DEC PDP-8 Family

MANAGEMENT SUMMARY

In July 1976, a new page was written into the already voluminous PDP-8 biography with the organization, or, more accurately, the consolidation, of an integrated PDP-8 marketing group. This consolidation marked a departure from DEC's traditionally applications-oriented marketing strategy by removing the PDP-8-based products from several product groups and forming the PDP-8 Product Line Group. The change was brought about by declines in end-user sales of PDP-8's due to the emphasis placed by several of these product groups on the 16-bit PDP-11 (Report M11-384-301) at the expense of the 12-bit PDP-8's. The new organization permits expanded support for PDP-8 products by concentrating resources that were previously spread throughout several product groups.

The integration was not total, however, but moved the PDP-8-based products formerly marketed by DEC's Laboratory Products Group, Educational Systems Group, Engineering Computational Group, Industrial Products Group, and Communications Products Group into the new PDP-8 Product Line Group. Excluded from the new group were Business Products, Typeset, Word Processing, and Educational Systems' Classic, which will continue to market PDP-8-based products as before.

THE PDP-8/E AND -8/M

As for the older PDP-8 models, the PDP-8/F, an end-user PDP-8 identical to the OEM PDP-8/M, has been discontinued. The two remaining members of the older PDP-8 line, the PDP-8/M and PDP-8/E, are still in volume production.

The PDP-8/E and -8/M are the older brothers of the newer 8/A's and are based on the KK9-E CPU. The 8/E ➢

The PDP-8 computer family is probably the oldest minicomputer line still manufactured. Its origins date back to 1965, and current estimates indicate that more than 35,000 have been installed. A recent reorganization of the PDP-8 marketing effort appears to signal the beginning of a new round of products and systems for this ubiquitous 12-bit computer.

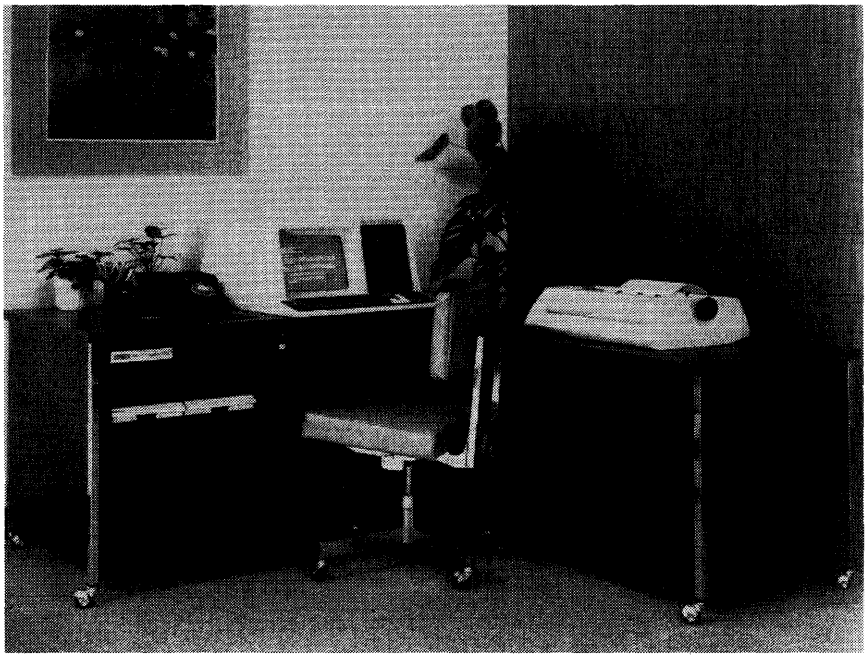
CHARACTERISTICS

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

Digital Equipment Corporation (DEC) is the world's largest manufacturer of minicomputer systems. DEC's product lines include general-purpose computing systems, laboratory monitoring and control systems, process control systems, industrial control systems, editing and typesetting systems, and business computing systems. DEC maintains 125 sales and service offices in over 30 countries and has manufacturing facilities in Puerto Rico, Mexico, Canada, Ireland, Scotland, Hong Kong, and Taiwan in addition to six facilities in the U.S. The company employs 25,000 persons worldwide and has installed more than 65,000 computer systems.

MODELS: PDP-8/E, PDP-8/M, 8A100, 8A400, 8A420, 8A600, 8A620, 8A800, and 8A820.

DATE ANNOUNCED: The first PDP-8 minicomputer was announced in 1965. The PDP-8/E, the oldest member of the current product line, was announced in 1970 and was followed in 1971 by the PDP-8/M. The PDP-8/A line, now referred to as the 8A Series, was first announced in 1974 (8A100 and 8A400), with later models introduced in 1975 (8A600 and 8A800). ➤



Even though DEC's Datasystem 310W does not represent the most common usage of the PDP-8, the system shown contains the elements found in typical PDP-8/A-based business-oriented products, whether obtained directly from DEC or through system builders. The Datasystem 310W is built around a 16K-word CPU with dual floppy disk drives and two special word-processing-oriented components: the specially-adapted VT52-WA 1920-character CRT terminal and the 45-cps letter-quality printer. This system is purchase-priced at $22,600. An update kit consisting of the WPS-8 word processing software, the VT52-WA terminal, and the LQP8 printer is available for existing PDP-8 systems for $10,600.

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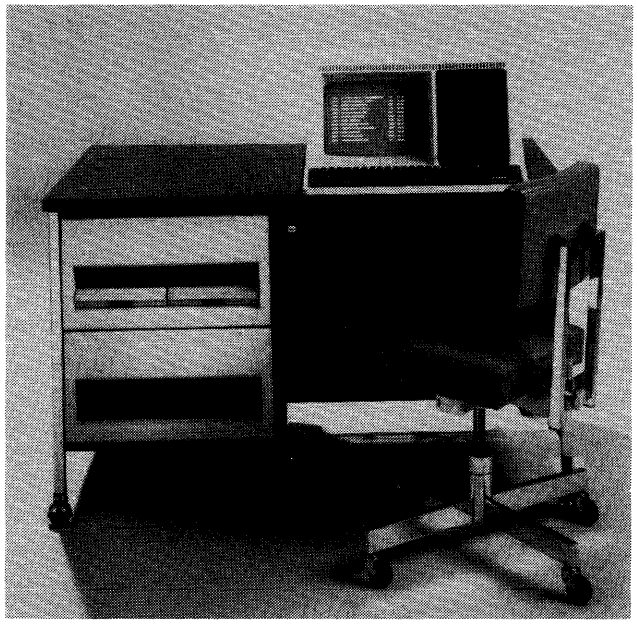

A typical PDP-8/A-based system, the MS800 packaged system consists of a 16K-word CPU mounted in a 12-slot chassis along with the memory extension and time-share control, power fail/restart, bootstrap loader, real-time clock, serial line interface, and 12-bit parallel I/O interface; a dual floppy disk subsystem; a VT50 console terminal; and a desk. The OS/8 operating software is included in the $11,740 purchase price. A version of this system that also includes an FPP8-A floating-point processor and FORTRAN software is priced at $15,245.

is for users who wish to assemble larger systems with many and varied peripherals. The 8/M, the OEM version of the 8/E, is smaller than the 8/E. Both use the same processor, which consists of four boards (and hence requires four Omnibus slots). The major differences among the models lie not in the processors, but in the chassis and power supplies of each. The 8/E comes with one 20-slot Omnibus and room for an extra one if desired. In addition, its power supply is large enough to supply the needed current to the extra cards. The 8/M, on the other hand, has room for only one 20-slot Omnibus and hence a slightly smaller power supply. Both Omnibusses can be expanded, however, through the use of the BA8-A expander—the 8/E to 74 slots and the 8/M to 56 slots.

Prices for the PDP-8/E range from $5,750 for a very basic system with processor, 4K words of core memory, programmer console, teletypewriter interface, power supply, and chassis to about $24,000 for a system with processor, 16K words of core memory, bootstrap loader, floppy disk, cartridge disk, DECwriter II, interfaces, cabinet, power supply, and OS/8 operating system.

Prices for the 8/M span a smaller range, owing to its OEM-centered marketing: $5,050 to $6,870 for a processor, various memory combinations, operator panel or programmer console, power supply, and chassis.

THE PDP-8/A SERIES

The PDP-8/A line, introduced in May 1974 as a one-board CPU for OEM's, and introduced again in November 1974 in more conventional configurations with memory, chassis, and power supply, is offered in an extensive line starting with the KIT8A one-board CPU and

DATE OF FIRST DELIVERY: PDP-8's were initially delivered in May 1965, while the PDP-8/E was delivered in March 1971 and the PDP-8/M in December 1971. Deliveries of various models of the 8A Series begin September 1974.

NUMBER INSTALLED TO DATE: Over 35,000 of all models.

DATA FORMATS

BASIC UNIT: 12-bit word.

FIXED-POINT OPERANDS: 12-bit words standard, with optional 24-bit double-precision operands. Half-word (6-bit) byte swaps can also be handled.

FLOATING-POINT OPERANDS: 36-bit single-precision operands with a 24-bit signed fraction and signed 12-bit exponent or 72-bit operand with a 60-bit signed fraction and signed 12-bit exponent for double precision. Floating-point processor hardware is optional on all models; software subroutines are also available.

INSTRUCTIONS: One-word instructions. 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 zero within the module, and one bit is used to specify whether direct or indirect addressing is used.

Through direct addressing, a memory reference instruction can reference any of 128 addresses on its own page or any of 128 addresses on page zero of its own 4K module; through 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 an an 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. These seven 1-bit indicators can be turned on in each Operate instruction, with each 1-bit flag referred to as a "micro-instruction" (not to be confused with microprogramming).

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.

MAIN STORAGE

TYPE: Core and static MOS RAM, ROM, and PROM (UV-erasable).

CYCLE TIME: Core—1.2 microseconds for a read cycle and 1.4 microseconds for a write cycle when used in the 8A600 or 8A620; 1.5 microseconds for both read and write cycles in the 8A400, 420, 800, or 820. RAM—2.4 microseconds for a read cycle and 2.8 microseconds for a write cycle. ROM—1.2 microseconds for a read cycle when used with the PDP-8/E, -8/M, 8A600, or 8A620, and 1.5 microseconds when used with the 8A100, 8A400, 8A420, 8A800, or 8A820. PROM—3.4 microseconds for a read cycle and 3.6 microseconds for a write cycle.

CAPACITY: The capacity of the basic PDP-8 is 4096 words. The addition of a KM8-E or KM8-AA extends the capacity to 32,768 words. Core memory modules are available in 8192- or 16,384-word modules. RAM (random-access memory) is available in 1024-, 2048-, or 4096-word modules. ROM (read-only memory) is offered in 1024-, 2048-, 3072-, or 4096-word modules, while PROM (programmable read-only memory) is available in 1024-word modules. The capacity of each system is dependent on both the power supply and chassis used. (See Report M13-100-101, *Minicomputer Add-On Memory*, for non-DEC alternatives.)

