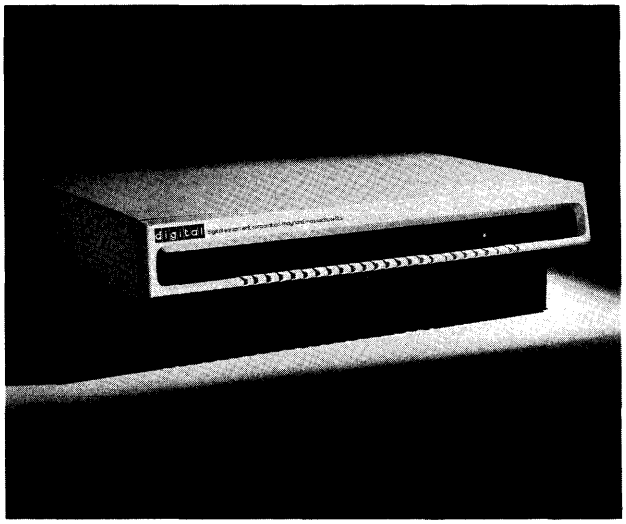
DEC PDP-11 Series



DEC's popular OEM-oriented PDP-11/05 minicomputer comes in a sleek, 5-1/4-inch-high chassis for convenient insertion into cabinets for larger assemblies. Among numerous popular end-user systems built around the 11/05 are DEC's own PDP-15/76 dual processor (PDP-11/05 plus a PDP-15), and the GT-40 DECgraphic-11 Graphic Display System.

The powerful 16-bit word PDP-11 Series offers a wide range of processing capabilities for the OEM or end-user. Models are available from $3,000 (dedicated subsystem controllers) to well over $200,000 (32-user timesharing or general-purpose systems).

MANAGEMENT SUMMARY

With the announcement of the PDP-11/20 minicomputer system in January 1969, DEC introduced the first member of what has become one of the industry's most popular families of mini- to midi-systems, currently numbering eight models. The PDP-11 family ranges from low-cost processors intended for use as built-in controllers of complex peripheral devices (11/05), to general-purpose, full-scale systems capable of supporting a 32-user timesharing network or handling general commercial applications in a multi-programming environment (11/45).

Other PDP-11 family members include a ruggedized system (11R20) for military or heavy industrial use; OEM products for use in intelligent terminals or process controllers (11/15); end-user systems for those same applications (11/10); a replacement for the original 11/20 patriarch of the family (11/40); and a limited-size, all-semiconductor version of the 11/45 (11/50).

In general, systems with model numbers ending in "5" are OEM products, while the next higher "0" suffix model is the end-user counterpart. (Instances in which that numbering system does not presently hold up include the 11/40 for which no OEM model "11/35" exists as of this writing, and the 11/50 which is not an end-user version of the 11/45, but rather an 11/45 with all semiconductor memory.)

Individual PDP-11 system purchase prices range from $3000 to more than $200,000 depending upon model and ➢

CHARACTERISTICS

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

MODELS: PDP-11/05, 11/10, 11/15, 11/20, 11R20, 11/40, 11/45 and 11/50.

DATA FORMS

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

FIXED-POINT OPERANDS: 16-bit words or eight-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 eight-bit exponent and signed 24-bit fraction on the 11/40; or 64-bit double-precision operands with an eight-bit exponent and signed 56-bit fraction on the 11/45 or 11/50. Single-precision hardware is available on the 11/40; single- or double-precision hardware is available on 11/45 or larger systems; other PDP-11 family models use floating-point software subroutines (also on 11/40 or larger).

INSTRUCTIONS: One-, two-, or three-word instructions. Seventy basic standard instructions and four optional instructions are provided on all PDP-11 models except the 11/40 (75 instructions) and the 11/45 or 11/50 (80 instructions). No decimal instructions are available for any PDP-11 Series member. Addressing in the PDP-11 family is done by byte through 16-bit internal registers allowing addressing of up to 64KB (the upper 8KB is reserved for I/O buffering). For the 11/40 and 11/45, a Memory Management option is required to address larger main storage.

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.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Magnetic core, MOS, or bipolar, depending on model. ➤

DEC PDP-11 Series

INSTRUCTION TIMES

Instruction	11/05, 11/10	11/15, 11/20, 11R20	11/40	11/45, 11/50 (semiconductor)		
				Core	MOS	Bipolar
Load/Store	5.4/3.9	3.7/3.8	2.42/2.24	1.84	1.01	0.75
Add/Subtract	4.2	3.8	2.66/2.80	1.84	1.01	0.75
Multiply/Divide	22.0/22.5	20.0/20.5	9.66/11.30	4.68/8.58	3.86/7.76	3.6/7.5
Compare, Branch	5.0	4.9	2.75	2.03	1.35	0.90

configuration size, and have found their way into numerous other DEC and non-DEC products as OEM components of end-user systems. DEC systems built upon the PDP-11 Series minicomputers include the business-oriented DEC Datasystems 500 (DOS batch), -700 (RSTS timesharing), and -800 (MUMPS data management system) built upon the 11/20, 11/40, and 11/45, respectively; the GT 40 Graphics Terminal (4K or 8K-word 11/10); and PDP-15/76 (4K-word 11/05).

