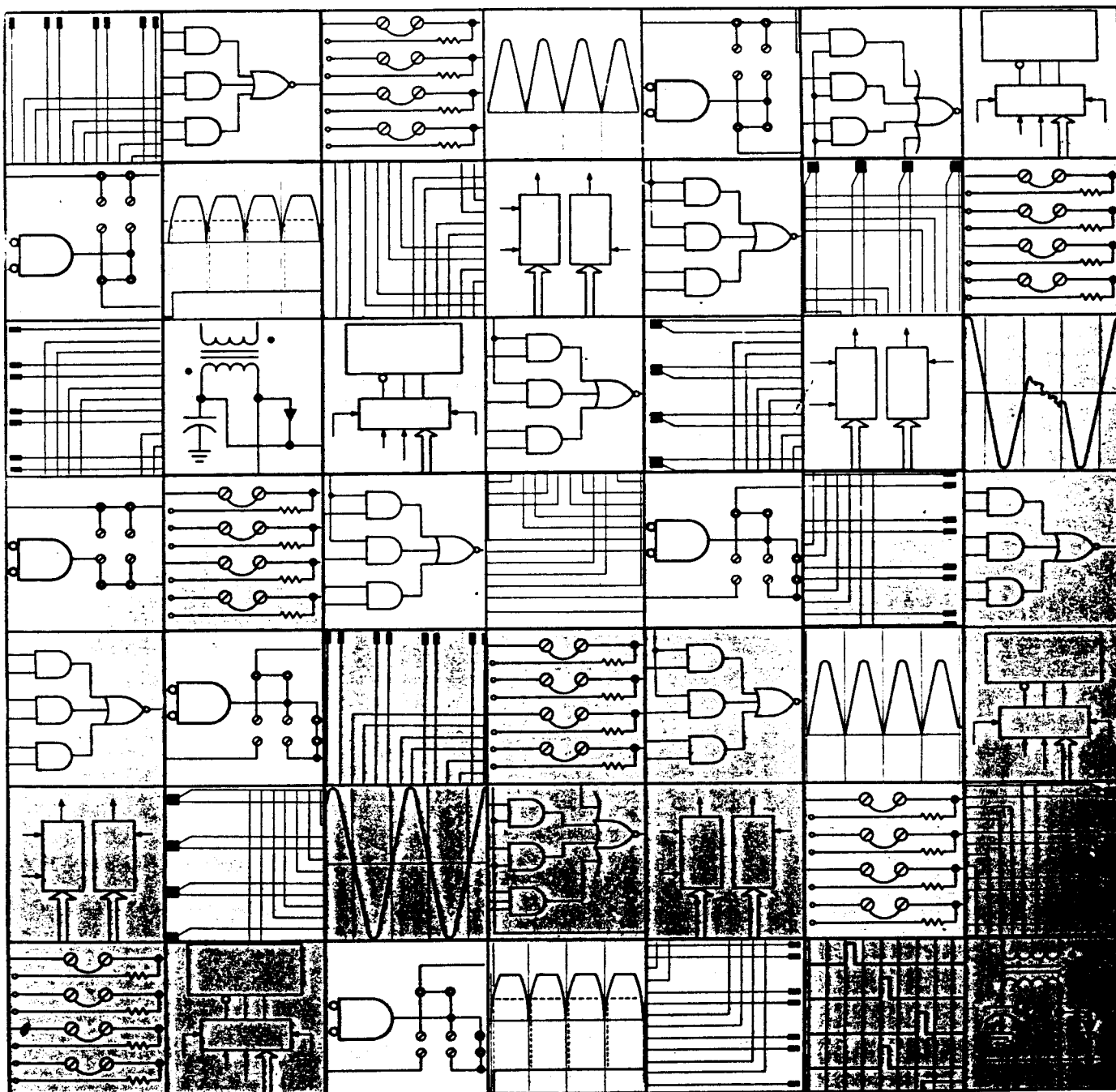


# pdp8/e

pdp8/f & pdp8/m

## processor maintenance manual volume 1





pdp8/e, pdp8/f & pdp8/m

MAINTENANCE MANUAL  
VOLUME 1

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# CHAPTER 1

## INTRODUCTION AND DESCRIPTION

### 1.1 PURPOSE OF MANUAL

This manual describes the PDP-8/E, PDP-8/F, and PDP-8/M Computer Systems manufactured by Digital Equipment Corporation, Maynard, Massachusetts. Each system consists of a basic computer, internal options, and external options. The three basic computers are quite similar in performance, operating procedures, and physical contents. The noticeable differences between the PDP-8/E and the PDP-8/F are physical size and front panel appearance: the depth of the PDP-8/E is almost twice that of the PDP-8/F, a fact that has significance when options are added to the basic computer; in addition to a slight difference in the silk-screening of the two front panels, the PDP-8/F indicating devices (light-emitting diodes) give off a red glow in contrast to the orange glow of the PDP-8/E indicator bulbs. Differences that are not noticeable are the type of power supply (the PDP-8/F power supply is less expensive) and the logic used on each KC8 Programmer's Console (the PDP-8/F logic is simpler); these differences are detailed in later chapters. These slight differences mean that the PDP-8/F is a less expensive basic computer than the PDP-8/E, even though it provides almost as much expansion capacity as the PDP-8/E. The PDP-8/M is an Original Equipment Manufacturer (OEM) version of the PDP-8/F that provides the OEM with a low-cost 12-bit computer giving performance identical to that of the PDP-8/F.