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
TU10W-E	Transport; 9-track, 45 ips, 800 bpi, 10.5-inch reels, 8 drives per controller, requires 4 slots; 36 KBS	DEC
TU10W-E	Transport; 7-track, 45 ips, 800 bpi, 10.5-inch reels, 8 drives per controller, requires 4 slots; 36 KBS	DEC
TS03-S	Transport; 9-track, 12.5 ips, 800 bpi, 7-inch reels, 2 drives per controller, requires 4 slots; 10 KBS	DEC
TU60-A	Dual Cassette Drive; 87K 8-bit bytes, 1 dual drive per controller, 8 controllers per system; 487 bytes/sec	DEC
LINE PRINTERS		
LA35-CE	DECwriter II; Printer; 132 positions, 96 ASCII characters; variable forms width, switch-selectable speeds; 10, 15, or 30 cps	DEC
LA8-PA	DECprinter; 132 positions, 96 ASCII characters, variable forms width, top-of-form control; 180 cps	DEC
LE8-VA	Drum; 132 positions, 64 ASCII characters, variable forms width, top-of-form control; 300 lpm	Dataproducts
LE-8WA	Drum; 132 positions, 96 ASCII characters, variable forms width, top-of-form control; 230 lpm	Dataproducts
PUNCHED CARD UNITS		
CM8-FA	Optical Mark Reader; 80-column cards or 40-column cards with timing marks; 300 cpm	Documation
CR8-FA	Punched Card Reader; 80-column cards; 300 cpm	Documation
PAPER TAPE EQUIPMENT		
PR8-E	Reader; 8-level, rack mount or tabletop; fanfold tape; 300 cps	
PL8-E	Reader/Punch; 8-level, rack mount or tabletop; fanfold tape; 300/50 cps	
TERMINALS		
LA36-CE	DECwriter II; 132 columns; 96-character ASCII upper/lower case keyboard; 14-key numeric keypad, variable forms width, switch-selectable speeds; 10, 15, or 30 cps	DEC
VT50-AA	DECscope; 80 characters x 12 lines, 64-character ASCII keyboard, full-duplex operation, switch-selectable data rates; 75 to 9600 bps	DEC
VT52-AA	DECscope; 80 characters x 24 lines, 64-character ASCII keyboard, full-duplex operation, direct cursor addressing, 19-key numeric keypad, escape sequences optional, switch-selectable data rates; 75 to 9600 bps	DEC
VT61-AA	DECscope; 80 characters x 24 lines, 128-character ASCII keyboard, 19-key keypad, block or character mode transmission, direct cursor addressing with Read Cursor Position, off-line editing capability, built-in self-test, escape sequences optional, switch-selectable data rates; 75 to 9600 bps	DEC

extending to the MS800 packaged systems. It is based on the KK8-A CPU, a slower, more densely packaged version of the KK8-E CPU. There is one restriction, however: the KK8-A cannot support additional Omnibus slots. All KK8-A-based models are restricted to the number of slots in the basic systems.

The market target for the 8/A originally consisted of OEM's and system builders, but recent models are clearly end-user-oriented. Specifically, the PDP-8/A is intended for use in systems with performance requirements that fall between the larger 16-bit computers and the small, slower, microcomputer-based products. The one-board PDP-8/A provides a low-cost computer usable with most

CHECKING: None.

STORAGE PROTECTION: None.

CENTRAL PROCESSORS

GENERAL: All of the PDP-8 processors, except the 8A800 and 8A820, 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. The two exceptions operate in 24-bit operands through the FPP8-A floating-point processor.

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CHARACTERISTICS OF THE PDP-8 PROCESSORS

Model	PDP-8/E	PDP-8/M	8A100	8A400	8A420
CPU	KK8-E	KK8-E	KK8-A	KK8-A	KK8-A
Cycle time, microseconds	1.2	1.2	1.5	1.5	1.5
Omnibus	20-slot; expandable to 74 slots	10-slot; expandable to 56 slots	10-slot; nonexpandable	12-slot; nonexpandable	20-slot; nonexpandable
Memory	Core, ROM	Core, ROM	MOS RAM, PROM, ROM	Core, ROM	Core, ROM
Maximum memory, words	32K	32K	16K*	32K	32K
Power supply, current @ 5 VDC available	13.0	11.7	13.6	16.5	40.5
Options included	Async, controller; memory expansion control	Async, controller; memory expansion control	None	Memory expansion control	Memory expansion control
Peripheral limitations	None	None	Cannot support core memory, cartridge disk, DECtape, magnetic tape, card readers, & line printers	None	None
Basic system price	$5,750 (4K)	$5,050 (4K)	$1,835 (1K)	$3,150 (8K)	$4,450 (8K)

*Limitations imposed by the power supply in this configuration.

conventional peripherals for systems that require no more than 32K words of memory space. While most minicomputer systems are pursuing large memory addressability, the PDP-8 addresses its intended market segment merely by staying the same.

Standard configurations start with the 8A100, a small-system package that consists of a 10-slot chassis and is expandable to 12K words of semiconductor ROM or 16K words of RAM, and 1K words of PROM. (These maximum memory configurations would leave no current for any other controllers or options, and therefore are not realistic applications.) The 8A100 is a semiconductor-only machine and cannot be expanded beyond the 10 slots.

The 8A400 is a core-only system that includes a 12-slot chassis, a 25-ampere power supply, and 8K words of 1.5-microsecond memory. A KM8-E memory expansion and time-share control are also provided in the basic system, permitting memory expansion to 32K words.

The 8A420 is virtually identical to the 8A400 in components and differs only in chassis and power supply. A 20-slot chassis and a 50-ampere power supply are provided instead of the 8A400's 12-slot box and 25-ampere power supply.

The 8A600 and 8A620 have the same relationship to each other as the 8A400 and 8A420, with the 600 having the 12-slot chassis and 25-ampere power supply combination and the 620 having the 20-slot chassis and 50-ampere power supply. What distinguishes the 600's from the 400's and 800's is the CPU. The 8A600's use the KK8-E CPU in place of the KK8-A, making this model group equivalent

There are two distinct processor versions of the same fundamental architecture. The KK8-E, a four-board CPU, is used with models 8/E, 8/M, 8A600, and 8A620; and the KK8-A, the newest processor model, is used in the 8A100, 8A400, and 8A420.

The PDP-8/E, -8/M, 8A600, and 8A620 have provisions for an optional Extended Arithmetic Element (EAE) that permits double-precision fixed-point operations plus hardware fixed-point multiply/divide. The EAE contains extension hardware that can operate on 24-bit signed numbers rather than the conventional 12-bit operands. The EAE adds 26 instructions to the basic repertoire.

The FPP8-A Floating Point Processor (FPP) is available for use with all PDP-8's. This unit provides the capability of operating with 24-bit fixed-point, 36-bit floating-point (24-bit mantissa and 12-bit exponent), or operands (60-bit mantissa and 12-bit exponent).

Four types of real-time clocks are offered for the PDP-8. These units vary in the timing source, using internal line frequency, a selected crystal frequency, or programmable intervals. The line frequency version marks off 16-millisecond intervals; the crystal model measures fixed intervals determined by a crystal oscillator (1, 50, 500, or 5000 interrupts per second); and the programmable internal model ticks off intervals specified by 12-bit constants loaded under program control. The fourth clock, a 100-Hertz real-time clock, is found with other options on the DKC8-AA module; it is usable with the KK8-A-based systems only. The line frequency clock is available only on the PDP-8/E and -8/M, while the crystal-controlled and programmable clocks can be used with all models.

Power failure/auto restart, bootstrap loader, and memory extension control are offered as separate options on the PDP-8/E and 8/M. These three options are combined on a single board in PDP-8/A systems. In addition, the memory extension control, which permits addressing memory locations above 4K, also contains a time-share control which provides monitor and user modes for time-shared operations, plus background/foreground real-time operations. Under

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CHARACTERISTICS OF THE PDP-8 PROCESSORS (Continued)

Model	8A600	8A620	8A800	8A820
CPU	KK8-E	KK8-E	KK8-A	KK8-A
Cycle time, microseconds	1.2	1.2	1.5	1.5
Omnibus	12-slot; expandable to 74 slots	20-slot; expandable to 74 slots	12-slot; nonexpandable	20-slot; nonexpandable
Memory	Core, ROM	Core, ROM	Core, ROM	Core, ROM
Maximum memory, words	32K	32K	32K	32K
Power supply, current @ 5 VDC available	16.0	41.0	6.7	31.7
Options included	Memory expansion control	Memory expansion control	Memory expansion control; floating-point processor	Memory expansion control; floating-point processor
Peripheral limitations	None	None	None	None
Basic system price	$3,950 (8K)	$5,250 (8K)	$6,150 (8K)	$7,450 (8K)

to the older PDP-8/E and 8/M, but housed in the newer cabinetry. The KK8-E CPU also has some functional advantages over the KK8-A. First, the KK8-E is a faster CPU (1.2 microseconds compared to 1.5 microseconds). Second, the older CPU can be expanded to larger configurations. The KK8-A-based systems (8A100, 400, 420, 800, and 820) cannot be expanded, whereas the KK8-E can drive an extra expansion box for a total of 74 Omnibus slots.

A third advantage of the KK8-E is the availability of the KE8-E Extended Arithmetic Element, which provides hardware multiply and divide operations plus other instructions. Only the PDP-8/E, -8/M, 8A600, and 8A620 can use this option.

One small disadvantage of the KK8-E is that the CPU requires four slots, three more than the slightly slower KK8-A CPU. In a system where the KK8-A's reduced performance can be tolerated, saving these three slots can save a lot of money.

The 8A800 and 8A820 are nearly identical to the 8A400 and 8A420, the only difference being the inclusion of DEC's new FPP8/A two-board floating-point processor that operates in parallel with the CPU. The FPP8/A is a 24-bit processor that provides for either 36- or 72-bit floating-point formats and is supported by OS/8 FORTRAN IV. The 8A800's were originally introduced as the Super 8 Series.

DEC has also added two packaged configurations to the 8A line. Designated the System 800, the desk-packaged systems include two models, the MS800 and the MS880. The smaller system, the MS800, includes the 8A400 computer with either 8K or 16K words of 1.5-microsecond core memory, a dual floppy disk drive, an asynchronous

the time-shared mode, certain instructions that would seriously hamper time-shared operation are inhibited and cause an interrupt.

Another combination of options, available on the PDP-8/A's only, is the DKC8-AA input/output options board for all KK8-A-based systems. This board contains a 100-Hz real-time clock, a programmer console control, a 12-bit parallel I/O interface, and an asynchronous serial line interface with switch-selectable speeds to 9600 bits per second.

REGISTERS: All models of the PDP-8 Family have eight major registers. Six are 12-bit registers: one accumulator (AC); one general-purpose register (MA) for use as temporary storage or a an extension of the accumulator if the Extended Arithmetic Element is employed; a program counter (PC); memory address (MA) register; a switch register (SR) to manually load memory or another register from a programmer's console; and a memory buffer (MB) register to transfer data between other registers and memory. A three-bit instruction register (IR) containing the op-code of the current instruction and a one-bit link (L) carry register for accumulator overflow are also provided.

Eight autoindexing registers are implemented in locations 8 through 16 of each 4K-word memory module. When any of these locations is addressed indirectly by a memory reference instruction, the contents are automatically incremented by one and then used as an address. When referenced directly as memory, these locations function as any others.

ADDRESSING: All PDP-8's have four addressing modes; direct (128 locations); indirect (one level); indirect indexed, using the auto-index registers in memory; and program-relative.

INSTRUCTION REPERTOIRE: All processors have 6 memory reference instructions, 4 interrupt system control instructions, 3 flag procesing instructions, and 41 operate instructions for logic control, etc. Models 8/E, 8/M, 8A600 and 8A620 can support the optional Extended Arithmetic Element which provides six additional shift instructions, four arithmetic instructions (including multiply/divide, and six double-precision instructions.

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interface for a console device, automatic self-test ROM-based diagnostics, and the OS/8 operating system, all housed in a desk cabinet. The cost of this system is $9,595 with 8K words of memory and $10,440 with 16K words. However, it must be noted that this configuration does not include a console device. Since such a unit is required for operation, the real costs of these two MS800 systems become $10,895 and $11,740, respectively, after adding a VT50 CRT display/keyboard.