Examples of major non-DEC end-user systems based upon the PDP-11 include Comress' Dynaprobe 8000 Programmed Computer Performance Monitor ($26,000-$95,000), National Information Services' Automated Bank General Ledger System ($60,000), Periphonics' Bank-Comm 7 banking/financial communications processor ($35,000), Systron-Donner's Model 3600 Computer Automated Test System ($60,000-$300,000), the Dataroyal Labor and Material Planning/Control System ($18,200), and Cybermatics' "Tin Can" communications system.

The distinguishing architectural design feature of the PDP-11 family that sets it apart from other DEC systems (as well as from competitive offerings) is the Unibus—a single bus that ties all system components together.
As a matter of interest, the fundamental Unibus design has been patented by DEC, in that the concept of a bi-directional asynchronous capability in any system component (except memory modules) to control the entire system is registered as unique. With the Unibus, any

CYCLE TIME: 1.2 or 0.95 microsecond for core; 450 nanoseconds for MOS; and 300 nanoseconds for bipolar memory.

CAPACITY: 4K-32K words of core memory for all PDP-11 family members (without Memory Management option) in increments of 8K words (the highest 4K of address space is typically reserved for I/O device registers); for the 11/45, a combination of core, MOS or bipolar memory up to 128K words (with Memory Management), with no more than 128K words of core (in 8K increments), 32K words of MOS (in 4K increments), and 8K words of bipolar memory (in 1K increments). The 11/50 has all semiconductor (MOS or bipolar) memory up to 32K words maximum. The 11/40 can be equipped with optional Memory Management to increase its address space for up to 128K words of core memory only. Note that 4K words of main memory are typically reserved for I/O device registers in the larger 11/40's and 11/45's. Also, lower-numbered 11-family models can be equipped with 1K words of memory for use as dedicated subsystem controllers (such as PDP-11/15).

CHECKING: Optional parity bit with each byte with most models; none on 11/05, 11/10 or 11/20.

STORAGE PROTECTION: None in hardware for the basic PDP-11 models. For the 11/40 or 11/45 with the Memory Management option, hardware protection is standard.

CENTRAL PROCESSORS

GENERAL: The PDP-11 Series is fundamentally built around four basic processors. The original 11/20 and its closely-related, stripped-down 11/15 version each contain about 19 boards and some 600 IC's. The 11/10 and 11/5 are identical to each other, but are about 20% slower than the 11/20 or 11/15, and are improved implementations of

SUMMARY DATA FOR DEC PDP-11 SERIES

	11/03	11/05	11/15	11/10	11/20	11R20	11/40	11/45
Announced	10/71	10/71	11/70	1/73	1/69	2/71	8/72	10/71
First Delivery	–	2/72	4/71	3/73	3/70	11/71	1/73	4/72
Typical Purchase*	$4K	$5K-6.5	$10K	$7K	$11K-17K	$16K	$13K	$20K
Number Installed**	0	3170	3170	2680	2680	2680	600	650

*CPU, console, and basic memory (if any).
**As of July 1, 1973

DEC PDP-11 Series

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	SPEED
MAGNETIC TAPE UNITS		
TU56 Dual DECtape	Block addressable, 147K words	5K words/sec.
TU10-E/F	Industry-compatible, 45 ips, 9-track (800 bps)/7-track (200/556/800 bpi)	36 KBS
TA11	Dual Drive Cassette, 43K words	—
LINE PRINTERS		
LP11-F,H,J,K	80- or 132- position, 64- or 95- character, (1 small peripheral controller)	300 lpm
LP11-R	132-position, 64-character (1 small peripheral controller)	1000 lpm
LP11-S	132-position, 96-character (1 small peripheral controller)	800 lpm
LS11	132-position, 64-character (1 small peripheral controller)	60 lpm
CARD EQUIPMENT		
CR11	Reader, 80-column tabletop (1 small peripheral controller)	300 cpm
CD11-A	Reader, 80-column (DMA interface) (1 system unit)	1000 cps
CD11-EA	Reader, 80 column (DMA interface) (1 system unit)	1200 cps
CM11	Optical Reader 80-column EIA-standard (1 small peripheral controller)	300 cpm
PAPER TAPE EQUIPMENT		
PC11	Reader/Punch (1 small peripheral controller)	300/50 cps
PR11	Reader (1 small peripheral controller)	300 cps
TERMINALS		
LA30 DECwriter	Hard copy, 97/128 character set	30 cps
VT05B	A/N CRT, 72 characters x 20 lines	110, 150, 300, 2400 bps
VT01	Tektronix 611 CRT	—
VR01	Tektronix RM503 Oscilloscope Display	—
VR14	Point Display, 7 x 9 inch	—
VR20	Color version of VR14	
RT01 DEClink	Hard copy, 4-12 digit numeric display	110, 300 bps

Note: Chassis mounting requirements are in parentheses. Refer to configuration rules.

peripheral device can transfer data to main storage or another buffered peripheral device without processor intervention. To support this capability, the PDP-11's can reserve addresses in main memory as I/O device register areas, thus permitting direct peripheral access by applications programs. This greatly simplifies I/O programming because the entire instruction set is available for input/output routines.

