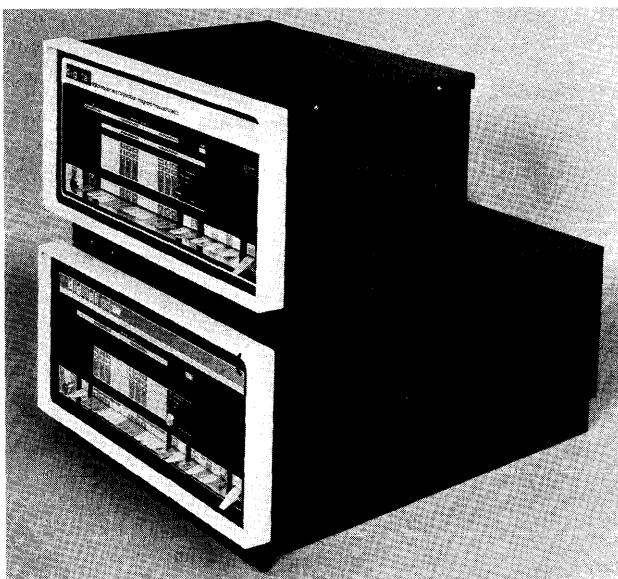


DEC PDP-8 Series



The PDP-8/E (on the bottom) is the most powerful in a long and extremely popular line of 12-bit minicomputers from DEC. It features a patented internal bus system called "Omnibus". DEC also offers a lower-priced, modular version called the PDP-8/M (perched above) for OEM customers.

MANAGEMENT SUMMARY

Digital Equipment Corporation's widely venerated PDP-8 family officially began life in 1965 with the first shipment of the original PDP-8. Actually, however, the architecture and basic concepts behind the PDP-8 really started with the PDP-5 in 1963.

The PDP-5 was based upon a 12-bit word length, and was intended for dedicated laboratory/process control applications with typical system prices of about \$28,500. The PDP-5 was manufactured with hand-wired production techniques, making it impractical to produce in large quantities. As it was, about 100 PDP-5's were produced (most of which continue in operation). The enthusiastic market demand for the PDP-5 delighted DEC, and plans were immediately made for a mass producible version—the PDP-8. The PDP-8 was not originally called a minicomputer, but was certainly the first of the popular, low-cost, small-scale machines that would soon revolutionize the computer industry.

The PDP-8 was announced less than two years after the PDP-5, and was identical to the PDP-5 except that the internal register for a program counter was built into hardware instead of being implemented in software as was the case for the PDP-5. The PDP-8 was widely recognized as 1) the first mass-produced computer, 2) the first popular minicomputer, and 3) the first computer selling for less than \$20,000 (CPU only; typical system costs were somewhat higher).

The PDP-8 computer family that started the whole minicomputer industry in the mid-60's is the most popular and widely installed system in the world. With about 20 thousand systems delivered to date, and shipments now at the highest level since introduction of the Series, this 12-bit mini family still appears to have a lot of mileage left in it.

CHARACTERISTICS

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

MODELS: PDP-8/E, -8/M, and -8/F.

DATA FORMATS

BASIC UNIT: 12-bit word with one optional parity bit per word.

FIXED-POINT OPERANDS: 12-bit words standard, with optional 24-bit double-precision operands. Half-word (six-bit) byte swaps can also be handled.

FLOATING-POINT OPERANDS: 36-bit single precision operand instructions with a 24-bit signed fraction and signed 12-bit exponent. Optional 72-bit operand with a 60-bit signed fraction and signed 12-bit exponent for double precision. Floating point processor hardware is optional on 8/E, 8/M, and 8/F; software subroutines are also available.

INSTRUCTIONS: One-word instructions. No decimal instructions available for any PDP-8 model. Memory reference instructions use the first three bits to specify the instruction, and the last nine bits to specify the operand address. In order for memory reference instructions to access memory directly, each 4K memory module is logically divided into 32 pages of 128 addresses each for page addressing. Seven of the nine bits are used to specify relative address within page; one bit is used to specify current page or page "O" within the module, and one bit is used to specify whether direct or indirect addressing is used.

For direct addressing, a memory reference instruction can reference any of 128 addresses on its own page, or any of 128 addresses on page "O" of its own 4K module; with indirect addressing, any location in memory can be referenced. For manipulation and/or testing of data, a group of "Operate" instructions is available that specify shift, clear, complement, and test (and skip) operations on the accumulator and its associated Link bit. The first three bits specify Operate-type instruction, the fourth bit specifies one of two groups of commands, and bits 5 through 11 are predefined by position to indicate particular functions.

