1,880	7
DMR11-AA	Network link DDCMP microprocessor and line unit modules for remote support; speeds up to 19,200 bps; operates full- or half-duplex; includes data set control for switched network operations; can be used to communicate over common carrier facilities to another DMR11, DMC11, or to a synchronous interface with software implementation of DDCMP version 3.1 or 4.0	4,400	37
DMR11-AE	Network link DDCMP microprocessor and line unit modules for remote support; speeds up to 1,000,000 bps; operates full- or half-duplex; includes data set control for switched network operations; can be used to communicate over common carrier facilities to another DMR11, DMC11, or to a synchronous interface with software implementation of DDCMP version 3.1 or 4.0	4,400	37
DMR11-AB	Network link DDCMP microprocessor and line unit modules for remote support; interfaces to CCITT V.35/DDS synchronous modems (Bell 500A LI/5 or equivalent) at speeds up to 1,000,000 bps; includes data set control for full- or half-duplex, private wire operation; can be used to communicate over common carrier facilities to another DMR11, DMC11 or to a synchronous interface with software implementation of DDCMP version 3.1 or 4.0	4,400	37
Communications Arithmetic Option			
KG11-A	Communications Arithmetic Option; computes cyclic redundancy check (CRC), longitudinal redundancy check (LRC), and block check characters (BCC)	1,350	7
DV11 Multiple Line Synchronous/Asynchronous Interfaces			
DV11-AA	Synchronous/asynchronous communications preprocessor for up to 16 EIA/CCITT lines; NPR input and output transfers, table-driven character processing, CRC calculation; up to 9600 bps full-duplex transmission for each line; requires one or two DV11-BA, DV11-BB, or DV11-BC line groups	6,970	13
DV11-BA	Eight-line synchronous group for use with DV11-AA; can handle character-oriented protocols with switch-selectable character size and format (5 to 8 data bits plus odd, even, or no parity); program-selectable per line choice of two switch-selectable sync characters; includes internal clock for local connection; switch-selectable parameters are on a 4-line basis	5,440	18
DV11-BB	Eight-line asynchronous group for use with DV11-AA; features programmable speeds and formats on a per line basis	4,800	18
DV11-BC	Eight-line synchronous/asynchronous group for use with DV11-AA; four lines are synchronous (compatible in-line capability to DV11-BA lines); four lines are asynchronous (compatible in-line capability to DV11-BB lines)	5,140	18
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	825	7

*CPU quantity level of 50-99.