The MS880 is a floating-point version of the MS800 that adds an FPP8/A floating-point processor to the above configuration. Cost of the MS880, including a VT50 terminal as a console device, the OS/8 operating system, and the FORTRAN IV compiler, is $14,400 for the 8K-word version and $15,245 for the 16K-word version.

HISTORY

DEC's 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 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. 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 an internal register for a program counter was built into hardware instead of being implemented at memory location 0 as in 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 (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. The PDP-12 is no longer an actively marketed product.

The PDP-8/S (S for "Serial") 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 8/L ("Low") IC version for

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

	PDP-8/E, 8/M	PDP-8/A
Load/store	2.6	3.0
Add/subtract	2.6/5.0	3.0/6.0
Multiply/divide	256.5/342.4	—
Compare & branch	2.4	3.0

INTERRUPTS: A single-line interrupt structure is provided, with software polling of I/O devices required to determine the origin and priority of each interrupt.

Two operating modes, user and executive, are possible if the extended memory control is present. 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 deifned to unauthorized user programs.

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

PHYSICAL SPECIFICATIONS: All PDP-8 chassis are 10.5 inches high and 19 inches wide. Chassis depth of the PDP-8/E is 21 inches, while the PDP-8/M chassis is 15.8 inches deep. Chassis for models 8A100, 8A400, 8A600, 8A400, and MS800 are 10.5 inches deep, and chassis for models 8A420, 8A620, and 8A820 are 23 inches deep. The weight of each model is given in the table below.

All 8/E and 8/M modules are quad modules, while the 8A modules are both hex and quad modules.

A standard cabinet is 72 inches high, 21 inches wide, 25 inches deep, and weighs 120 pounds. A short cabinet is 42 inches high, 21 inches wide, 25 inches deep, and weighs 90 pounds.

Power requirements for all PDP-8's are 90 to 132 VAC, 59 to 61 Hertz or 180 to 264 VAC, 49 to 51 Hertz. Maximum power consumption and heat dissipation figures are provided in the following table.

Unit	Power Consumption, watts	Heat Dissipation, BTU/hr.	Weight, pounds
PDP-8E	460*	1560*	100
PDP-8M	440*	1500*	90
8A100	400	1365	55
8A400	550	1880	55
8A420	1100	3760	120
8A600	550	1830	55
8A620	1100	3760	120
8A800	550	1880	55
8A820	1100	3760	120
MS800	1200	4096	360
MS880	1200	4096	360
RK05	200	2400	110
LA36	300	1020	102
VT50, 52	300	1020	43
RX8 (dual)	200	680	60

***Estimated.**

The operating environment tolerances of all PDP-8's are the same: 41 to 122 degrees Fahrenheit at 10 to 90 percent noncondensing relative humidity.

The above operating environment figures are for the basic CPU, memory, and internal options only. Environmental requirements for system I/O devices vary considerably and generally impose stricter tolerances.

INPUT/OUTPUT CONTROL

OMNIBUS: A synchronous bus is provided with each processor. (One is standard in the PDP-8/E, with a second

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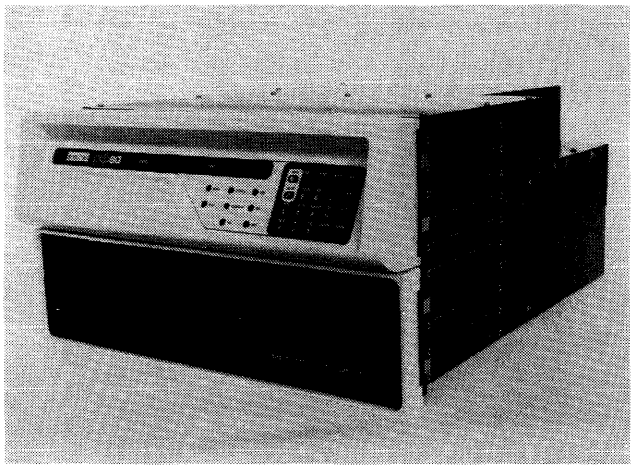
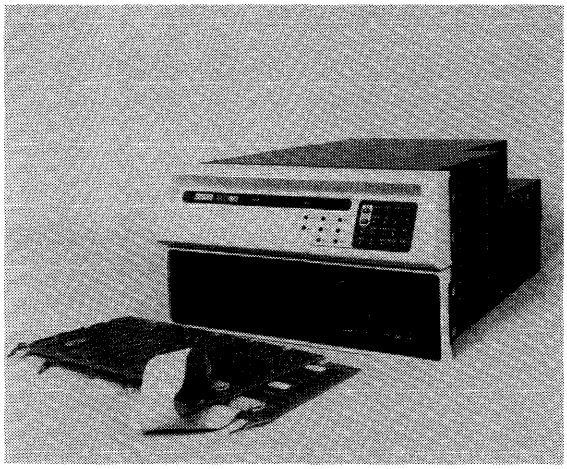




The 8A620 (left) and the look-alike 8A820 (right), although both packaged in 20-slot chassis, differ markedly. The 8A620 is based on the KK8-E processor, the same four-board unit used in the older PDP-8/E and PDP-8/M, while the 8A820 is based on the slower KK8-A processor, the true one-board PDP-8/A. The 8A620, though it has three fewer Omnibus slots in the basic configuration, can be increased through expander boxes to a maximum of 74 slots, while the 8A820 cannot be expanded past the configuration shown. The two-board unit shown in front of the 8A820 is the FPP8-A floating-point processor, a 24-bit CPU that actually takes over most arithmetic functions of the KK8-A, effectively converting the 12-bit PDP-8/A to a 24-bit architecture. The FPP8-A is included in the 8A820 system. Purchase prices for the two units are $5,250 for the 8A620 with 8K words of memory, and $7,450 for the 8A820, including 8K words of memory and the floating-point processor.

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 also used in the current PDP-8/M (OEM-oriented). During the period between the release of the 8/I and the 8/E, work was under way on the more powerful DEC PDP-11 family, and it seemed to many in the computer industry that the PDP-8's lifespan would be terminated. But DEC did not share that view, and the latest addition—the PDP-8/A Series—keeps the PDP-8 family current with improvements that reflect the latest technological advances.

The most recent venture for the PDP-8 is word processing. A version of the Datasystem 310 designated the 310W was recently introduced as DEC's entrance into this rapidly developing market.

Among the packaged PDP-8 systems available from DEC are the Typeset/8 for graphic arts and typesetting applications ($95,000 to $150,000), the Datasystem 310 small general business system ($12,000 and up), and the CLASSIC educational computer system ($8,900).

Surprisingly, the trend toward 16-bit (and, more recently, 32-bit) minicomputers has not dampened the demand for PDP-8's. There are still certain applications in which the PDP-8 family's price/performance characteristics make it the best choice. This choice is further enhanced by the vast quantity of fully developed software for these systems.

Those who thought the advent of DEC's 16-bit PDP-11 family signaled the beginning of the end for the PDP-8 have had to concede that this enormously popular family of 12-bit minicomputers will continue to be with us for quite some time to come.

Omnibus as an option.) The Omnibus permits plugging memory/processor options or I/O devices into any available slot location, eliminating the need for special back-panel wiring. The maximum programmed data transfer rate is 50,000 words/second.

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 controller with a 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) direct to memory locations with processor intervention. The maximum DMA data transfer rate is 833,000 words/second.

CONFIGURATION RULES: The key to configuring the PDP-8/E and 8/M is the Omnibus, which consists of prewired slots that permit physical attachment of I/O devices and/or memory/processor options, and the capacity of the power supply included with each configuration. Neither the number of Omnibus slots nor the capacity of the power supply can be exceeded.

Each Omnibus has 20 slots in it, and when an additional Omnibus is added, one slot position in each is occupied by the interconnection cables. In a basic 4K-word 8/E, one Omnibus is included, with 10 slots used for the processor, console interface, and basic 4K words of core memory (11 slots if 8K words are present); this leaves 10 slots (9 with 8K words) for attachment of additional devices or optional features.

The 8/E can be further expanded in 18-slot increments to a total capacity of 56 or 74 slots using a BA8 expander box. The basic 8/M comes with one Omnibus for a capacity of 20 available slots that can be increased to 38 or 56 total slots with the addition of one expander box. The first memory board occupies four slots, with each expansion board occupying three slots. Each 256-word bootstrap ROM, the programmable clock, floating-point hardware, and the extended arithmetic option, requires two slots. 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.

DEC PDP-8 Family

USER REACTION

Datapro contacted 33 PDP-8 users through both our yearly minicomputer user survey and individual telephone interviews. These 33 users collectively owned over 207 systems, and at least 5 were OEM's continually increasing this number. It would not be possible to characterize the entire user population without citing extensive statistics, so we will simply mention samples of the broad spectrum of organizations that currently employ members of the PDP-8 line.

Foremost in quantity were the 5 OEM system builders, who accounted for over 135 of the 207 systems. The remaining 28 users were all end users, having from one to four systems each. This group included colleges, insurance companies, industrial equipment manufacturers, government organizations, printing and publishing houses, and others. Applications for the PDP-8's varied, though not as widely as the user population. Business and scientific/engineering applications were nearly equal in number and accounted for over half of the users, and real-time control and data communications applications accounted for another quarter. The remaining applicational areas included editorial and typesetting systems, data base management, word processing, and educational systems.

Statistically, the typical system had been installed for 38 months, a figure that we found impressive in view of the one- and two-year product life cycles that are common in the minicomputer field. But even more impressive was the fact that nine systems had been in use since 1969. The average memory size was 16K words, and a great majority of the systems had at least one RK05 disk drive.

One comment noted by several of the users was that they considered their PDP-8's obsolete, having an unsophisticated instruction set and limited memory expansion capabilities. These criticisms are valid, to a point. First, the design of the PDP-8 dates back to 1965 and earlier. It was one of the first successful minicomputers on the market, and probably is the *most* successful minicomputer to date, having sold over 35,000 units. There has been some improvement in the line in the form of the newer PDP-8/A's, but nearly all of the users responding to our inquiry had older PDP-8/E's and -8/M's. When viewed side by side with today's newer systems, the 8's do show their age.

Why, then, do so many users, OEM and otherwise, keep buying and using PDP-8's? Software, for one reason. Many of those who criticized the older design of the PDP-8 noted that its strength lay in available software. The PDP-8 has one of the most extensive collections of software packages of any minicomputer system, and most of these packages are available either free or for a nominal charge. The software is especially rich in scientific applications.

The results of the survey are tabulated below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	12	21	0	0	3.4
Reliability of mainframe	19	21	2	0	3.5
Reliability of peripherals	8	15	10	0	2.9
Responsiveness of maintenance service	11	11	6	2	3.0
Effectiveness of maintenance service	9	16	2	3	3.0
Technical support	7	10	7	6	2.6
Operating systems	7	11	3	2	3.0

The 12-slot 8A600 and the 20-slot 8A620 use the same 4-board CPU (KK8-E) as the PDP-8/E and -8/M. In both models the CPU occupies four slots, the memory expansion and time-share control occupy one slot, and the 8K or 16K memory module occupies two slots, leaving 5 slots in the 8A600 and 13 slots in the 8A620. Unlike the PDP-8/E and -8/M, memory expansion modules require two slots apiece. Both models can be expanded through one BA8-C expansion chassis, providing 19 additional slots.

The Model 8A100 has a 10-slot Omnibus, Models 8A400 and 8A800 each have a 12-slot Omnibus, and models 8A420 and 8A820 each have a 20-slot Omnibus. All models initially lose a total of four slots to the CPU (one slot), memory expansion control (one slot), and core memory (two slots for 8K or 16K), leaving eight slots for system expansion. However, the 8A800 also includes an FPP-8A floating point processor that requires two more slots. Models 8A420 and 8A820 have 20-slot chassis, providing 16 and 14 slots, respectively, for expansion. None of these models can be expanded beyond the 12- or 20-slot capacities.