Thus, up to seven one-bit indicators can be "turned on" in each operate instruction, with each one-bit flag referred to as a "micro instruction" (not to be confused with micro-programming). For I/O instructions, the first three bits specify I/O, the next six bits select a device, and the last three bits specify the operation to be performed.

INTERNAL CODE: Binary.

DEC PDP-8 Series

► The PDP-8 (and its "crowd pleaser" transparent chassis) was followed a year later by the PDP-8/S—the first OEM computer—and the Laboratory Instrumentation Computer (LINC-8). The LINC-8 grew out of a project to produce a PDP-8-like system that had both the PDP-8 and the original MIT Lincoln Lab instruction sets. The LINC-8 was a specialized system with a relatively narrow market appeal (about 100 were delivered). It was succeeded by the PDP-12, a laboratory system retaining many of the LINC-8's best features. PDP-12's are marketed today as part of DEC's LDP (laboratory Data Processor) series.

The PDP-8/S (S for "serial", and more commonly "slow"), took more than five times as long to execute a typical instruction as did the original PDP-8. The "S" used serial rather than parallel internal logic and was widely advertised as the first computer selling for less than \$10,000.

The next developments in the PDP-8 family were an integrated circuit version of the processor—8/I—for end-users, and then a low-cost configuration 8/L ("low") IC-version for OEM's built with a limited I/O configurability and a correspondingly less powerful power supply.

It was not until 1970 that the PDP-8 Series received its next major enhancement with release of the PDP-8/E ("Expanded") OEM or end-user processor that employs the design used in each of the current PDP-8 Series systems—PDP-8/E, -8/M (OEM-oriented), and 8/F (end-user version of the -80/M). During the period between the release of the 8/I and 8/E, work was under way on the more powerful PDP-11 family and it seemed to many in the computer industry that the PDP-8's lifespan would be terminated. DEC did not share that view, however, and has kept the PDP-8's current with improvements that reflect the latest technological advances. DEC appears ready to continue doing so into the future in order to assure continued PDP-8 Series growth.

(Please note the Summary Data Chart on the bottom of this page as a convenient way to recap the history of the many PDP-8 models.)

► MAIN STORAGE: Magnetic core; woven-wire (braid) read-only memory (ROM); diode ROM.

CYCLE TIME: 1.2 microseconds for all.

CAPACITY: 4K-32K words in 4K or 8K increments for main memory; up to 32 words of programmable diode ROM (bootstrap); and up to 2.0K-5.6K words (8/E), or 1.2K to 4.8K words (8/M, 8/F) of woven-wire ROM (depending upon configuration limit) in increments of 256 words.

Each 256-word increment uses three slot positions. Typical ROM installations consist of 512 words. All ROM memory consumes address space, and the maximum PDP-8 address space is 32K words.

CHECKING: Optional.

STORAGE PROTECTION: None. (For the obsolete PDP-8/L, read/write or read-only protection was standard).

CENTRAL PROCESSORS

GENERAL: All of the PDP-8 Series are single-address, fixed-word length, parallel machines using two's complement arithmetic on 12-bit binary numbers with an accumulator and multiplier-quotient architecture and direct accumulator-to-device and device-to-accumulator I/O transfers. There are four distinct processor versions of the same fundamental architecture: three are used with the "traditional" (and no longer actively marketed), PDP-8, -8/S, -8/I, and 8/L. The fourth and current processor—KK8-E—is used with the models 8/E, 8/M, and 8/F.

The "E" or extended processor incorporates a patented synchronous Omnibus I/O structure (two in the 8/E); a programmer console interface (turnkey panel in the OEM-oriented 8/M); optional power failure/automatic restart, extended arithmetic element (EAE) option; real-time clocks; and floating point processor (FPP-12, available in a separate rack-mounted unit). The traditional PDP-8 instruction set has been enhanced for the E-processor to include a byte (6-bit) swapping instruction for better character handling, and one interrupt level accessed by four interrupt control instructions. Also, a general-purpose register has been added to handle extended arithmetic or to serve as temporary storage during standard operations.

