

**PDP-11/45, 11/50,  
and 11/55 system  
user's manual**

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## INTRODUCTION

The basic PDP-11/45 and 11/50 systems, prior to 1976, were available with a KB11-A central processor, an FP11-B floating point unit, and MOS or bipolar memory. With the introduction of a high-performance floating point unit (the FP11-C), the KB11-A underwent extensive revision, generating a new CPU version – the KB11-D. An entirely new system, including the KB11-D, FP11-C, and bipolar memory, is now available as a PDP-11/55. The PDP-11/45 and 11/50 systems are still available as they were prior to 1976, but the PDP-11/45 is now also available with the KB11-D and its compatible options.

This manual explains the installation procedures that apply to all components and options of the PDP-11/45, PDP-11/50, and PDP-11/55 systems. The basic PDP-11/50 system uses a KB11-A central processor and a solid-state (MOS) memory. The basic PDP-11/55 system uses the KB11-D central processor and bipolar memory. The basic PDP-11/45 system uses a KB11-A or KB11-D central processor and can have either (or both) MOS and bipolar memory. The basic PDP-11/45, 11/50, and 11/55 systems each generally contain a minimum of 16K words of memory.

All references to PDP-11/45 system in this manual also apply to PDP-11/50 and 11/55 systems, except where otherwise indicated. The manual is organized as follows:

Chapter 1 describes the basic system configurations and specifications and lists related reference documents and engineering drawings.

Chapter 2 details site preparation, unpacking and installation procedures, and installation checkout procedures for the basic system.

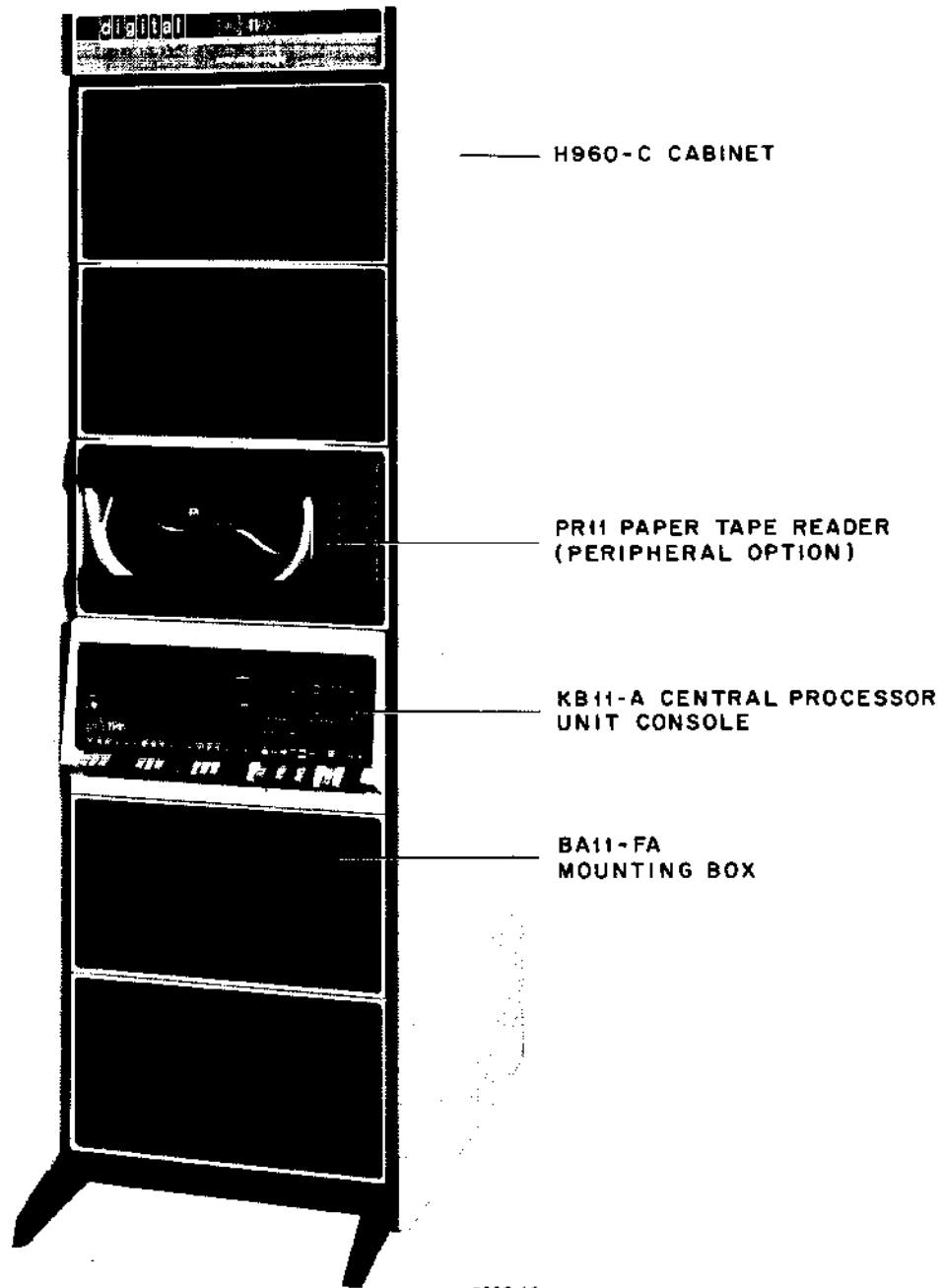
Chapter 3 presents a general description of the power distribution within the CPU cabinet.

Chapter 4 refers to the plug-in card options.

Chapter 5 refers to the system unit options.

Appendix A lists PDP-11 options and their specifications.

The major components and options for the PDP-11/45, 11/50, 11/55 systems are individually described in a series of manuals listed in Table 1-8, Related Documentation.



Typical PDP-11/45, 11/50, 11/55 System

# CHAPTER 1

## GENERAL DESCRIPTION

### 1.1 BASIC SYSTEM DESCRIPTION

The basic PDP-11/45, 11/50, 11/55 system components are located in a single H960 Cabinet Assembly (Figures 1-1 and 1-2). Table 1-1 lists the major components and assemblies included in the basic PDP-11/45 system. Table 1-2 lists components and major assemblies included in the basic PDP-11/50 system. Table 1-3 lists the major components and assemblies included in the basic PDP-11/55 system.

Note that four different power distribution systems exist for the PDP-11/45, 11/50, and 11/55 systems due to accumulated revisions. Paragraph 3.3 explains the revisions and Table 3-2 lists the power system versions. Note also that the PDP-11/55 uses only the latest version; the PDP-11/50 and the PDP-11/45 can have any of the four power system versions depending upon the date of manufacture.

#### 1.1.1 Physical Characteristics

The overall dimensions of the cabinet supplied with the basic PDP-11/45, 11/50, 11/55 systems are:

Height:	71-7/16 in. (181.3 cm)
Width:	21-11/16 in. (54 cm)
Depth:	30 in. (76 cm)
With Cabinet Feet:	39 in. (99 cm)

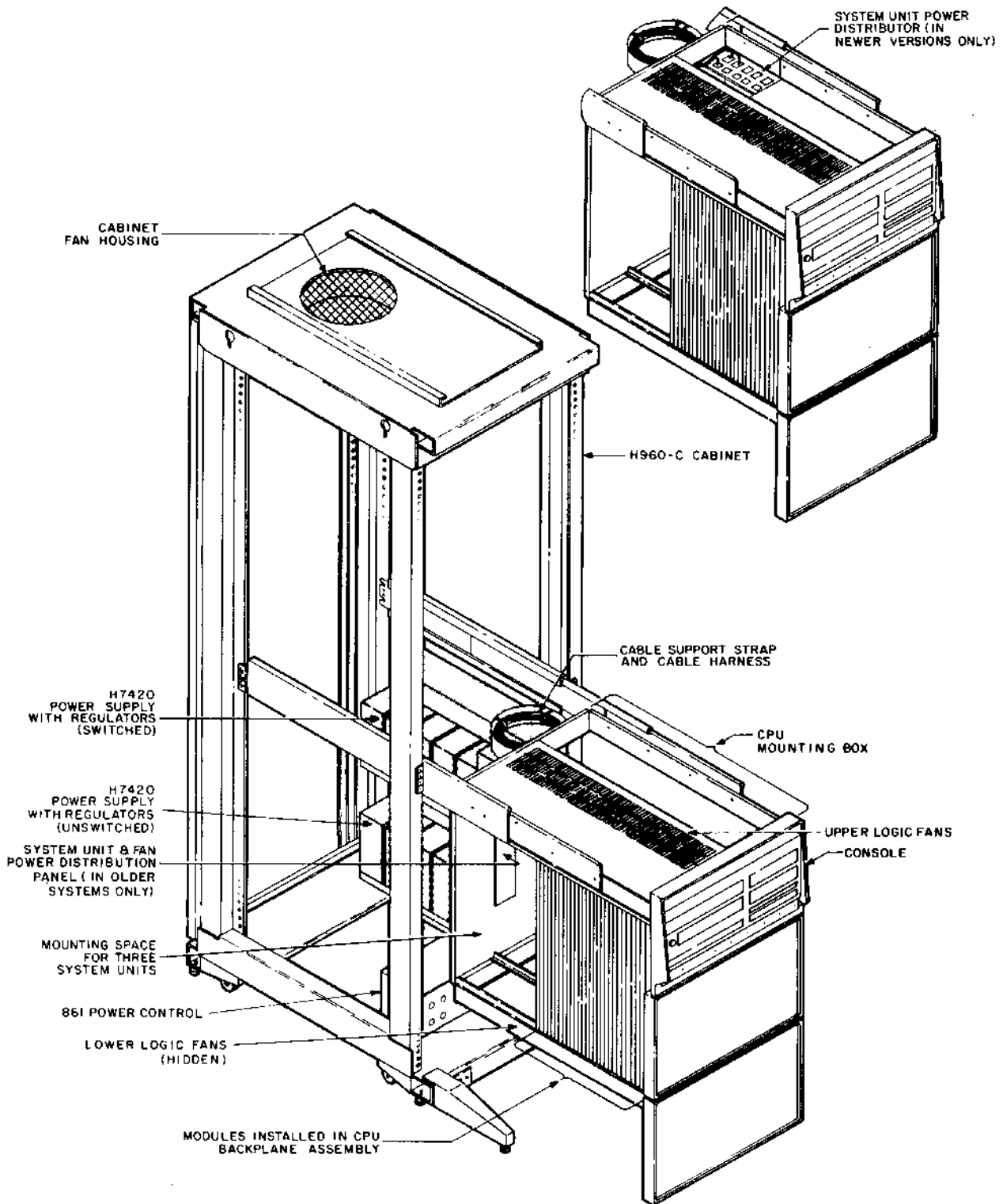
A fully configured cabinet with all options implemented and three additional system units weighs approximately 300 lb (135 kg). Maximum weight, with peripherals, is approximately 500 lb (225 kg).

Additional details are provided on engineering drawings D-UA-H960-D-0, Cabinet Assembly, and E-UA-H950-A-0, H950A 19-Inch Frame Assembly.

#### 1.1.2 General Power Requirements and Electrical Specifications

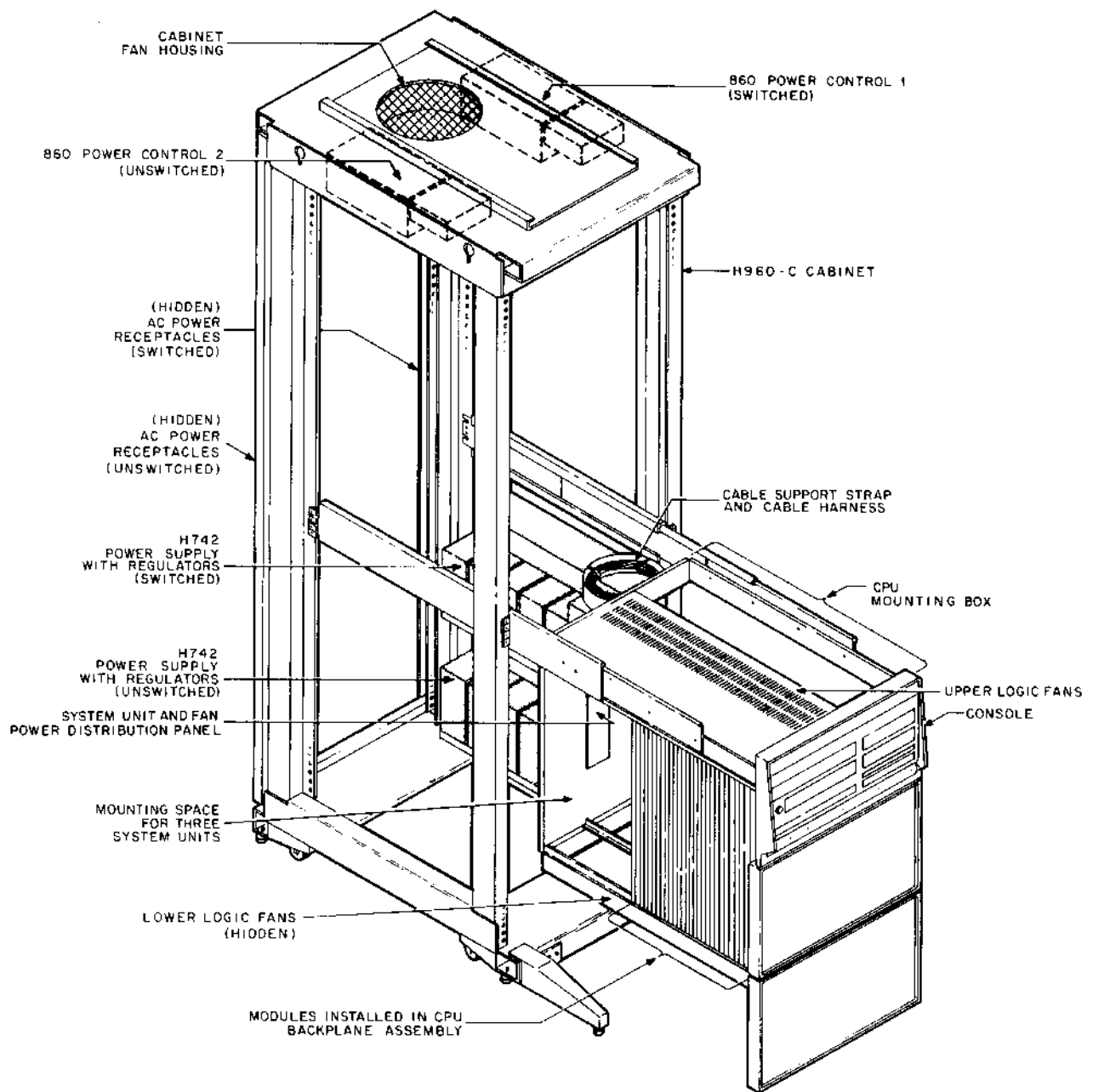
The 11/45, 11/50, and 11/55 come in many configuration variations depending upon the various combinations of options that are used together. However, from an input power standpoint only two variations need be considered: a 115 V two-phase (or two of three phases) variation of which the 11/45-CA will be taken as an example, and a 230 V variation of which the 11/45-CB will be taken as an example.





11-4303

Figure 1-1 Location of Major Components and Assemblies Showing New Models Using 861 Power Control



11-2290

Figure 1-2 Location of Major Components and Assemblies Showing 860 Power Controls Used on Early Models

**Table 1-1 Basic PDP-11/45 Configuration**

Item*	Description
Cabinet Assembly	Refer to Figure 1-1. Houses all other major assemblies and components, except terminal.
CPU Mounting Box	Refer to Figure 1-1. Houses KB11-A, D CPU plus other 11/45 options.
KB11-A, D Central Processor Unit	Basic 16-bit processor logic module installed in wired CPU backplane (part number 7008871). See Table 1-2 for KB11-A modules and Table 1-3 for KB11-D modules.
H7420 Power Supplies†	Refer to Figure 1-1. Upper H7420 provides switched power; lower H7420 provides unswitched power.
H744 +5 Regulators	Three H744 +5 V regulators installed in upper H7420 power supply (slots B, C, and D).
H745 -15 Regulator	One H745 -15 V regulator installed in upper H7420 power supply (slot E).
861 Power Control	Refer to Figure 1-1. Controls both switched and unswitched H7420 power supplies. Replaces two 860 power controls used on early systems as shown in Figure 1-2.
MF11-UP 16K Core Memory and Control	Provides 16K core memory, with parity. Mounts in two system unit locations on BA11-FA.
MM11-UP 16K Core Memory	Additional 16K core memory to provide total 32K core memory for basic system.
LA36 DECwriter	Serial I/O terminal; described in related manual.
DL11-A Terminal Control	LA36 DECwriter II interface to Unibus; described in related manual.