The number of slots provided by each CPU/memory configuration and the number of slots required by each option are included in the descriptions found in the Equipment Prices section of this report.

MASS STORAGE

For the PDP-8 line, DEC offers standard cartridge disk and floppy disk subsystems plus the unique DECtape system that uses a preformatted tape as a random-access device.

TD8-E DECtape Subsystem: A magnetic tape system in which the tape is preformatted into blocks in much the same way that a disk pack is formatted. The basic unit contains dual bidirectional drives, each holding a 250-foot reel of 10-track tape. Data is recorded on three redundant, non-adjacent data tracks. A separate timing channel and mark channel are also defined. Since the tape is preformatted, searches and random access operations can occur much more efficiently than with standard magnetic tape subsystems. The controller can accommodate one dual TU56 transport, each capable of storing up to 189K 12-bit words per reel. Data transfer rate is 8,325 12-bit words per second. Recording density is 350 bpi, and tape speed is 97 ips in either direction.

RX8 FLOPPY DISK: The RX8 is a flexible disk drive with a capacity of 128K 12-bit words per drive. Up to two drives per controller can be configured. Average access time is 483 milliseconds; rotational speed is 360 rpm, yielding an average rotational delay of 83 milliseconds. A track-to-track move takes at least 10 milliseconds. The surface of the diskette is divided in 77 tracks, each with 26 sectors. The RX8 floppy disk drive is manufactured by DEC.

RK8 CARTRIDGE DISK SUBSYSTEM: Includes an RK05J cartridge disk drive with one removable IBM 5440-type cartridge and a controller for up to eight drives. The RK05J drive records data at 256 words per sector, 16 sectors per track, and 203 tracks per surface. Formatted capacity is 1.6 million 12-bit words. Average rotational delay is 20 milliseconds, and average head-positioning time is 50 milliseconds. Data transfer rate is 120K words per second. The RK05J cartridge disk drive can be intermixed with the RK05F double-density drive on the same controller. The RK05J disk drive is manufactured by DEC.

RK05F CARTRIDGE DISK DRIVE: A double-density version of the RK05J cartridge disk drive having 406 tracks per surface. It uses a nonremovable cartridge and has a capacity of 3.2 million words. The RK05F drives can be intermixed with the RK05J drives on the same controller, although there must be at least one RK05J drive in the subsystem. To the operating software, one RK05F appears as two logical RK05J's. Hence, a maximum subsystem using RK05F's has three RK05F drives and one RK05J drive. The RK05F disk drive is manufactured by DEC.

In addition to the disk products offered by DEC, more than 15 manufacturers currently supply DEC-compatible disk drives. These units are either DEC-equivalent units or IBM 2315, 5440, or 3470 equivalents. A detailed summary of these

DEC PDP-8 Family

	Excellent	Good	Fair	Poor	WA*
Compilers and assemblers	6	17	4	0	3.1
Applications programs	3	8	2	4	2.6
Ease of programming	7	11	10	1	2.8
Ease of conversion	2	4	4	1	2.6
Overall satisfaction	13	15	2	0	3.4

*Weighted Average on a scale of 4.0 for Excellent.

It is obvious from these user ratings that the PDP-8 is a reliable CPU and that, despite their criticism, the users are still quite satisfied with most aspects of the system. There were, however, some negative aspects that bear discussion. Peripherals were rated much lower than the CPU, and our further inquiries did not reveal a particular trend or pattern. One user cited a bad batch of VT50 display terminals that made him rate this category low, while another pointed to floppy disk problems, and still another mentioned a disk drive problem. Datapro discovered that some of the users who gave low ratings to peripheral reliability had systems obtained from system builders and were not using DEC peripherals. However, there were some with systems totally supplied by DEC who also rated this category low.

Another cause for Datapro to make additional inquiries was the low ratings given to the category of technical support. In addition, there were several "fair" and "poor" ratings in the two related categories concerning maintenance service. Although the users who were not satisfied with these aspects of DEC support were a distinct minority, there were enough to warrant follow-up. Most of the technical support criticisms appeared to be valid. Specific examples were cited, and, even though many of the problems had been rectified, these users were left with unpleasant memories. As for the maintenance service, that was another story. We found that nearly all those who reported deficient maintenance service did not have maintenance contracts, but instead had purchased preventive and corrective maintenance on an "as-needed" basis. In fact, one user who had obtained his system from a system builder was rating the latter's service rather than DEC's.

Applications programs, of course, were rated only by those who were employing them. While it is true that a vast quantity of applications programs can be easily obtained for the PDP-8, most of these programs were written for specific usage and may not be the best for another installation. They are available through DEC only as a service to customers, and most are not supported. They are often made available to serve as a starting point for applications programming, and should be recognized as such.

Despite the users' criticism of several aspects of the PDP-8, the "bottom line" category of overall satisfaction was rated 3.4, with only two users not awarding a "good" or "excellent" rating.

The PDP-8 has been and will continue to be a serious competitor in the minicomputer market, and although many users will eventually upgrade to 16-bit systems, it's likely that there will be new users and applications waiting to fill the vacancies.□

products is presented in Report M13-100-201, *Minicomputer Disk Storage,* and Report M13-100-251, *Minicomputer Floppy Disk Storage.*

INPUT/OUTPUT UNITS

See Peripherals/Terminals table on the third page of this report. Also, several independent manufacturers offer direct replacement magnetic tape drives for the PDP-8 series computers; these units are summarized in Reports M13-100-301, *Minicomputer Reel-to-Reel Magnetic Tape Units,* and M13-100-351, *Minicomputer Cassette/Cartridge Magnetic Tape Units.* Similarly, a number of vendors manufacture direct replacement line printers for the PDP-8 series, as outlined in Report M13-100-401, *Minicomputer Printers.* Finally, non-DEC punched card and punched tape units can be located in Reports M13-100-501 and M13-100-601, *Minicomputer Punched Card Units* and *Minicomputer Punched Tape Units.*

The KA8-E External Interface is a general-purpose interface for positive I/O bus DEC peripherals that can also interface non-DEC devices. The KA8-E provides only for programmed data transfers, but can be augmented with the KD8-E Data Break Interface to permit direct memory transfers. A KD8-E DMA interface is required for each device. Up to 12 KD8-E's can be connected to a PDP-8 system. Currently, only the DC08-W Automatic Call Unit Control requires the KA8-E interface.

The DR8-EA Twelve-Channel Buffered Digital I/O Interface is used to provide control and interfacing between the PDP-8 and up to 12 external circuits or devices. This unit is especially useful in the design of specialized systems with nonstandard I/O devices, since it provides data interfacing and buffering, control signal decoding, and interrupt capabilities to these devices. It requires one slot and is limited to eight per system.

The DB8-EA Interprocessor Buffer permits multiple PDP-8's to transfer words through programmed I/O (maximum of eight per system).

COMMUNICATIONS CONTROL

The following units are provided to control various communication interfaces.

The KL8-JA Asynchronous Serial Line Interface provides full- or half-duplex control of one local RS-232C or 20mA current-loop line. Data rates range from 110 to 9600 bits per second and are switch-selectable. This unit is required to connect such peripherals as the VT50 Video Terminal, the LT33 teletypewriter terminal, the LA36 DECwriter terminal, and the RT01 and RT02 DEClink data entry terminals to the Omnibus. Modem control disciplines can be added to the KL8-JA through addition of the KL8-M Modem Control Interface. This add-on unit allows the system to interface one Bell 103 or 202 or equivalent modem.

The KL8-A Four-Channel Asynchronous Interface provides partial modem controls on three channels and full modem controls on the fourth. The unit features 15 switch-selectable data rates from 50 to 9600 bps and can be used with both 20-milliampere and EIA RS-232C interfaces.

The DP8-EA Synchronous Modem Interface controls Bell 201 or equivalent modems. Its strap-selectable interfacing includes RS-232C/CCITT, 20-milliampere current loop, and logic levels. Character length is strap-selectable for six-, seven-, or eight-bit characters. The interface operates in full- or half-duplex modes on data break (DMA) channels. Data rates are strap-selectable to 71K bits per second. Sync codes can be specified by straps on the board. The DP8-EB is similar and provides an interface for a Bell 300 or equivalent modem. Up to four DP8-E's can be connected in a system.

The KG8-E Redundancy Check Unit provides hardware-generated LRC, VRC, and industry-compatible CRC characters to multiple output data streams. It also checks the same data on multiple input streams. The unit occupies one slot.

The DC08-H Automatic Calling Unit and 10-Channel Multiplexer controls Bell 801A and 801C or equivalent automatic call units. Dialing interface to individual lines is made through a DC08-J adapter. This unit does not connect to the Omnibus, but rather is used with the KA8-E external interface. It is not available for the PDP-8/A-100 or KIT8A.

DEC PDP-8 Family

SOFTWARE

Many of the software products described in this section, although still available from DEC, are not undergoing further development and are described for reference purposes. Only those software products being actively marketed and developed are listed in the Software Prices section of this report.

OPERATING SYSTEMS: There are five operating systems available to PDP-8 users: OS/8, CAPS-8, TSS/8, RTS/8, and COS-310. The first four are directed toward OEM and end-user applictions; the fifth, the COS-310 Data Management System, is available only as a bundled package with the PDP-8/A-based Datasystem 310. This business system is marketed by DEC's Business Products Group and is covered in detail in Report M11-385-101.

In addition, the recently introduced WPS-8 word processing system qualifies as an operating system. This package is a stand-alone text processing system for office and business use.

OS/8 is a comprehensive magnetic tape or disk executive system for batch and interactive operation on an 8K-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, a well as modular program development support for FORTRAN II and IV, BASIC, FOCAL, BATCH, 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 an relocatable program loaders.

OS/8 is the software basis for nearly every specialized package PDP-8 system offered by DEC except the Datasystem. Examples of these numerous offerings are briefly summarized below.

The CLASSIC (CLASSroom Interactive Computer) system (see Report M11-385-301), a classroom education system designed to introduce and accustom students to computers is marketed by the Educational Products Group.

The Typeset/8 Storage and Edit Systems, for the graphic arts and typesetting industries, are marketed by (naturally) the Typeset Group.

The LAB/8-E Laboratory Control System contains application software which performs peak signal analysis, signal averaging, and other highly specialized laboratory computational and control functions., The application software is offered on several media and runs either in stand-alone fashion or under OS/8. Laboratory peripherals, analog/digital (A/D) input/output, a programmable clock, and point-plot or storage displays are supported by OS/8 BASIC and FORTRAN IV.

The *CAPS-8* operating system is an elementary or entry-level PDP-8 software product. As such, CAPS-8 runs on PDP-8's with a TA8 cassette subsystem, an 8K-word CPU, a console terminal device (such as the LA36 DECwriter II), and an optional line printer. CAPS-8 provides a monitor-level executive with file handling capabilities, facilities for fault detection, and program development support for a subset of BASIC, the PAL-C Symbolic Assembler, and the EDIT Symbolic Editor.

RTS/8 (Real-Time System for PDP-8 family) allows concurrent running of up to 63 fixed-priority tasks. The RTS monitor controls scheduling, startup and suspension of tasks, and intertask communications. It can also support foreground/background operation. RTS/8 is oriented toward I/O and data collection involving real-time operations. As such, it supports time-driven operations (clocks), power-fail features and most standard I/O and process interfaces. RTS/8 exists as a small run-time module, whose tasks are created at development time using OS/8.

RTS/8 supports only assembly ianguage modules in the foreground, but FORTRAN and BASIC modules can be run under OS/8 by expanding the system to 12K words of memory. Expansion to 16K words permits OS/8 BATCH to be run in the background.