REGISTERS: The PDP-8's (8/E, 8/M, 8/F) have eight major registers: Six are 12-bit registers: one accumulator (AC), one general-purpose register for MQ use with the extended arithmetic option, a program counter (PC), memory address (MA) register, switch register (SR) to manually load

SUMMARY DATA FOR PDP-8 SERIES

	PDP-5	PDP-8	PDP-8/S	LINC-8	PSP-8/I	PDP-8/L	PDP-12	PDP-8/E	PDP-8/M	PDP-8/F
Announced	1963	1965	1966	1966	1968	1968	1969	1970	1971	1972
First Delivered	9/63	5/65	9/66	9/66	3/68	7/68	6/70	3/71	12/71	11/72
CPU Price (\$)	27,000	18,000	10,000	38,000	13,500	8,500	20,000	5,000	4,000	4,000
Avg. System (\$)	28,500	22,500	12,500	40,000	17,000	11,500	32,000	13,500	8,000	9,500
Cycle Time	—	1.5	8.0	—	1.5	1.6	1.6	1.2	1.2	1.2
Number Installed*	90	1,400	900	135	3,170	3,875	725	9,150 Total		

*As of June 30, 1973.

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	SPEED
MAGNETIC TAPE UNITS		
TU56 DECtape	Block addressable, 189K words	7.5K words/sec
TR07	Industry compatible, 45 or 75 ips, 9-track (1600 bpi)	120 KBS
TU66-AC	Industry compatible, 25 ips, 9-track (1600 bpi)	40 KBS
TU66-AE	Industry compatible, 45 ips, 9-track (1600 bpi)	72 KBS
TU66-AF	Industry compatible, 75 ips, 9-track (1600 bpi)	120 KBS
TU10-E/F	Industry compatible, 45 ips, 9-track (800 bpi)/7-track (200/556/800 bpi)	36 KBS
TA8	Dual Drive DEC Cassette; 87K-93K bytes, 300-700 bpi (1 slot)	487 bytes/sec
LINE PRINTERS/PLOTTERS		
LS8	132-position, 64-character (1 slot)	165 cps
LE8-F	80-position, 64-character (1 slot)	356 lpm
LE8-H	80-position, 96-character (1 slot)	253 lpm
LE8-J	132-position, 64-character (1 slot)	245 lpm
LE8-K	132-position, 96-character (1 slot)	173 lpm
LP08-MA/MB	132-position, 64/96 character (1 slot)	700 lpm
LP08-RA/RB	132-position, 64/96-character (1 slot)	1250 lpm
LV8	Electrostatic Plotter	123K dots/sec; 500 lpm
PUNCHED CARD EQUIPMENT		
CM8	Optical Reader, 80 column (1 slot)	300 cpm
CR8	Reader, 80-column (1 slot)	300 cpm
PAPER TAPE EQUIPMENT		
PR8	Reader (1 slot)	300 cps
PC8	Reader/Punch (1 slot)	300/50 cps
TERMINALS		
LA30 DECwriter	Hard copy, 64-character	30 cps
VT05	A/N, 20 lines X 72 character CRT	110, 150, 300 bps
VR20	Point Plot, 6.75" X 9", 2-color CRT	—
VT01	Tektronix 611 Display	—
VT8	A/N Graphic Display, 20 lines X 64 characters	—
VN01	X-Y Tablet, 11" X 11" to 36" X 36"	200 points/sec.
RT01 DEClick	A/N, 4-12 digit numeric display	110 bps
RT02 DEClick	A/N, 32 digit numeric display	110,150, 300,1200 bps

Note: Chassis mounting requirements in parentheses refer to Configuration Rules.

► The 8/E processor employs an MSI large-board structure, an expanded instruction set, and a patented Omnibus to improve system efficiency in process control/real-time environments. The 8/E enjoyed a tremendous success, and to-date, about three years after initial delivery, about as many 8/E's alone have been delivered as all earlier PDP-8-type systems combined. (nearly 8 years passed from introduction of the original PDP-8 until initial deliveries of the PDP-8/E began.)

Thus, the story of the PDP-8 Series is the story of the beginning of the minicomputer industry, and many of the factors that have influenced subsequent minicomputer de-

► the contents of memory or other registers, and memory buffer (MB) register to transfer information between other registers and main memory. A three-bit instruction register (IR) that contains the operation code of the current instruction and a one-bit link (L) carry register that handles AC overflow for two's complement arithmetic are also provided.

Eight special "auto indexing" registers are contained in locations 8 through 15 of the 128-word page "O" of each 4K-word memory field (module). When one of these locations is addressed indirectly by a memory reference instruction, its contents are automatically incremented by one, and it is used as an operand. When referenced directly, however, the auto index registers act as any other memory location.

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► sign and marketing practices for the industry as a whole were identified during the development and marketing of the PDP-8's. The PDP-8 family's current models are viable systems today, with continuing brisk business done by DEC in OEM PDP-8 sales, but more recently with a heavy emphasis upon packaged end-user systems.