DEC PDP-11 Family

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
UNIBUS COMMUNICATIONS OPTIONS (Continued)			
	Modems		
DF02-AA	Direct connect, full-duplex, asynchronous modem with self-contained power supply operating at speeds of 0-300 bps; allows terminals and processors to communicate over unconditioned, dial-up lines; compatible with DF03 modem, Bell System 103J, 212A data sets, and all Digital asynchronous data communication controllers that support EIA RS-232-C interface standard and dial-up modem control	450	11
DF02-AC	Consists of a DF02 modem with serial Automatic Call Unit (ACU); ACU allows initiating calls without operator intervention, and uses an asynchronous ASCII input format at switch-selectable data rates of 110 or 300 bps; can store up to 16 digits for dialing/redialing	925	13
DF03-AA	Direct connect, full-duplex, synchronous/asynchronous modem with self-contained power supply operating at speeds of 0-300 bps or 1200 bps; allows terminals and processors to communicate over unconditioned, dial-up lines; low-speed operation (0-300 bps) is asynchronous; high-speed operation (1200 bps) can be either character-asynchronous or bit-synchronous; compatible with DF02 modem, Bell System 103J, 212A data sets, and all Digital data communication controllers that support EIA RS-232-C interface standard and dial-up modem	950	14
DF03-AC	Consists of a DF03 modem with serial Automatic Call Unit (ACU); ACU allows initiating calls without operator intervention and uses an asynchronous ASCII input format at switch-selectable data rates of 110, 300, or 1200 bps; can store up to 16 digits for dialing/redialing	1,350	15
REALTIME I/O OPTIONS			
	PDP-11/03 and PDP-11/23 (LSI-11 Bus) Realtime I/O Options		
AAV11-A	12-bit 4-channel digital-to-analog converter and CRT control	1,500	11
ADV11-A	12-bit 16-channel single ended (or 8-channel quasi-differential) analog-to-digital converter	1,600	10
DRV11	General purpose program-controlled parallel line interface unit; permits program-controlled data transfers at rates up to 40K words per second	300	6
DRV11-B	General purpose direct memory access (DMA) parallel line interface unit; permits data transfers at rates up to 250K words per second in single cycle mode and up to 500K words per second in burst mode	670	9
KMV11-A	16-bit programmable realtime clock; four programmable modes and five crystal-controlled frequencies are user-selectable; can be used to start the ADV11-A analog-to-digital converter	860	6
	UNIBUS Realtime I/O Options		
LPA11-KK	Package of LPA11-K Direct Memory Access (DMA) microprocessor subsystem, ADK11-KT analog-to-digital converter package, and DD11-CK backplane	8,600	97
AA11-KT	Package of AA11-K, 12-bit 4-channel digital-to-analog converter and CRT control, distribution panel, and BC08R cable	2,850	35
AD11-K	12-bit, 16-channel single-ended/8-channel true differential analog-to-digital converter with self-test and software-controlled vernier offset		
ADK11-KT	Package of AD11-K analog-to-digital converter, KW11-K realtime clock, distribution panel, and two BC08R cables	3,950	53
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	16
AR11-KT	Package of AR11 analog realtime subsystem, which includes 10-bit analog-to-digital, 16-channel multiplexer, sample hold, two 10-bit digital-to-analog converter, CRT control, and crystal clock with programmable frequencies; includes distribution panel and BC08R cables	2,500	21
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	8,250	70
DR11-KT	DR11-K general purpose digital interface package; 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	10
KW11-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	19
KW11-P	Programmable realtime clock; program-selectable interrupts of 100 KHz, 10 KHz, line frequency or external signal	880	9

*CPU quantity level of 50-99.

SOFTWARE PRICES

		<u>License Fee</u>
Fortran IV/RT-11		
QJ813-AD	Magtape (9-track, 800 bpi)	\$1,250
QJ813-AG	DECTape II (TU58)	1,250
QJ813-AH	Disk Cartridge (RL02)	1,310
QJ813-AQ	Disk Cartridge (RL01)	1,250
QJ813-AY	Floppy Disk (RX01)	1,250