Because system dissimilarities are minor, it is possible to provide a description that, in most instances, applies equally to each. Thus, the maintenance manual refers to the PDP-8/E only, except where differences exist and must be pointed out. This manual consists of three volumes, each containing installation procedures, detailed logic theory, and maintenance instructions:

- a. Volume 1 deals with the basic computer; viz., memory, central processor, timing, I/O control (for the companion Teletype<sup>®</sup>), front panel controls, and power supply.
- b. Volume 2 deals with internal bus options; they are self-contained devices that, when added to the basic computer, function with no external connections (two of these options, the positive I/O bus interface and the data break interface, defy this definition for reasons that will be given later).
- c. Volume 3 deals with external bus options; they are options that consist of a peripheral and a control that is added to the basic computer and is connected by external cabling to the peripheral.

Maintenance procedures for the PDP-8/E system are provided in Chapter 4 of this manual. These procedures have been developed from the careful analysis and long experience of DEC's Field Service staff. They will be extremely helpful in maintaining the PDP-8/E in good operating condition. Maintenance personnel must be familiar with the detailed logic theory and operating procedures for the PDP-8/E.

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<sup>®</sup> Teletype is a registered trademark of Teletype Corporation.

#### NOTE

Chapter 2 of the *PDP-8/E & PDP-8/M Small Computer Handbook* describes the PDP-8/E front panel controls and indicators; the Teletype controls, indicators, and keyboard; manual operation of the PDP-8/E controls; preliminary program-loading procedures; and initiation of automatic system operation.

Companion documents include:

- a. *Introduction to Programming*, DEC 1972
- b. *Programming Languages*, DEC 1970
- c. PDP-8/E Engineering Drawings
- d. PDP-8/F Engineering Drawings
- e. PDP-8/M Engineering Drawings
- f. *PDP-8/E & PDP-8/M Small Computer Handbook*, 1972.

## 1.2 DESCRIPTION

The PDP-8/E performs arithmetic calculations, controls machine operations, makes on-line measurements of both analog and digital information, and stores large quantities of data for future use and/or modification.

The machine design enables the user to purchase the basic PDP-8/E computer and add options as his requirements increase. The internal bus options logic and the peripheral controls logic is mounted on printed circuit boards called "quad" modules. These quad modules plug into slots in a two-way bus, called OMNIBUS, that is mounted on the computer chassis (see Chapter 9 of the *PDP-8/E & PDP-8/M Small Computer Handbook* for a description and photographs of the OMNIBUS and representative quad modules). One OMNIBUS contains 20 slots that are, for the most part, non-dedicated (see Table 2-3 for the recommended arrangement of quad modules on the OMNIBUS). Ten slots are needed for the basic computer; thus, 10 are available for expansion. An OMNIBUS expander enables the user to increase the number of slots by 20 (PDP-8/E only).

Further expansion of the PDP-8/E only, by a total of 40 slots, can be accomplished by connecting an expander box containing an OMNIBUS and an OMNIBUS expander to the basic computer. The PDP-8/F and PDP-8/M basic computer can be expanded by a total of 40 slots when an expander box containing the OMNIBUS and an OMNIBUS expander are connected to the basic chassis.

The PDP-8/E is currently available in table-top and rack-mountable versions (Figures 1-1 and 1-2, respectively). The PDP-8/F and the PDP-8/M are available in rack-mountable versions (Figures 1-3 and 1-4, respectively). Note that the PDP-8/E and the PDP-8/F are equipped with the KC8 Programmer's Console (KC8-EA and KC8-FL, respectively), while the PDP-8/M is equipped with the KC8-M Operator's Panel. Various front panel options are available for each basic computer; the user should consult the *PDP-8/E & PDP-8/M Small Computer Handbook* for complete information on all options.