Among these packaged PDP-8 systems available directly from DEC are the Typeset/8 graphic arts/typesetting packages (\$15,000-\$95,000); IDACS-8/C industrial data acquisition and control systems (\$20,000-\$30,000); DEC Datasystem-300 small general business system; Edu-Batch IBM 2780-type terminal for IBM 360/370 communications (\$15,000); PAMILA Lab Automation (\$13,000-\$50,000); and some fifteen EduSystem educational configurations (\$6,000-\$120,000).

Other non-DEC packaged systems using PDP-8 minicomputers include the Consolidated Computer Key-Edit data entry systems, Computer Machinery's CMC-7 and -9 Key Processing data entry systems, Codon's Distribution Management System, Computer Interactions CI-2 Small Accounting Computer, Scidata's Series 5 wholesale distribution system, Edit Systems' five-terminal shared processor data entry system, Information Control Systems' 16-terminal word processing system, and Search's System 70 and 75 small accounting computers.

In the dozens of major market areas (including OEM) that the 12-bit PDP-8 is sold, competition is encountered from a variety of other minicomputer manufacturers, including Digital Computer Control (D-112), General Automation (SPC-12), and Nuclear Data (ND 812), as well as a number of systems with longer word lengths. The PDP-8's, however, must be regarded as the industry's most successful overall minicomputer system to date and DEC has won more competitive contests with the PDP-8 than all of its competition combined.

(It is interesting to note that PDP-8/E benchmarks run against IBM's 360/30—a system with typical monthly rentals about five times that of a PDP-8/E configuration running under OS/8 software—show that matrix inversions and other mathematical calculations take about half as long on the PDP-8).

PDP-8 users contacted by Datapro report a generally excellent rating for the systems, with ease of operation, high reliability, and the wide range of peripherals being commonly singled out. Also, the LA30 DECwriter console appears to be particularly effective. Some of the criticisms of the PDP-8 family include the limited instruction repertoire (caused largely by the relatively short 12-bit word length) and the main memory limitation of 32K words.

With the trend today toward larger word-length systems (e.g. 16-bit), most exciting new minicomputer developments are generally expected to occur in that area. If not

► INDIRECT ADDRESSING: Yes.

INSTRUCTION REPERTOIRE: All "E" processors have six memory reference instructions, four interrupt system control instructions, three flag processing instructions, and 41 "operate" instructions for logic control, etc. With the optional Extended Arithmetic Element (EAE), six shift instructions, four arithmetic instructions (including multiply/divide), and six double-precision instructions are added.

INSTRUCTION TIMING: All times are for full-word, fixed-point operands in microseconds.

Load/Store	2.6
Add/Subtract	2.6/5.0
Multiply/Divide	256.5/342.4
Compare, Branch	3.8

INTERRUPTS: A single-line interrupt structure is provided, with software polling of I/O devices required to determine the precise nature and priority of the interrupt. Through I/O instructions, a device can be programmed to generate a specific interrupt.

PROCESSOR MODES: Two operating modes are provided, user and executive (for systems with extended memory, i.e., more than 4K). User mode is the only standard mode of operation, with executive mode being an option requiring a hardware modification on the processor board. In executive mode, full access is available to all programmable machine functions. In user mode, (invoked for time-sharing or foreground/background multiprogramming), direct I/O access is denied to unauthorized user programs.

STACK ORGANIZATION: Automatic push-down stacks are implemented in software to facilitate sharable (re-entrant) routines. The size of the push-down stacks are limited only by the size of available memory.

INPUT/OUTPUT CONTROL

OMNIBUS: A synchronous bus is provided with each processor (one standard in the PDP-8/E with a second Omnibus as an option) that permits the plugging of memory/processor options or I/O devices into any available slot location. Thus, the Omnibus eliminates the need for back panel wiring. The maximum Omnibus data transfer rate is 134 thousand words/second, and up to three Omnibus units can be attached to the 8/F or 8/M; up to four can be attached to the 8/E.

DIRECT MEMORY ACCESS: A standard 12-channel DMA ("data break") feature is provided for high-speed block data transfers between memory and higher speed peripheral/terminal devices on a cycle stealing basis and is an integral part of the Omnibus. Any peripheral/terminal controller with an DMA interface can operate directly to memory. In conjunction with the DMA feature, multiple external devices can directly increment multiple memory locations, and external data can be combined (add/subtract) directly to memory locations without processor intervention. The maximum DMA data transfer rate is 833 thousand words/second.