DEC PDP-11 Family

SOFTWARE PRICES

		<u>License Fee</u>
Basic-11/RT-11		
QJ913-AD	Magtape (9-track, 800 bpi)	1,450
QJ913-AG	DECTape II (TU58)	1,450
QJ913-AH	Disk Cartridge (RL02)	1,500
QJ913-AQ	Disk Cartridge (RL01)	1,450
QJ913-AY	Floppy Disk (RX01)	1,450
MU Basic-11/RT-11		
QJ921-AG	DECTape II (TU58)	1,320
QJ921-AH	Disk Cartridge (RL02)	1,380
QJ921-AQ	Disk Cartridge (RL01)	1,320
QJ921-AY	Floppy Disk (RX01)	1,320
DECnet-RT		
QJ685-AD	Magtape (9-track, 800 bpi)	1,750
QJ685-AG	DECTape II (TU58)	1,750
QJ685-AM	Magtape (9-track, 1600 bpi)	1,750
QJ685-AQ	Disk Cartridge (RL01)	1,750
QJ685-AT	Disk Cartridge (RK06)	1,930
QJ685-AV	Disk Cartridge (RK07)	2,010
QJ685-AX	Floppy Disk (RX02)	1,750
QJ685-AY	Floppy Disk (RX01)	1,750
RT-11 2780/3780 Protocol Emulator		
QJD59-AD	Magtape (9-track, 800 bpi)	3,500
QJD59-AG	DECTape II (TU58)	3,500
QJD59-AH	Disk Cartridge (RL02)	3,530
QJD59-AQ	Disk Cartridge (RL01)	3,500
QJD59-AX	Floppy Disk (RX02)	3,500
QJD59-AY	Floppy Disk (RX01)	3,500
FMS-11/RT-11		
QJ713-AG	DECTape II (TU58)	3,110
QJ713-AH	Disk Cartridge (RL02)	3,160
QJ713-AQ	Disk Cartridge (RL02)	3,110
QJ713-AY	Floppy Disk (RX01)	3,110
FMS-11/RSX Upgrade		
QJ718-AD	Magtape (9-track, 800 bpi)	1,550
QJ718-AH	Disk Cartridge (RL02)	1,550
QJ718-AM	Magtape (9-track, 1600 bpi)	1,550
QJ718-AQ	Cartridge Disk (RL01)	1,550
QJ718-AT	Cartridge Disk (RK06)	1,670
QJ718-AV	Cartridge Disk (RK07)	1,760
DATATRIEVE-11		
QP301-AD	Magtape (9-track, 800 bpi)	7,000
QP301-AG	Disk Cartridge (RL02)	7,050
QP301-AM	Magtape (9-track, 1600 bpi)	7,000
QP301-AQ	Disk Cartridge (RL01)	7,000
QP301-AT	Disk Cartridge (RK06)	7,150
QP301-AV	Disk Cartridge (RK07)	7,240
DATATRIEVE-11/RSX-11M Upgrade		
QP311-AD	Magtape (9-track, 800 bpi)	9,670
QP311-AH	Disk Cartridge (RL02)	9,720
QP311-AM	Magtape (9-track, 1600 bpi)	9,670
QP311-AQ	Disk Cartridge (RL01)	9,670
QP311-AT	Disk Cartridge (RK06)	9,820
QP311-AV	Disk Cartridge (RK07)	9,900
Basic-11/IAS-RSX		
QP240-AD	Magtape (9-track, 800 bpi)	3,520
QP240-AH	Disk Cartridge (RL02)	3,580
QP240-AM	Magtape (9-track, 1600 bpi)	3,520
QP240-AQ	Disk Cartridge (RL01)	3,520
QP240-AT	Disk Cartridge (RK06)	3,660
QP240-AV	Disk Cartridge (RK07)	3,750

DEC PDP-11 Family

SOFTWARE PRICES

		<u>License Fee</u>
PDP-11 Basic-PLUS-2		
QJ918-AD	Magtape (9-track, 800 bpi)	6,400
QJ918-AH	Disk Cartridge (RL02)	6,450
QJ918-AM	Magtape (9-track, 1600 bpi)	6,400
QJ918-AQ	Disk Cartridge (RL01)	6,400
QJ918-AT	Disk Cartridge (RK06)	6,540
QJ918-AV	Disk Cartridge (RK07)	6,640
RSX-11 2780/3780 Emulator		
QJD82-AD	Magtape (9-track, 800 bpi)	6,400
QJD82-AH	Disk Cartridge (RL02)	6,430
QJD82-AM	Magtape (9-track, 1600 bpi)	6,400
QJD82-AQ	Disk Cartridge (RL01)	6,200
QJD82-AT	Disk Cartridge (RK06)	6,380
QJD82-AV	Disk Cartridge (RK07)	6,660
Fortran IV/IAS-RSX		
QP230-AD	Magtape (9-track, 800 bpi)	1,250
QP230-AH	Disk Cartridge (RL02)	1,310
QP230-AM	Magtape (9-track, 1600 bpi)	1,250
QP230-AQ	Disk Cartridge (RL01)	1,250
QP230-AT	Disk Cartridge (RK06)	1,600
QP230-AV	Disk Cartridge (RK07)	1,710
PDP-11 Fortran IV-PLUS/RSX		
QJ668-AD	Magtape (9-track, 800 bpi)	6,670
QJ668-AH	Disk Cartridge (RL02)	6,670
QJ668-AM	Magtape (9-track, 1600 bpi)	6,670
QJ668-AQ	Disk Cartridge (RL01)	6,670
QJ668-AT	Disk Cartridge (RK06)	6,790
QJ668-AV	Disk Cartridge (RK07)	6,900
PDP-11 Cobol		
QP012-AD	Magtape (9-track, 800 bpi)	10,240
QP012-AH	Disk Cartridge (RL02)	10,290
QP012-AM	Magtape (9-track, 1600 bpi)	10,240
QP012-AQ	Disk Cartridge (RL01)	10,240
QP012-AT	Disk Cartridge (RK06)	10,390
QP012-AV	Disk Cartridge (RK07)	10,480
RMS-11K		
QP901-AD	Magtape (9-track, 800 bpi)	3,620
QP901-AH	Disk Cartridge (RL02)	3,680
QP901-AM	Magtape (9-track, 1600 bpi)	3,620
QP901-AQ	Disk Cartridge (RL01)	3,620
QP901-AT	Disk Cartridge (RK06)	3,770
QP901-AV	Disk Cartridge (RK07)	3,860
SORT-11		
QP602-AD	Magtape (9-track, 800 bpi)	950
QP602-AH	Disk Cartridge (RL02)	1,000
QP602-AM	Magtape (9-track, 1600 bpi)	950
QP602-AQ	Disk Cartridge (RL01)	950
QP602-AT	Disk Cartridge (RK06)	1,090
QP602-AV	Disk Cartridge (RK07)	1,190
DECnet-11M		
QJ684-AD	Magtape (9-track, 800 bpi)	4,000
QJ684-AH	Disk Cartridge (RL02)	4,030
QJ684-AM	Magtape (9-track, 1600 bpi)	4,000
QJ684-AQ	Disk Cartridge (RL01)	4,000
QJ684-AT	Disk Cartridge (RK06)	4,180
QJ684-AV	Disk Cartridge (RK07)	4,260
CORAL 66		
QP066-AD	Magtape (9-track, 800 bpi)	7,600
QP066-AQ	Disk Cartridge (RL01)	7,600
QP066-AT	Disk Cartridge (RK06)	7,600
QP066-AV	Disk Cartridge (RK07)	8,000