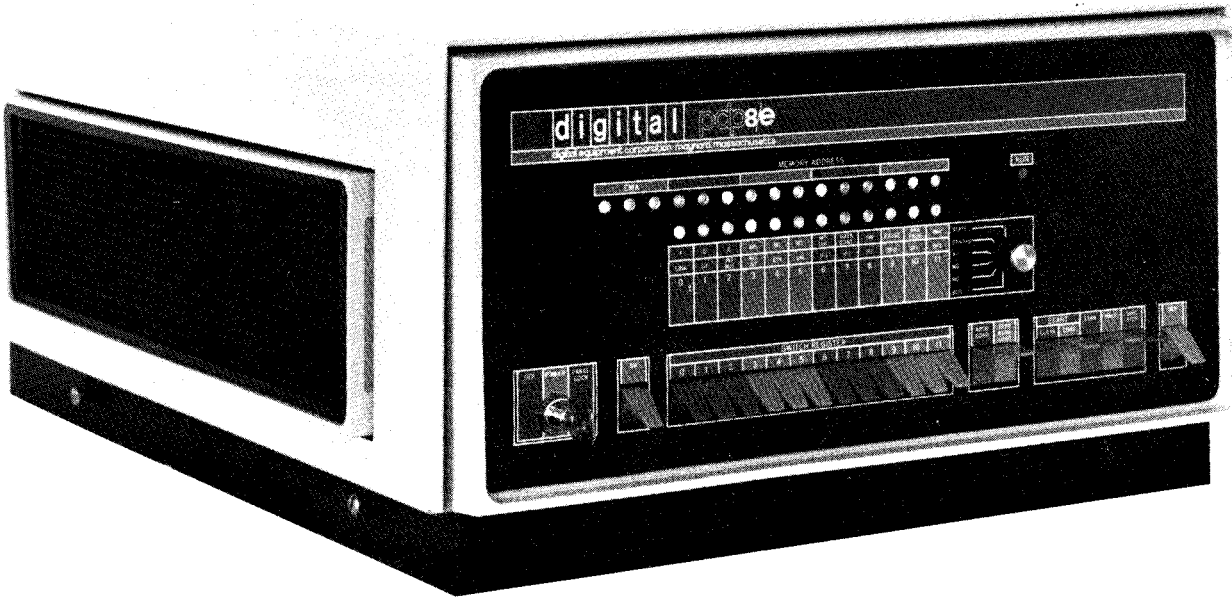


Figure 1-1 PDP-8/E Processor - Table-Top Model

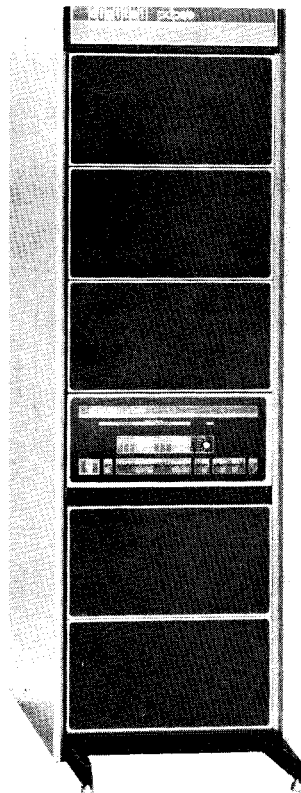


Figure 1-2 PDP-8/E Processor - Rack-Mounted Model



Figure 1-3 PDP-8/F Computer

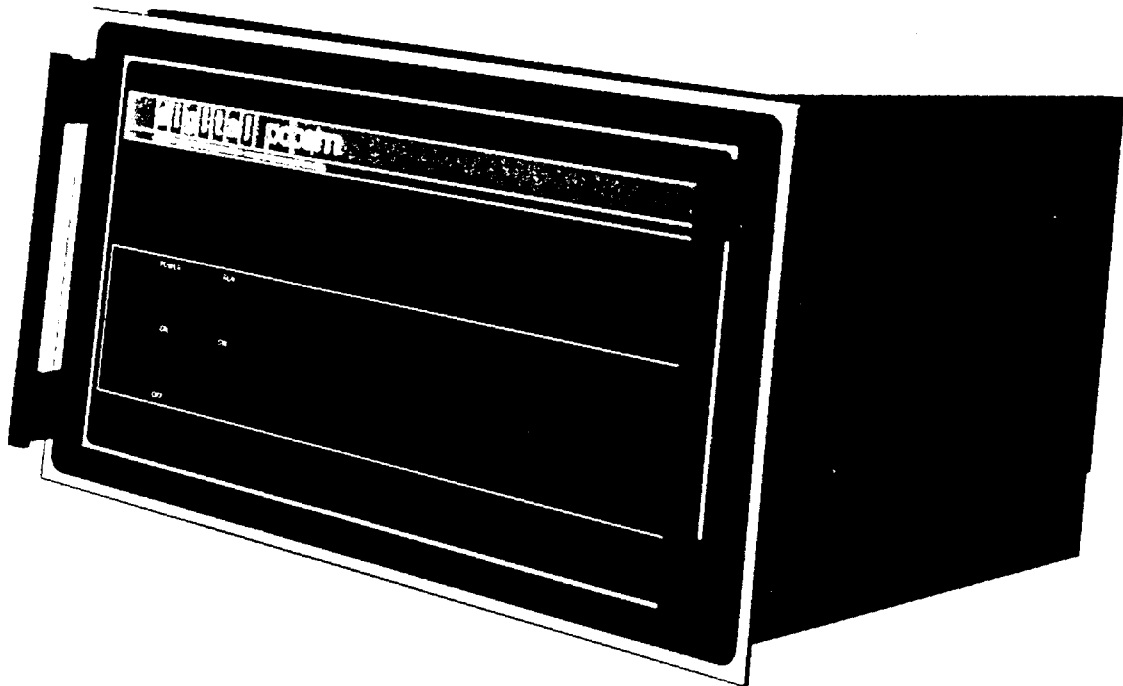


Figure 1-4 PDP-8/M Computer

The computer can be operated manually from the front panel (programmer's console) or automatically from program tapes that are either punched or entered via the companion Teletype reader/punch. More efficient methods of entering programs are available with magnetic tape system options, such as DECtape systems. Mass storage can be achieved by using magnetic tape or disk systems. Data can be displayed, via the 33 ASR Teleprinter, or by employing one of DEC's display system or line printer options.

### 1.2.1 Functional Description

The PDP-8/E basic computer uses 10 quad modules that connect to the OMNIBUS as illustrated in Figure 1-5 (also shown is the positive I/O bus interface, the data break interface, the power supply, and a block labeled "options" that represents connected internal and external options). Memory comprises three modules: Sense/Inhibit, X/Y Driver and Current Source, and Stack. The Central Processor Unit (CPU) comprises two modules: Major Register Control and Major Registers. The Timing Generator, bus loads, Teletype control, RFI shield, and the Programmer's Console each use one module. Power supply connections to the OMNIBUS are made through standard tabs located on the back of the OMNIBUS.