The monitor occupies less than 700 words in main memory, and tasks require an additional 10 words each. The RTS/8 system modules support most standard DEC peripherals. Minimum system requirements are simply any PDP-8 series CPU, 4K words of main memory, a console terminal, and an input medium.

A monitor console routine (MCR) in the RTS/8 system permits the user to exercise on-line control, inspect, and debug the system. Functions that can be performed through the MCR include: request task execution, suspend task execution, execute task at a specified time, examine memory, enter value into memory, enter date, enter time, print task status, and return to OS/8. Single functions or strings of functions can be entered and performed.

DECNET/8 extends the capabilities of RTS/8 to permit PDP-8 systems to interconnect with other DECNET systems. Under this system, tasks running in the RTS/8 environment can exchange data with other tasks executing on remote systems in the DECNET system. DECNET/8 supports the DDCMP protocol in full-duplex, point-to-point mode, over asynchronous and synchronous lines. Network Services Protocol (NSP) allows tasks on DECNET systems to establish logical links to other tasks executing on other systems. Variable-length messages of up to 528 bytes can be transferred over logical channels on a message basis through multiplexed physical links.

DECNET/8 is implemented as a special task in the RTS/8 environment and requires a minimum of 4K words of main memory for its own operation. The software package supports one aynchronous communications line at data rates up to 9600 bps, full-duplex. Also required is either a KL8-E or KL8-J asynchronous interface.

TSS/8 provides general-purpose time-sharing for up to 17 concurrent users on a 24K-word system with a disk for swapping and storage of user programs. The minimum system requirements are 16K, supporting up to 8 users. With on-line editing and debugging programs, TSS/8 supports interactive program development in a time-shared environment. (The system is also known as EduSystem 50).

Languages supported under TSS/8 include BASIC, FORTRAN, ALGOL, Assembly Language, FOCAL, and QUICK-POINT. All languages are available simultaneously to users of the system.

WPS-8 uses a menu-driven editor to create and update documents stored on floppy disks. The system features dynamic floppy disk allocation and allows up to 200 documents to be stored on one disk. Editing provisions include the ability to cut and paste blocks of text, boilerplate insertions for library files, operations by grammatical units (sentence, paragraph, character, tab position, etc.), use of shorthand expressions, deletion and rubout of either characters or words, and key-initiated transposed character swapping. Format controls include automatic centering of text on a line and pagination controls (discretionary or semi-automatic).

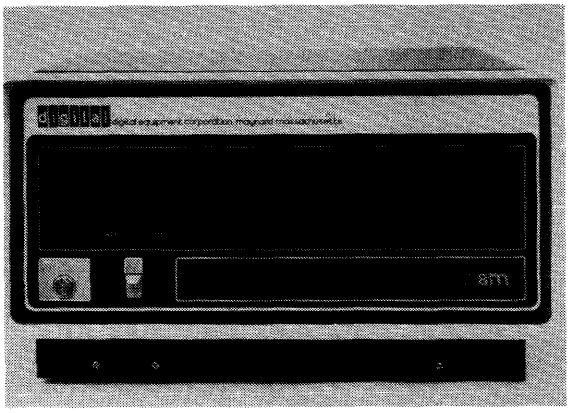
The WPS-8 system requires two special hardware units not found in the standard price list. These items, the VT52-WA and the LQP8, are part of the packaged system that makes up the 310W Word Processing System. The VT52-WA is a CRT display with a special keyboard for word processing applications, while the LQP8 is a letter-quality printer based on a Diablo mechanism. These two peripherals, plus the WPS-8 software, are included in the WP310 upgrade kit.

A remote communications package, WPS-8/RCP, enables a WPS-8 system to communicate with a host computer system. Transmission is in serial, asynchronous, RS-232C-compatible mode using standard ASCII codes.

LANGUAGES: The following are PDP-8 supported languages.

PAL III (Program Assembly Language, version III) is a two-pass assembler (with an optional third pass) designed for the

DEC PDP-8 Family



Still alive and well, the PDP-8/M is the OEM-oriented member of the older line of PDP-8's. Shown here in its basic configuration, the 8/M package includes a 10.5-inch chassis, power supply, and 20-slot Omnibus, in addition to the KK8-E CPU and 8K words of 1.2/1.4-microsecond core memory. Like the PDP-8/E, the 8/M can be expanded, but only to 56 Omnibus slots, compared to the 74 that are possible using a PDP-8/E. The PDP-8/M shown here is priced at $4,600 and includes an operator panel, the memory expansion and time-share control unit, and a serial line interface for a console terminal.

PDP-8 series minicomputers. During the first pass of the assembly, all user symbols are defined and placed in the symbol table. In the second pass, the binary equivalents of the input source language are generated and punched. The third pass (optional)(produces an assembly listing. The binary output tape is then loaded by the Binary Loader for execution.

PAL III requires a PDP-8 with 4K words of memory and a teletypewriter console. The assembler can also use either the high-speed paper tape reader, the high-speed paper tape punch, or both. The symbol table can be changed by the programmer to reflect the specific machine configuration.

MACRO-8 is also a 4K two-pass paper tape assembler that is similar to PAL III but contains several additional features. These features include link generation, literals, Boolean operators, double-precision integer output, floating-point input, a text input facility, and user-defined macros.

The *4K PAL-D Assembler* operates under the PDP-8/I Disk Monitor System and the PDP-8 Time-Sharing System. PAL-D is compatible with PAL III, except for memory reference instructions, and is also compatible with MACRO-8 in respect to Boolean operators, linkage generation, literals, and its text facility. It does not have the user-defined macros, floating-point constants, nor double-precision numbers of MACRO-8.

PAL8 is an 8K two-pass assembler designed to run under the OS/8 operating system. The first pass reads the input file and sets up the symbol table. The second pass reads the input file and uses the symbol table to generate the object file in binary. The binary file is an absolute binary tape that can be loaded into memory via either the Absolute Loader or the Binary Loader. An optional third pass produces octal and symbolic listings and a listing of the symbol table. PAL8 can handle I/O from any OS/8 devices supporting ASCII text, and has pseudo-operations and options not avilable in the other PDP-8 assemblers. It is loaded and saved via the OS/8 Monitor and Absolute Loader. It will accept input generated by the Editor and generates output acceptable to the Absolute Loader and CREF.

SABR (Symbolic Assembler for Binary Relocatable programs) is an 8K one-pass assembler that produces relocatable binary code with automatically generated page and field linkages. It supports an extensive list of pseudo-operations, which provide several facilities including external subroutine calling with argument passing and conditional assembly.

SABR differs from DEC's other 8K assembler, PAL8, in the following ways:

- SABR produces relocatable binary code; PAL8 produces absolute or location-dependent binary code.
- SABR is page- and field-independent; PAL8 is page-dependent.
- SABR programs are loaded with the 8K Linking Loader and use run-time linkage routines provided by Loader; PAL8 does not require any run-time routines.

SABR requires a PDP-8 with 8K words of memory and a teletypewriter. A high-speed paper tape reader/punch is recommended.

OS/8 SABR is a modified version of the 8K SABR assembler. It can be used as the automatic second pass of the FORTRAN II compiler, called separately to do assemblies of FORTRAN-compiled files, or used as an independent assembler with its own assembly language. In addition, SABR statements can be used in an OS/8 FORTRAN II program to expand the capabilities of the FORTRAN II language.

FLAP and *RALF* are assemblers that translate PDP-8 processor and Floating-Point Processor (FPP) operation codes in a source program into binary codes in two or three passes. The first pass assigns numeric values to the symbols and places them in the symbol table. The second pass generates the binary coding. The third pass generates the program listing. FLAP or RALF is used to assemble programs using the RPP instructions and capabilities.

FLAP is designed to run on an OS/8 system with a Floating Point Processor (FPP) without any supporting programs. It generates absolute binary output, which is valid input to the OS/8 Absolute Loader. RALF, an extension of FLAP, is part of the OS/8 FORTRAN IV system. It accepts assembly-language files or FORTRAN compiler output and generates relocatable binary modules that can be loaded by the relocatable loader.

BASIC is a language designed for use in scientific and business environments to solve both simple and complex mathematical problems. DEC provides four versions of BASIC for the PDP-8.

4K BASIC for EduSystem 10 is the most elementary BASIC. It is directed primarily toward use in an educational environment and requires a minimum of 4K words of memory.

8K BASIC is an extended version of 4K BASIC that has additional facilities including one- and two-dimensional subscripting, faster execution time, user-coded functions, use of the LE8 high-speed line printer and high-speed reader/punch, and specification of input and output devices from any part of a program. Minimum requirements to support 8K BASIC include a PDP-8 with 8K words of memory. The high-speed reader/punch and the LP08 line printer is supported.

OS/8 BASIC, which runs under OS/8, has greater capabilities than 8K BASIC, with such features as chaining, string manipulation, and file-oriented input/output. LAB8/E functions are also supported, enabling the user to solve a range of real-time and pseudo real-time problems using BASIC.

Industrial BASIC combines the mathematical and decision-making ability of Dartmouth BASIC with a real-time executive to perform industrial control applications such as analog and digital input and output, time-based scheduling, and servicing of external interrupts. File handling and editing capabilities have also been implemented. Minimum system requirements for Industrial BASIC are 8K words of main memory, an industrial control subsystem (ICS-8), a real-time clock, and either a dual DECtape or a cartridge disk. Industrial BASIC is available to both OEM's and end users.

FOCAL-8 is a high-level programming language designed for students, managers, and technicians who do not have the time to learn complex languages and yet need problem-

DEC PDP-8 Family

solving capabilities. It consists of 12 commands, which are all the programmer (user) needs. These commands are: TYPE, ASK, SET, GO or GOTO, IF, DO, RETURN, QUIT, FOR, COMMENT or CONTINUE, ERASE, ERASE ALL, and MODIFY.

The minimum system requirement for running FOCAL-8 is a 4K PDP-8 with an ASR 33 teletypewriter.

FORTRAN is available in three versions for the PDP-8. The 8K paper tape *FORTRAN II* system consists of a one-pass compiler, the SABR Assembler, the Linking Loader, and a library of subprograms. The language itself enables the programmer to express his problem using common English words and mathematical statements. The FORTRAN source program may be initially prepared off-line or by using the appropriate Editor program. The computer translates the programmer's source program into symbolic language (SABR). The symbolic version of the program is then assembled into relocatable binary code. Minimum requirements for running FORTRAN II include a PDP-8 series computer with 8K words of memory, a teletypewriter, and a high-speed reader and punch.

OS/8 8K FORTRAN is an expanded version of 8K paper tape FORTRAN II that runs under the OS/8 operating system. Its additional features include Hollerith constants, implied DO loops, chaining, mixing of SABR and FORTRAN statements, and device-independent I/O.

OS/8 FORTRAN IV provides full standard ANSI FORTRAN IV under the OS/8 operating system. The compiler accepts a single FORTRAN source-language program or subroutine as input, examines each FORTRAN statement for validity, and produces a list of error diagnostics plus a RALF assembly-language version of the source program, along with an optional annotated source listing. A job of one or more subroutines is executed by compiling and assembling the main program and each subroutine separately, then combining them with the loader.

OS/8 FORTRAN IV requires a minimum hardware configuration of a PDP-8 with 8K words of mainframe memory, a console terminal, and at least 96K of mass storage. Additional equipment that can be utilized when present includes an extended arithmetic element, a floating point processor, up to 32K words of mainframe memory, LAB/8-E peripherals, and any I/O device supported by the PDP-8 series.

UTILITIES: The following are PDP-8 utility programs.

BITMAP is an OS/8 utility program that constructs a table (map) showing the memory locations used by specified binary files. BITMAP runs on the standard OS/8 configuration and requires the OS/8 software package. It uses 8K words of memory to map programs that use up to 16K, but requires 12K words to map programs using more than 16K of memory.