DEC PDP-11 Family

SOFTWARE PRICES

		<u>License Fee</u>
DBMS-11/RXS-11M		
QP376-AD	Magtape (9-track, 800 bpi)	23,800
QP376-AM	Magtape (9-track, 1600 bpi)	23,800
RSX-11/3271 Protocol Emulator (PE)		
QJD76-AD	Magtape (9-track, 800 bpi)	6,700
QJD76-AH	Disk Cartridge (RL02)	6,730
QJD76-AM	Magtape (9-track, 1600 bpi)	6,700
QJD76-AQ	Disk Cartridge (RL01)	6,700
QJD76-AT	Disk Cartridge (RK06)	6,880
QJD76-AV	Disk Cartridge (RK07)	6,960
RSX-11M/IAS RJE/HASP		
QJS60-XS	Magtape (9-track, 800 bpi)	9,900
QJS60-XH	Disk Cartridge (RL02)	9,900
QJS60-XM	Magtape (9-track, 1600 bpi)	9,900
QJS60-XQ	Disk Cartridge (RL01)	9,900
QJS60-XT	Disk Cartridge (RK06)	9,900
QJS60-SV	Disk Cartridge (RK07)	9,900
FMS-11/RSX		
QJ715-AD	Magtape (9-track, 800 bpi)	3,110
QJ715-AH	Disk Cartridge (RL02)	3,160
QJ715-AM	Magtape (9-track, 1600 bpi)	3,110
QJ715-AQ	Disk Cartridge (RL01)	3,110
QJ715-AT	Disk Cartridge (RK06)	3,680
QJ715-AV	Disk Cartridge (RK07)	3,310
RSX-11M/SNA Protocol Emulator		
QJD69-AD	Magtape (9-track, 800 bpi)	10,000
QJD69-AH	Disk Cartridge (RL02)	10,030
QJD69-AM	Magtape (9-track, 1600 bpi)	10,000
QJD69-AQ	Disk Cartridge (RL01)	10,000
QJD69-AT	Disk Cartridge (RK06)	10,180
QJD69-AV	Disk Cartridge (RK07)	10,260
RSX DLX-11		
QJ689-AD	Magtape (9-track, 800 bpi)	800
QJ689-AH	Disk Cartridge (RL02)	830
QJ689-AM	Magtape (9-track, 1600 bpi)	800
QJ689-AQ	Disk Cartridge (RL01)	800
QJ689-AT	Disk Cartridge (RK06)	890
QJ689-AV	Disk Cartridge (RK07)	1,060
DECnet-11M-PLUS		
QR580-AD	Magtape (9-track, 800 bpi)	5,000
QR580-AM	Magtape (9-track, 1600 bpi)	5,000
DBMS-11/RSX-11M-PLUS		
QR515-AD	Magtape (9-track, 800 bpi)	21,850
QR515-AM	Magtape (9-track, 1600 bpi)	21,850
DBMS-11/RSX-11M-PLUS Upgrade		
QR516-AD	Magtape (9-track, 800 bpi)	10,520
QR516-AM	Magtape (9-track, 1600 bpi)	10,520
Fortran IV/RSTS/E		
QR435-AD	Magtape (9-track, 800 bpi)	3,870
QR435-AH	Disk Cartridge (RL02)	3,920
QR435-AM	Magtape (9-track, 1600 bpi)	3,870
QR435-AQ	Disk Cartridge (RL01)	3,870
QR435-AT	Disk Cartridge (RK06)	4,020
QR435-AV	Disk Cartridge (RK07)	4,110