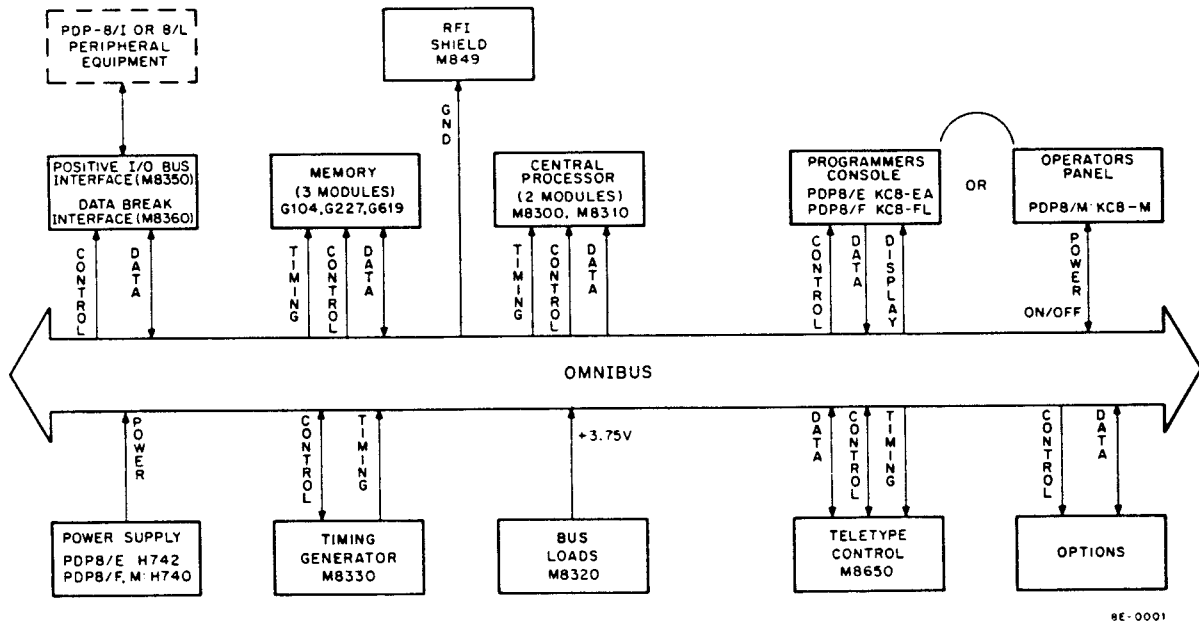


Figure 1-5 Basic Computer, Functional Block Diagram

System expansion can be accomplished in two ways: options can be added directly to the OMNIBUS, as already described; or, if the user has PDP-8/I or PDP-8/L compatible peripherals, the M8350 and M8360 interfaces will enable connection to the PDP-8/E OMNIBUS. The OMNIBUS is the signal path between options. Bus loads keep each signal line at a +3.75V level until a signal is asserted that causes the line on the OMNIBUS to go to ground. This permits maximum interplay between signal generators and data generating circuits. Three types of signals are used on the OMNIBUS, viz., control, timing, and data.

### 1.2.2 Physical Description

The PDP-8/E table-top model is 10½ inches high, 19 inches wide, 24 inches deep, and weighs 100 pounds. The rack-mountable model is 10½ inches high, 19 inches wide, 23¼ inches deep, and weighs 90 pounds. Both the PDP-8/F and the PDP-8/M are 10½ inches high, 19 inches wide, 13 inches deep (14½ inches deep with chassis slides), and weigh 35 pounds.

The machine construction minimizes the wiring (most signals are applied via the OMNIBUS). An internal view of the PDP-8/E is shown in Figure 1-6. The OMNIBUS, into which all modules are inserted, is secured to the bottom of the main frame next to the power supply. A cutaway on the side of the power supply provides an area in which all interface cabling can be run and secured.