A rather broad marketing classification has been used with regard to the inclusion of specific individual processors in the PDP-11 family. In particular, the 11/45 processor offers about half a dozen times more processing speed than the least powerful member of the family (11/05), and with semiconductor memory, more than three times the processing speed of the next most powerful member of the family (11/40).

the basic PDP-11, using only two boards and about 200 IC's. The 11/40 offers design improvements with a rearranged data path, using TTL logic to optimize performance with core memory. The top of the line 11/45 or 11/50 uses Shottky logic, multilayer PC boards, and an additional bus to optimize performance with fast bipolar memory.

REGISTERS: All 11-family members have eight user-accessible 16-bit registers (six general-purpose, one stack pointer, and one program counter), and a 16-bit processor status register. The general-purpose registers can be used as index registers, hardware stack pointers, or accumulators. In the 11/40, there are two stack pointers (kernel and user modes), whereas the 11/45 and 11/50 have three stack pointers (kernel, user, and supervisor model) and a full duplicate set of general-purpose registers.

INDIRECT ADDRESSING: Standard for all models.

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The 11/40 itself is about twice as fast as the 11/15 and 11/20, which in turn are roughly 1.2 times faster than the 11/05 and 11/10.

Other significant attributes that differentiate the 11/45 from lower-numbered members of the PDP-11 family include multiprocessor interconnection options, a wide choice of memory types and speeds, two Unibusses and a total memory up to four times larger than that of the smaller PDP-11 models (the 11/40 can also have up to 124K words of address space or memory while other systems can have only 28K words). Thus, although the basic architecture of the 11/45 retains a fundamental similarity to that of the smaller PDP-11's, the inclusion of this considerably larger "midi-computer" in the PDP-11 family stretches the imagination a little, and defines one of the widest spans of performance for a single minicomputer family in the industry.

The low-end PDP-11/03, a stripped down system released with the 11/05, offers such limited capability that none has been ordered to date. And while not formally withdrawn, the 11/03 no longer receives any mention by DEC.

From an applications point of view, practically no business or industry area has been neglected for automation by some member of the PDP-11 family: commercial batch processing and multiprogramming; commercial, scientific, and educational timesharing networks; communications front-end processing; intelligent terminals; process controllers; laboratory instrumentation; etc. In these varied applications environments DEC offers a multitude of applications-oriented packaged systems for both end-user as well as OEM use. These include the Typeset-11, DECcomm communications systems, IDACS-11/07 industrial controllers, PHA-11 pulse height analyzer for physical science applications, the LAB-11 for laboratory monitoring, EduSystem 85 educational timesharing system, etc.

Individual PDP-11 Series models can be compared to a host of non-DEC competitive products, ranging from systems such as Hewlett-Packard's HP 3000 or Data General's 840 (against the 11/45) to the IBM System/360 Models 22 or 30 (against smaller PDP-11 family members). Historically, DEC has won its share of such contests (more than 5,000 installed to date). And the competitive position of the PDP-11 family continues to improve with an active product development program and increased market emphasis upon applications-oriented configurations.

A recent development—the "mini system"—is a packaging concept introduced by DEC in August 1973 that provides tightly defined configurations of equipment at substantial discounts.

INSTRUCTION REPERTOIRE: All processors have 16 arithmetic, 21 branch, 7 trap and interrupt, 19 data manipulation, and 7 logic instructions. The 11/40 and 11/45 have additional instructions beyond the basic set. Optional floating-point instructions are available for the 11/40, 11/45 and 11/50; a multiply/divide option is available for the 11/05 through 11/20.

INSTRUCTION TIMES

INSTRUCTION TIMINGS: All times are for full-word, fixed-point operands in microseconds. (See table at top of page M11-384-302.)

INTERRUPTS: Four-level automatic priority interrupt system for all models except the 11/15, and a single interrupt priority level for the basic 11/15 (expandable to four). On the 11/45 and 11/50, seven additional software-supported levels of interrupts are provided. Each of the interrupt levels can attach multiple, independently prioritized peripheral devices.

VIRTUAL STORAGE: The 11/40 or 11/45 can access up to 128K words of main memory in 32K-word segments through one or two sets of eight address translation registers (150 nanoseconds per address translation), and an 18-bit Unibus interface. 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.

PROCESSOR MODES: With Memory Management, the 11/40 operates in either a "kernel" or a "user" mode, where the user mode prevents programs from modifying key machine states relating to memory mapping and protection. The 11/45 or 11/50 with Memory Management has three modes: kernel, user, or supervisor. The supervisor mode is intended to facilitate multiprogramming by providing a control program state for more efficient and secure system management. All other 11-family systems operate in basic kernel mode only, i.e., with all memory accessible by all.