\*Items listed are major components of basic PDP-11/45-CC, -CD systems. Refer to engineering drawing A-PL-11/45-0-0 for complete parts list for all PDP-11/45 systems.

†Early versions of the PDP-11/45 used H742 power supplies.

**Table 1-2 Basic PDP-11/50 Configuration**

Item*	Description
Cabinet Assembly	Refer to Figure 1-1. Houses all other major assemblies and components, except terminal supplied.
CPU Mounting Box	Refer to Figure 1-1. Houses KB11-A CPU, plus other 11/50 options.
KB11-A Central Processor Unit	Basic 16-bit processor logic modules installed in wired CPU backplanes (part number 7008871).
Consists of the following:	<ul style="list-style-type: none"> <li>M8100 DAP Module      Data and address paths (slot 6)</li> <li>M8101 GRA Module     General registers and control (slot 7)</li> <li>M8102 IRC Module     Instruction register and decode (slot 8)</li> <li>M8103 RAC Module     ROM and ROM control (slot 9)</li> <li>M8104 PDR Module     Processor data and Unibus registers (slot 10)</li> <li>M8105 TMC Module     Trap and miscellaneous control (slot 11)</li> <li>M8106 UBC Module     Unibus and console control (slot 12)</li> <li>M8116 SJB Module     System jumper board (slot 14)</li> <li>M8109 TIG Module     Timing generator (slot 15)</li> </ul>
H7420 Power Supplies†	Refer to Figure 1-1. Upper H7420 provides switched power, lower H7420 provides unswitched power for MOS memory.
H744 +5 Regulators	Three H744 +5 V regulators installed in upper H7420 power supply (slots B, C, and D).
H745 -15 Regulator	One H745 -15 V regulator installed in upper H7420 power supply (slot E).
861 Power Control	Refer to Figure 1-1. Controls both switched and unswitched H7420 power supplies. Replaces two 860 power controls used on early systems as shown in Figure 1-2.
MS11-BC MOS Memory Control	Controls up to two 16K of MOS memory; described in related manual.
Consists of the following:	<ul style="list-style-type: none"> <li>M8110 SMC Module     Semiconductor memory control (slots 16 and 21)</li> <li>H744 +5 Regulator     One H744 +5 V regulator installed in lower H7420 power supply (slot J)</li> <li>H746 MOS Regulator   One H746 MOS regulator installed in low H7420 power supply</li> </ul>
MS11-BP 4K MOS Memory	Up to eight can be used to provide up to 32K MOS memory.
Consists of the following:	<ul style="list-style-type: none"> <li>G401 YA MOS Memory Matrix   Each provides 4K words of MOS memory with two additional bits for byte parity storage (slots 17, 18, 19, and 20).</li> </ul>
LA36 DECwriter	Serial I/O terminal; described in related manual.
DL11-A Terminal Control	LA36 DECwriter II interface to Unibus; described in related manual.

\* Items listed are major components of basic PDP-11/50-CC,-CD systems. Refer to engineering drawing A-PL-11/50-0-0 for complete parts list for all PDP-11/50 systems.

† Early versions of the PDP-11/50 used H742 power supplies.

**Table 1-3 Basic PDP-11/55 Configuration**

Item*	Description
Cabinet Assembly	Refer to Figure 1-1. Houses all other major assemblies and components, except terminal supplied.
CPU Mounting Box	Refer to Figure 1-1. Houses KB11-D CPU, plus other 11/55 options.
KB11-D Central Processor Unit	Basic 16-bit processor logic modules installed in wired CPU backplane (part number 7008871).
Consists of the following:	
M8100 DAP Module	Data and address paths (slot 6)
M8101 GRA Module	General registers and control (slot 7)
M8132 IRC Module	Instruction register and decode (slot 8)
M8123 RAC Module	ROM and ROM control (slot 9)
M8104 PDR Module	Processor data and Unibus registers (slot 10)
M8105 TMC Module	Trap and miscellaneous control (slot 11)
M8119 UBC Module	Unibus and console control (slot 12)
M8109 TIG Module	Timing generator (slot 15)
KT11-CD Memory Management Unit	Basic 18-bit extension of the processor address space.
Consists of the following:	
M8107 SAP Module	System address path (slot 14)
M8108-YA SSR Module	System status register
H7420 Power Supplies	Refer to Figure 1-1. Upper H7420 provides switched power, lower H7420 provides unswitched power for bipolar memory.
H744 +5 Regulators	Three H744 +5 V regulators installed in upper H7420 power supply (slots B, C, and D).
H745 -15 Regulator	One H745 -15 V regulator installed in upper H7420 power supply (slot E).
861 Power Control	Refer to Figure 1-1. Controls both switched and unswitched H7420 power supplies. Replaces two 860 power controls.
MS11-CC Bipolar Memory Control	Controls up to two 16K bipolar memory; described in related manual.
Consists of the following:	
M8120 SMC Module	Semiconductor memory control (slots 16 and 21)
H744 +5 Regulator	Two H744 +5 V regulator installed in lower H7420 power supply (slots H and J)
MS11-AP 4K Bipolar Memory	Up to eight can be used to provide up to 32K bipolar memory.
Consists of the following:	
M8121-YA Bipolar Memory	Each provides 4K words of bipolar memory with two additional bits for byte parity storage (slots 17, 18, 19, and 20).
M9301-YB Bootstrap Loader	Provides memory space for bootstrap programs (slots A and B).

**Table 1-3 Basic PDP-11/55 Configuration (Cont)**

Item*	Description
LA36 DECwriter	Serial I/O terminal; described in related manual.
DL11-W Terminal Control	LA36 DECwriter II interface to Unibus; described in related manual. Replaces DL11-A and KW11-L of early 11/55 version (slot DEV.1).
DL11-A Terminal Control†	LA36 DECwriter II interface to Unibus; described in related manual.
KW11-L Line Time Clock†	Provides timing pulses for DECwriter; described in related manual (slot 1).

\*Items listed are major components of basic PDP-11/55-CC,-CD systems. Refer to engineering drawing A-PL-11/55-0-0 for complete parts list for all PDP-11/55 systems.

†Items used only in early production versions instead of the DL11-W Terminal Control

The 11/45-CA and 11/45-CB variations consist of the following:

	11/45-CA	11/45-CB
Central Processor (no options installed)	KB11-A,D	KB11-A,D
Cabinet	H960-C	H960-C
Mounting Box	BA11-FA	BA11-FA
Power Control	861-A (115 V two-phase)	861-B (230 V single-phase)
Power Supply (2)	H7420-A (or H742-A)	H7420-B (or H742-B)

Table 1-4 provides the input specifications for the 11/45-CA and 11/45-CB variations. These specifications will apply equally to the corresponding 11/50 and 11/55 configurations.

**1.1.2.1 Internal Option Power Requirements** - For a given 11/45, 11/50, 11/55 CPU configuration the total power required will be dependent on the options installed. Table 1-5 lists option dc power, ac power, and ac current. To determine the total ac power and ac current for a given system configuration, the ac powers and ac currents for the options (from Table 1-5) must be added to the basic power and current specified in Table 1-4.

**Table 1-4 Input Specifications**

<b>Characteristic</b>	<b>11/45-CA</b>	<b>11/45-CB</b>
Voltage		
Range	95–130 Vrms-ac	190–260 Vrms-ac
Nominal	115 Vrms-ac	230 Vrms-ac
Frequency	47–63 Hz	47–63 Hz
Power	870 W* (2971 Btu/hour)	870 W* (2971 Btu/hour)
Current	9 Arms*	4.5 Arms*
Over-Voltage (period < 50 ms)	Up to 180 Vrms-ac	Up to 360 Vrms-ac
Inrush Current (< 20 ms)	240 A peak/phase	150 A peak/phase
Line Dips and Outages		
Extended Operation:	> 95 Vrms-ac	> 190 Vrms-ac
Temporary Line Loss:	The dc outputs of the power supplies will remain within tolerance for at least 20 ms after loss or reduction of power below operating range. The power-fail warning signals to the KB11-A, D will be generated in time for an orderly shutdown before loss of dc regulation.	
Circuit Breaker Rating	20 A/phase for each of two phases, simultaneous trip	
Voltage Dynamic Variation	< ±10%/second	
Harmonic Distortion	< 5% of fundamental	
Single Harmonic	< 3% of fundamental	
High Voltage Transients (either polarity, differential or common mode)	< 300 V peak (< 0.2 watt-second) < 0.5 W average power	
Single Transients	< 600 V peak (< 2.5 watt-second)	

\*Basic configuration only, for calculating total input power and current with options installed, see Paragraph 1.1.2.1.

**Table 1-5 Option Power Requirements (Maximum)**

Option	Name	DC Power (watts)	AC Power		AC Current (AMPS)	
			(watts)	(Btu/hour)	@ 115 V	@ 230 V
KB11-A	Central Processor	145	290	990	3.8	1.9
KB11-D	Central Processor	145	290	990	3.8	1.9
FP11-B	Floating Point Processor	75	150	512	1.5	0.75
FP11-C	Floating Point Processor	125	250	854	2.6	1.3
KT11-C	Memory Management	40	80	273	0.8	0.4
KT11-CD	Memory Management	40	80	273	0.8	0.4
MS11-AP	4K Bipolar Parity Memory Matrix	60	120	410	1.3	0.7
MS11-BC, BD	MOS Memory Control	15	30	130	0.3	—
MS11-BM, BP, BR, BT	4K MOS Memory Matrix	40	80	273	0.8	0.4
MS11-CC	Bipolar Memory Control	15	30	102	0.3	0.15
MS11-CM, CP	1K Bipolar Memory	55	110	376	1.2	0.6

**NOTES**

1. KB11-A and KB11-D are included for reference only. They are already included in the basic 11/45-CA and 11/45-CB specifications.
2. Each type of memory matrix requires a memory control.



There is mounting space for three system unit options (SU) at the rear of the CPU box. In addition, the CPU backplane is prewired for three quad-height small-peripheral controller modules (SPC). The processor power supply provides power to these option mounting areas via the harness and backplane. The amount of power available is shown below.

+5.0 V :24.0 A	} SU locations only
+15.0 V :1.5 A	
+20.0 V :8.0 A	
-5.0 V :8.0 A	
-15.0 V :9.5 A	

#### NOTE

The slot E H754 may be removed and an H745 installed in its place. (Machines with serial numbers less than 2000 always have the H745 in slot E.) With the H745 regulator in slot E:

1. There is an additional 9.5 A of -15 V available to the three SPC slots (in the CPU backplane).
2. There is an additional 10 A of -15 V available to the three system unit locations at the back of the CPU box.
3. There is NO +20 V or -5 V available to the three system unit locations at the back of the CPU box.

**1.1.2.2 Determining Option Power and Line Current Requirements** - To determine the power and line current required by non-CPU options not listed in Table 1-5, perform the calculations below. An example is also provided.

1. Find the maximum total dc current for each supply voltage used by an option and then multiply the total current by its respective voltage and add the products to determine the total dc power requirement.

*Example:*

$$\begin{aligned}
 \text{MF11-U} &= +5 \text{ V @ } 6.1 \text{ A} = 30.5 \text{ watts dc} \\
 &+20 \text{ V @ } 3.4 \text{ A} = 68.0 \text{ watts dc} \\
 &-5 \text{ V @ } 0.5 \text{ A} = \underline{2.5 \text{ watts dc}} \\
 \text{Total dc power requirement} &= 101.0 \text{ watts dc}
 \end{aligned}$$

2. Double the dc power requirement to obtain the ac power requirement. (Combined efficiency of regulator and transformer is 50% minimum.)

*Example:*

$$\begin{array}{r} 101 \text{ watts dc (from step 1)} \\ \times 2 \\ \hline 202 \text{ watts ac} \end{array}$$

3. Divide ac power by 0.85 to compensate for worst case power factor to give maximum input volt-amperes (reactive) and then divide again by 115 V (or 230 V) to obtain nominal ac current for the option.

*Example:*

$$\text{a. } \frac{202.0 \text{ watts ac}}{0.85} = 237.6 \text{ volt-amperes (reactive)}$$

$$\text{b. } \frac{237.6 \text{ volt-amperes (reactive)}}{115} = 2.07 \text{ amperes rms ac}$$

Total ac current requirement = 2.07 amperes rms

4. To obtain Btu/hour, multiply total watts ac (step 2) by 3.415 (Btu/watt-hour).

*Example:*

$$\begin{array}{r} 202 \text{ watts} \\ \times 3.415 \text{ Btu/watt-hour} \\ \hline 689.8 \text{ Btu/hour} \end{array}$$

### 1.1.3 H7420 Power Supply Characteristics

Each H7420 contains space for up to five plug-in voltage regulators (See Paragraphs 1.1.4 and 1.1.5). These regulators furnish dc to the processor backplane and the processor console. In addition to the regulators, each H7420 contains a 5411086 regulator. The 5411086 in the upper H7420 provides +8 and 15 V to the processor backplane and functions as a power line monitor for the upper supply. The upper 5411086 also produces the line clock output that is used to drive the KW11-L or DL11-W (Line Frequency Clock option). The 5411086 in the lower H7420 provides -15 V to the processor and monitors the lower power supply's input line voltage.

Each H7420 also contains an input terminal block and transformer assembly. The input terminal block in the upper H7420 provides 115 Vac to the elapsed time meter, power supply fans, and transformer primary. The input terminal block in the lower H7420 provides 115 Vac to the power supply fans, transformer primary, and the processor mounting box fans. By altering a jumper configuration on the terminal block, 230 Vac operation is available. The transformer produces 20-30 Vac for its associated voltage regulators.

### 1.1.4 H742 Power Supply Characteristics

Each H742 power supply has space for five plug-in voltage regulator modules. One function of each H742 power supply is to provide 20-30 Vac to its associated voltage regulators. They also provide the power fail control signals AC LO and DC LO, to the processor. The upper H742 provides +15 Vdc at 3A to enable the H745 -15 V regulators and the M8109 TIG module, +8 Vdc for maintenance card indicators, and the line clock signal. The lower H742 provides -15 Vdc to the M8110 SMC module when the MS11 Semiconductor Memory System is installed in the system.

### 1.1.5 Voltage Regulator Characteristics

In a basic system, the upper H742 is equipped with three H744 +5 V regulators (in slots B, C, and D) and an H745 -15 V regulator (in slot E). As options are added to the basic system, additional H744 +5 V, H745 -15 V, and/or an H746 MOS regulator are added to slots A, F, H, J, K, and L; an H754 regulator replaces the slot E -15 V regulator if options requiring +20 V and -5 V (such as MF11-U/UP) are installed in system units 1, 2, or 3 (refer to Table 1-6).

### 1.1.6 Interface Specifications

The PDP-11/45, 11/50, 11/55 system is completely compatible with the standard PDP-11 Unibus interface, which is fully described in a related manual. Provision is made on the CPU backplane for two separate PDP-11 Unibus interface connections, designated Unibus A and Unibus B. Block diagrams of the system Unibus interfaces are shown in Figure 1-3. Briefly, Unibus A connects directly to the KB11-A, D, and Unibus B connects to the MS11 Semiconductor Memory System when that option is implemented in the system. Unibus interconnection details are provided in Chapter 2 of this manual (Paragraph 2.3.5.1).

### 1.1.7 Environmental Specifications

The basic PDP-11/45, 11/50, 11/55 electronics operate in the following environment (at sea level):

Temperature range        50° to 110° F (10° to 40° C)

Relative humidity        10% to 90%  
(without condensation)

For operation above sea level, the maximum operating temperature must be reduced by 1.0° F/1000 ft (1.6° C/1000 m).

Peripheral equipment associated with the system may require closer environmental tolerances. Refer to Appendix A for specifications.

## 1.2 SYSTEM CONFIGURATIONS AND OPTIONS

Table 1-6 lists some of the PDP-11/45 options that can be implemented within the CPU mounting box. A block diagram that shows the relationship of these options is provided in Chapter 1 of the *KB11-A, D Central Processor Unit Maintenance Manual*. Peripherals or options that may be installed in the upper half of the H960-CD cabinet are not included in Table 1-6.

### 1.3 EXPANSION CABINET OPTION

An H960-D expansion cabinet option is available with the PDP-11/45, 11/50, 11/55 systems. It is not included as part of the basic system, but may be ordered as required to house additional peripheral devices or memory. The basic components that may be included in each expansion cabinet option are summarized in Appendix A.

The H960-D cabinet includes a BA11-FB mounting box in the lower half of the cabinet which provides space for nine system units. The upper half of the H960-D cabinet is available for mounting other equipment. The H960-D includes an H7420 power supply that can adequately service the nine system units that can be installed in the BA11-FB mounting box. Additional power supplies must be provided for or included as part of the additional equipment that is installed in the upper half of the cabinet.