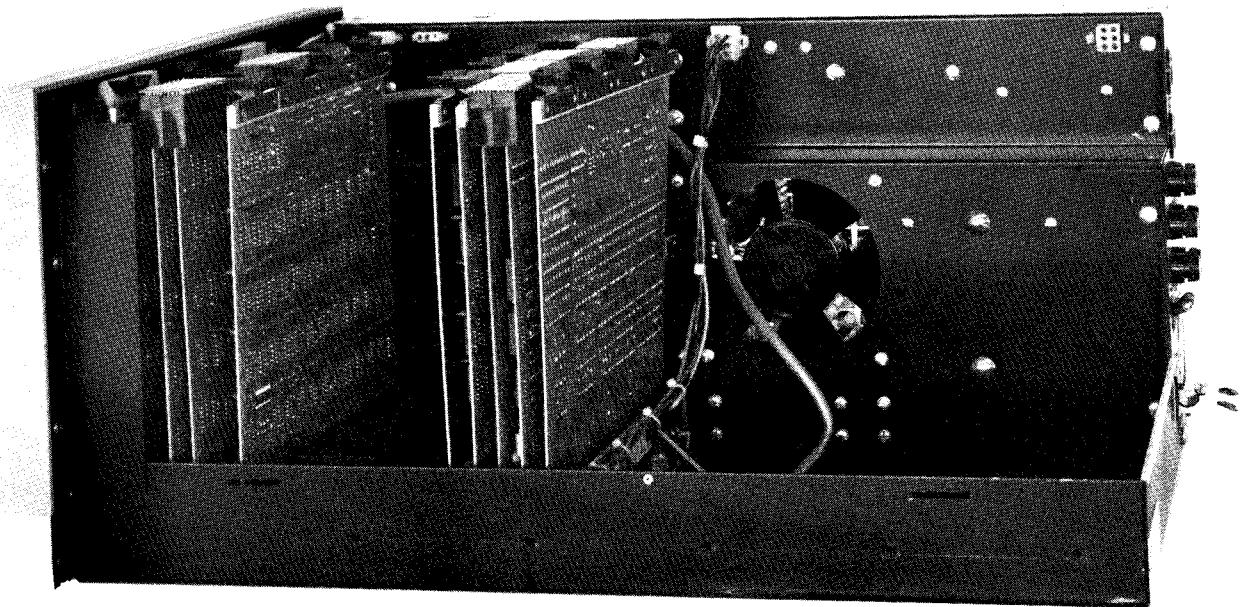


Figure 1-6 PDP-8/E Processor Without Cover

The PDP-8/E table-top model includes a super cover that completely encloses the top, rear, and sides of the main frame. A top cover is provided for the rack-mountable model (PDP-8/F and PDP-8/M, also). No air conditioning is required for the basic computers; fans located in the power supply provide adequate cooling.

### 1.3 TECHNICAL CHARACTERISTICS

The technical characteristics of the PDP-8/E processor are summarized in Table 1-1.

**Table 1-1**  
**PDP-8/E Technical Characteristics Summary**

Characteristics	PDP-8/E Specifications																								
Speed	<p>Two memory cycle speeds are provided:</p> <ul style="list-style-type: none"> <li>a. Fast cycle accomplishes a FETCH, internal IOT instruction, or DEFER (non-autoindex) in 1.2 <math>\mu</math>s.</li> <li>b. Slow cycle accomplishes (after FETCH) an instruction execution or DEFER (autoindex) in 1.4 <math>\mu</math>s.</li> </ul>																								
Instruction Execution Time (MRI only)	The instruction execution time, beginning with FETCH and ending with the instruction completely executed, requires one fast and one slow memory cycle or 2.6 $\mu$ s.																								
Word Length	12 bits.																								
Addressing Capability	Direct memory addressing is controlled on the front panel or through the Data Break System. Programmed addressing is accomplished as a function of software. 400 <sub>8</sub> memory locations can be directly addressed (except when on page 0) by the program during any one memory cycle, and 7400 <sub>8</sub> locations indirectly addressed.																								
Instruction Set	<p>Eight basic instructions constitute the instruction set.</p> <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 10%;">AND</td> <td style="width: 10%;">0000</td> <td>Logical AND</td> </tr> <tr> <td>TAD</td> <td>1000</td> <td>2's complement add</td> </tr> <tr> <td>ISZ</td> <td>2000</td> <td>Increment and skip if zero</td> </tr> <tr> <td>DCA</td> <td>3000</td> <td>Deposit and clear AC</td> </tr> <tr> <td>JMS</td> <td>4000</td> <td>Jump to subroutine</td> </tr> <tr> <td>JMP</td> <td>5000</td> <td>Jump to another memory location</td> </tr> <tr> <td>IOT</td> <td>6000</td> <td>In/Out transfer</td> </tr> <tr> <td>OPR</td> <td>7000</td> <td>Operate</td> </tr> </tbody> </table>	AND	0000	Logical AND	TAD	1000	2's complement add	ISZ	2000	Increment and skip if zero	DCA	3000	Deposit and clear AC	JMS	4000	Jump to subroutine	JMP	5000	Jump to another memory location	IOT	6000	In/Out transfer	OPR	7000	Operate
AND	0000	Logical AND																							
TAD	1000	2's complement add																							
ISZ	2000	Increment and skip if zero																							
DCA	3000	Deposit and clear AC																							
JMS	4000	Jump to subroutine																							
JMP	5000	Jump to another memory location																							
IOT	6000	In/Out transfer																							
OPR	7000	Operate																							
I/O Capability	<p>Three types of I/O transfers are provided:</p> <ul style="list-style-type: none"> <li>a. Programmed I/O data transfer</li> <li>b. Programmed interrupt I/O data transfers</li> <li>c. Data break I/O data transfers</li> </ul>																								
Memory Capacity	4096 12-bit word memory locations (up to 32K optional).																								
Power Input (processor)	95-130 Vac, 47-63 Hz, approx. 6A, single phase or 185-250 Vac, 47-63 Hz, approx. 3A, single phase 450W power dissipation.																								

**Table 1-1 (Cont)**  
**PDP-8/E Technical Characteristics Summary**

Characteristics	PDP-8/E Specifications
Power Input (Teletype)	115 ±10% Vac, 60 Hz ±0.45 Hz, or 230 ±10% Vac, 50 Hz ±0.50 Hz, 2A line current drain 150W power dissipation.
Environmental	The PDP-8/E is designed to operate from +0° to 55°C and with a relative humidity of from 10 to 95% (without condensation).
Cable Requirements	The PDP-8/E I/O cable is a combination shield and ribbon or coaxial cable. The maximum length of the data bus I/O cable is 30 ft using a coaxial or 25 ft using ribbon cable. Maximum length of the programmed I/O bus is 50 ft using coaxial or 45 ft using ribbon cable.