BOOT is an OS/8 program used to bootstrap from one PDP-8 system to another and to bootstrap from one device to another, which is accomplished by typing commands on the keyboard. BOOT can run from OS/8, COS-310, or any other PDP-8 operating system (e.g., CAPs-8).

BUILD is the OS/8 system generation program; it allows the usser to: 1) create an OS/8 monitor system from elements on cassettes or paper tapes; 2) maintain and update device handlers in an existing OS/8 system; 3) add DEC-supplied device handlers to a new or existing system; and 4) add user-written device handlers to a new or existing system. Simple keyboard commands are used to manipulate the device handlers which make up the OS/8 peripheral configuration, and BUILD allows the user to easily insert devices that are not standard on the system.

CAMP (Cassette and Magnetic Tape Positioner) is used to position cassettes, magnetic tapes, and other devices. CAMP can position these devices to the beginning of a storage medium or another selected position on a given tape.

CREF (Cross Reference Program) assists the programmer in writing, debugging, and maintaining assembly-language programs by providing the ability to pinpoint all references to a given symbol. CREF operates on output from the PAL8, SABR, and RALF assemblers.

PIP (Peripherals Interchange Program) is the OS/8 system program that is used to transfer files between devices, to merge and delete files, and to list, zero, and compress directories. PIP accepts up to nine input files and performs output to a single file. Since PIP performs file transfers for all types of files (ASCII, Image or SAVE format, or binary) there are no assumed extensions. All extensions for either input or output files must be explicitly specified in the commands to PIP.

MCPIP, a variant of PIP, is an OS/8 program used to transfer files between standard cassettes or magnetic tapes and other OS/8 system devices, delete such files, and transfer file directories. MCPIP can read or write any standard cassette file on a DEC cassette or magnetic tape. Specifically, it can read or write any file created by or to be used by the CAPS-8 system or by the OS/8 system (using any OS/8 device handler). MCPIP can also read or write any magnetic tape file tht is in standard cassette file format (i.e., a file created by MCPIP or by CAPS-8). MCPIP can be run on any OS/8 system equipped with at least 8K words of memory and TA8 cassette drives or TM8 magnetic tape drives. MCPIP supports any OS/8 system device.

RESORC (Systems Resources) is an OS/8 program that is used to determine what device handlers are present on a given OS/8 system. Other information about the device handlers is also available through the use of the RESORC options.

SRCCOM (Source Compare) is an OS/8 utility program that compares two source files line by line and prints all of the differences. Usually, the two files being compared are different versions of a single program. In that case, SRCCOM prints all of the editing changes that have occurred. Used in this manner, SRCCOM can be a valuable debugging tool.

DDT (Dynamic Debugging Tool) and *ODT* (Octal Debugging Tool) are a pair of debugging routines included in the system software package for the PDP-8. These routines allow the programmer to run his binary program on the computer and use the teletypewriter keyboard to control program execution, examine registers, change their contents, and make other alterations to his program.

RTAPE and *WTAPE* are two DECtape read and write subprograms available for the 8K FORTRAN and 8K SABR systems. These subprograms are furnished on one relocatable, binary-coded paper tape, which is loaded into field 0 by the Linking Loader. RTAPE or WTAPE allow the user to read and write any amount of memory-image data onto DECtape in absolute, non-file-structure data blocks. They can be called from any 8K FORTRAN or SABR program. The arguments are the same for both subprograms and are formatted in the same manner. They specify the following: DECtape unit number (from 0 to 7); number of the DECtape block at which transfer is to start; number of words to be transferred; and core address at which the transfer is to start.

DIRECT is an OS/8 program that produces listings of OS/8 device directories. These directories can be of several types, depending upon the options specified in the DIRECT command line. The standard directory listing consists of file name, file name extension, length (decimal) in blocks written, and creation date.

EPIC is the Edit, Punch, and Compare utility program for OS/8. It assists users in reading and punching paper tape files and patches, editing arbitrary files, and comparing files in any format. After EPIC is loaded, a command entered from the console selects the function desired.

FOTP is an OS/8 program used to transfer files from one device to another, delete files from a device, and rename files. It is faster than PIP and performs some functions not available in PIP, such as transferring files longer than 256 blocks and performing multiple-file transfers and deletions without requiring multiple accesses to the directory.

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FOTP copies files in image mode, word for word and character for character, without making any changes in the file. Thus, it can be used to copy memory-image and binary files as well as ASCII files, without specifying options to identify the types of files.

LIBSET is the FORTRAN Library Setup Program. It creates a library of subroutines from the relocatable binary output of SABR. These library files can then be scanned by the Linking Loader.

The *Linking Loader* is the PDP-8 system program used to load and link a user's program and subprograms into any field of memory. It can be called automatically to load or load and start a FORTRAN or SABR program, or independently to load or load and start a relocatable binary file stored on a device. It can load programs over itself, and has options to obtain storage map listings of memory availability.

The Linking Loader can load any number of user and library programs into any field of memory. Typically, several programs are loaded into each field. Any common storage reserved by the programs being loaded is allocated in a specified field, and the space reserve for common storage is subtracted from the available loading area in field 1. The program reserving the largest amount of common storage must be loaded first.

The Run-Time Linkage Routines necessary to execute SABR programs are automatically loaded into the required areas of every field by the Linking Loader as part of its initialization. The user needs to know nothing more about these routines than the particular areas of memory they occupy.

SS BIN (Self-Starting Binary Loader) reads binary-format paper tapes from either the high-speed or low-speed reader and, if a starting address has been specified, automatically starts the program at the completion of loading. SS BIN itself is a read-in mode (RIM) format program and is loaded with the RIM Loader or the hardware bootstrap, generally as the first part of a two-part tape. (The second part of this tape is the object program or data to be loaded, which is physically separated from SS BIN by leader/trailer codes.) SS BIN occupies 156 locations of the memory field into which it has been loaded.

The *Symbolic Editor* (EDIT) allows users to create and modify symbolic source program tapes from the teletypewriter keyboard. As the program is typed on the keyboard, it is entered into memory, where it can be checked, corrected, and modified. When modification is complete, the Editor will produce a source program tape suitable for assembling or compiling into an object binary tape.

EDIT occupies about 1000 memory locations, leaving all but the last page for the source program. On a 4K machine, this allows about 60 lines of heavily commented text, or about 340 lines of text without comments. The source program is stored in the text buffer area of memory. When the text buffer is full, the teletypewriter bell rings. At that time, the buffer may be enlarged or the contents of the buffer may be punched onto paper tape. If punched, the buffer can then be cleared, and the user can continue placing the rest of the source program into memory and punching it out until the entire source program is on one tape ready for compilation or assembly. Text can also be entered into memory via the high-speed paper tape reader.

OS/8 TECO (Text Editor and Corrector) is a useful text editing and correction program that runs under the OS/8 operating system. OS/8 TECO can be used to edit such ASCII text as program listings, manuscripts, correspondence, and the like. Because TECO is a character-oriented editor rather than a line editor, text editor with TECO does not have line numbers associated with it. Further, it is not necessary to replace an entire line of text in order to change one character.

APPLICATIONS SOFTWARE: DEC's extensive and numerous applications programs are generally sold as an integral part of the specialized end-user systems available from each of four market groups: Typeset Group, Education Systems Group, Business Products Group, and the newly created PDP-8 Group, which incorporates the products formerly sold by the Industrial Products Group, Engineering Computational Group, and Laboratory Data Products Group. In addition, more than 1600 application and utility programs are maintained by the Digital Equipment Computer Users Society (DECUS).

PRICING

POLICY: PDP-8 systems, purchased as end-user equipment on a package basis, include installation and set-up charges in the package prices. In addition, these systems are generally covered by a 90-day warranty. Maintenance contracts are negotiated separately. Any modifications to the system (additional I/O, memory, etc.) are subject to DEC's OEM policies. Discounts of up to 20 percent on both unit volume and dollar volume are available to end users.

Systems purchased for OEM purposes do not include warranty or installation. These must be purchased separately under one of three plans:

- System installation and 30-day on-site warranty priced at the greater of $300 or 3 percent of list price.
- System installation and 30-day on-site warranty priced at the greater of $500 or 5 percent of list price.
- Installation and 30-day on-site warranty for certain specified units, priced at the standard field installation charge plus maintenance for one month.

PDP-8/A modules are warranted on a return-to-factory basis for three months from the date of delivery.

For OEM customers, discounts of up to 35 percent for most electronic subassemblies and up to 28 percent on other hardware items are available, while discounts for software products can go as high as 56 percent.

Prices for field installation of options are the sum of all the individual field installation charges (FIC's), or $75 minimum, plus a one-time travel charge from the nearest DEC Service Center if the straight-line distance exceeds 100 miles. Installation prices for areas considered remote (not normally serviced by DEC or its subsidiaries) must be quoted individually.

Return-to-factory warranties and services can be obtained from seven locations in the United States and Canada. These locations are: Chicago, Illinois; Sunnyvale, California; Kanata, Ontario; Maynard, Massachusetts; Houston, Texas; Santa Ana, California; and Princeton, New Jersey.

Software prices usually include a one-time licensing fee that also includes one of two support plans. The first plan includes installation and testing of software packages, on-site remedial services for problems detected within 90 days of installation, and one-year coverage under DEC's Software Performance Report system, in which customers submit descriptions of their problems and remedies or emergency bypasses are supplied through a periodical maintenance document. The second plan provides only the one-year Software Performance Report coverage.

EQUIPMENT: The following systems illustrate typical PDP-8 systems and includes all controllers, cabinets, and cabling. Also see Reports M11-385-101 and M11-385-301 for other systems based on the PDP-8 computers.

MS800 SINGLE-USER COMPUTATIONAL SYSTEM: Includes an 8A400 CPU package with 16K words of core memory; a DKC8-AA option board serial line unit with integral real-time clock; a KM8-AA multiple option board with memory expansion and time-share control, power fail/restart, and bootstrap loader; an operator panel; self-test diagnostics; an FPP8-A floating-point processor; one 1.6-million-word cartridge disk subsystem; a VT52 CRT display/keyboard; a 180-cps DECprinter; a desk and short cabinet; the OS/8 operating system; and the FORTRAN compiler. Purchase price for the system is $29,160, and monthly maintenance charge is $228.