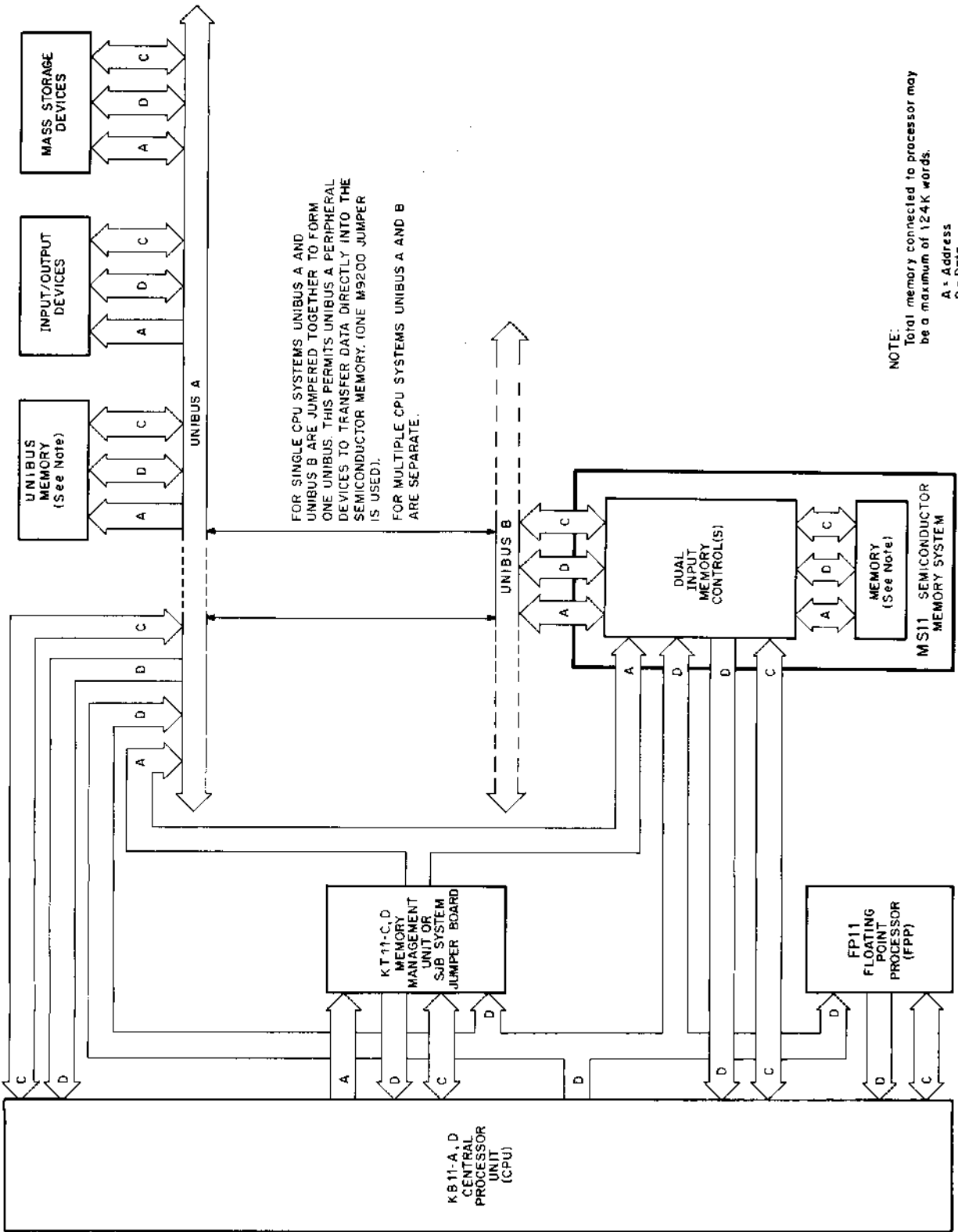


Figure 1-3 Unibus A and B Connectors

Table 1-6 PDP-11/45 System Options

Option*	Description
<b>FP11-B, C Floating Point Processor</b>	
<p>Consists of the following:</p> <p><b>FP11-C FP11-B</b>  M8128 M8112 FRM Module  M8129 M8113 FXP Module  M8126 M8114 FRH Module  M8127 M8115 FRL Module  H744 +5 V Module</p>	<p>Described in related manual.</p> <p>Logic modules mount in CPU backplane, in slots indicated.</p> <p>FP ROM and ROM control (slot 4).  FP exponent and data path (slot 5).  Fraction data path – high order (slot 2).  Fraction data path – low order (slot 3).  Mounts in space provided on upper H7420 power supply (slot A).</p>
<b>KT11-C, CD Memory Management Unit</b>	
<p>Consists of the following:</p> <p><b>KT11-CD KT11-C</b>  M8108-YA M8108 SSR Module  M8107 SAP Module</p>	<p>Described in related manual. Required for all systems with more than 28K of memory. Permits addressing of up to 124K of memory.</p> <p>Logic modules mount in CPU backplane in slots indicated.</p> <p>System status registers (slot 13).  System address path (slot 14, replaces the M8116 SJB module).</p>
<b>KW11-L Line Frequency Clock</b>	
<p>Consists of the following:</p> <p>M787 Line Time  Clock Module</p>	<p>Described in related manual. Mounts in CPU backplane slot 1, row C.</p>
<b>MS11-B MOS Memory</b>	
<p>MS11-BC MOS Memory Control</p> <p>Consists of the following:</p> <p>M8120 SMC Module</p> <p>H744 +5 V Regulator</p> <p>H746 MOS Regulator</p>	<p>Described in MS11 manual. Controls up to four G401 or G401YA MOS memory matrix modules (16K words of MOS memory).</p> <p>Semiconductor memory control for first 16K of MOS memory. Mounts in CPU backplane (slot 16).</p> <p>One required. Mounts in slot J of lower H7420 power supply.</p> <p>One required. Mounts in slot H of lower H7420 power supply.</p>

\*See engineering drawings for complete parts lists.

Table I-6 PDP-11/45 System Options (Cont)

Option*	Description
<b>MS11-B MOS Memory (Cont)</b>	
MS11-BD MOS Memory Control	Second MOS memory control for up to additional 16K words of MOS memory.
Consists of the following:	
M8110 SMC Module	Semiconductor memory control for second 16K of MOS memory. Mounts in CPU backplane (slot 21).
H746 MOS Regulator	One additional H746 voltage regulator is required for second 16K of MOS memory. Mounts in slot L of lower H7420 power supply.
MS11-BM 4K MOS Memory	Provides 4K words of MOS memory.
Consists of the following:	
G401 MOS Memory Matrix	Mounts in CPU backplane. Slots 17 through 20 accommodate first four 4K modules. Slots 22 through 25 accommodate second four 4K modules.
MS11-BP 4K MOS Memory	Provides 4K words of MOS memory with two additional bits for byte parity storage.
Consists of the following:	
G401YA MOS Memory Matrix	Mounted in CPU backplane in same configuration indicated for G401 modules.
<p><b>NOTE</b></p> <p>A complete 32K MOS memory system consists of two M8110 SMC Modules, eight G401 MOS Memory Matrix Modules, one H744 +5 V Regulator, and two H746 MOS Regulators.</p>	
<b>MS11-A, C Bipolar Memory</b>	
MS11-CC Bipolar Memory Control	Described in MS11 manual. Controls up to four M8111 or M8121-YA Bipolar Memory Matrix Modules.
Consists of the following:	
M8120 SMC Module†	Semiconductor memory control. Mounts in CPU backplane Control for first 4K of bipolar memory mounts in slot 16 Control for second 4K of bipolar memory mounts in slot 21.
H744 +5 V Regulators	Two required for each 4 bipolar memory matrix modules. If no MOS memory is implemented, H744s mount in lower H7420 power supply slots H and J. If MOS is implemented, H744s for bipolar memory mount in lower H7420 power supply slots K and L.

\*See engineering drawings for complete parts lists.

†Early versions of the MS11-CC used an M8110 SMC Module.

Table 1-6 PDP-11/45 System Options (Cont)

Option*	Description
<b>MS11-A, C Bipolar Memory (Cont)</b>	
<p>MS11-AP 4K Bipolar Memory</p> <p>Consists of the following:</p> <p style="padding-left: 40px;">M8121-YA Bipolar Memory Matrix Module</p>	<p>Provides 4K words (18 bits: 16 bits plus 2 bits for byte parity storage) of bipolar memory.</p> <p>Mounts in CPU backplane. Slots 17 through 20 accommodate first four 4K modules. Slots 22 through 25 accommodate second four 4K modules.</p>
<p>MS11-CM 1K Bipolar Memory</p> <p>Consists of the following:</p> <p style="padding-left: 40px;">M8111 Bipolar Memory Matrix Module</p>	<p>Provides 1K word of bipolar memory.</p> <p>Mounts in CPU backplane. Slots 17 through 20 accommodate first four 1K modules. Slots 22 through 25 accommodate second four 1K modules. If bipolar is mixed with MOS, M8111 modules mount in slots 22 through 25.</p>
<p>MS11-CP 1K Bipolar Memory</p> <p>Consists of the following:</p> <p style="padding-left: 40px;">M8111-YA Bipolar Memory Matrix Modules</p>	<p>Provides 1K words of bipolar memory with two additional bits for byte parity storage.</p> <p>Mounted in CPU backplane in same configuration as M8111 modules.</p>

**NOTE**

A complete 8K bipolar memory system consists of two M8120† SMC modules, eight M8111 bipolar memory matrix modules and four 744 +5 V regulators. A complete 32K bipolar memory system consists of two M8120† SMC modules, eight M8121 bipolar memory matrix modules and four H744 +5 V regulators.

**MF11-U/UP 16K Core Memory and Control**

<p>Includes the following:</p> <p style="padding-left: 40px;">MF11-U M8293 16K Unibus Timing Module G114 Sense Inhibit Module G235 X-Y Driver Module H217D Stack Module (16 bits) 7009295 Backplane Assembly</p>	<p>Described in related manual. Mount space and power for one of these units is provided in the CPU mounting box. Additional MF11-U/UP units can be installed in separate H960-D Cabinets.</p>
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\*See engineering drawings for complete parts lists.

†Early versions of the MS11-CC used an M8110 SMC Module.

Table 1-6 PDP-11/45 System Options (Cont)

Option*	Description
<b>MF11-U/UP 16K Core Memory and Control (Cont)</b>	
<p>MF11-UP  M8293 16K Unibus Timing Module  G114 Sense Inhibit Module  G235 X-Y Driver Module  H217C Stack Module  (18 bits including parity)  7009295 Backplane Assembly  M7259 Parity Control Module</p> <p>MM11-U Module Set  Includes all modules listed in MF11-U but does not include backplane assembly</p> <p>MM11-UP Module Set  Includes all modules listed in MF11-UP but does not include backplane assembly</p>	

**NOTE**

The MF11-U/UP option cannot be installed in CPU Cabinets containing the older power distribution system. It can, however, be used in the older version of the Expansion Cabinets. Refer to Paragraph 5.3.2.

<b>MF11-L, MF11-LP 8K Core Memory and Control</b>	
<p>Includes the following:</p> <p>MF11-L  G110 Control Module  G231 Driver Module  H214 8K Core Stack (16 bits)  11/45 System Unit</p> <p>MF11-LP  G109 Control Module  G231 Driver Module  H215 8K Core Stack with Parity (18 bits)  M7259 Parity Module  11/45 System Unit</p>	<p>Described in related manual. Mount space and power for three of these units is provided in the CPU Mounting Box. Additional MF-11 units can be installed in the separate H960-D Expansion Cabinets.</p>

\*See engineering drawings for complete parts lists.



**Table 1-6 PDP-11/45 System Options (Cont)**

Options*	Description
<b>Bootstrap Loaders</b>	
<p>MRI 1-DB Bootstrap Loader</p> <p>Consists of the following:</p> <p style="padding-left: 40px;">M792-YD ROM Diode Matrix</p> <p style="padding-left: 40px;">M792-YE ROM Diode Matrix</p> <p>M9301-YB Bootstrap/Terminator</p> <p>BM873-YB Restart/Loader</p>	<p>64-word bulk storage bootstrap loader (slots 27 and 28).</p> <p>512-word bulk storage bootstrap loader and Unibus termination (slot 1).</p> <p>256-word bulk storage bootstrap loader (slot 27).</p>
<b>DL11-A,W DECwriter Interface</b>	
<p>DL11-A Asynchronous Interface</p> <p>DL11-W Asynchronous Interface</p> <p>Consists of the following:</p> <p style="padding-left: 40px;">M7856</p>	<p>Interface between a single teletypewriter and the PDP-11 (slot 26).</p> <p>Interface between a single teletypewriter and the PDP-11 with a line frequency clock (DL11-A and KW11-L)</p>

\*See engineering drawings for complete parts lists.

#### **1.4 REFERENCE DOCUMENTS**

Table 1-7 describes the following reference material:

1. A six-manual series of PDP-11/45, 11/50, 11/55 maintenance manuals.
2. The maintenance manuals for the various components supplied as part of the basic system.
3. Several reference manuals that describe the PDP-11/45, 11/50, 11/55 system and provide essential information pertaining to all PDP-11 systems.

Documentation for specific peripherals and options that are external to the CPU cabinet are not listed in the table. When peripherals and options are included in the system, the appropriate manuals are supplied with the system.

#### **1.5 ENGINEERING DRAWINGS**

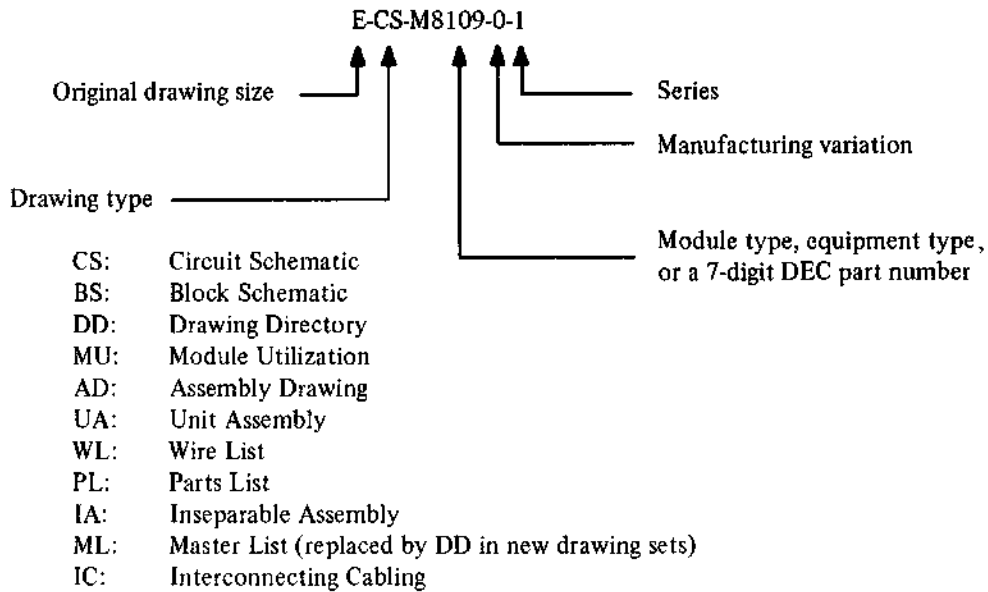
PDP-11/45, 11/50, 11/55 systems are shipped with a set of engineering drawings for the basic components and applicable options. Table 1-8 lists the contents of the drawing sets that are provided. Information pertaining to additional engineering drawings is contained within each set.

**Table 1-7 Related Documentation**

Title
<b>PDP-11/45 Manuals*</b>
KB11-A, D Central Processor Unit Maintenance Manual MS11-A, B, C Memory Systems Maintenance Manual FP11-B Floating Point Processor Maintenance Manual FP11-C Floating Point Processor Maintenance Manual KT11-C, CD Memory Management Unit Maintenance Manual MF11-U/UP Core Memory System Maintenance Manual MM11-S, MF11-L, and MF11-LP Core Memory Systems
<b>Reference Manuals</b>
PDP-11/04, 05, 10, 35, 40, 45 Processor Handbook, 1975, 76 PDP-11 Peripherals Handbook, 1975

\*A set of engineering drawings is provided with each of the components and options in the PDP-11/45, 11/50, 11/55 systems.