## CHAPTER 2 INSTALLATION

This chapter contains supplementary information and procedures for installing the PDP-8/E Computer System. Basic installation and planning information, such as space requirements, environmental requirements, installation requirements, and system configuration data, is provided in Chapter 11 of the *PDP-8/E & PDP-8/M Small Computer Handbook*. Installation functions and responsibilities are summarized in Table 2-1.

**Table 2-1  
Summary of Installation Functions**

Responsibility	Function
User	Identify space and power required for system configuration.
User/DEC Representative	Survey proposed site.
User/Optionally DEC Representative	Prepare site in accordance with environmental space and power requirements.
User/DEC Representative	Unpack equipment and check inventory checklist.
DEC Representative	Install equipment.
User/DEC Representative	Run customer acceptance test.
User	Enter results of acceptance test in log book.

### 2.1 SITE CONSIDERATIONS

Adequate site planning and preparation can simplify the installation process and result in an efficient, more reliable PDP-8/E system installation. DEC Sales Engineers or Field Service Engineers are available for counseling and consultation with user personnel regarding the installation.

Site planning should include a list of the actual components to be used in the installation; this list should also include such items as: storage cabinets, Teletype supplies, work tables, etc.

Primary planning considerations are:

- a. the availability and locations of adequate power
- b. protection against direct heat sources
- c. electrical noise radiation
- d. shock
- e. the existence of fire protection devices.

If existing environmental conditions dictate, air conditioning and/or dehumidifying equipment (though not required for the PDP-8/E) can become part of the site planning program.

### 2.1.1 Power Source

The power source should be free of conductive interference. To ensure interference-free power input, DEC offers a line filter option. In addition, all computer system supplies should be connected to the same power source to avoid loading and source differentials that may affect computer operation.

### 2.1.2 I/O Cabling Requirements

The cabling for table-top and rack-mounted computers differs slightly. For rack-mounted equipment, cables can be routed into the cabinet through a panel located at the bottom of the cabinet. Subflooring is not necessary because casters elevate the cabinet high enough to provide sufficient cable clearance. For table-top models, cables are routed from the lower rear side and then through the adjustable strain relief of the processor (Figure 2-1). The cabling should be located where it cannot be damaged. This is especially important if the processor and peripherals are not in close proximity.

### 2.1.3 Fire and Safety Precautions

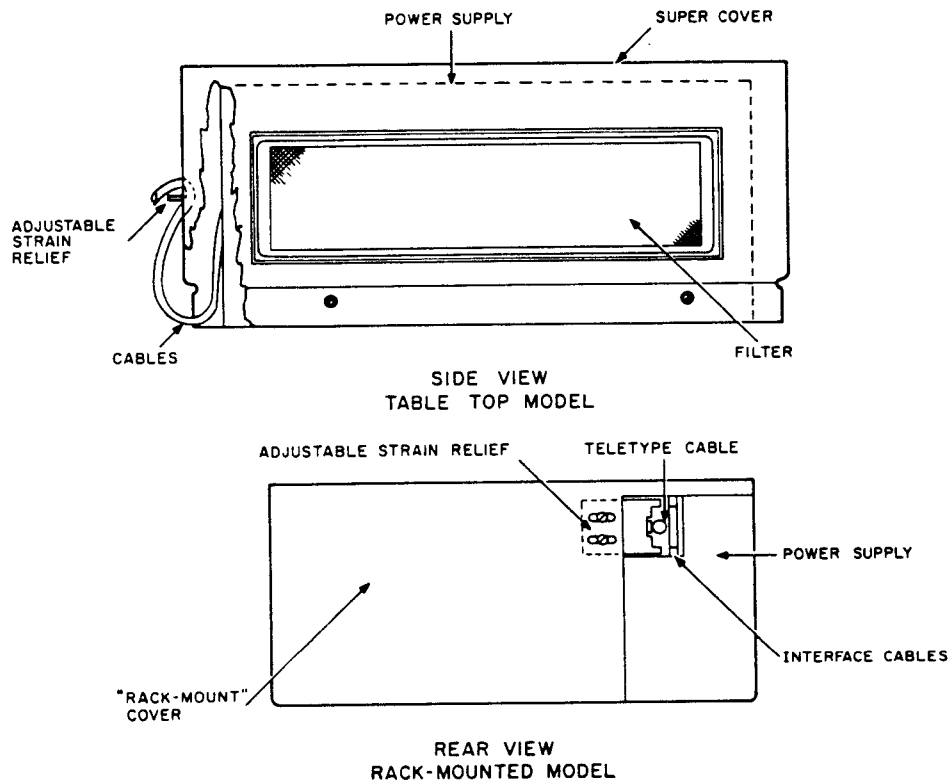
The PDP-8/E power supply contains a thermal cut-out switch, circuit breaker, and six fuses for protection against overheating and overloading. Both the cabinet and the power receptacle must be adequately grounded to ensure safe operation. A water pipe or steel beam provides an adequate ground. Refer to Chapter 11 of the *PDP-8/E & PDP-8/M Small Computer Handbook* for grounding and power installation procedures.

#### **WARNING**

**The frame of the computer must be grounded to protect personnel from dangerous electrical shock.**

Grounding is achieved automatically if a table-top computer with a 3-wire plug is used. However, a voltage reading from frame to ground should be performed initially.