CONFIGURATION RULES: The key to configuring the PDP-8 Series is the Omnibus, which not only provides a certain size bandwidth to enable the interface of various peripherals, but also consists of prewired slots that permit physical attachment of these devices and/or memory/processor options. Each Omnibus has 20 slots in it, and when

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► there, then many would say that the important action is occurring at the other end of the minicomputer spectrum, namely, with smaller microprocessors (processors-on-a-chip). Yet the recent PDP-8 models appear to remain solidly cost-effective. With field service provided by more than 1,500 support personnel in more than 130 locations worldwide, shipments are higher now for PDP-8's than ever before. The expectation is that DEC will continue to improve the line with low-cost, newer technology from time to time, and will continue to support its software and ever increasing array of peripherals. Doing so, the PDP-8 Series will probably retain a significant place in the minicomputer industry into the foreseeable future. □

► an additional Omnibus is added, one slot position in each is occupied by the interconnection cables. In a basic 4-K-word 8/E, two Omnimuses are included, with ten slots used up for the processor, console interface, and basic 4K words of core memory (11 slots if 8K words are present), which leaves 28 slots (27 with 8K words) for additional device/optimal feature attachment.

The 8/E can be further expanded in 18-slot increments to total capacities of 46 or 64 slots (45 or 63 with 8K words). The 8/M and 8/F come with one Omnibus for a capacity of ten (or nine) available slots that can be increased to 28 or 46 (27 or 45) total slots with the addition of one or two Omnimusses, respectively. The first memory boards (4K or 8K) occupy four slots, with each expansion board (4K or 8K) occupying three slots. Memory parity uses three slots, and each 256-word ROM, the programmable clock, floating-point hardware, on the extended arithmetic option, requires two slots; while power failure/ automatic restart, the fixed interval real-time clock, and the bootstrap loaders each use one slot. The asynchronous line interfaces, I/O interfaces, and general purpose interfaces use one slot, whereas the synchronous line interface uses two slots.

Refer to the Peripherals/Terminals table and Equipment Pricing section for specific device/slot requirements.

MASS STORAGE

DF32 DISK FILE AND CONTROL: This fixed-head storage device provides 32,768 13-bit words (12 bits plus parity) of storage per spindle with an average access time of 16.67 milliseconds and a data transfer rate of 15.2K words/second. Data is stored on one surface of a nickel-cobalt-plated disk and accessed by 15 read/write heads. Up to three additional DF32 Expander Disks can be added for a maximum subsystem capacity of 131,072 words. The DF32 is housed in a separate cabinet and requires a KA8E/KD8E interface.

RS08 DISK FILE: Provides fixed-head storage of 262,144 13-bit words (12 bits plus parity) of storage per spindle with an average access time of 16.9 milliseconds and a data transfer rate of 62.5K words/second. Data is stored on a single disk surface which is serviced by 128 read/write heads (2K words per track). Eight read/write protect switches on each RS08 can block access to blocks of 16K words in locations 0-13K. Up to four RS08 drives can be attached to an RS08 controller. The RS08/RF08 subsystem is housed in a separate cabinet(s) and does not use any chassis slots.

RK8 REMOVABLE DISK CARTRIDGE AND CONTROLLER: Provides storage for 1.6 million 12-bit words with an average access time (including head movement) of 50 milliseconds, and a data transfer rate of 120K words/

second. Each disk cartridge records on both surfaces of a single disk, on 200 cylinders, with 2 tracks per cylinder, 16 sectors per track, and 256 words per sector. Up to three RK05 Disk Cartridge Drives can be added to the basic RK8 system for a total of 6.6 million words of storage. The RK 8 subsystem uses RK03 disk cartridges, is housed in a separate cabinet(s), and plugs into three Omnibus slots.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

COMMUNICATIONS CONTROL

KL8 ASYNCHRONOUS DATA COMMUNICATIONS: A variety of KL8 serial-line interface models provide EIA compatible interface for send/receive communications at speeds varying from 110 to 2400 bits/second. KL8-M Modem Control interfaces for Bell System 103 and 202 series modems or H308 Full Modem Adapters are used with the KL8 subsystem. Up to 17 KL8's can be attached to a PDP-8, with one Omnibus slot required per KL8, and one slot per modem controller.

DP8 SYNCHRONOUS DATA COMMUNICATIONS SUB-SYSTEM: Provides interface for Bell System 201-type modems or Bell 300 series modems. The DP8 interface requires two Omnibus slots.