DEC drawing numbers are interpreted as indicated in the following example:



**Table 1-8 Reference Drawing Summary**

Drawing Number	Title
<b>PDP-11/45 System Engineering Drawings</b>	
B-DD-11/45-0-0 D-CS-5409684-0-1 D-IC-11/45-0-2	Drawing Directory Circuit Schematic – Console Board 11/45 Back Panel PC Board
<b>KB11-A Central Processor Unit</b>	
B-DD-KB11-A-0 E-MU-KB11-A-1 D-BD-KB11-A-2 D-FD-KB11-A-3 E-CS-M8100-0-1 E-CS-M8101-0-1 E-CS-M8102-0-1 E-CS-M8103-0-1 E-CS-M8104-0-1 E-CS-M8105-0-1 E-CS-M8106-0-1 E-CS-M8116-0-1 E-CS-M8109-0-1 D-IC-KB11-A-BG C-CS-M930-0-1 C-CS-M920-0-1 E-CS-5409910-0-1 E-CS-5409912-0-1	Drawing Directory Module Utilization Block Diagram Flow Diagram M8100 DAP Module Schematic M8101 GRA Module Schematic M8102 IRC Module Schematic M8103 RAC Module Schematic M8104 PDR Module Schematic M8105 TMC Module Schematic M8106 UBC Module Schematic M8116 SJB Module Schematic M8109 TIG Module Schematic Bus Cables and Grant Chain Circuit Schematic – Bus Terminator Circuit Schematic – Internal Bus Connector Circuit Schematic Circuit Schematic
<b>KB11-D Central Processor Unit</b>	
B-DD-KB11-D E-MU-KB11-D-1 D-IC-KB11-A-BG D-BD-KB11-D-2 D-FD-KB11-C-1 E-CS-M8100-0-1 E-CS-M8101-0-1 E-CS-M8132-0-1 E-CS-M8123-0-1 D-CS-M8104-0-1 E-CS-M8105-0-1 E-CS-M8119-0-1 E-CS-M8109-0-1 D-CS-M8116-0-1 C-CS-M930-0-1 C-CS-M920-0-1 E-CS-5409910-0-1 E-CS-5409912-0-1	Drawing Directory Module Utilization Bus Cables and Grant Chain Block Diagram KB11-C Flow Diagrams M8100 DAP Module Schematic M8101 GRA Module Schematic M8132 IRC Module Schematic M8123 RAC Module Schematic M8104 PDR Module Schematic M8105 TMC Module Schematic M8119 UBC Module Schematic Timing Generator System Jumper Board Circuit Schematic Circuit Schematic Circuit Schematic Circuit Schematic

**Table 1-8 Reference Drawing Summary (Cont)**

<b>Drawing Number</b>	<b>Title</b>
<b>FP11-B Floating-Point Processor</b>	
B-DD-FP11-B-0 E-CS-M8112-0-1 E-CS-M8113-0-1 E-CS-M8114-0-1 E-CS-M8115-0-1 D-FD-FP11-B	Drawing Directory M8112 FRM Module Schematic M8113 FXP Module Schematic M8114 FRH Module Schematic M8115 FRL Module Schematic FP Data Paths and Flow Diagrams
<b>FP11-C Floating-Point Processor</b>	
B-DD-FP11-C-0 D-FD-FP11-C- D-CS-M8126-0-1 D-CS-M8127-0-1 D-CS-M8128-0-1 D-CS-M8129-0-1	Drawing Directory Flow Diagrams M8126 FRH Module Schematic M8127 FRL Module Schematic M8128 FRM Module Schematic M8129 FXP Module Schematic
<b>KT11-C, CD Memory Management Unit</b>	
B-DD-KT11-C-0 D-BD-KT11-C-1 E-CS-M8107-0-1 E-CS-M8108-0-1	Drawing Directory Block Diagrams M8107 SAP Module Schematic M8108 and M8108-YA SSR Module Schematic
<b>MS11-AP Bipolar Memory</b>	
B-DD-MS11-A D-CS-M8121-YA-1 A-SP-MS11-A-1	Drawing Directory Bipolar Memory Matrix MS11-A, C Bipolar Installation Procedure
<b>MS11-B MOS Memory</b>	
B-DD-MS11-B-0 D-BD-MS11-0-1 E-CS-M8110-0-1 E-CS-G401-0-1 E-CS-G401-YA-1	Drawing Directory Block Diagram M8110 SMC Module Schematic G401 MOS Memory Matrix Schematic G401YA MOS Memory Matrix Schematic with parity
<b>MS11-C Bipolar Memory</b>	
B-DD-MS11-C-0 D-BD-MS11-0-1 E-CS-M8110-0-1 E-CS-M8111-0-1 E-CS-M8111-YA-1	Drawing Directory Block Diagram M8110 SMC Module Schematic M8111 Bipolar Memory Matrix Schematic M8111YA Bipolar Memory Matrix Schematic with parity

**Table 1-8 Reference Drawing Summary (Cont)**

<b>Drawing Number</b>	<b>Title</b>
<b>MF11-U 16K Core Memory</b>	
B-DD-MF11-U D-CS-G114-0-1 D-CS-G235-0-1 D-CS-M8293-0-1 D-CS-H217-0-1 D-MU-MF11-U-MU D-TD-MF11-U-1 D-CS-5410345-0-1	Drawing Directory 16K Sense Memory 16K X-Y Drive 16K Unibus Timing Memory Stack (16K X 16) Module Utilization Timing Diagram Backplane
<b>MF11-LP 8K Core Memory</b>	
B-DD-MM11-F-0 D-MU-MM11-F-0 D-CS-G109-0-1 D-CS-G231-0-1 D-CS-H215-0-1 D-CS-M7259-0-1	Drawing Directory Module Utilization G109 Module Schematic G231 Module Schematic H215 8K Memory Matrix Schematic M7259 Parity Module Schematic
<b>KW11-L Line Frequency Clock</b>	
A-ML-KW11-L-0	KW11-L Master List
<b>Power Systems</b>	
D-IC-11/45-0-1 B-DD-H7420-0 D-CS-H7420-0-0 D-CS-5411086-0-1 E-UA-H7420-0-0 A-PL-H7420-0-0 B-DD-H742-0 D-CS-H742-0-1 C-CS-5409730-0-1 B-DD-H744-0 D-CS-H744-0-1 B-DD-H745-0 D-CS-H745-0-1 B-DD-H746-0 D-CS-H746-0-1 D-CS-H754-0-1 B-DD-860-0 C-CS-860-0-1 C-CS-5409770-0-1 D-CS-861-A-1 D-CS-861-B-1	Interconnection Diagram H7420 Drawing Directory Wiring Diagram Power Line Monitor (Regulator) H7420 Power Supply H7420 Power Supply H742 Drawing Directory H742 Circuit Schematic H742 Power Control Board Circuit Schematic H744 Drawing Directory H744 Circuit Schematic H745 Drawing Directory H745 Circuit Schematic H746 Drawing Directory H746 Circuit Schematic H754 Circuit Schematic 860 Drawing Directory 860 Circuit Schematic 860 Power Control Board 861-A Power Control 861-B Power Control

**Table 1-8 Reference Drawing Summary (Cont)**

Drawing Number	Title
<b>DL11-A Asynchronous Line Interface</b>	
B-DD-DL11-0	Drawing Directory
C-UA-DL11-0-1	Asynchronous Line Interface
A-PL-DL11-0-0	Asynchronous Line Interface
E-CS-M7800-YA-11	Asynchronous Line Interface
D-IA-7008360-0-0	Cable, Modem BC05C
A-SL-DL11-0-4	Cable Assembly (KL8/E)
A-AL-DL11-0-5	Modem Test Connector
A-SP-DL11-0-2	Installation Procedure

### **1.6 DRAWING CONVENTIONS**

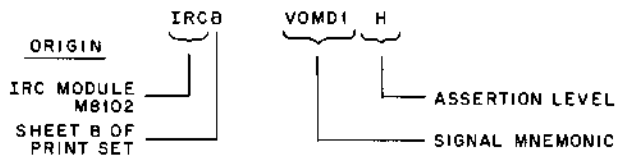
Figure 1-4 illustrates some of the drawing conventions used on the circuit schematics. Example A defines the meaning of each part of a typical signal mnemonic. Example B provides the following information:

1. CLR SL YEL L, originating on sheet D of the TMC drawing (on which this gate is shown), is asserted when low (0 V).
2. UBCE INIT H is input to TMC module on pin CJ1, as indicated by the arrow. (This pin mates with backplane connector pin C11J1.)
3. The NOR gate is provided by pins 1, 2, and 3 of a type 8885 integrated circuit located at position E24 on the TMC module.
4. TMCC SERF (1) H is the high (+3 V) output of the SERF flip-flop, when the flip-flop is set.

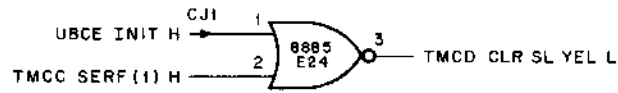
Example C shows the arrows indicating signals that leave the module. TMCE BUST OUT L is output on pin DL1 of the TMC module.

Examples D and E show the flip-flop conventions. Note in D that IRCA IR05 (1) H is the same pin as IRCA IR05 (0) L, and that IRCA IR05 (1) L is the same pin as IRCA IR05 (0) H.

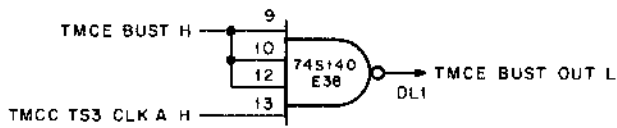
The same type of flip-flop has been re-defined in example E - the D input is inverted; the 1 and 0 outputs are interchanged as are the Set and Reset inputs.



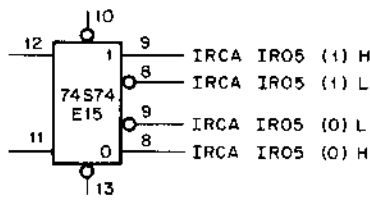
Example A



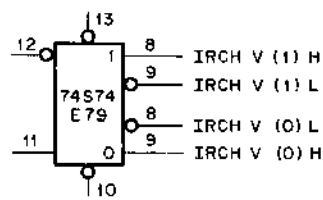
Example B



Example C



Example D



Example E

17-1135

Figure 1-4 PDP-11/45, 11/50, 11/55 Drawing Convention Examples

## CHAPTER 2 SYSTEM INSTALLATION

### 2.1 GENERAL

This chapter contains installation information and recommendations to ensure a successful PDP-11/45 installation. Installation of new options in an existing PDP-11/45, 11/50, 11/55 system is described in Chapters 4 and 5 for PC board and system units options.

Customer assistance is provided during site planning, preparation, and installation; the final layout plan should be approved by both the customer and DEC prior to delivery of the equipment.

Planning considerations should include:

- Shipping and access routes; e.g., door, hall, passageway, elevator restrictions, etc.
- Floor plan layout for equipment
- Electrical and environmental considerations
- Fire and safety precautions
- Storage facilities for accessories and supplies

Site preparation is dictated by the customer's requirements and can range from providing the required source power to complete construction or remodeling of the selected installation site. Therefore it is recommended that any and all requirements and restrictions be considered and effected prior to shipment and installation of the equipment.

### 2.2 SITE PREPARATION

Adequate site planning and preparation simplifies the installation process. DEC Sales and Field Service Engineers are available for consultation and planning with customer representatives regarding objectives, course of action, and progress of the installation. The information in this paragraph is provided primarily to permit review of the site planning; use the *PDP-11/45 Site Configuration Worksheet* to perform the initial site planning.

#### 2.2.1 Physical Dimensions

The overall dimensions and total weight of a particular system – the dimensions, weight of any optional cabinets, cable lengths, and the number of free-standing peripherals – should be known prior to shipment.

The route the equipment is to travel from the customer receiving area to the installation site should be studied; measurements of doors, passageways, etc., should be taken to facilitate delivery of the equipment. All measurements and floor plans should be submitted to the DEC Sales Engineer and Field Service to ensure that the equipment is packed to suit the installation site facilities. Any restrictions (such as bends or obstructions in hallways, etc.) should be reported to DEC.



If an elevator is to be used for transferring the PDP-11/45, 11/50, or 11/55 and its related equipments to the installation site, DEC should be notified of the size and gross weight limitations of the elevator so that the equipment can be shipped accordingly.

The site space requirements are determined by the specific system configuration to be installed and, when applicable, provision for future expansion. To determine the exact area required for a specific configuration, a machine-room floor plan layout is helpful. When applicable, space should be provided in the machine room for storing tape reels, printer forms, card files, etc. The integration of the work area with the storage area should be considered in relation to the work flow requirements between areas.

In large installations where test equipment is maintained, DEC recommends that the test equipment storage area be within or adjacent to the machine room.

Operational requirements determine the specific location of the various options and free-standing peripherals of the system. Dimensions, weights, and cable lengths of freestanding peripheral equipment must be known prior to installation – preferably during site preparation and planning. The computer peripherals must not be located at distances where connecting cables exceed maximum limits. The following points should be considered when planning the system layout:

1. Ease of visual observation of input/output devices by operating personnel.
2. Adequate work area for installing tapes, access to console, etc.
3. Space availability for contemplated future expansion.
4. Proximity of the cabinets and peripherals to any humidity-controlling or air-conditioning equipment.
5. Adequate access to equipment (e.g., rear door, etc.) for service personnel.

The final layout will be reviewed by the DEC Sales Engineer, Field Service, and in-house engineering personnel to ensure that cable limitations have not been exceeded and that proper clearances have been maintained.

### **2.2.2 Fire and Safety Precautions**

The following fire and safety precautions are presented to aid the customer in maintaining an installation that affords adequate operational safeguards for personnel and system components.

1. If an overhead sprinkler system is used, a *dry pipe* system is recommended. Upon detection of a fire, this system removes source power to the room and then opens a master valve to fill the room's overhead sprinklers.
2. If the fire detection system is the type that shuts off the power to the installation, a battery-operated emergency light source should be provided.
3. If an automatic carbon dioxide fire protection system is used, an alarm should sound prior to release of the CO<sub>2</sub> to warn personnel within the installation.
4. If power connections are made beneath the floor of a raised-floor installation, waterproof electrical receptacles and connections should be used.
5. An adequate earth ground connection should be provided to protect operating personnel.

### **2.2.3 Environmental Requirements**

An ideal computer room environment has an air distribution system that provides cool, well-filtered, humidified air. The room air pressure should be kept higher than that of adjacent areas to prevent dust infiltration.

**2.2.3.1 Humidity and Temperature** – The PDP-11/45, 11/50, and 11/55 electronics are designed to operate in a temperature range of from 50° F (10° C) to 110° F (40° C) at a relative humidity of 10 to 90 percent with no condensation. However, system configurations that use input/output devices such as magnetic tape units, card readers, etc., may require closer control of the environment. See Appendix C for detailed specifications. Nominal operating conditions for a typical system configuration are a temperature of 70° F (20° C) and a relative humidity of 45 percent with no condensation. (For operation above sea level, see Paragraph 1.1.7)

**2.2.3.2 Air Conditioning** – When used, computer room air-conditioning equipment should conform to the requirements of the “Standard for the Installation of Air Conditioning and Ventilating Systems (non-residential),” N.F.P.A. No. 90A, as well as the requirements of the *Standard for Electronic Computer Systems*, N.F.P.A. No. 75. Remember, air flow in a PDP-11 is from top to bottom of cabinets.

**2.2.3.3 Acoustical Damping** – Some peripheral devices (such as line printers and magnetic tape transports) are quite noisy. In installations that use a group of high noise-level devices, an acoustically damped ceiling will reduce the noise.

**2.2.3.4 Lighting** – If CRT peripheral devices are part of the system, the illumination surrounding these peripherals should be reduced to enable the operator to conveniently observe the display.

**2.2.3.5 Special Mounting Conditions** – If the system will be subjected to rolling, pitching, or vibration of the mounting surface (e.g., aboard ship), the cabinetry should be securely anchored to the installation floor by mounting bolts. Since such installations require modifications to the cabinets, DEC must be notified when the order is placed so that the necessary modifications can be made.

**2.2.3.6 Static Electricity** – Static electricity can be an annoyance to operating personnel and can (in extreme cases) affect the operational characteristics of the PDP-11/45, 11/50, 11/55 and related peripheral equipments. If carpeting is installed on the computer floor, it should be of a type designed to minimize the effects of static electricity. Flooring consisting of metal panels, or flooring with metal edges, should be adequately grounded.

### **2.2.4 Electrical Requirements**

The PDP-11/45, 11/50, 11/55 operates from a nominal 115 V, 50/60 Hz or 230 V, 50/60 Hz, ac power source. The primary ac operational voltages should be maintained within the tolerances defined in Paragraph 1.1.2.

For certain options that use synchronous motors, line voltage tolerance should be maintained within  $\pm 15$  percent of the nominal values, and the 50/60 Hz line frequency should not vary more than  $\pm 2$  Hz.

Primary power to the system should be provided on a line separate from lighting, air-conditioning, etc., so that computer operation will not be affected by voltage transients. The wiring should conform to the following general guidelines:

1. All electrical wiring must conform with the National Electric Code (NEC).
2. The ground terminal on the receptacle will normally have a green colored screw; the neutral terminal will be white or silver colored; and the “hot” terminals will be brass colored.
3. Under the NEC (in the U.S. only), the color coding for the neutral wire is either white or gray, and the ground wire is solid green, green with one or more yellow stripes, or bare. There are no specified colors for the “hot” wires.