Electrical fires, although extremely unlikely, should always be extinguished by a Class 3 (CO<sub>2</sub>) fire extinguisher.



8E-0002

Figure 2-1 Rack-Mounted and Table-Top Models

## 2.2 INSTALLATION

The PDP-8/E, PDP-8/F, and PDP-8/M Computers are shipped in secure, individual containers. Both the PDP-8/E and the PDP-8/F can also be shipped mounted in DEC cabinets; if this is the case, a fork-lift truck is necessary to move the pallet-mounted containers. To unpack and install the computer or cabinet only small hand tools — pliers, screwdrivers, etc. — and a volt-ohmmeter to check installation potentials are needed.

### 2.2.1 Unpacking

#### NOTE

Do not attempt to unpack or install the system until the DEC Sales Office has been notified and a Field Service representative is present. His presence is required to validate the warranty.

**2.2.1.1 Individual Containers** — If the computer is packaged in its own container, follow the steps listed below. Be sure to keep all packing material — cartons, spacers, pads, polyethylene bags, etc. — for reshipment, if such a step is contemplated.

- 1 Open the outer carton and remove the inner carton.
- 2 Open the inner carton.

- 3 If the computer is a PDP-8/E, remove the switch protector and carefully slide the computer, in its polyethylene bag, out of the carton.

If the computer is a PDP-8/F or PDP-8/M, lift off the side spacer; remove the filter, cables, software, etc., from the rear of the computer; push the computer against the rear of the box so that the switch protector can be removed; lift the computer, in its polyethylene bag, out of the carton.

- 4 Remove the polyethylene bag; untape the power cord from the rear of the computer.
- 5 If the computer is a PDP-8/E table-top model, attach the air filters to the sides of the super cover (the filters are shipped in a separate carton together with cables, software, manuals, etc.).

If the computer is a PDP-8/F or PDP-8/M, attach the air filter to the side of the computer; attach the chassis tracks with the hardware provided (the chassis tracks and hardware are shipped in a separate carton).

- 6 Check that all equipment specified on the accessory list has been received.

#### 2.2.1.2 Cabinet-Mounted Containers – If the computer is mounted in a cabinet, follow the steps listed below.

- 1 Remove the outer shipping container.

##### NOTE

The container can be either heavy corrugated cardboard or plywood. Remove all metal straps first, and then remove any fasteners and cleats securing the container to the skid. If applicable, remove the wood framing and supports from around the cabinet.

- 2 After removing the outer container, if applicable, remove the cardboard container.
- 3 Remove the polyethylene cover from the cabinet.
- 4 Remove the tape or plastic shipping pins from the cabinet rear door.
- 5 Unbolt the cabinet from the shipping skid. The bolts are located on the lower supporting side rails and can be reached by opening the access door.
- 6 Raise the leveling feet above the level of the casters.
- 7 Use wooden blocks and planks to form a ramp from the skid to the floor and carefully roll the cabinet onto the floor.
- 8 Roll the cabinet to the prepared site.

#### 2.2.2 Inspection

After unpacking, inspect and inventory the equipment.

- 1 Inspect the external surfaces of the chassis for surface, bezel, switch and light damage, etc.
- 2 Inspect the inside of the cabinet for console and processor damage, loose or broken modules, fan damage, loose nuts, bolts, screws, etc.

- 3 Inventory all hardware against the key sheet.
- 4 Inventory all software program tapes against the software checklist.
- 5 Inventory all prints against the drawing directory.

### 2.2.3 ac Power Check

Check the site power wiring as outlined below.

#### **WARNING**

**After the power plug has been inserted in the ac outlet, do not touch the computer or cabinet until it has been determined that the installation is properly grounded.**

- 1 Turn the power switch off.
- 2 Make sure that all ac power is received from the same source.
- 3 Insert the power plug into the ac outlet.
- 4 Use the volt-ohmmeter to ensure that there is no ac voltage from frame-to-ground.
- 5 Remove the power plug from the ac outlet.
- 6 Turn the power switch and circuit breaker on.
- 7 Repeat Steps 3 and 4.
- 8 Turn the power switch off.

### 2.2.4 Module Check

Check module jumpers according to Table 2-2; check module locations with the recommended order given in Table 2-3.

#### **NOTE**

**The recommended order of modules on the OMNIBUS will result in best-case timing and permit widest margins.**

**Table 2-2  
Jumpers**

Module	Location	Inserted	Omitted
M8330	Center	Slow Cycle Only	Fast Cycle/Slow Cycle
M8650	Upper Right	1) 37 ASR 2) 33 & 35 ASR	33 & 35 ASR 37 ASR
G104	Lower Right	EMA 0 = "0" EMA 1 = "0" EMA 2 = "0"	EMA 0 = "1" EMA 1 = "1" EMA 2 = "1"
<p>These are used to select which field this memory will be.</p> <p>(All inserted = Field "0")</p>			
G104	Middle Left	Slice voltage. Factory selected only.	
G227	Upper Middle	Current control. Factory selected only.	