STACK ORGANIZATION: All 11-family processors have an instruction stack capability to facilitate the implementation of sharable (reentrant) routines. The size of the push-down stacks is limited only by the size of available memory.

INPUT/OUTPUT CONTROL

UNIBUS: The PDP-11 Series uses a single common Unibus that treats all components or modules of an 11-family system as equal-level devices for data access/transfers including the processor, memory modules, and peripherals. (The PDP-11/45, and 11/50 have two Unibusses, plus a special dedicated bus). The priority of any device connected to the bus is determined by its physical position, and the processor is normally attached so as to give it the highest priority. There is no logical limit to the number of device attachments that can be made to the Unibus, with bus access and control handled by the interrupt system.

The maximum Unibus data transfer rate is 2.5 million words/second, and it always operates in a master/slave manner.

On the 11/45 and 11/50, a high-speed memory bus is provided to permit the execution of programs from

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The first such system, the PDP-11/E-10, is the lowest cost hardware configuration for disk operating systems, and consists of a 16K processor (11/10 with expanded 10½-inch cabinet), integral disk controller, dual-drive DEC cassette, moving-head disk, and LA30 DECwriter. The price of this "mini system" is $21,000, a 30% reduction over the combined individual unit prices. Recommended software for the PDP-11/E-10 is the $750 RT11 single-user operating system.

User reactions to the PDP-11 family are generally good, with a high degree of satisfaction expressed in DEC's equipment and maintenance service (handled directly by more than 1,000 DEC personnel through more than 50 service locations worldwide). On the other hand, many of the PDP-11 end-users are quite self-reliant, and actively do most of their own software development. Thus, while a good operating system environment and hardware maintenance are provided by DEC, the PDP-11 end-user generally must be capable of handling specific applications program development himself with some assistance from the DECUS (DEC User's Society) library of software subroutines. □

high-speed semiconductor memory at up to three-million words per second without excessively affecting the Unibus's capacity.

CONFIGURATION RULES: In general, all PDP-11 devices that tie in to 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. 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) can contain one complex (large) device interface or controller; or the SU may contain four small peripheral controller (SPC) slots. For memory/processor modules, a "dual SU" can be used that has room for up to nine slots (instead of eight as with two single SU's). 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 11 family model.

The 11/05 or 11/10 basic chassis has a prewired nine-slot dual system unit. Four of these individual slots are prewired for SPC's (DD11); three for 8K words of memory; and two for the CPU, console interface, and real-time clock. Memory expansion is handled by the addition of an ME-11 Memory Expander Box with 8K words of memory (plus room for two more 8K memory stacks). Additional peripherals can be added to the 11/05 or 11/10 through the BA11 Expander Box that provides six additional system units. (Therefore, the BA11 can accommodate 24 individual SPC slots.)

The 11/15, 11/20 or 11/R20 basic chassis is similar to the BA11 Expander Box with room for six SU's. The dual nine-slot SU does not fit the 11/15, 11/20, nor 11/R20 chassis. Two-and-one-half SU's (10 individual slots) are used for the processor, 8K words of memory, and the console interface. The second half of one SU is prewired for two individual SPC positions. The remaining three system unit positions are available for additional peripherals. Memory expansion is handled by the ME-11 Memory Expander Box (see above), and additional peripherals can be added through a BA11 Expander Box (see above).

The 11/40 basic chassis has room for nine SU's (four of which are replaced by dual SU's for a capacity of 18 individual slots instead of 16). Two of these SU positions are reserved for the CPU, extended instruction set, floating-point instructions, real-time clock, memory management option, and console interface. Two more SU positions are used for the basic 8K MF11-L memory, with room for an additional 16K words of memory. The remaining five system unit positions are available for memory expansion or peripheral attachment. If additional memory is required beyond the capacity of the basic chassis (more than 80K words), an H960-D General Purpose Expander Box (nine system units) can be added. For additional peripherals, either the H960-D or a BA11 Expander Box can be added (see above).

The 11/45 and 11/50 basic chassis is similar to the 11/40 box with nine SU positions. On the 11/45, eight of these are prewired to contain the processor, real-time clock, floating-point instructions, Memory Management option, space for up to 32K words of semiconductor memory, 16K words of core, and space for 8K additional words of core. One SU position is available on the 11/45 for additional memory or peripherals.

The 11/50 is identical to the 11/45 except that only six SU positions are prewired, and no provisions are made for core memory modules. This results in the availability of three SU positions for peripheral devices in the basic chassis. If more peripherals (11/50 or 11/45) or main memory (11/45 only) are required than can be handled by the basic chassis, either an H960D expander (nine SU positions) or an H960E Expander (18 SU positions) can be used.