DC08 AUTOMATIC CALLING UNIT INTERFACE: Provide direct interface for up to ten Bell System 801 A/C units through a DC08-H controller and one or more DC08-J channels.

SOFTWARE

OPERATING SYSTEMS: There are four main operating systems for the PDP-8 Series, plus two lower levels of system control programming support. The DEC/X8 Systems Exerciser is available on paper tape or magnetic tape and provides a basic monitor capability including loaders, symbolic editor, on-line debugger, a floating-point math package, and a subroutine library. Program development support is provided for the PAL III Assembler. In addition to DEC/X8, the DECdisk keyboard monitor (provides FORTRAN and assembly program development support on a basic PDP-8) and Basic and Extended Software kits are available to support fundamental mainframe diagnostic programs.

OS/8 SYSTEM: OS/8 is a comprehensive tape or disk executive system for batch and interactive operation on a 12K-word (or larger) PDP-8 system with one or more tape drives, or a minimum of 64K words of disk storage. OS/8 provides standard dynamic I/O handling for a maximum of 15 I/O devices, as well as modular program development support for FORTRAN, Basic, Focal, six different levels of assembly language, and PIP (Peripheral Interchange Program). Modules in more than one language can be combined to form a composite programming system. Also supported under OS/8 are a Symbolic Editor, Dynamic Debug Programs, and absolute and relocatable program loaders.

Recently, an ANS-compatible FORTRAN IV compiler was announced for the OS/8 system that will run on the OS/8 basic system configuration but which can be dramatically speeded up with the addition of an EAE Unit or the FPP-12 Processor.

TS8/E TIME-SHARING SYSTEM: Provides general-purpose time sharing for up to 17 concurrent users on a 12K-word system with a disk for swapping and storage of the

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► user programs. With on-line editing and debugging programs, TS8/E supports interactive program development in a time-shared environment. (Also known as TSS/8 or EduSystem 50).

COS300 DATA MANAGEMENT SYSTEM: Supports small-to-medium scale commercial applications from a tape or disk system residence. COS300 includes DIBOL (Business oriented Cobol-like language) for program development support, a data entry package, system generation maintenance programs, sort-merge utility, user file directories, source data editing, and a system monitor with device handlers. COS300 can support batch or interactive operation.

CASSETTE PROGRAMMING SYSTEM: CAPS-8 is available for PSP-8/E's with a TA8 cassette subsystem, an 8K-word CPU, a console terminal device such as an LA30 DECwriter, and an optional line printer. The M18 bootstrap loader is a recommended, although not required, feature for use with CAPS-8. CAPS-8 provides a monitor-level executive with file handling capabilities, facilities for fault detection, and program development support for a subset of BASIC, PAL-C Symbolic assembler (although an extended symbol table for 1,800 entries requires a 12K system), and the EDIT symbolic editor. Utility support includes COPY, a system cassette copy program and memory map utility processor.

INDUSTRIAL DATA ACQUISITION AND CONTROL SYSTEMS: ICACS/8 systems are used either as on-the-floor satellite computers, or as stand-alone development/process control systems to provide hierarchical configurations with process or communication control capability. In addition to PAL D and PAL III Assembly language, IDACS/8 systems can be programmed in INDAC, an industrial control macro system, and an industrial version of BASIC.

TYPESET 8 PUBLISHING/GRAFIC ARTS SYSTEMS: Typeset 8 systems are packaged PDP-8 configurations with special newspaper/graphic applications packages to handle a variety of tasks from foreign language hyphenation, proofing and editing to classified ad storage, general publications financial bookkeeping/financial applications, and photo composition text setting.

LAB/8 LABORATORY AUTOMATION SYSTEMS: These packaged PDP-8 configurations are supplied with a special complement of laboratory software including PAMILA (Peak Analysis for Multi-Instrument Lab Automation), a program that supports an extended FOCAL language (a laboratory version of BASIC); and TSAR, a signal processing language that runs on an 8/E processor under OS/8 with a floating point processor (FPP), 16K words of memory, and tape or disk auxiliary storage. TSAR is able to operate in batch or interactive modes, and supports graphic output on a CRT device.

PROGRAMMING: Program development support for PDP-8's consists of DIBOL-a COBOL-like business oriented language (Digital Equipment Corporation Business Oriented Language); FORTRAN IV (3K-32K words for 350-2450 program statements); ALGOL; FOCAL (formula calculator) -an on-line, conversational mathematical programming language requiring 2.5K-8K words for 120-400 program statements; BASIC (six versions occupying from 2K-32K words for 50-400 program statements); and several levels of assembly language. A COGO-8 (coordinate geometry) package for operation on a 16K system under OS/8 with FORTRAN IV is also available.