The PDP-11/45, 11/50, 11/55 cabinet grounding point should be connected to the building power transformer ground or the building ground point. Direct any questions regarding power requirements and installation wiring to the local DEC Field Service Engineer.

## **2.3 INSTALLATION AND INSPECTION**

### **CAUTION**

**Do not attempt to install the system until DEC has been notified and a DEC Field Service Representative is present.**

The procedures in Paragraphs 2.3.1 through 2.3.5 are provided to assist in receipt, unpacking, inspection, and installation of the PDP-11/45, 11/50, 11/55, and associated peripherals and equipments. Paragraphs 2.4 and 2.5 describe the procedures recommended for bringing the system up.

#### **2.3.1 Unpacking**

Before unpacking the equipment, check the shipment against the packing list provided. Check that the correct number of packages has been delivered and that each package contains all the items listed on the accompanying packing slip. Also, check that all items on the accessories list in the Customer Acceptance Procedures have been included in the shipment. Unpack the cabinets as follows:

1. Remove outer shipping container.
2. Remove the polyethylene cover from the cabinets.
3. Remove the tape or plastic shipping pins from the cabinet(s) rear access door(s).
4. Unbolt cabinet(s) from the shipping skid as follows: to remove shipping bolt from right side of cabinet.
  - a. Remove the shipping bracket. Pull CPU mounting box out to locked position and remove side panels from cabinet.
  - b. Remove nut and washer from the underside of the shipping skid.
  - c. There are three 10-32 screws attaching the lower power supply to the front upright of the cabinet; loosen these three screws (no more than three turns).
  - d. At the rear of the lower power supply are three additional screws. Remove these completely and swing the power supply toward the middle of the cabinet 1 to 1-1/2 in. Holding the power supply, remove the shipping bolt by pulling straight up.
  - e. Swing the power supply back to the original position, replace the rear screws and tighten the front screws.
5. Raise the leveling feet so that they are above the level of the roll-around casters.

6. Use wood blocks and planks to form a ramp from the skid to the floor and carefully roll the cabinet onto the floor.
7. Roll the system to the proper location for installation.
8. If necessary, repeat steps 1 through 7 for the expansion cabinets. When the cabinets are properly oriented, follow the procedure of Paragraph 2.3.3 to install the cabinet(s).

### **2.3.2 Inspection**

After removing the equipment packing material, inspect the equipment and report any damage to the local DEC sales office. Inspect as follows:

1. Inspect external surface of the cabinets and related equipments for surface, bezel, switch, light damage, etc.
2. Open the rear door of the cabinet, and internally inspect the cabinet for console, processor, and interconnecting cable damage; loose mounting rails; loose or broken modules; blower or fan damage; any loose nuts, bolts, screws, etc.
3. Inspect the wiring side of the logic panels for bent pins, broken wires, loose external components, and foreign material.
4. Inspect the power supply for proper seating of fuses and power connections.
5. Inspect all peripheral equipment – including magnetic tape and DECTape transport heads, motors, paper-tape sprockets, etc. – for internal and external damage.

#### **CAUTION**

**Do not operate any peripheral device that employs motors, tape heads, sprockets, etc., if these items appear to be damaged.**

### **2.3.3 Cabinet Installation**

The cabinets are provided with roll-around casters and adjustable leveling feet so it is not necessary to bolt the cabinet to the mounting floor unless conditions indicate otherwise (e.g., shipboard installation). In multiple cabinet installations, receiving restrictions may require that cabinets be shipped individually or in pairs. In such cases, the cabinets are connected at the installation site. Cabinet installation procedures are as follows:

1. With the cabinets positioned in the room, install H952-GA filler strips between cabinet groups (filler strips are shipped attached to the end of a cabinet group). Remove four bolts each from the front and rear filler strips. Butt the cabinet groups together while holding the filler strips in place and rebolt through both cabinets and the filler strips (drawing C-UA-H952-G-0). Do not tighten the bolts securely at this time.
2. Lower the leveling feet so that the cabinets are not resting on the roll-around casters but are supported on the leveling feet.
3. Tighten the bolts that secure the cabinet groups together. Ensure that all leveling feet are planted firmly on the floor.
4. Electrical connections, including intercabinet ground strapping, are described in Paragraphs 2.3.4 and 2.3.5.

### **2.3.4 AC Power Connections**

Paragraph 2.2.4 defines the electrical requirements and the ac power outlets required at the site. Early systems include two 860 power controls as shown in Figure 1-2. Current versions are equipped with a single 861 power control as shown in Figure 1-1. Most of the additional cabinets in a system include a power control and ac connector that are similar to that supplied in the basic CPU cabinet. All ac power is distributed from the power control to the appropriate power supplies within the cabinet.

The power controls in all cabinets are connected to provide central control of power turn-on and turn-off from the CPU console POWER switch. Before connecting any power cables to the site source power, check all building wiring. Ensure that power receptacles of the appropriate types have been provided for each cabinet and that the receptacles are positioned close enough to the cabinet positions to allow the cables to be connected without stretching or crossing the cables. In particular, check that the phase and neutral wires have been connected to the same pins in each receptacle.

### **2.3.5 Intercabinet Connections**

When a multi-cabinet system is assembled, three types of electrical connections must be made between cabinets (refer to Paragraph 2.3.3 for mechanical connections). These connections are:

1. Unibus connections – A BC11-A cable must connect the last system unit in a cabinet to the first system unit in the next cabinet.
2. Remote power connections – All cabinet power controls are connected to a control bus that provides for system turn-on and turn-off.
3. Ground strapping – The frame ground of the system is distributed through the cabinets by direct electrical connections between the cabinet frames.

**2.3.5.1 Unibus Connections** – The BC11-A Unibus cable is the I/O bus that connects all system components. To connect the Unibus between the CPU cabinet and an expansion cabinet, insert the BC11-A cable in the rear system unit slot of the mounting box of the CPU cabinet. The cable runs through a cable clamp in the upper left corner at the rear of the CPU mounting box and passes under the power supply mounting rails into the next cabinet. In the expansion cabinet, the cable passes through a similar cable clamp and is inserted in the appropriate slot of the first system unit of the mounting box.

**2.3.5.2 Remote Power Connections** – The power controls in all cabinets must be interconnected to ensure common power turn-on and turn-off.

**2.3.5.3 Ground Strapping** – Electrical safety is provided by connecting all the cabinet frames to the ground level of the site power system. This is accomplished by connecting a wire in each power cable between the frame and the power system ground; this is not a load-carrying wire – it is intended only as an emergency ground path. The green wire in each power cable is the frame ground, while the white wire is the neutral, or return wire, that carries the load current.

To improve the level of safety provided by the frame ground connections, all cabinet frames are connected by braided copper straps or No. 4 AWG solid wire with crimp-on lugs which are fastened to copper studs that are welded to the frames (this also prevents the generation of ground loops between cabinets that are connected by signal-carrying cables). The studs are welded to the bottom side rails of the cabinet frame, facing inward; the stud on the left side of the cabinet is slightly forward of center while the stud on the right side is slightly to the rear.

The ground strap supplied with each cabinet is fastened to one stud, passed over the side rail of that cabinet and the side rail of the adjacent cabinet, and fastened to the stud in that cabinet. The copper studs are threaded and nuts are supplied on the studs.

Similar strap/stud grounding is used to ground the H7420 power supplies to the cabinet frame.

**2.3.5.4 Wire Trough Cabling** – An optional wire trough system can be installed which provides cable organization that improves the appearance of the system's cabling and helps reduce cable damage. Device location in the CPU cabinet and expansion cabinet determines required cable lengths and trough configuration. For planning and installation procedures, refer to the *Wire Trough Installation Manual*.

## **2.4 INITIAL POWER TURN-ON**

This portion of the system installation is discussed in the *PDP-11/45, 11/50, and 11/55 System Maintenance Manual*.

## CHAPTER 3 POWER SYSTEM

This chapter describes the several versions of power distribution, both ac and dc, in the CPU cabinet. Expansion cabinet power is described in Chapter 5.

### 3.1 OVERALL SYSTEM DESCRIPTION

Figure 3-1 is a block diagram of the CPU cabinet power system. The basic components are two H7420 power supplies and their associated power control(s). AC power from the building mains is fed to the power control unit(s), which provides two sets of ac outlets: one switched, the other unswitched. Two H7420 power supplies are provided in the CPU cabinet; one is plugged into the switched power control outlet, the other is plugged into the unswitched power control outlet. These H7420 power supplies are designated *upper* and *lower* according to their mounting location in the cabinet (refer to Figures 1-1 and 1-2). Each H7420 contains a complement of voltage regulators, which depend upon the system configuration.

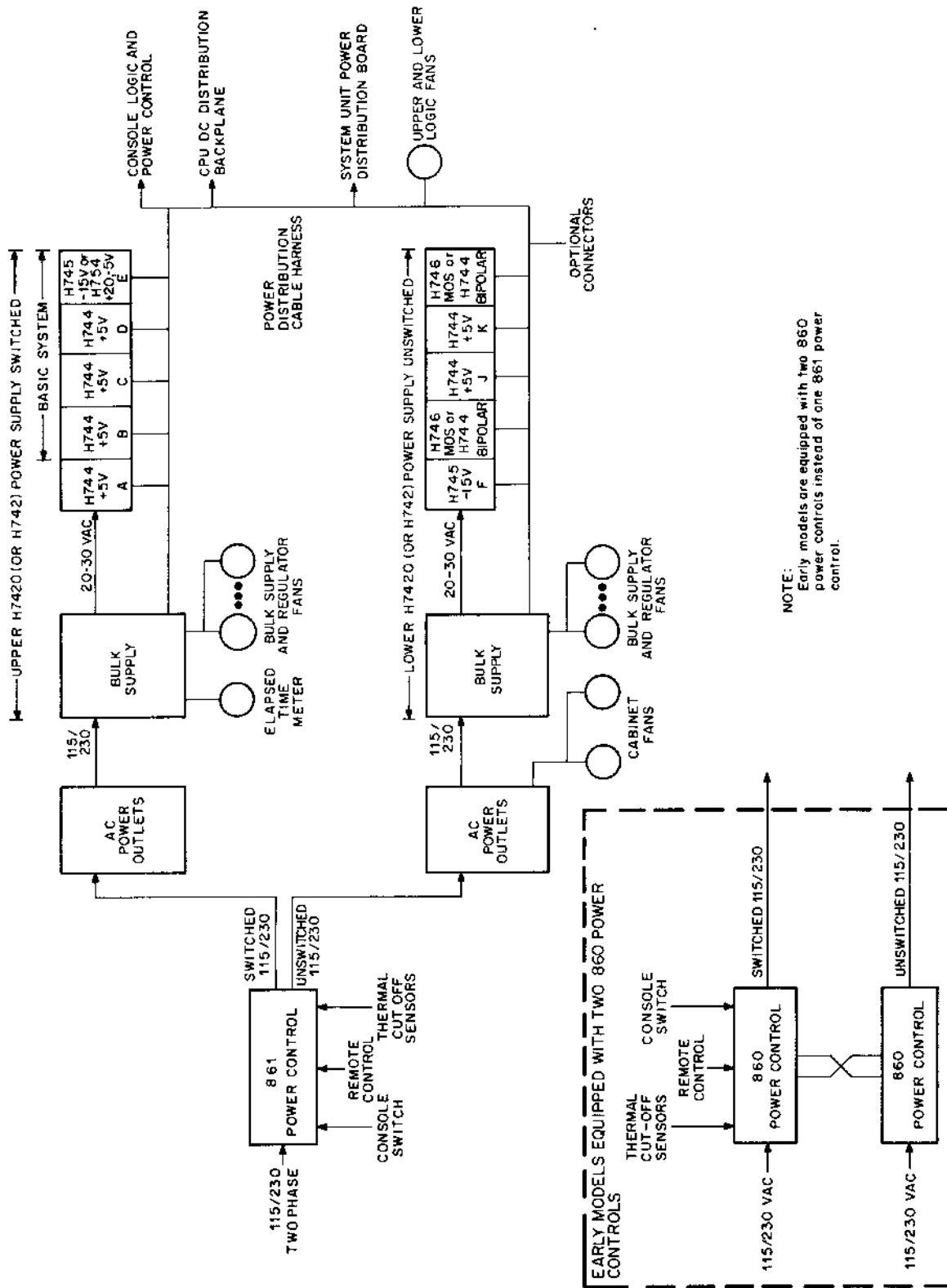
The power system block diagram shows a typical complement of voltage regulators installed in the appropriate slots of the upper and lower H7420 power supplies (Figure 3-1). Some voltage regulators are supplied with the basic system and others are supplied as part of system options. The voltage regulator complement for the basic system and options is summarized in Tables 3-1 and 3-2.

The primary purpose of the switched supply is to provide dc power to the KB11-A, D and to the options, other than semiconductor memory, that are installed in the CPU mounting box. The lower H7420 subsystem (except for the H745 -15 Vdc regulator in slot F) is unswitched because it must remain on at all times during normal operation to provide dc power to the optional MS11 Semiconductor Memory System, plus ac power to the logic fans and cabinet fans. The power supplied to these components must not be inadvertently switched off because

1. If the power is switched off, the semiconductor memory contents are lost.
2. Other Unibus devices, or another processor, may be accessing the MOS or bipolar memories. Core memory is shut off (-15 V) via +15 V from the upper supply.
3. Fan voltage is required for cooling semiconductor memories.

### 3.2 115 Vac AND 230 Vac MODELS

The PDP-11/45, 11/50, 11/55 power system operates with 115 Vac or 230 Vac primary source power inputs. The 861-A (CPU cabinet) or -C (expansion cabinet) or the 860-A power controls are used with 115 Vac source power and the 861-B or 860-B power controls are used with 230 Vac source power. The differences between the power controls are described in Chapter 4. The H742-A or H7420-A power supply is used with the 115 Vac source and the H742-B or H7420-B power supply is used with the 230 Vac source. Appropriate jumper connections are made at its primary input for operation on 115 or 230 Vac input power, as shown on drawing No. D-CS-H742-0-1, sheet 1, or D-CS-H7420-0-1, sheet 1.



11-4300

Figure 3-1 Typical PDP-11/45, 11/50, 11/55 Power System



**Table 3-1 Voltage Regulator Configuration Data CPU Cabinet Serial Numbers 2000 and Higher**

Type	Name	Quantity	Location	Comments
<b>Basic System</b>				
H744	+5 V Regulator	3	B C D	+5 V to CPU modules slots 6–9.  +5 V to CPU and KT11-C, CD modules, slots 10–15.  +5 V to internal options, slots 26–28, systems units 1, 2, and 3, and Console.
H745	-15 V Regulator	1	F	-15 V to CPU and internal option modules and to system until 1, 2, and 3, if slot E regulator is a H754. This supply is switched, even though in the lower H742, because it is fed by +15 Vdc from the upper H742.
<b>FP11-B, C Floating-Point Processor</b>				
H744	+5 V Regulator	1	A	+5 V to FP11 modules, slots 2–5.
<b>MS11-A, C Bipolar Memory</b>				
H744	+5 V Regulator	2	H	+5 V to control and first two matrix modules (slots 16–18).
			J	+5 V to third and fourth matrix modules (slots 19–20).
		2	K	+5 V to control and first two matrix modules (slots 21–23).
			L	+5 V to third and fourth matrix modules (slots 24–25).
<b>MS11-B MOS Memory</b>				
H744	+5 V Regulator	1	J	+5 V to control and matrix modules, slots 16–25.
H746	MOS Regulator	2	H, L	+19.7 V, +23.2 V, and -5 V to MOS matrix modules; H slots 17–20; L slots 22–25.
<b>MM11 Core Memories and Controls</b>				
H745	-15 V Regulator	1	E	-15 V to Systems Units 1–3 (if MF11-UP is not installed).
H754	+20, -5 V Regulator	1	E	+20 and -5 Vdc to MF11-U/UP.

**Table 3-2 Voltage Regulator Configuration Data CPU Cabinet Serial Numbers Less Than 2000**

Type	Name	Quantity	Location	Comments
<b>Basic System</b>				
H744	+5 V Regulator	3	B C D	+5 V to CPU modules, slots 6–9. +5 V to CPU and KT11-C, CD modules, slots 10–15. +5 V to internal options, slots 26–28, system units 1, 2, and 3, and Console.
H745	-15 V Regulator	1	E	-15 V to CPU and internal option modules and system units 1 and 2.
<b>FP11-B, C Floating-Point Processor</b>				
H744	+5 V Regulator	1	A	+5 V to FP11 modules, slots 2–5.
<b>MS11-A, C Bipolar Memory</b>				
H744	+5 V Regulator	2 2	H, J K, L	+5 V to control and matrix modules if no MOS memory is installed, or only 4K is used. H: slots 16–18; J: slots 19–20. If MOS memory is also installed, or if more than 4K of bipolar is used. K: slots 21–23, L: slots 24–25.
<b>MS11-B MOS Memory</b>				
H744	+5 V Regulator	1	J	+5 V to control and matrix modules, slots 16–25.
H746	MOS Regulator	2	H, L	+19.7 V, +23.2 V, and -5 V to MOS matrix modules; H slots 17–20; L slots 22–25.
<b>MM11 Core Memories and Controls</b>				
H745	-15 V Regulator	1	F	-15 V to System Unit 3. H745 provided in basic system supplies System Units 1 and 2. This supply is switched even though in the lower H7420, because it is fed by +15 Vdc from the upper H7420.