Slot requirements for memory and special processor/interface features include: one SU position for each 4K word module (except for the newer 8K-word modules on the 11/40 or 11/45 that also requires only one SU position); one SPC for each diode memory (ROM), except two SPC's for the 11/40 or 11/45 64-word ROM loader; one SU position for each asynchronous interface (DC11, DL11) or synchronous interface (DP11) or automatic dial (DN11)/General Purpose "B" (DR11B) interface; two SU positions for the DM11 asynchronous interface multiplexor; and one SPC for general-purpose interface "A" and "C" (DR11A,C). Other processor options generally require one SPC, except the extended arithmetic feature which uses one SU position.

Individual device mounting requirements are included in the mass storage device descriptions and the Peripherals/Terminals table.

SIMULTANEOUS OPERATIONS: The PDP-11/40 and larger processors provide overlapped instruction execution and memory access. Individual blocks of 8K words can be independently interleaved on the 11/45.

MASS STORAGE

RS11 FIXED-HEAD DISK: Stores up to 256K words per drive with an average access time of 16.9 milliseconds and a

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data transfer rate of 62.5K words/second. Up to eight RS11's can be attached to an RF11 controller.

RS64 DECDISK FIXED-HEAD DISK DRIVE: Provides storage for 64K words per drive with an average access time of 16.1 milliseconds and a data transfer rate of 62.5K words/second. Up to four RS64's can be attached to an RC11 Controller. The RC11 mounts in a 10½-inch panel.

RK05 DECPACK REMOVABLE DISK CARTRIDGE SYSTEM: This removable disk cartridge system stores up to 1.2 million words per drive with an average access time (including head movement) of 70 milliseconds, and a data transfer rate of 90.25K words/second. Up to eight RK05's can be attached to an RK11 controller.

RP03 MOVING-HEAD DISK: Stores up to 20 million words per drive with an average access time (including head movement) of 29 milliseconds, and a data transfer rate of 133.3K words/second. Up to eight RP03's can be attached to an RP11 Controller. Each drive has its own freestanding cabinet.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

COMMUNICATIONS CONTROL

DC08 TELEGRAPH LINE INTERFACE: Accommodates up to 16 Dual-Line transmit and receive telegraph adapters. Terminal blocks and line current adjustment panel for individual line monitoring are available. Interfaces through a DM11-AB Asynchronous single-speed multiplexer for rates from 110 to 1200 bits/second. (Uses two system units.)

DC11 DUAL ASYNCHRONOUS SERIAL LINE SYSTEMS: Includes clock and mounting facilities for two DC11DA Full Duplex Serial Module Sets, Program selectable speeds of 50, 75, 110, 134.5, 150, 300, 600, and 1200 bits/second, depending upon model. Attaches directly to Unibus. (One system unit.)

DN11 BELL 801 AUTOMATIC CALLING UNIT INTERFACE: DNLL-DA Module Sets provide direct interface for up to four Bell System units through a DN11-AA controller. (One system unit.)

DP11 FULL/HALF DUPLEX SYNCHRONOUS INTERFACE: Double buffered for EIA/CCITT termination. 10,-11-, and 12-bit data characters can be handled over synchronous lines at 2400, 4800, 9600, 19.2K or 40.8K bits/second with the DP11-CA Data/Sync Register Extender and DP11-KA Internal Clock. (One system unit.)

DR11-A GENERAL-PURPOSE DIGITAL INTERFACE: Permits bidirectional, 16-bit parallel transfers between the user's device and the Unibus. (One Small Peripheral controller.)

DR11-B GENERAL PURPOSE DMA INTERFACE: Moves data directly between user's device and memory. Includes word count, current address, and data registers. Can be used for high-speed interprocessor communications. (One System unit.)

M786 GENERAL-PURPOSE INTERFACE MODULE: 16-bit flip-flop register with bus receivers and transmitters.

M920 UNIBUS CONNECTOR MODULE: Used to interconnect System Units.

See Peripherals/Terminals table for standard communications terminals.

SOFTWARE

OPERATING SYSTEMS: Many levels of operating systems software are available for various configurations of the PDP-11 Series. Each of these includes an appropriate supply of language processors and utility programs. The most common systems are listed below.

PAPER TAPE SYSTEM: (RT-11): This is the most primitive PDP-11 operating system and runs on all PDP-11 systems. RT-11 requires a paper tape reader/punch for program and data I/O, a console terminal for output and command input, and 4K words of memory. Languages supported are BASIC, PAL-11 Assembler, FOCAL, text editor, and debug programs. An 8K BASIC and PAL-11 relocating assembler and linker are also available.

CASSETTE PROGRAMMING SYSTEM: CAPS-11, a subset of DOS, requires 8K words of memory and the TA11/TU60 cassette unit. Program development support includes PAL-11 relocating Assembler, BASIC, EDIT, ODT, LINK-11, and PIP peripheral interchange package.

REAL-TIME OPERATING SYSTEM: RT-11, a single-user DECtape or RK11 disk-based system, is particularly suited to real-time jobs and program development. Language support is provided for MACRO-11, EDIT and a mass storage real-time BASIC. A powerful LINK program allows large programs to operate in 8K to 28K words of memory. An ODT debugging utility and PIP peripheral interchange package are also supplied.