The PDP-8 Assemblers include PAL-III, a basic 4K (600 symbols) symbolic Assembler; MACRO-8, an advanced 4K assembler with literals, double precision and floating-point constants, and macro generation; PAL-P, a disk version of PAL-III (1000 symbols) plus literals, and automatic linking to off-page symbols; 8K SABR, a relocatable symbolic assembler with page independent relocatable code, automatic linkage to off-page symbols, conditional assembly; and PAL-8, an advanced PAL-III for disk or tape systems (1800 symbols).

APPLICATIONS: More than one thousand 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-8 Series on a purchase basis with separately priced maintenance agreements. Packaged configurations (EduSystem, etc.) are also available on lease. Depending upon the package, certain system control programming and/or applications programs may be included at no additional charge or may be separately priced. 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 and adapters.

BASIC OEM SYSTEM: Includes PDP-8/M CPU, 4K core memory, and operator's panel. Purchase price is \$3,690.

EXPANDED OEM SYSTEM: Includes PDP-8/E CPU, 8K core memory, programmer's console, and console teletype control. Purchase price is \$5,650.

MEDIUM OS/8-10 TAPE RESIDENT OPERATING SYSTEM: Includes PDP-8/E CPU, 12K core memory, dual DECTape drive, bootstrap loader, DECwriter data terminal, and line printer. Purchase price is \$21,600.

MEDIUM OS/8-80 DISK RESIDENT OPERATING SYSTEM: Includes PDP-8/E CPU, 12K core memory, DECwriter data terminal, 262K-word RS08 disk, paper tape reader/punch, and line printer. Purchase price is \$34,900.

TYPESET/8-200 STORAGE AND EDIT SYSTEM: Includes PDP-8 CPU, 16K core memory, four dual DECTape transports, teletype, and line printer. Purchase price is \$62,950 (does not include software).

ADVANCED LAB-8/E-15: Includes PDP-8/E CPU, 8K core memory, paper tape reader and punch, DECwriter data terminal, 10-bit Point Plot Display Controller, 10-bit A/D Converter, and 7" X 9" Point Plot Display (CRT). Purchase price is \$20,000 (includes LAB-8/E Software).

REAL-TIME FORTRAN IV SYSTEM: Includes 8/E CPU, 8K core memory, DECwriter data terminal, 10-bit Point Plot Display Controller, 10-bit A/D Converter, 7" X 9" Point Plot Display (CRT), 256-word ROM, dual DECTape drive, Floating Point Processor, and 1.6 million words disk cartridge subsystem. Purchase price is \$38,850 (includes software). ■

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EQUIPMENT PRICES

MODEL PROCESSORS

PDP-8/E	CPU plus 4K memory	\$4,490	\$60
PDP-8/F	CPU plus 4K memory	3,990	60
PDP-8/M	CPU plus 4K memory	3,690	60

PROCESSOR AND MEMORY OPTIONS

MC8-E	4K memory and Timeshare option	2,750	20
MC8-EJ	8K memory and Timeshare option	4,150	40
MM8-E	4K memory expansion	2,500	20
MM8-EJ	8K memory expansion	3,900	40
MP8-E	Memory Parity	3,000	10
M18	32-word Bootstrap ROM	540	5
MR8	256-word ROM	860	5
KC8-E	8/E Console	540	0
KC8-F/M	8/F/M Console	430	0
KE8	Extended Arithmetic Element (EAE)	1,080	5
KP8	Power Fail Detector/Auto Restart	270	2
FPP12-AB	36-bit Floating Point (single processor)	7,450	48
FPP12-AE	Additional 36-bit Floating Point (double precision for FPP12-AB)	2,700	15
DK8-EA	Line Frequency Real-Time Clock	270	2
DK8-EC	Crystal Frequency Real-Time Clock	320	2
DK8-EP	Programmable Real-Time Clock	810	3
BA8	System Expander Box (includes Omnibus)	1,620	0
BE8	Additional Omnibus	540	0

MASS STORAGE

DF32	Disk File and Control (32K words)	6,480	30
DS32	DF32 Disk Expander	3,780	15
RF08	Disk Control	6,480	35
RS08	RF08 Disk File (262K words)	9,720	45
RK8	Disk Cartridge and Control (1.6 million words)	7,900	70
RK05	RK8 Disk Cartridge Drive (add-on for RK8)	5,100	60