DEC PDP-11 Family

SOFTWARE PRICES

		<u>License Fee</u>
PDP-11 Fortran IV/PLUS/RSTS/E		
QR100-AD	Magtape (9-track, 800 bpi)	6,670
QR100-AH	Disk Cartridge (RL02)	6,670
QR100-AM	Magtape (9-track, 1600 bpi)	6,670
QR100-AQ	Disk Cartridge (RL01)	6,670
QR100-AT	Disk Cartridge (RK06)	6,790
QR100-AV	Disk Cartridge (RK07)	6,900
RSTS/E-2780		
QPD10-AD	Magtape (9-track, 800 bpi)	7,000
QPD10-AH	Disk Cartridge (RL02)	7,030
QPD10-AM	Magtape (9-track, 1600 bpi)	7,000
QPD10-AQ	Disk Cartridge (RL01)	7,000
QPD10-AT	Disk Cartridge (RK06)	7,180
QPD10-AV	Disk Cartridge (RK07)	7,260
QPD10-QY	Floppy Disk (RX01)	7,000
DECnet/E		
QP690-AD	Magtape (9-track, 800 bpi)	3,750
QP690-AH	Disk Cartridge (RL02)	3,780
QP690-AM	Magtape (9-track, 1600 bpi)	3,750
QP690-AQ	Disk Cartridge (RL01)	3,750
QP690-AT	Disk Cartridge (RK06)	3,930
QP690-AV	Disk Cartridge (RK07)	4,010
RSTS/E High Performance 2780/3780 Emulator		
QRD06-AD	Magtape (9-track, 800 bpi)	7,400
QRD06-AH	Disk Cartridge (RL02)	7,430
QRD06-AM	Magtape (9-track, 1600 bpi)	7,400
QRD06-AQ	Disk Cartridge (RL01)	7,400
QRD06-AT	Disk Cartridge (RK06)	7,580
QRD06-AV	Disk Cartridge (RK07)	7,660
RSTS/E 3271 Protocol Emulator		
QRD05-AD	Magtape (9-track, 800 bpi)	8,000
QRD05-AH	Disk Cartridge (RL02)	8,030
QRD05-AM	Magtape (9-track, 1600 bpi)	8,000
QRD05-AQ	Disk Cartridge (RL01)	8,000
QRD05-AT	Disk Cartridge (RK06)	8,180
QRD05-AV	Disk Cartridge (RK07)	8,260
MUX200/RSX-1AS Multiterminal Emulator		
QJ070-AD	Magtape (9-track, 800 bpi)	7,600
QJ070-AH	Disk Cartridge (RL02)	7,600
QJ070-AM	Magtape (9-track, 1600 bpi)	7,600
QJ070-AQ	Disk Cartridge (RL01)	7,600
QJ070-AT	Disk Cartridge (RK06)	7,600
UN1004/RSX/Univac 1004 Terminal Emulator		
QJ170-AD	Magtape (9-track, 800 bpi)	7,200
QJ170-AT	Disk Cartridge (RK06)	7,200