DISK OPERATING SYSTEM: DOS is a batch-oriented system for PDP-11's with 16K words, one or more disk subsystems (RK11, RF11, or RP03), and a DECtape or high speed magnetic tape subsystem. Language support is provided for FORTRAN IV, MACRO-11 Assembler, as well as a text editor, debug programs, a Linker, librarian facility, and file utility and PIP program.

RESOURCE TIMESHARING SYSTEM: RSTS is a BASIC program development system for up to 16 simultaneous terminal users supporting a total of up to 32 million characters of on-line disk files and interactive terminals at up to 2400 bps. RSTS runs on a PDP-11 with a minimum of 24K words, a 256K word disk, and dual DECtape units. RSTS/E, and extended version of RSTS for the 11/45 with 40K words supports Memory Management and up to 32 users with a combined on-line storage capacity of 343 million characters.

COMMUNICATIONS ORIENTED MULTI-TASK EXECUTIVE: COMTEX is a communications package that supports a PDP-11 connected to communications lines or servicing multiple data terminals for remote batch, store/forward, front ends, satellite processing, concentration, message switching, or telemetry. COMTEX program development support is available for PAL-11S Assembler on the DECsystem-10, CDC 6000, and IBM System/360 and 370 host processors. COMTEX runs on any PDP-11 with 3K words plus 47 bytes per line (typically 4K-6K words). COMTEX also operates as a user program under the DOS-11 Operating System, thereby adding device supports for disks, magnetic tape, etc.

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ADVANCED REAL-TIME EXECUTIVE: The real-time multitasking systems available range from RSX-11A, a small core-only or core-disk system that can run in as little as 4K words of memory, to RSX-11D, a high performance disk-based system for the 11/40 or 11/45. Up to 250 levels of software priorities, disk resident tasks, dynamic memory allocation, memory management support, extended FORTRAN IV, and background BATCH processing, are supported under RSX-11D.

INDUSTRIAL DATA ACQUISITION AND CONTROL SYSTEMS: IDACS systems are used either as on-the-floor satellite computers, or as standalone development/process control systems to provide hierarchical configurations with computer-process or computer-communication capability. IDACS Systems operate under RSX.

PROGRAMMING: The most widely used language on the PDP-11 family is Assembler, with applicability for all environments. FORTRAN IV is a powerful scientific language, and BASIC or BASIC-PLUS are most often used in educational environments with good applicability for scientific use also.

APPLICATIONS: Several hundred scientific routines are available through DECUS (Digital Equipment Computer User's Society) including a small number of business packages.

PRICING

POLICY: DEC generally provides the PDP-11 minicomputers on a purchase basis with separately priced maintenance agreements. Packaged configurations (EduSystems, etc.) are also available on lease. Depending upon the package, certain system control programming and/or applications programs may be either included at no additional charge or might be separately charged for.

On an OEM basis, DOS is $3,000; batch operating system enhancement for DOS is $1,500; RSTS is $2,500 on all but the 11/45 (on the 11/45 RSTS is $4,000); and the 11/45 Real-Time operating system is $5,000.

On-site installation and basic education are included in most system prices. One-time installation charges are generally made to install add-on equipment. Separately priced training is available.

EQUIPMENT: The following typical systems purchase prices include all required control units, adapters, and software.

TYPICAL 11/05 OEM CONFIGURATION: Includes PDP-11/05 processor with 8K words of core memory, TA11 dual magnetic tape cassette, bootstrap loader, and LA30 DECwriter data terminal (30 cps). Purchase price is $13,910.

TYPICAL PDP-11/40 BATCH CONFIGURATION: Includes 11/40 processor with 16K words of core memory, a bootstrap ROM loader, real-time clock, TC11 dual DECtape drive, CR11 card reader (300 cpm), one RK11 DEC disk system (1.2 million words), and a DECwriter terminal (30 cps). Purchase price is $42,720.

TYPICAL PDP-11/40 RSTS (Resource Time Sharing System for expansion up to 16 simultaneous users) USING BASIC-PLUS: Includes 11/40 Processor with 24K words of core memory, real-time clock, a bootstrap ROM loader, TM11 magnetic tape subsystem, RK11 DECpack Removable disk cartridge subsystem (1.2 million words per drive), and LA30 DECwriter. Purchase price is $51,270.

TYPICAL DECcomm 11D26 (IBM 2780 Data Transmission Terminal capability for RJE): Includes KA11 processor with 8K words of 0.9-microsecond core memory, Teletype programmer's console, real-time clock, synchronous line interface, communications arithmetic element, and COMTEX-11 software. Purchase price is $17,550.