MAGNETIC TAPE EQUIPMENT

TC08	DECtape Control	4,860	20
TU56	Dual DECtape Drives, 7.5K words/sec.	4,700	30
TU56-H	Single DECtape Drive	2,350	20
TD8-EH	Single DECtape Drive and Omnibus interface	3,240	30
TD8-EM	Single DECtape Drive and Omnibus interface	5,400	40
TM8	Controller and Tape Drive, 36K BPS	10,745	95
TU10	Add-on Drive for TM8	7,505	70
TA8	Dual Cassette Drive and Omnibus Interface, 487 bytes/sec.	3,900	38
TR07-AC	Controller for 4 TU56	8,745	100
TR07-AD	Controller for 8 TU66	13,175	135
TU66-AC	Tape Drive, 25 ips, 40 KBS	7,560	80
TU66-AE	Tape Drive, 45 IPS, 72 KBS	6,900	110
TU66-AF	Tape Drive, 75 ips, 120 KBS	9,100	140

PUNCHED CARD EQUIPMENT

CM8	Optical Reader and Control, 300 cpm	5,290	50
DR8	Card Reader and Control, 300 cpm	4,860	50

PAPER TAPE EQUIPMENT

PR8	Reader and Control, 300 cps	2,400	15
PC8	Reader/Punch and Controls, 300/50 cps	3,900	30

LINE PRINTERS/PLOTTERS

LS8	Printer and Control, 165 cps	5,615	48
LS01	Printer	5,180	42
LE8F	Printer and Control, 356 lpm	12,000	60
LE8H	Printer and Control, 253 lpm	13,500	65
LE8J	Printer and Control, 245 lpm	17,500	75
LE8K	Printer and Control, 173 lpm	19,000	80
LP43	Mohawk MDS-4330 interface	3,000	35

DEC PDP-8 Series
EQUIPMENT PRICES

Purchase Price	Monthly Maint.
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LINE PRINTERS/PLOTTERS (Continued)

LP08-MA	Printer, 700 lpm	\$25,000	\$120
LP08-MB	Printer, 700 lpm	27,000	130
LP08-RA	Printer, 1250 lpm	34,000	145
LP08-RB	Printer, 1250 lpm	36,000	155
LT73	Selectric 731/735 Interface	3,020	22
XY8	Plotter Control Module	540	8

TERMINALS

VT8	CRT Display, 20 lines x 64 characters	2,050	30
VC8	Point Plot Display Control	1,185	10
VT05	A/N CRT, 20 lines x 72 characters	2,795	22
VT01	Modified Tektronix 611 Display	3,240	75
KV8	VT01 Control	5,075	40
H306	Joystick cursor for KV8	320	5
LA30	DECwriter Data Terminal (serial), 30 cps	3,195	30
LA30	DECwriter Data Terminal (parallel), 30 cps	2,795	30
LA30	Read Only DECwriter Data Terminal, 30 cps	2,500	30
RT01	DEClink Data Entry Terminal, 110 bps	600	10
RT02	DEClink Data Entry Terminal with Display, 110-1200 bps	1,300	10

DATA COMMUNICATIONS

KL8-E	Asynchronous Line Interface	320	10
KL8-EA/EG	Asynchronous Line Interface	375	5
KL8-FA/FK	Double buffered Asynchronous Line Interface	455	5
KL8-M	Modem Control Interface	270	5
H308	Null Modem Adapter	65	0
DP8	Synchronous Modem Interface	1,620	10
DC08-H	Bell 801 A/C Auto Call Unit	2,000	6
DC08-J	DC08-H Channel	250	2
DC01-AA	Serial Line Scanner Control	3,455	20
DC01-AL	Full-duplex option for DC01-AA	485	0

I/O INTERFACES

KA-8	Positive I/O External Interface	270	3
KD8	Data Break Interface	540	3
DB8	Interprocessor Buffer	540	5
DR8	12-channel Buffered Dital I/O	540	5
DW8	Positive to Negative Bus	1,620	7
M1703	Omnibus Input Interface	81	0
M1709	Omnibus I/O Interface	135	0
AD8	10-bit A/D Converter (16 channel)	1,185	10
AM8	8-channel Multiplexor for AD8	860	10
AD1	10-bit A/D Converter (32 channel)	2,590	20
A124	4-channel Multiplexor for AD1	65	2
AA50	D/A Converter System	1,620	10
BA614	D/A Converter for AA50	405	5