**Table 2-3  
Recommended Module Installation Order**

Module Designation	Description
KC8-EA KC8-FL KC8-ML	Programmer's Console
M8330	Timing Generator (always after Programmer's Console)
M8340	EAE
M8341	EAE
M8310	C P Major Register Control
M8300	C P Major Registers
M837	Extended Memory & Time Share Control
.	.
.	.
.	.
.	Other Non-Memory Options
.	.
.	.
.	.
M8350	Positive I/O Bus Interface
M849	RFI Shield
G104	Memory Sense/Inhibit (0)
H220	Memory Stack (0)

**Table 2-3 (Cont)**  
**Recommended Module Installation Order**

Module Designation	Description
G227	Memory X/Y Drivers (0)
.	.
.	.
G104	Memory Sense/Inhibit (n)
H220	Memory Stack (n)
G227	Memory X/Y Drivers (n)
.	.
.	.
.	Other Memories
.	.
.	.
G105	Memory Sense/Inhibit (Parity)
H220	Memory Stack (Parity)
G227	Memory X/Y Drivers (Parity)
M8320	Bus Loads (always in last slot)

**2.2.5 Initial Operating Check**

Turn on the power switch and check the operation of the front panel switches and indicators. Use the following simple program to check the operation of the basic computer.

- a. Load Address 0000
- b. Deposit 7001
- c. Deposit 2101
- d. Deposit 5001
- e. Deposit 5000
- f. Load Address 0000
- g. Rotary Switch to AC position
- h. Clear and Cont
- i. Observe AC Register incrementing

**2.2.6 Teletype Unpacking, Assembly, and Initial Check**

- 1 Open the Teletype carton and remove the packing material. Remove the back cover from the stand. Remove and unwrap the copyholder, chad box, and power pack. Remove the stand from the shipping carton. Remove the Teletype console from the carton, holding it by the wooden pallet attached to the bottom. Snap the power pack in place at the top of the rear side of the Teletype stand. Remove the Teletype console from the pallet, and mount it on the stand. Remove reader, punch, and printer shipping restraints. Connect the Teletype console to the power pack (a 6-lead cable attached at the console is connected to the power pack by means of a white plastic Molex 1375 Female Connector that mates with a male output plug on the power pack). Pass the 3-wire power cable, and the 7-conductor signal cable (which is terminated by a Mate-N-Lok connector) through the opening at the lower left-hand corner of the Teletype stand; then replace the back cover of the stand using the two mounting screws.
- 2 Turn computer power off.

- 3 Connect Mate-N-Lok (with 2 ft cable on the M8650) to ensure that the Mate-N-Lok remains inside the cover.
- 4 Connect the 3-prong male connector of the Teletype power cable to the same ac power source as the computer.
- 5 Turn the POWER switch on.
- 6 Install a roll of printer paper into the Teletype keyboard/printer, and install a tape in the punch as described in the Teletype technical manual.
- 7 Set the LINE/OFF/LOCAL switch to LOCAL.
- 8 Verify off-line Teletype operation in accordance with the procedures in Chapter 2 of the *PDP-8/E & PDP-8/M Small Computer Handbook*.
- 9 Verify on-line Teletype punch and reader operation by performing the following test. Load address 0000 and deposit this routine in sequence:

Location	Contents
0000	6032
0001	6031
0002	5001
0003	6036
0004	6046
0005	6041
0006	5005
0007	5001

- 10 Load address 0000 and press START. Type any character on the keyboard and observe a corresponding echo return on the printer. 11/16,

### 2.3 ACCEPTANCE TEST

Perform the acceptance tests referenced in Table 2-4. If abnormal indications are encountered, terminate testing and refer to Chapter 4 for maintenance. Refer to Chapter 2 of the *PDP-8/E & PDP-8/M Small Computer Handbook* for loading the diagnostic programs. The procedure is the same as the example provided in Figure 2-9 of the handbook.

Equipment required: Computer (with 4K of R/W memory), MAINDEC, Programmer's Console, Teletype (33 or 35 ASR modified for operation with computer).

#### NOTE

**If Programmer's Console and Teletype, as described, are not part of the system being installed, they must be made available in good working order by the customer.**

**Table 2-4  
Acceptance Tests**

Program Name	MAINDEC No.	SA/SR Setting	Execute Time	Ind.	Accept. Time
Inst. Test I & II	8E-D0AA	200/7777	2 sec	Bell	3 min.
Inst. Test II	8E-D0BA	200/0000	2 sec	Bell	3 min
Adder Test	8E-D0CA	200/0000	35 min	1 SIMAD 2 SIMROT 3 FCT 4 RANDOM	35 min
Basic JMP JMS Test	8E-D0IA	200/0000	10 sec	Bell	3 min
Random TAD Test	8E-D0EA	200/0000	5 sec	T	3 min
Random AND Test	8E-D0DA	200/0000	2 sec	A	3 min
Random ISZ Test	8E-D0FA	200/0000	8 sec	FA	3 min
Random DCA Test	8E-D0GA	200/0000	5 sec	Bell	3 min
Random JMP Test	8E-D0HA	200/0000	8 sec	HA	3 min
Random JMP-JMS Test	8E-D0JA	200/0000	11 sec	JA	3 min
Memory Address Test	8E-DLEA	200/0000	50 sec	EA	5 min
Checkerboard Test	8E-DLAA	200/0000	5 min	5	15 min
Teletype Control Test	8E-D2AA	200/0000			40 min
Mem. ON/OFF Test	8E-DLGA	200/0000			

**NOTE** When ordering from Program Library:

PB for Binary Tape e.g., after MAINDEC-D0AA-PB  
D for Document MAINDEC-D0AA-D