### 3.3 DIFFERENT POWER SYSTEM VERSIONS

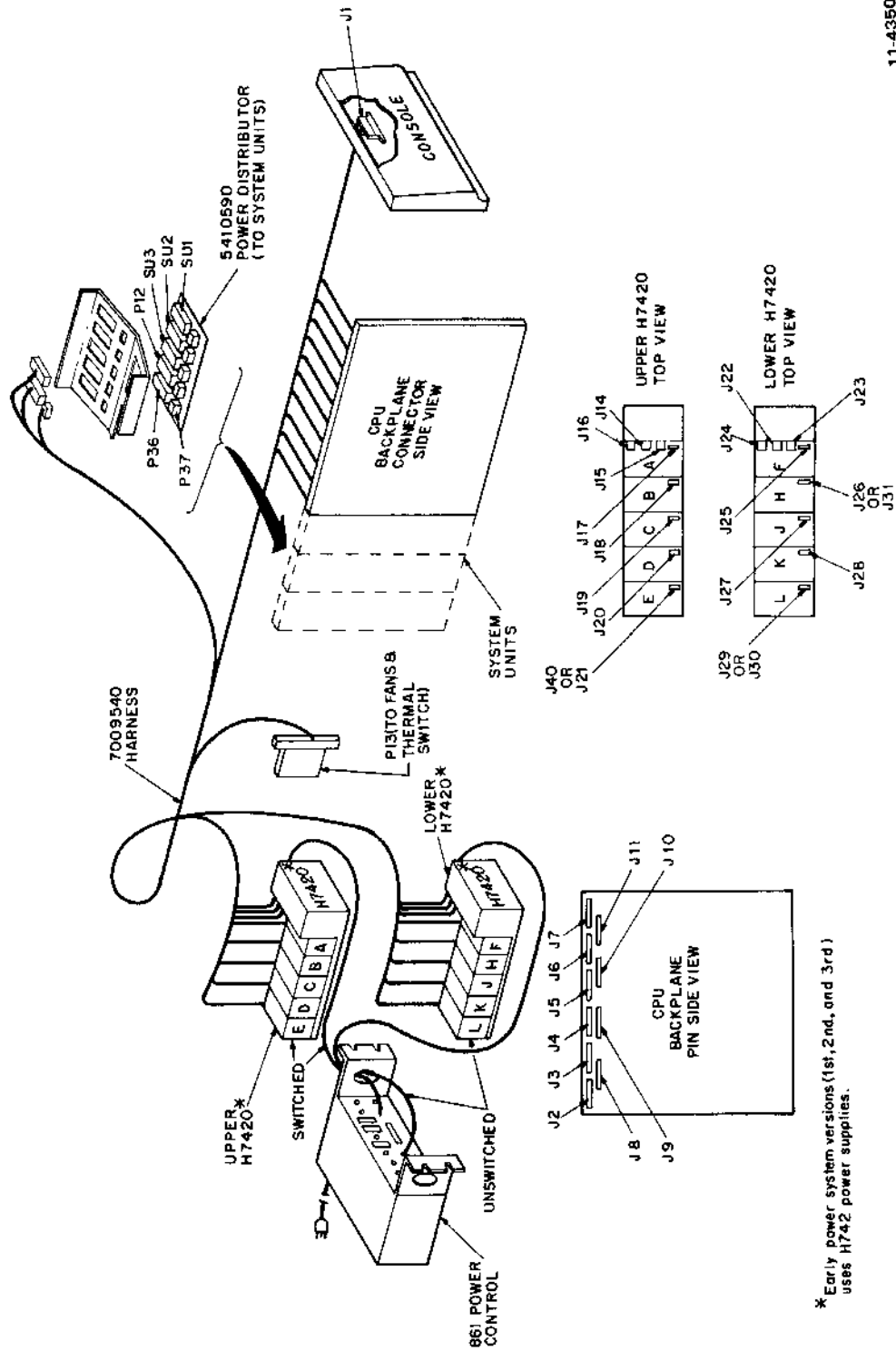
The CPU Cabinet Power Distribution System exists in four versions. The types of power control, harness, and supply used in the CPU cabinet determine the version of power system. Table 3-3 lists each version. The first version includes two 860 power controls, a 7008784 power harness and a H742 power supply. The two 860 power controls were then replaced by one 861 power control to generate the second version. A different power harness was then utilized, when CPU cabinet serial number 2000 was produced, to generate the third version. The latest version contains the previous revisions and a different power supply – the H7420 instead of the H742. Figure 3-2 shows a pictorial representation of the second and third versions. Figure 3-3 shows a pictorial representation of the first and second versions.

Each 11/45 or 11/50 uses one of the four versions of the power systems. The 11/55 uses only the most current power system version (4th).

Table 3-3 Power System Versions

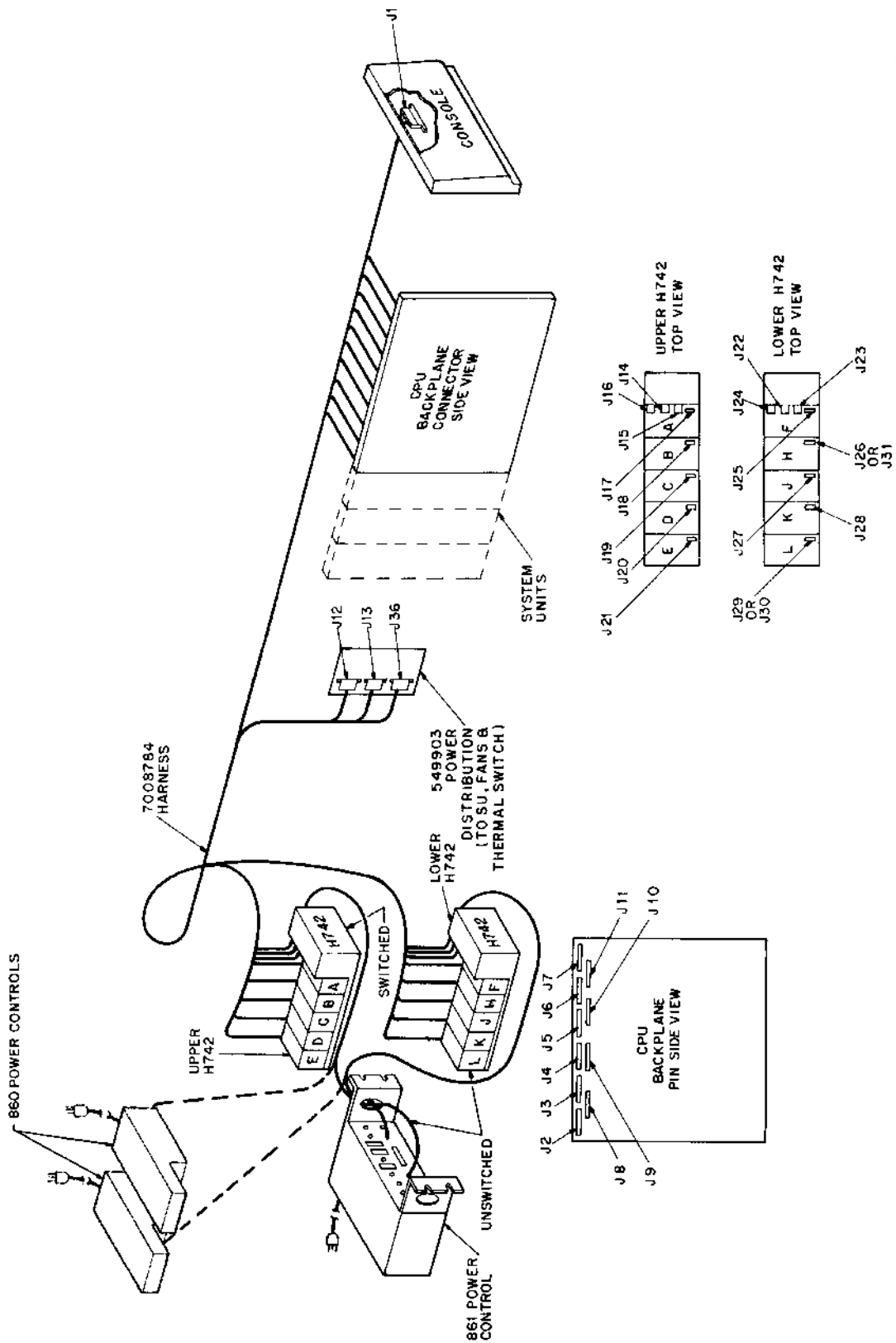
	Power System Version			
	1st	2nd	3rd	4th (Current)
Power Control	(2) 860	861	861	861
Power Harness*	7008784	7008784	7009540	7009540
Power Supply	H742	H742	H742	H7420
	Below CPU cabinet serial number 2000		Above CPU cabinet serial number 2000	

\*Power harness of the CPU cabinet. Note the entire power system uses a number of power harnesses.



11-4350

Figure 3-2 Newer Versions (3rd and 4th) of Power System;  
CPU Cabinet Serial Numbers 2000 and Higher



11-2282

Figure 3-3 Early Versions (1st and 2nd) of Power System; CPU Cabinet Serial Numbers Less Than 2000

## CHAPTER 4 PLUG-IN CARD OPTIONS

This chapter provides the information needed to install PC board options in an existing PDP-11/45, 11/50, 11/55 system. Options included are:

- FP11-B Floating Point Processor (for the KB11-A)
- FP11-C Floating Point Processor (for the KB11-D)
- KT11-C Memory Management Unit (for the KB11-A)
- KT11-CD Memory Management Unit (for the KB11-D)
- MS11 Semiconductor Memory Systems
- KW11 Line Clock

### Additional SPC Space

The DD11 system interfacing unit provides additional SPC slot positions for plug-in card options other than those provided by the standard backplanes and system units. It is usually mounted in the processor cabinet or expansion cabinet. The DD11-A and DD11-B each provide four SPC slots and are described in the *PDP-11 Peripherals Handbook*. The DD11-D provides nine SPC slots and a modified Unibus connection. (A description of the DD11-D is provided in the *PDP-11/34 System User Guide*).

## 4.1 FP11-B, C FLOATING POINT PROCESSOR

### 4.1.1 Installation

The following steps outline the procedure necessary to install the FP11-B, C Floating-Point Processor.

1. Turn power off at the console by shutting off both circuit breakers on the power supplies.
2. Install the H744 +5 V regulator in slot A of the upper H742 power supply as indicated on the power supply decal located at the rear of the CPU mounting box.
3. Install FRH module (M8114 for the FP11-B or M8126 for the FP11-C) in slot 2 of the CPU backplane assembly.
4. Install FRL module (M8115 for the FP11-B or M8127 for the FP11-C) in slot 3 of the CPU backplane assembly.
5. Install FRM module (M8112 for the FP11-B or M8128 for the FP11-C) in slot 4 of the CPU backplane assembly.
6. Install FXP module (M8113 for the FP11-B or M8129 for the FP11-C) in slot 5 of the CPU backplane assembly.

7. Turn circuit breakers on and recheck the +5 Vdc and -15 Vdc regulator outputs for proper voltages. Readjust as required in accordance with Paragraph 6.2.2 in the *PDP-11/45, 11/50, and 11/55 System Maintenance Manual*. Refer to Table 6-2 for test points.
8. Set the Data Display switch on the console to  $\mu$ ADRS FPP/CPU and press the HALT switch. The FP11-B, C microaddress should display 076. Connect an oscilloscope probe to A2A1 to determine that the oscillator is running. Press the START switch and check that the FP11-B, C cycles back to address 076.
9. Run the diagnostic programs listed in Paragraph 7.2 of the system maintenance manual.

## **CHAPTER 5**

### **SYSTEM UNIT OPTIONS**

#### **5.1 SYSTEM UNITS**

Many of the options available for the PDP-11/45, 11/50, and 11/55 systems consist either in whole or in part of system units. Appendix A lists these as SU in the Mounting Code column. A system unit consists of:

1. The backplane, which can be either single (four card slots) or double (nine card slots), and either wire-wrapped or printed circuit etch connected.
2. PC module(s) that plug into the backplane.
3. A power harness (option harness) that brings power from the cabinet power distribution system to the option backplane. Harness numbers are listed in Appendix A.

If the system unit is a peripheral device controller, the cable to the peripheral device plugs into a connector on one of the modules. System units may be installed, within the limits set by the applicable configuration rules, in either the CPU or in an expansion cabinet. Three single system units can be installed in the PDP-11/45, 11/50, 11/55 CPU cabinet and nine in an H960-D expansion cabinet; a double SU takes up the space of two single units.

#### **5.2 EXPANSION CABINETS**

The H960-D cabinet contains one BA11-FB mounting box containing up to nine system units and an associated H7420 (or H742) power supply. The H960-C Version of the expansion cabinet is merely the empty cabinet frame and panels. The ac power distribution for the cabinet is shown in engineering drawing D-IC-H960-0.

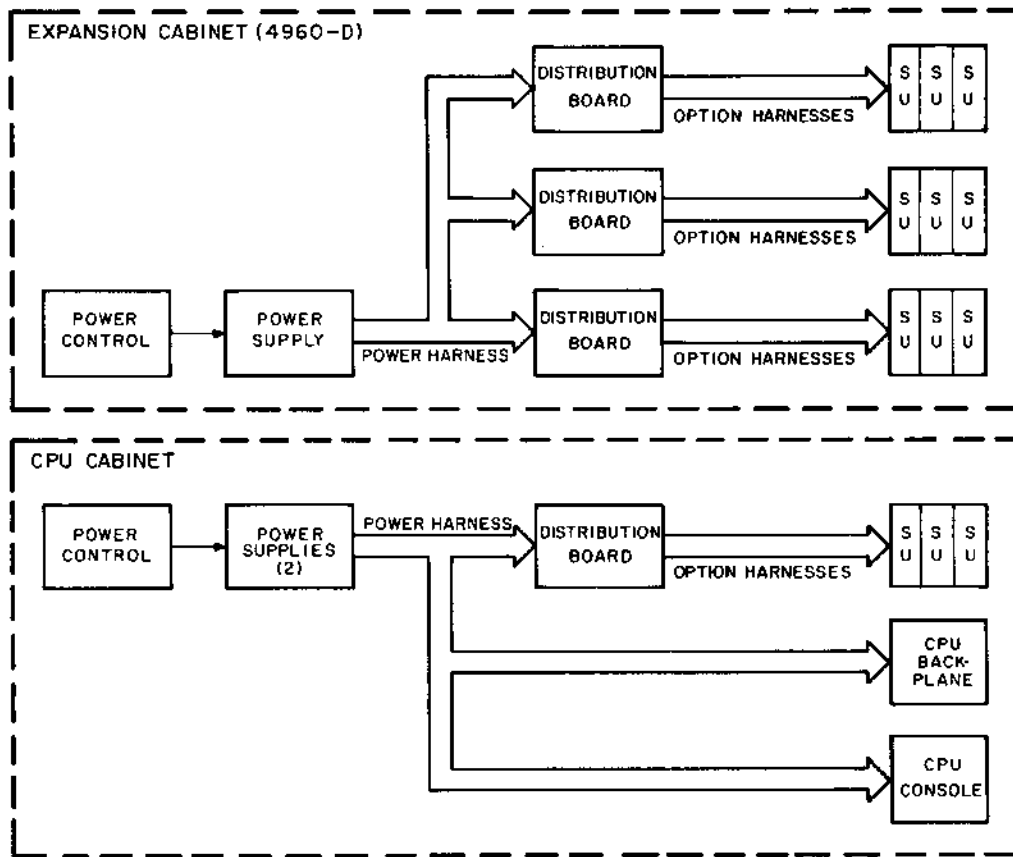
The ac power control system is the same as that for the CPU cabinet, with the exception that only one (switched) H7420 (or H742) is provided per BA11-FB mounting box.

The voltage regulator complement varies with the system unit configuration. DC power distribution is explained in Paragraph 5.3.

#### **5.3 DC POWER DISTRIBUTION**

Refer to the block diagram of Figure 5-1. Chapter 3 of this manual refers to the power harness in the lower half of the figure connecting the power supplies with the CPU backplane, console, and distribution board. A second power harness is needed to connect a third power supply and the distribution boards of the expansion cabinet. The power distribution boards provide a link between the power harnesses and option harnesses (SU power harnesses). Each power distribution board can handle three system units; therefore, the CPU cabinet contains one distribution board and the expansion cabinet contains three distribution boards.