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FOUR-USER PDP-8/E SYSTEM: Includes a PDP-8/E CPU with 32K words of core memory, KE8-E extended arithmetic element, KP8-E power fail/restart, KM8-E memory expansion and time-share control, FPP8-E floating-point processor, DK8 real-time clock, dual RK05 4.8 million-word disk subsystem, dual RX8 floppy disk subsystem, 300-lpm line printer, four LA36 DECwriter II's and interfaces, expansion bus, cabinet, the OS/8 and RTS/8 operating software, and the FORTRAN compiler. Purchase price for this configuration is $63,100, and monthly maintenance charge is $542. ■

EQUIPMENT PRICES

		Purchase Price	Monthly Maintenance
PDP-8/A CPU BOARDS			
KIT8A-AC	KK8-A CPU with 1K words of 2.4-microsecond RAM	$ 985	—
KIT8A-AE	KK8-A CPU with 2K words of 2.4-microsecond RAM	1,350	—
KIT8A-AK	KK8-A CPU with 4K words of 2.4-microsecond RAM	1,645	—
KIT8A-FA	KK8-A CPU with 1K words of 3.4-microsecond PROM	1,525	—
KIT8A-EM	KK8-A CPU with 8K words of 1.5-microsecond core memory; "includes" memory expansion control and time-share control	2,255	—
KIT8A-BM	KK8-A CPU with 8K words of 1.5-microsecond core memory; includes memory expansion control, time-share control, power fail/restart, and bootstrap loader	2,455	—
KIT8A-EP	KK8-A CPU with 16K words of 1.5 microsecond core memory; includes memory expansion control and time-share control	3,100	—
KIT8A-BP	KK8-A CPU with 16K words of 1.5 microsecond core memory; includes memory expansion control, time-share control, power fail/restart, and bootstrap loader	3,300	—
H9193	Six-slot Omnibus for KIT8A CPU's	195	—
PDP-8/E AND PDP-8/M COMPUTERS			
	Includes KK8-E CPU with 1.2-microsecond core memory, 110-bps TTY controller, programmer console, chassis, power supply, and a 20-slot quad module chassis; computers with memory greater than 4K words also include a memory expansion and time-share control. (Available chassis slots are indicated after the description.)		
PDP8E-DC	With 4K words of memory, 10 slots available	5,750	53
PDP8E-DE	With 8K words of memory, 10 slots available	5,850	74
PDP8E-DS	With 16K words of memory, 6 slots available	7,670	117
PDP8E-EC	With 4K words of memory, 10 slots available, table-top mounted	5,750	53
PDP8E-EE	With 8K words of memory, 9 slots available, table-top mounted	5,850	74
PDP8E-ES	With 16K words of memory, 6 slots available, table-top mounted	7,670	117
PDP8M-DH	With 4K words of memory, 10 slots available	5,050	53
PDP8M-DK	With 8K words of memory, 9 slots available	5,150	74
PDP8M-DS	With 16K words of memory, 6 slots available	6,870	117
	Includes KK8-E CPU with 1.2-microsecond core memory, programmer console, power supply, and a 20-slot quad module chassis; computers with memory greater than 4K words also include a memory expansion control and time-share control. (Available chassis slots are indicated after the description.)		
PDP8E-FH	With 4K words of memory, 11 slots available	5,600	53
PDP8E-FK	With 8K words of memory, 10 slots available	5,700	74
PDP8E-FS	With 16K words of memory, 7 slots available	7,520	117
PDP8M-EH	With 4K words of memory, 11 slots available	4,900	53
PDP8M-EK	With 8K words of memory, 10 slots available	5,000	74
PDP8M-ES	With 16K words of memory, 7 slots available	6,750	117
	Includes KK8-E CPU with operator console, 20-slot quad module chassis, and power supply; computers with memory greater than 4K words also include a memory expansion and time-share control. (Available chassis slots are indicated after the description.)		
PDP8M-MH	With 4K words of 1.2-microsecond core memory, 12 slots available	4,500	—
PDP8M-MK	With 8K words of 1.2-microsecond core memory, 11 slots available	4,600	—
PDP8M-MS	With 16K words of 1.2-microsecond core memory, 8 slots available	6,400	—
PDP-8/A COMPUTERS			
	8A100 includes KK8-A CPU with operator panel, 10-slot chassis, power supply, and battery back-up. (Available chassis slots are indicated after the description.)		
8A100-AC	With 1K words of 2.4-microsecond RAM, 8 slots available	1,835	—
8A100-AE	With 2K words of 2.4-microsecond RAM, 8 slots available	2,200	—
8A100-AK	With 4K words of 2.4-microsecond RAM, 8 slots available	2,455	—
8A100-FA	With 1K words of 3.4-microsecond PROM, 8 slots available	2,375	—
	8A400 includes KK8-A CPU with 1.5-microsecond core memory, operator panel, memory expansion and time-share control, chassis, and power supply. (Available chassis slots are indicated after the description.)		
8A400-EM	With 8K words of memory, power fail/restart and bootstrap loader, 12-slot chassis, 8 slots available	2,950	43
8A400-BM	With 8K words of memory, power fail/restart and bootstrap loader, 12-slot chassis, 8 slots available	3,150	44
8A400-EP	With 16K words of memory, 12-slot chassis, 8 slots available	3,795	48
8A400-BP	With 16K words of memory, power fail/restart and bootstrap loader, 12-slot chassis, 8 slots available	3,995	49
8A420-BM	With 8K words of memory, memory expansion and time-share control, power fail/restart and bootstrap loader, 20-slot chassis, 16 slots available	4,450	49
8A420-BP	With 16K words of memory, memory expansion and time-share control, power fail/restart and bootstrap loader, 20-slot chassis, 16 slots available	5,295	54
	8A600 includes KK8-E CPU with 1.2-microsecond core memory, memory expansion and time-share control, power fail/restart and bootstrap loader, operator panel, chassis and power supply. (Available chassis slots are indicated after the description.)		

DEC PDP-8 Family

EQUIPMENT PRICES

PDP-8/A COMPUTERS (Continued)		Purchase Price	Monthly Maintenance
8A600-BM	With 8K words of memory, 12-slot chassis, 5 slots available	3,950	49
8A600-BP	With 16K words of memory, 12-slot chassis, 5 slots available	4,795	54
8A620-BM	With 8K words of memory, 20-slot chassis, 13 slots available	5,250	54
8A620-BP	With 16K words of memory, 20-slot chassis, 13 slots available	6,095	59
	8A800 includes KK8-A CPU, 1.5-microsecond core memory, memory expansion and time-share control, power fail/restart and bootstrap loader, floating-point processor, operator panel, chassis and power supply. (Available chassis slots are indicated after the description.)		
8A800-PM	With 8K words of memory, 12-slot chassis, 6 slots available	6,150	60
8A800-PP	With 8K words of memory, 12-slot chassis, 6 slots available	6,995	65
8A820-PM	With 8K words of memory, 20-slot chassis, 14 slots available	7,450	65
8A820-PP	With 8K words of memory, 20-slot chassis, 14 slots available	8,295	70
PACKAGED SYSTEMS			
	Includes CPU; 1.5-microsecond core memory; memory expansion and time-share control; power fail/restart and bootstrap loader; DKC8-AA multiple option board with asynchronous line controller, real-time clock, programmer console control, and 12-bit parallel I/O interface; dual floppy disk drives; 12-slot chassis; control panel; self-test ROM; power supplies; and desk with power control and fans. (Available chassis slots are indicated after the description.)		
MS800-AA	8A400 with 8K words of memory, 6 slots available	9,595	85
MS800-BA	8A400 with 16K words of memory, 6 slots available	10,440	90
MS880-CA	8A800 with 8K words of memory, floating-point processor, 4 slots available	13,100	101
MS880-DA	8A800 with 16K words of memory, floating-point processor, 4 slots available	13,945	105
PROCESSOR OPTIONS			
KC8-EA	Programmer console for PDP-8/E; requires 1 slot	740	—
KC8-ML	Programmer console for PDP-8/M; requires 1 slot	675	—
KC8-AA	Programmer console for PDP-8/A; includes cables; requires DK C8-AA option board (FIC $120)	550	8
KC8-AB	Remote programmer console for PDP-8/A; includes cables; requires DKC8-AA option board (FIC $120)	750	8
KE8-E	Extended Arithmetic Element for PDP-8/E, -8/M, -8A600, and -8A620; includes hardware divide, registers, and extended instruction set; requires 2 slots (FIC $60)	1,400	55
FPP8-A	Floating-Point Processor for PDP-8A; provides 24-bit fixed-point, and 36-bit or 72-bit floating-point arithmetic operations; requires 2 slots (FIC $120)	3,000	16
FPP8-EA	Floating Point Processor and Expander Box; includes FPP8-A mounted in expansion box, for PDP-8/E and -8/M; includes cables, requires 3 slots in processor plus 1 in expansion box (FIC $190)	4,500	25
KP8-E	Power Fail/Restart Detector for PDP-8/E and -8/M; requires 1 slot (FIC $60)	330	2
KM8-E	Memory Expansion Control and Time-Share Control for all PDP-8's; required for systems greater than 4K words of memory; requires 1 slot (FIC $60)	385	2
KM8-AA	Extended Option Board for PDP-8/A; includes memory expansion control for systems greater than 4K words, time-share control, power fail/restart and bootstrap loader for paper tape, cartridge disk, floppy disk, and cassette tape; requires 1 slot (FIC $60)	500	8
DKC8-AA	I/O Option Board for PDP-8/A; includes 100-Hertz real-time clock, programmer console control, 12-bit parallel I/O interface, asynchronous serial line unit, 110 to 9600 bps; requires 1 slot (FIC $120)	500	8
DK8-EA	Line Frequency Clock for PDP-8/E and PDP-8/M; requires 1 slot (FIC $60)	300	2
DK8-EC	Fixed-Interval Real-Time Clock for all PDP-8's; 1, 50, 500, or 5000 interrupts per second; requires 1 slot (FIC $60)	350	2
DK8-EP	Programmable Real-Time Clock for all PDP-8's; 100-Hertz to 1M-Hertz base, 12-bit counter; requires 2 slots (FIC $100)	740	3
MR8-SL	PROM Loader; for use with MR8-FB PROM memory module; requires 8K words of memory, KM8-E or KM8-AA memory expansion control, terminal, and paper tape input unit; requires 1 slot (FIC $80)	2,625	21
MI8-E	Bootstrap Loader; provides 32 words of diode ROM memory, user-programmable, for paper tape, DECtape, cartridge disk, cassette tape, or floppy disk; requires 1 slot (FIC $60)	630	5
ZF006-RB	Basic processor and memory diagnostic kit, for use with PDP-8/A CPU with 4K or greater RAM or or core memory	70	—
ZF007-RB	Basic processor and memory diagnostic kit, for KIT8A or 8A100 CPU with up to 3K words of RAM	70	5
ZF209-RB	Diagnostic kit for KM8-AA or KM8-E option boards	70	—
ZF196-RB	Diagnostic kit for PDP-8/A with PROM memory	28	—
ZF226-RB	Diagnostic kit for FPP8-A Floating-Point Processor	—	—
MEMORY			
Core Memory			
MC8-EJ	8K words for PDP-8/E and -8/M; includes KM8-E memory expansion and time-share control, requires 1.2/1.4-microsecond cycle time (FIC $175)	2,850	42
MM8-EJ	8K words for PDP-8/E and -8/M; requires KM8-E memory expansion control, requires 3 slots, 1.2/1.4-microsecond cycle time (FIC $175)	2,500	42
MM8-AA	8K words for all PDP-8/A models except 8A100; 1.5-microsecond cycle time (1.2/1.4-microsecond cycle time on 8A600 and 8A620 systems); requires KM8-E or kM8-AA expansion control, requires 2 slots (FIC $120)	1,500	10
MM8-AB	16K words of core memory; same specifications as MM8-AA above, requires 2 slots (FIC $130)	2,500	15
2.4/2.8-Microsecond MOS RAM Memory			
MS8-AA	1K words for KIT8A and 8A100; can be directly addressed by MR8-A ROM memory, requires 1 slot	570	—
MS8-AB	2K words for KIT8A and 8A100; can be directly addressed by MR8-A ROM memory, requires 1 slot	935	—
MS8-AD	4K wrods for KIT8A and 8A100; can be directly addressed by MR8-A ROM memory, requires 1 slot	1,230	—

1.2-Microsecond ROM Memory—cycle time. is 1.5 microseconds when used with KIT8A, 8A100, 8A400, 8A420, or 8A820 system

FIC—Field Installation Charge.