TYPICAL LARGE-SCALE 11/45 CONFIGURATION: Includes KB11 Processor with 92K words of 0.9-microsecond core memory and 4K words of 0.3-microsecond bipolar memory, bulk storage bootstrap loader, floating-point processor, 40 million words of removable RP03 disk storage, two TU56 DECtape transports, one industry compatible 9-track tape drive, 300-cpm card reader, DECwriter, (30 cps), and 1200-lpm printer. Purchase price is $223,800. ■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS			
PDP-11/-5	Basic System #1 (includes 4K words of 0.9 microsec. memory and console)	$4,795	$50
PDP-11/05	Basic System #2 (same as above with 8K words)	6,495	65
PDP-11/10	Basic System (includes 8K words of 0.9 microsec. memory and console)	6,995	65
PDP-11/15	Central Processor only	3,000	40
PDP-11/15	Central Processor plus cabinet	3,650	40
PDP-11/20-AA	Basic System (includes 4 K words of 0.95 microsec. memory and console)	10,800	110
PDP-11/20-CE	Same as above except replacement of console with PC11 and LA30	15,650	124
PDP-11/21-CA	Same as Basic 11/20-AA with 8K words of 0.9 microsec. memory	13,650	120
PDP-11/21-CE	Same as above except replacement of console with PC11 and LA30	17,850	134
PDP-11R20	Ruggedized version of Basic 11/20-AA	13,900	110
PDP-11/40	Basic System (includes 8K words of 0.9 microsec. memory and console)	12,995	120
PDP-11/45	Central Processor only	12,950	150

DEC PDP-11 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSOR FEATURES AND MEMORY			
ME11-LA	8K 0.9 microsec. core memory	$ 5,200	$ 35
ME11-L	8K 0.9 microsec. core memory	4,700	35
MF11-LP	8K 0.9 microsec. core memory & parity	5,400	35
MM11-LK	12K 0.9 microsec. core memory	7,100	55
MM11-L	8K 0.9 microsec. core memory	4,400	35
MM11-LP	8K 0.9 microsec core (parity) memory	5,400	35
MM11-S	8K 0.9 core memory controller	4,700	36
MMR11-E	4K 1.2 microsec. (ruggedized) core memory	4,500	25
MMR11-EX	8K 0.9 microsec. interleaved (ruggedized) core memory	9,000	40
MR11-DB	64-word Bulk Storage Bootstrap Loader (11/45)	540	5
MS11-BC	First MOS Memory Control (4 MS11-BMs or -BPs)	1,950	12
MS11-BD	Second MOS Memory Control (4 MS11-BM's or -BP's)	1,500	12
MS11-BM	4K 450-nsec MOS Memory (11/45)	4,500	40
MS11-BP	4K 450-nsec MOS Memory (byte-parity 11/45)	5,200	44
MS11-CC	Bipolar Memory Control (11/45)	1,950	12
MS11-CM	1K 300-nsec Bipolar Memory (byte parity-11/45)	1,950	15
MS11-CP	1K 300-nsec Bipolar Memory (byte parity-11/45)	2,500	19
M792	32-word ROM Diode Memory Bootstrap loader (not 11/45)	300	3
DA11-F	Multiprocessor Interlink Window (PDP-11/45)	5,950	–
DR11-C	Direct interface	430	5
FP11-B	Floating Point Processor (PDP-11/45)	4,900	42
KE11-E	Extended Instruction Set (11/40)	1,295	10
KE11-F	Floating Point Unit (11/40)	1,400	10
KF11-A	3-line priority interrupt (11/15)	400	3
KG11	Communications Arithmetic Hardware	810	6
KP11-A	Power Fail/Restart (11/15)	400	3
KT11-C	Memory Segmentation (11/45 with more than 28K)	3,900	30
KW11-L	Real Time Clock; 16.6 ms (not for 11/05)	270	3
KWR11-L	Ruggedized KW11-L Clock	300	3
KW11-P	Programmable Real Time Clock	645	3
KY11-F	Ruggedized Programmer's Console	2,500	–
KY11-C	Programmer's Console (11/15)	200	5
MASS STORAGE			
RS64	DECdisk Fixed-Head Drive, 64K words	4,860	15
RC11-A	RS64 and Controller	7,505	35
RS11	Fixed-Head Disc Drive, 256K words	9,000	40
RF11-AA	RS11 and Controller	14,400	65
RK11-DE	RK05 and Controller, 1.2 million words	11,000	100
RK05	DECpack Removable Disc System	5,100	60
RK05-KA	Disc Cartridge for RK05's	99	–
RP03	Removable Disk Drive, 20 million words	20,000	150
RP11	RP03 and Controller	31,800	220
MAGNETIC TAPE EQUIPMENT			
TC11	TU56 and controller for up to 4 TU56's	8,700	42
TU56	Dual DECtape Transport, 5.0K words/sec.	4,700	30
TU10-E/F	Industry-Compatible Tape, 36KBS	7,505	70
TM11	TU10 and control unit	10,745	95
TA11	Dual DECcassette Transport and control, 487 bytes/sec.	3,900	36
PUNCHED CARD EQUIPMENT			
CM11	Mark-Sense Card Reader (not 11/45), 300 cpm	5,290	50
CR11	Card Reader, 300 cpm	4,860	50
CD11-A	Card Reader, 1000 cpm	10,800	70
CD11-EA	Card Reader, 1200 cpm	15,120	90
PRINTERS			
LP11-F	Line Printer 80-column, 64 characters, 300 lpm	12,000	60
LP11-H	Line Printer, 80 column, 96 characters, 300 lpm	13,500	65
LP11-R	Line Printer, 132 column, 64 characters	30,000	135
LP11-S	Line Printer, 132 column, 96 characers	33,000	135
LS11	Line Printer, 132 column, 64 characters	5,615	48
LP11-J	Line Printer, 132 column, 64 characters	17,500	75
LP11-K	Line Printer, 132 column, 96 characters	19,000	80