11-4294

Figure 5-1 DC Power Distribution; Simplified Block Diagram

Paragraph 3.3 of this manual defines four versions of the dc power distribution system in terms of control, harness, and supply. When CPU cabinet serial number 2000 was produced, its power distribution board was also changed with the power harness. When expansion cabinet serial number 7000 was produced, its power distribution boards and power harness were also changed. These changes are tabulated in Table 5-1.

Distribution board location is described in the following paragraphs.

Table 5-1 Power Distribution Components

Part	Version	Cabinet	
		CPU	H960-D
Harness	Older	7008784	7008754
	Newer	7009540	7009566
Distribution Board	Older	5409903	5409944
	Newer	5410590	5410590

### 5.3.1 CPU Cabinet

The connectors of the distribution board for the SU power harnesses (option harnesses) are at the rear of the CPU mounting box in the older versions (Figures 5-3 and 1-1) and at the top of the CPU box in the newer versions (Figures 5-2 and 1-1). See engineering drawings D-UA-11/45-0-1 for more detail on both versions. (Equivalent 11/50 or 11/55 drawings present detail on newer versions only.)

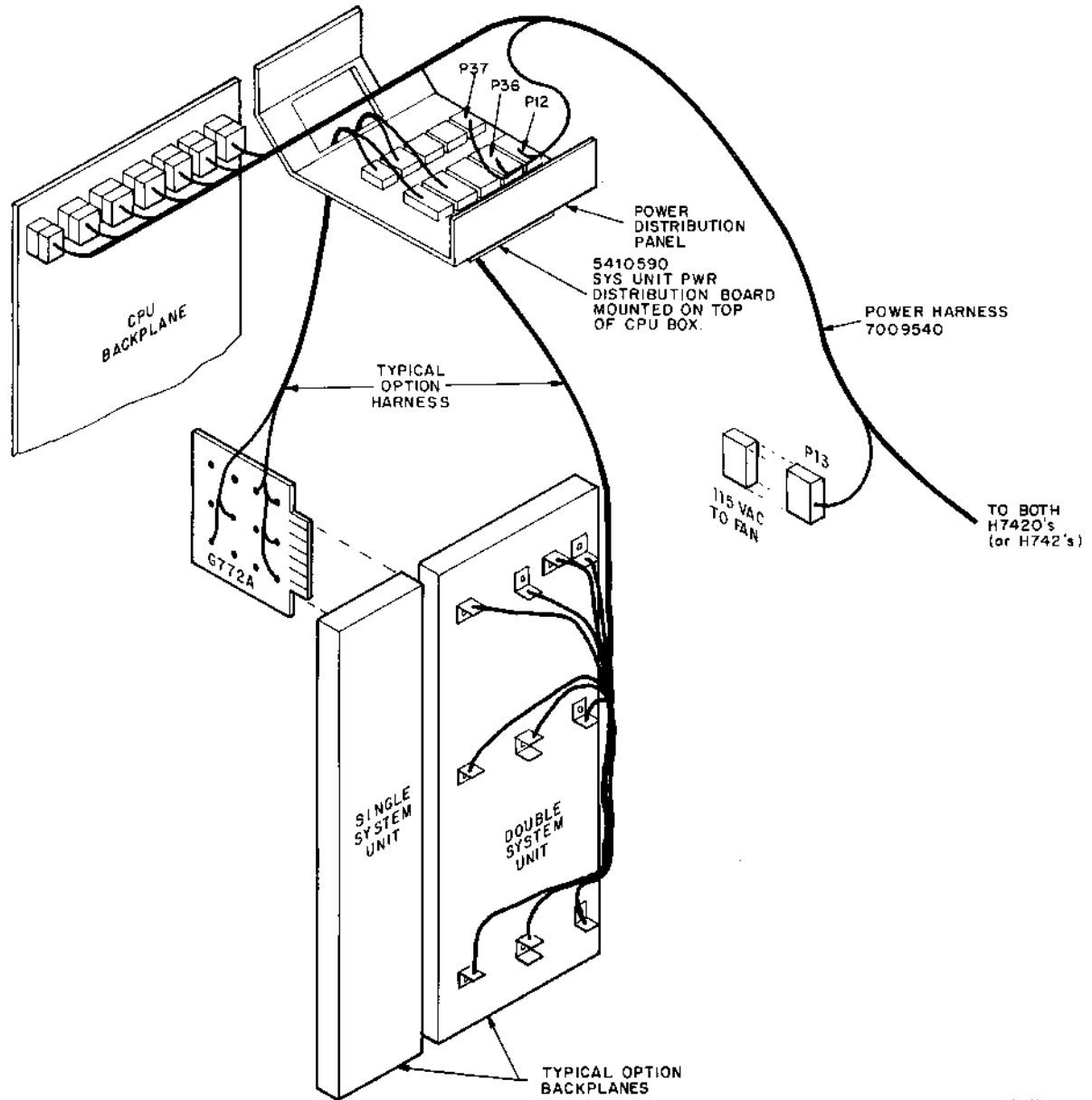


Figure 5-2 Installation of System Units, Later Systems, CPU Cabinet Serial Numbers 2000 and Higher

11-2301

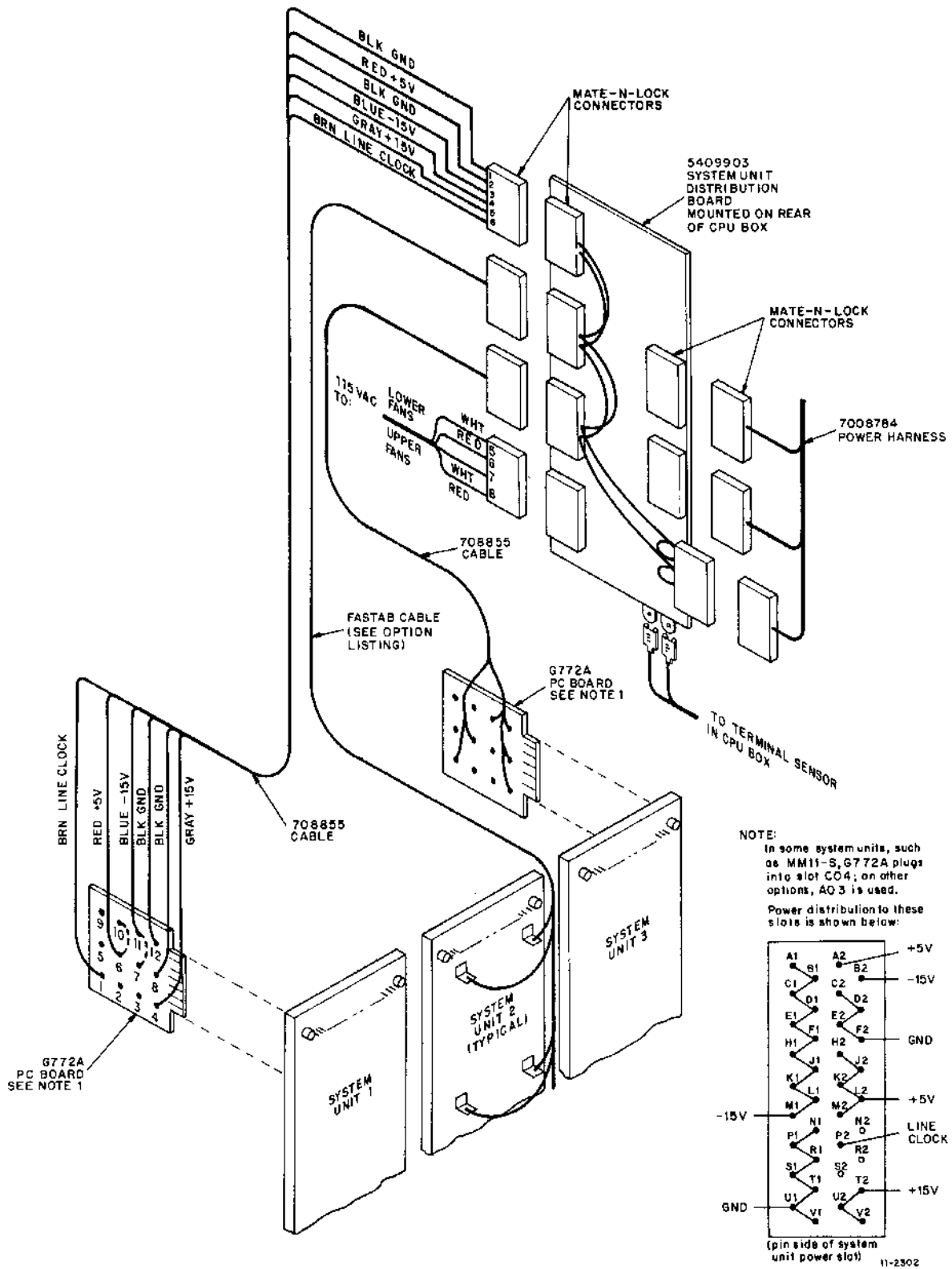


Figure 5-3 Installation of System Units, Early Systems, CPU Cabinet Serial Numbers Less than 2000

### 5.3.2 Expansion Cabinets

In the older versions, the power distribution boards are mounted vertically and are shown in Figure 5-5; the newer ones are mounted horizontally and are shown in Figure 5-4. Drawings D-UA-H960-D-0 show the complete assembly of both old and new expansion cabinets. The newer harness is installed in cabinets bearing serial numbers 7000 and higher.

### 5.4 MF11 CORE MEMORY

A system unit option for the PDP-11/45, 11/50, and 11/55 is the MF11 Core Memory System. Refer to the *MF11-U/UP Core Memory System Maintenance Manual* for installation and maintenance procedures. The diagnostic programs used with the MF11 Memory Systems are described briefly below. Table 5-2 lists the diagnostic programs used with the MF11.

Table 5-2 MF11 Core Memory System Diagnostic Programs

Number	Tests
MAINDEC-11-DZMMJ	Mem 0–24K
MAINDEC-11-DZQMA (1)	Mem I/O Exerciser
MAINDEC-11-DZQMB	0–124K Memory Exerciser
MAINDEC-11-DCMFA (2)	Mem Parity Control Logic Check

- (1) Requires NPR device input  
 (2) Parity memories only

DZMMJ – This program is a combination of eight test patterns that can be used to test 0–24K of memory. This program may find problems not found by DZQMB.

DZQMA – This test checks memory up to 124K, using NPR devices.

DZQMB – This test checks 0–124K of memory for unique addressing and worst-case noise patterns.

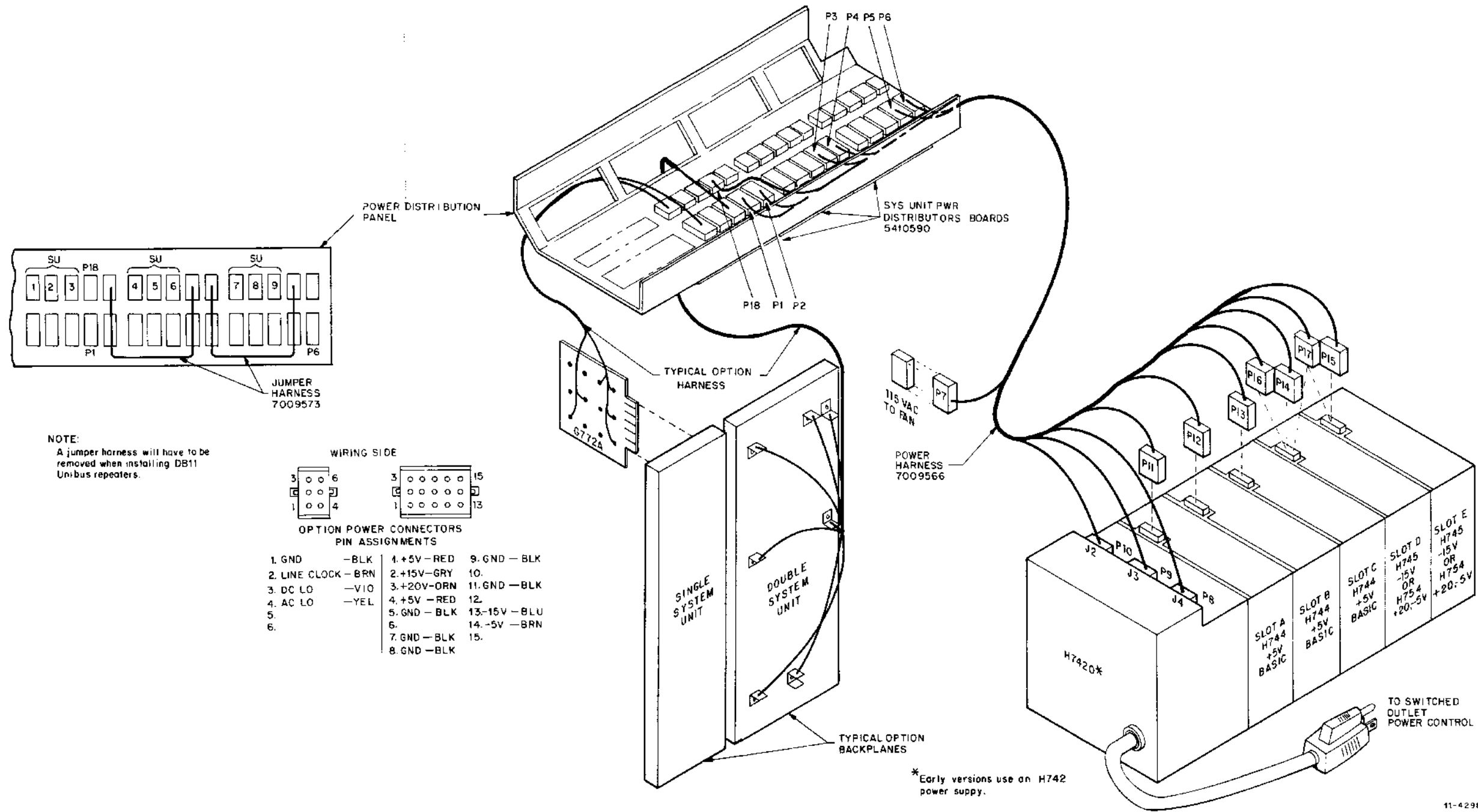
DCMFA – This program locates the Parity Memory Registers for the memory and performs a check of the bits in each. It then creates a map showing the Memory controlled by each parity register. The Parity Registers and the memory are then tested using the information in the map.

### 5.5 INSTALLATION OF SYSTEM UNIT

The installation of a system unit requires the items listed in Table 5-3.

Table 5-3 SU Installation Requirements

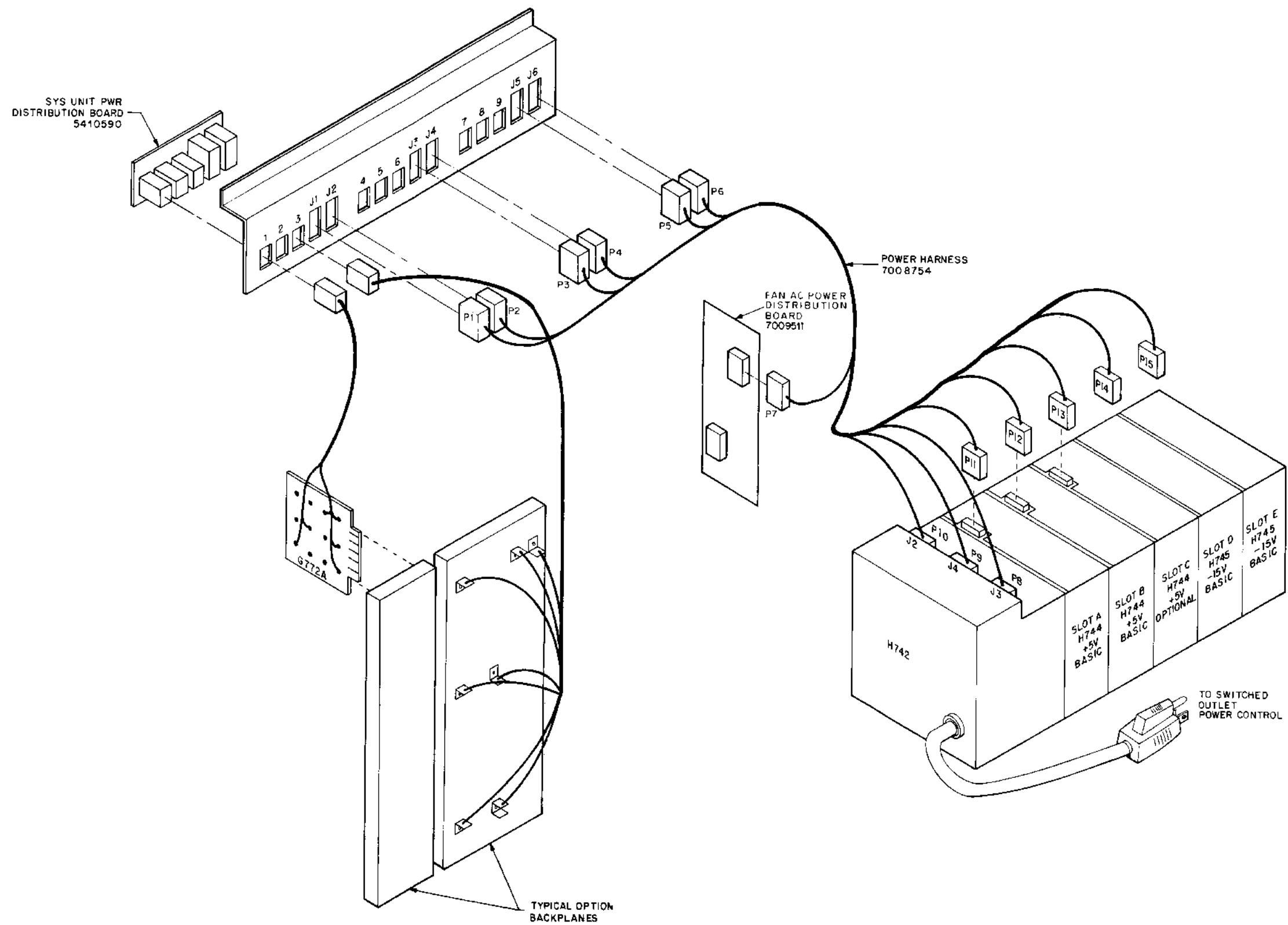
Qty	Item	Remarks
1	Backplane	
1	Power Harness	See Appendix A
1	M920 Unibus Jumper Module	Except when the SU is the first installed in a BA11-FB expansion box.