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EQUIPMENT PRICES

MEMORY (Continued)		Purchase Price	Monthly Maintenance
MR8-AA	1K words, requires 1 slot	480	—
MR8-AB	2K words, requires 1 slot	760	—
MR8-AC	3K words, requires 1 slot	1,030	—
MR8-AD	4K words, requires 1 slot	1,300	—
3.4/3.6-Microsecond PROM			
MR8-FB	1K words; up to 256 words can be programmed as read/write memory, requires 1 slot	995	—
MASS STORAGE			
All cartridge disk subsystems can be used with all PDP-8 computers *except* KIT8A and 8A100.			
RK8J-EA	Cartridge Disk Drive and Controller; 1.6 million words, 8 drives maximum, includes cartridge, requires 3 slots (FIC $364)	7,900	49
RK05J-AA	Cartridge Disk Drive for use with RK8J-EA subsystem; 1.6 million words, maximum of 7 per subsystem, includes cartridge (FIC $260)	5,100	39
RK05K-08	Disk Cartridge for RK8J-EA or RK05J-AA	99	—
RK05F-AA	Cartridge Disk Drive for use with RK8-EA subsystem; 3.2 million words, maximum of 1 per subsystem, includes cartridge (FIC $364)	6,500	54
RX8-AA	Single Floppy Disk Drive and Controller; one drive per controller, maximum 8 per system, for all PDP-8's, requires 1 slot (FIC $251)	3,045	25
RX8-BA	Dual Floppy Disk Drive and Controller; one dual drive per controller, maximum 8 per system, for all PDP-8's, requires 1 slot (FIC $251)	4,095	33
MAGNETIC TAPE EQUIPMENT			
Standard magnetic tape subsystems can be used with all PDP-8's *except* KIT8A and 8A100.			
TD8-EM	Dual DECtape Drive and Controller; one dual drive per controller, maximum 4 per system; requires 1 slot (FIC $240)	6,960	42
TM8-MA	Tape Transport and Controller; 9-track, 12.5 ips, 800 bpi, master subsystem, can have one TS03-SA slave transport, maximum 1 per system, requires 4 slots (FIC $425)	6,450	75
TS03-SA	Tape Transport and Controller; slave subsystem for use with TM8-MA above (FIC $270)	3,500	50
TM8W-EA	Tape Transport and Controller; 9-track, 45 ips, 800 bpi, master subsystem, can have up to 7 TU10W-EE slave transports, maximum 1 per system, requires 4 slots (FIC $640)	12,075	101
TU10W-EE	Tape Transport for use with TM8W-EA subsystem above; maximum of 7 (FIC $400)	8,400	74
TM8W-FA	Tape Transport and Controller; 7-track, 45 ips, 800 bpi, master subsystem, can have up to 7 TU10W-FE slave transports, maximum 1 per system, requires 4 slots (FIC $640)	13,885	101
TU10W-FE	Tape Transport for use with TM8W-FA subsystem above, maximum of 7 (FIC $400)	10,210	74
TA8-AA	Dual cassette Tape Drive and Controller; one dual drive per controller, maximum 8 per system, for all PDP-8's, requires 1 slot (FIC $220)	3,630	40
TU60-K	Cassette for TA8-AA drives	8	—
PUNCHED CARD EQUIPMENT			
For use with all PDP-8's *except* KIT8A and 8A100			
CM8-FA	Optical mark reader and control, requires 1 slot, 300 cpm (FIC $250)	6,270	53
CR8-FA	Punched card reader and control, requires 1 slot, 300 cpm (FIC $240)	5,610	53
PAPER TAPE EQUIPMENT			
For use with all PDP-8's			
PR8-E	Paper tape reader and control, requires 1 slot, 300 cps (FIC $160)	2,850	21
PC8-E	Paper tape reader/punch and control, requires 1 slot, 300/50 cps (FIC $320)	4,600	37
LINE PRINTERS/PLOTTERS			
LA8-PA	Printer and controller; 132 columns, 96-character set, variable form width, requires 1 slot, for all PDP-8's; 180 cps (FIC $95)	3,585	53
LE8-VA	Printer and controller; 132 columns, 64-character set, requires 1 slot, 300 lpm; not offered with KIT8A or 8A100 (FIC $220)	11,235	72
LE8-WA	Printer and controller; 132 columns, 96-character set, requires 1 slot, 300 lpm; not offered with KIT8A or 8A100 (FIC $220)	13,375	72
XY8-E	Plotter Control Interface for Calcomp Series 500, 600, 700, and 800; Houston Instruments Model 6400, DP-1, and DP-10; for all PDP-8's, requires 1 slot (FIC $50)	630	8
TERMINALS			
LA35-CE	DECwriter II Printer for use with all PDP-8's; 132 columns; 96-character set; requires synchronous serial line unit; 10, 15, or 30 cps (FIC $95)	2,150	25
LA36-CE	DECwriter II for use with all PDP-8/A's; 96-character set; upper/lower case keyboard; requires asynchronous line unit; 10, 15, or 30 cps	2,350	25
VT50-AA	DECscope; 80 character x 12 lines, 64-character ASCII keyboard, requires asynchronous serial line unit; 75 to 9600 bps (FIC $95)	1,300	22
VT52-AA	DECscope; 80 characters x 24 lines, 96-character ASCII keyboard plus 19-key keypad, requires asynchronous serial line unit, 20-milliampere interface; 75-9600 bps (FIC $95)	2,095	20
VT52-AE	DECscope; similar to VT52-AA with EIA interface (FIC $95)	2,095	20
VT61-AE	DECscope; 80 characters x 24 lines, 128-character ASCII keyboard plus 19-key keypad, 20-milliampere interface; 75 to 9600 bps	2,950	—

FIC—Field Installation Charge.

DEC PDP-8 Family

EQUIPMENT PRICES

TERMINALS (Continued)		Purchase Price	Monthly Maintenance
VT61-AA	DECscope; similar to VT61-AE with EIA interface	2,950	—
VT61T-AA	Modified DECscope, for use in text editing applications; 128-character ASCII keyboard plus 19-key keypad modified with special functions, EIA interface; 75 to 9600 bps	2,950	—
VC8-E	Point Plot Display Controller for graphics applications; three-axis control (X, Y, Z); includes reference power supply (FIC $100)	1,300	11
DATA COMMUNICATIONS			
KL8-JA	Asynchronous Interface for all PDP-8's; 20-milliampere or EIA interface, double-buffered, full-duplex, maximum 17 per system, requires 1 slot; 110 to 9600 bps (FIC $60)	500	11
KL8-M	Modem Control for KL8-JA interface; for Bell 103A, E, F, G, and H, 113B, 202C and 202D, or equivalent modems, requires 1 slot (FIC $60)	450	5
KL8-A	4-Channel Asynchronous Interface for all PDP-8/A's; partial modem controls on 3 channels and full modem controls on 1 channel, 20-milliampere or EIA interface, requires 1 slot, 50 to 9600 bps (FIC $120)	995	18
H312-A	Null Modem Adapter for local EIA devices connected directly to EIA devices, for all PDP-8's (FIC $50)	95	2
H313-A	20-Milliampere to EIA Adapter, for all PDP-8's (FIC $25)	300	5
DP8-EA	Synchronous Interface for all PDP-8's; bipolar (EIA) or TTL levels, DMA transfer, requires 2 slots, for Bell 200 series or equivalent modems, maximum of 4 per system; up to 71,000 bps (FIC $100)	1,250	11
DP8-EB	Synchronous Interface for all PDP-8's; similar to DP8-EA above, for Bell 300 series or equivalent modems (FIC $100)	2,600	11
KG8-EA	Redundancy Check Option for use with DP8 interfaces; provides VRC, LRC, and CRC checks; requires 1 slot (FIC $60)	220	5
DC08-H	Control for Bell 800 series ACU's; up to 10 channels, requires DC08-J interfaces, for all PDP-8's except KIT8A and 8A100, requires KA8-E interface (FIC $60)	2,200	6
DC08-J	Single Channel Interface for DC08-H; maximum of 10 per DC-08-H (FIC $10)	315	2
I/O INTERFACES			
KA8-E	External I/O Bus Interface for all PDP-8's, for both positive and negative I/O bus, peripherals; maximum 1 per system, requires 1 slot (FIC $60)	440	3
KD8-E	Data Break Interface for all PDP-8's; provides DMA capabilities to one device, maximum 12 per system, requires KA8-E Interface, requires 1 slot (FIC $60)	640	3
DW08-A	I/O conversion Panel for all PDP-8's; converts positive bus to negative bus, requires KA8-E and KD8-E interfaces (FIC $160)	2,500	7
EXPANSION SUBASSEMBLIES			
H9300-BC	12-slot Expansion Box for 8A600 and 8A620; includes power supply, provides 11 slots	NA	NA
H9300-BE	12-Slot Expansion Box for PDP-8/E and -8/M; includes power supply, provides 11 slots	NA	NA
BA8-CC	20-Slot Expansion Box for 8A600 and 8A620; includes power supply, provides 19 slots	NA	NA
BA8-CE	20-Slot Expansion Box for PDP-8/E and -8/M/; includes power supply, provides 19 slots	NA	NA
BE8-A	20-Slot Expansion Omnibus for use with PDP-8/E; maximum of 1 can be added, provides 19 slots	725	—
H721-C	Expansion Power Supply for PDP-8/E; requires BE8-A Expansion Omnibus (FIC $60)	1,100	5
CABINETS			
H960-BC	Cabinet; 71.5 inches high, includes end panels, power control, and fan	935	—
H961-AA	Option Cabinet; 71.5 inches high, includes power control and fan	660	—
H967-BA	Cabinet; 50 inches high, includes end panels, power control, and fan	935	—
H967-AA	Option Cabinet; 50 inches high, includes power control and fan	660	—
861-C	Cabinet Power Control, 115 VAC, 60 Hertz	300	—
861-B	Cabinet Power Control, 230 VAC, 50 Hertz	350	—

FIC—Field Installation Charge.

NOTE: All equipment except the KIT8A is for 115-volt, 60-Hertz operation; versions for 230-volt, 50-Hertz operation are available at no extra charge.

DEC PDP-8 Family

SOFTWARE PRICES

		Purchase Price
QF015-A	OS/8 Operating System, license and binaries; includes monitor, PAL assembler, FORTRAN II, PIP, system builder and file utility	$ 400
QF015-B	OS/8 Operating System, sources	950
QF006-A	OS/8 Extension Kit, license and binaries; adds OS/8 BATCH, TECO text editor, and OS/8 BASIC to OS/8 system; requires OS/8	200
QF006-E	OS/8 Extension Kit, sources	950
QF008-A	FORTRAN IV, license and binaries; includes FORTRAN IV compiler, assembler, library, and run-time system; requires OS/8	700
QF008-E	FORTRAN IV, sources	1,000
QF014-A	OS/8 FORTRAN IV plotter routines; license and binaries; includes routines to drive Calcomp 563, 565, or equivalent requires OS/8 and FORTRAN	300
QF014-E	OS/8 FORTRAN IV plotter routines, sources	150
QF020-X	RTS/8 Real-Time Operating System; license and sources; includes executive, swapper, console monitor, mass storage drivers, OS/8 support program, clock handler, power fail/auto restart, and process control interface drivers; requires OS/8	500
QF095-Z	Industrial BASIC, license and binaries; includes editor, compiler, loader, run-time systems (core-only or OS/8-based), and extended arithmetic element support overlays; requires OS/8	1,600
QF090-A	Industrial BASIC and OS/8, license and binaries; includes QF095-A and QF015-A	1,650
QF081-C	PTS-8 Paper Tape-Based Development System, license and binaries; includes editor, PAC III and Macro 8 assemblers, floating-point math package, loader, and debug utilities	750
QF007-A	CAPS-8 Cassette Tape-Based Operating System, license and binaries; includes editor, monitor, PAL assembler, and debug utility	250
QF007-E	CAPS-8 Cassette Tape-Based Operating System, sources	250
—	TSS/8 Time-Sharing System; license and binaries	5,000
WP310-AA	Upgrade package for adding word processing functions to existing PDP-8/A system; includes T52-AA word-processing terminal, LQP8 letter-quality printer, and WPS-8 word processing software	10,600