DEC PDP-11 Series

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MISCELLANEOUS INPUT/OUTPUT UNITS			
PC11	High Speed Paper Tape Reader/Punch, 300/500 cps	$ 3,900	$ 30
PR11	High-Speed Paper Tape Reader, 300 cps	2,400	15
COMMUNICATIONS EQUIPMENT			
LA30	DECwriter Data Terminal, 30 cps	2,795	30
LC11	Controller for LA30	430	6
VT05B	A/N CRT Display, 20 lines x 72 characters	2,795	2
AA11-A,B,C,	Control for 611 Scope, RM503, or VR14	600	4
VT01-A	Tektronix 611 Storage Tube Display	3,240	75
VR01-A	Tektronic RM503 Oscilloscope Display	1,080	14
VR14	Point Plot Display, 7- x 9-inch	3,240	18
AA11-DA	Digital to Analog Display Control	1,080	6
DC11-AA	Dual Asynchronous Serial Line System Unit; 110, 134.5, 150, or 300 bps	290	3
DM11-AA	Asynchronous 16-line Single Speed Multiplexor	3,200	30
DC08-CS	Telegraph Line Interfaces (not for 11/45)	2,160	4
SPECIAL INTERFACES			
AD01	Analog to Digital Subsystem for 72 channels	2,400	20
A124	Multiplexor Module (4 channels) for AD01	60	2
AH04	Sample and Hold for AD01	320	3
AH05	Sign Bit for AD01	430	6
BA614	Digital to Analog Converter	375	5
DC08-CM	1 Dual Telegraph Terminal Line Adapter	230	2
DC08-EB	Telegraph Line Current Adjustment Panel	2,160	2
DC08-D	Distribution Panel	1,080	2
H793	DC08 Power Supply	546	7
893	DC08 Fuse Panel	1,080	—
DB11-A	Unibus Repeater for 18 unit loads	1,080	5
M783	Unibus Transmitter Module for 12 devices	32	—
M785	Unibus Transceiver Module (8 receivers, 8 drivers)	37	—
DC11-AB	DC11-AA for 110, 300, 1,200 or 1,800 bps	270	3
DC11-AC	DC11-AA for 110, 150, 600, or 12,00 bps	270	3
DC11-AD	DC11-AA for 50, 110, 134.5, 150 bps	375	3
DC11-AE	Same as DC11-AA for 75, 110, 134.5, 150 bps	375	3
DC11-AG	Same as DC11-AA for 134.5, 150, 300, 1,200 bps	270	3
DC11-AH	DC11-AA for 110, 134.5, 600, 1,200 bps	270	3
DC11-AX	DC11-AA for 110, 134.5, 150 bps	375	3
DCR11	DC11 for 11R20	495	3
DC11-DA	Full Duplex Serial Module Set	645	7
DE11-A	EIA Level RS232C Line Adapter	100	2
DM11-B	Modem Control Multiplexer (16 line)	1,295	18
DM11-DA	Line Adapter (4 teletype lines)	170	5
DM11-DB	Line Adapter (4ETA lines)	485	10
DM11-DC	Line conditioning	860	5
DN11-AA	Prewired System Unit	320	5
DN11-DA	Module Set for DN11-AA	320	3
DP11-DA	Synchronous Line Module Set	1,510	18
DP11-DC	DP11-DA for use with Bell System 303 modem	1,940	18
DP11-CA	Extender to handle 10-, 11-, and 12-bit characters	320	3
DP11-KA	Internal Clock	215	3
DR11-A	General-Purpose Digital Interface	400	12
DRR11-A	DRLL-A for 11/R20	1,000	5
DR11-B	General-Purpose Direct Memory Access Interface	1,290	12
H312A	Asynchronous Null Model	65	2
M786	General-Purpose Interface Module	220	—
M105	Address Selector Module (4 addresses)	70	—
M782	Interrupt Control Module (for 2 interrupts)	108	—
M920	Unibus Connector Module	45	—
DL11-A	Asynchronous Line, 20 ma. Loop	430	6
DL11-B	Asynchronous Line, EIA data only	450	6
DL11-C	Asynchronous Line, 20 ma. Loop	430	6
DL11-D	Asynchronous Line, EIA data only	450	6
DL11-E	Asynchronous Line, Data Set Control	500	6