\*Early versions use an H742 power supply.

11-4298

Figure 5-4 Expansion Cabinet Power Distribution  
Cabinet Serial Numbers 7000 and Higher



11-2304

Figure 5-5 Expansion Cabinet Power Distribution  
Cabinet Serial Numbers Less than 6999

The following steps outline the procedure to be used when installing a system unit option. The rear of the CPU mounting box, which is housed in the H960-CA or H960-DB (Table 1-1) processor cabinet, can accommodate three system units. An additional nine system units can be installed in an expansion cabinet mounting box, which is housed in the H960-D cabinet.

1. Install the required number of system units in the H960 cabinets and secure them to the mounting boxes, using the thumbscrews provided.
2. Plug in the system unit power cables. Two types are used; one connects to the SU backplane by means of a G772A power connector card (see Figure 5-3 for wiring details); the other uses Fastab connectors. The G772As are standard, while the Fastab harnesses vary with the option. The other end of this cable has one (older systems) or two (newer versions) Mate-N-Lok connectors which plug into the power distributor panels. Installation is shown in detail as indicated in Table 5-4.

**Table 5-4 SU Power Cable Installation**

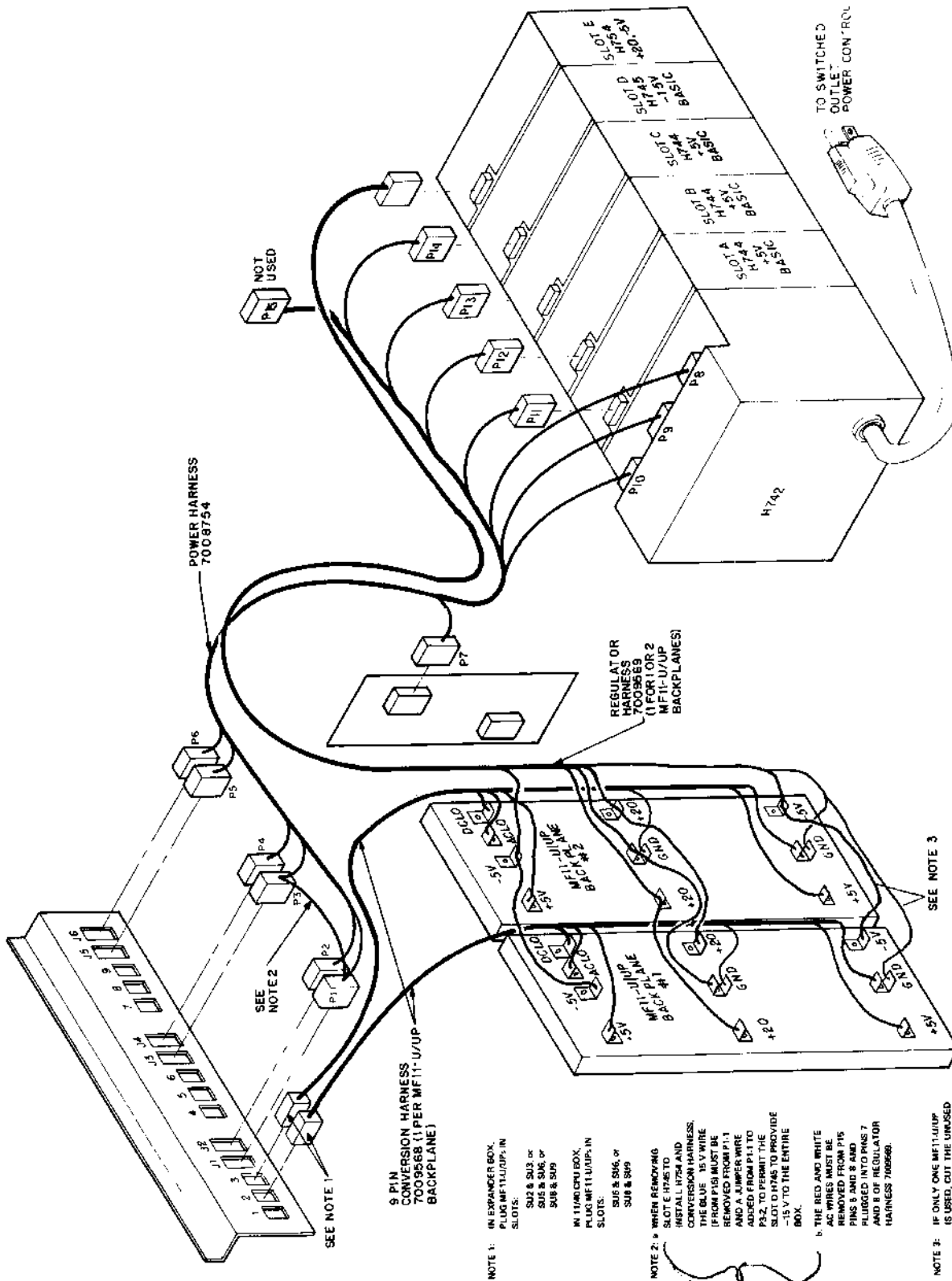
Version	Cabinet	
	CPU	H960-D
older	Figure 5-3	Figure 5-5
newer	Figure 5-2	Figure 5-4

3. Plug in an M920 Unibus jumper module for each system unit that is installed. This module jumpers the Unibus from one system unit to slots A01, B01 of the next system unit.

When system units are to be installed in an H960-D expansion cabinet, a Unibus cable is connected from the last system unit in the processor cabinet to the first system unit in the expansion cabinet.

4. A special case is that of an MF11-U/UP 16K memory installed in an old style H960-D cabinet (it cannot be used in an old version CPU cabinet). In this case (Figure 5-6) a 7009569 conversion harness must be used between the H754 +20, -5 Vdc regulator and the backplane, in addition to the 7009568 harness to the power distributor. One 7009569 can power two MF11-U/UP backplanes. If only one is used, the jumpers between backplanes should be cut. One 7009568 is required per backplane.

A field modification kit (FM11-U) is available for these installations. The FM11-U permits installation of one or two MF11-U/UP backplanes. Refer to the field modification kit print set for installation procedures (DD-FM11-U).



11-2308

Figure 5-6 Installation of MF11-U/UP and FM-11 Kit in Early Systems, Expansion Cabinet Serial Numbers Less than 6999



## APPENDIX A SUMMARY OF EQUIPMENT SPECIFICATIONS

This table provides mechanical, environmental, and programming information for PDP-11 optional equipment. The equipment is arranged in alphanumeric order by model number.

### NOTES

#### 1. Mounting Codes

**CAB** = Cabinet mounted. If a cabinet is included with the option, it is indicated by an X in the "Cab Incl" column.

**FS** = Free standing unit. Height × Width × Depth dimensions are shown in inches.

**TT** = Table top unit.

**PAN** = Panel mounted. Front panel height is shown in inches. An included cabinet is indicated when applicable.

**SU** = System Unit. SU mounting assembly is included with the option.

**SPC** = Small Peripheral Controller. Option is a module that mounts in a quad module, SPC slot.

**MOD** = Module. Height is single, double, or quad.

( ) = Option mounts in the same space as the equipment shown within the parentheses.

Some options include 2 separate physical parts and are indicated by use of a plus (+) sign.

2. Cabinet and peripheral equipment (such as magnetic tape) are included in the specifications.
3. Relative humidity specifications mean without condensation.
4. Equipment that can supply current is indicated by parentheses ( ) around the number of amps in the **POWER** section. **MEMORY POWER**: MF11- and MM11- require the same amount of power. In this table, MF11- power figures show the power required when the memory is active, while MM11- figures reflect that required by an inactive unit.
5. Non-Processor Request devices are indicated by an X in the "NPR" column.
6. 7008855 in 11/45, 11/50, 11/55 CPU; 7008909 in H960-D and 11/40.

7. 7009174. If first MF11-L in 11/40, use 7009103.
8. 7009560. If first MF11-L in 11/40, use 7009565.
9. H960-C, D only (not CPU Cabinet): one 7009568 per backplane (9 pin conversion) and one 7009569 for two backplanes (regulator harness).
10. 7009162 in 11/45, 11/50, 11/55 CPU; 7009099 in H960-D and 11/40.

**CONVERSION FACTORS**

(inches)	× 2.54	= (cm)
(lbs)	× 0.454	= (kg)
(Watts)	× 3.41	= (Btu/hr)
$[(^{\circ}\text{C}) \times 9/5] + 32$		= ( $^{\circ}\text{F}$ )

Model Number	Description	Mounting Code	MECHANICAL				ENVIRONMENTAL		POWER			PROGRAMMING		UNIBUS			Model Number	
			Size H X W X D (inches)	Cab Incl	Weight (lbs)	Power Harness		Oper Temp (°C)	Rel Humid (%)	Cur needed/(supplied)		Power Dis (W)	1st Reg Address	Int Vector	BR Level	NPR		Bus Loads
						Early	New			+5 V	115 Vac / Other (amps)							
AA11-D AD01-D AFC11 BA11-ES	D/A Subsystem A/D Subsystem A/D Subsystem Mounting Box	SU PAN CAB PAN	5½  10½		100	Note 6	7009562	10-50 0-55 10-55	20-95 10-95 10-95	3	0.5 0.5 15	60 60 1700	776 756 776 770 772 570	140,144 130 134	4,5 4-7 4		1 1 1	AA11-D AD01-D AFC11 BA11-ES
BA614 BB11 BB11-A	D/A Converter Blank Mntg Panel Blank Mounting Panel (non-slotted blocks)	(AA11-D) SU SU																BA614 BB11 BB11-A
BC11A BM792-Y CB11	UNIBUS Cable Bootstrap Loader Telephone Switching Interface	SPC Cab		X	300			10-50	10-90	0.3	5.6	650	764 000	float	4-7		1 1.2	BC11A BM792-Y CB11
CD11-A CD11-E CM11-F CR11	Card Reader Card Reader Card Reader Card Reader	SU + TT SU + TT SPC + TT SPC + TT	14 X 24 X 18 38 X 24 X 38 11 X 19 X 14 11 X 19 X 14		85 200 60 60	Note 6 Note 6	7009562 7009562	10-50 10-50 10-50 10-50	10-90 10-90 10-90 10-90	2.5 2.5 1.5 1.5	4 6 4 4	450 700 400 400	772 460 772 460 777 160 777 160	230 230 230 230	4 4 6 6	X X	1 1 1 1	CD11-A CD11-E CM11-F CR11
DA11-B DA11-F DB11 DC11-A	UNIBUS Link UNIBUS Window Bus Repeater Asynch Line Inter	SU SU SU SU				Note 6 7009099 Note 6 Note 6	7009562 7009563 7009562 7009562			4 5 3.2			772 410	124 float	5 7	X X	1 1 1+1 1	DA11-B DA11-F DB11 DC11-A
DD11-A DD11-B DD11-D DECKit 01-A	Periph Mntg Panel Periph Mntg Panel Periph Mntg Panel Remote Analog Data Concentrator: 8 Channels, Serial	SU SU 2 SU PAN	5½ X 19 X 13		15	Note 6 Note 10	7009562 7009563	0-50	10-95		1.5 @ 115 Vac 0.75 @ 230 Vac	175						DD11-A DD11-B DD11-D DECKit 01-A
DECKit 11-F  DECKit 11-H	I/O Interface: 3 Words In/4 Words Out  I/O Interface: 4 Words In/4 Words Out	SU  SU				Note 6  Note 6		0-70  0-70	10-95  10-95	1.84  3.91			User  User	User  User	7  5-6		4  4	DECKit 11-F  DECKit 11-H
DECKit 11-K DECKit 11-M	I/O Interface: 8 Words In I/O Interface: Instrumentation Interface	SU SU				Note 6 Note 6		0-70 0-70	10-95 10-95	1.97 1.75			User User	User User	4		2 2	DECKit 11-K DECKit 11-M
DF01-A DF11 DH11 DJ11	Acoustic Coupler Line Sig Cond Asynch Line MX Asynch Line MX	TT DF slot 2 SU SU	6 X 7 X 12		6		7009466 7009099 7009561 7009563	0-60 5-45			0.3 see Product Bull. 0.24 A @ -15 V see Product Bull.		float float	float float	5 5	X	2 1	DF01-A DF11 DH11 DJ11
DL11-A DL11 (others) DL11-W	Terminal Control Asynch Line Inter Asynchronous Interface and Line Clock	SPC SPC SPC	Quad Ht							1.8 1.8 2	0.15 A @ -15 V 0.15 A @ -15 V 0.05 A @ +15 V 0.15 A @ -15 V	10	777 560 776 500 Switch Selectable (SS)	060,064 float A. Int.-SS Line CLK-104	4 4 A. Int.-4 Line CLK-6		1 1 1	DL11-A DL11 (others) DL11-W
DM11-BB DMC-11  DN11	Modem Ctr. MUX Microprocessor and Line Unit  Auto Calling Unit	(DH11) 2 SPC  SU	2 Hex Ht							2.8 4.5 3			775 000	float	5	X	1 1	
DP11 DQ11	Synch Line Inter DMA Sync Line Interface	SU SU				Note 6 7009099	7009562 7009563	0-40 0-40 10-50	20-90 20-90 10-90	1.4 2.5 5.7	0.10 A @ ±15 V 0.10 A @ ±15 V 0.07 A @ -15 V		775 200 774 400 float	float float float	4 5 5		1 1 1	DN11 DP11 DQ11
DR11-B	DMA Interface	SU				Note 6	7009562	10-50	20-90	3.3			772 410	124	5	X	1	DR11-B
DR11-C DT03-F DX11 GT40	General Interface UNIBUS Switch IBM Chan. Interface Graphics Terminal	SPC PAN CAB TT	5½  18 X 20 X 24	X	180 150			10-50 10-55 15-35	20-90 10-90 20-80	1.5	2 2.5 15		767 770 776 200 float	float user float float	5 7 4-7	X	1 1+1 1 1	DR11-C DT03-F DX11-B GT40

Model Number	Description	MECHANICAL						ENVIRONMENTAL		POWER			PROGRAMMING		UNIBUS			Model Number
		Mounting Code	Size (H X W X D) (inches)	Cab Incl	Weight (lbs)	Power Harness		Oper Temp (°C)	Rel Humid (%)	Cur needed/(supplied)		Power Dis (W)	1st Reg Address	Int Vector	BR Level	NPR	Bus Loads	
						Early	New			+5 V	115 Vac / Other (amps)							
H312-A H720-E H722 H742	Null Modem Power Supply Transformer Power Supply	(BA11) (PC11-A) (H960-D)			30			0-50	20-95	(22)	6 (10A) @ -15 V 1.5 A @ 230 Vac 8 (1 A) @ +15 V	700						H312-A H720 H722 H742
H7420 H744 H745 H746	Power Supply +5 V Regulator -15 V Regulator MOS Regulator	(H960-D) (H7420 or H742) (H7420 or H742) (H7420 or H7420)								(25) (25)	(10 A) @ -15 V (1.6 A) @ 23.2 V (3.3 A) @ 19.7 V (1.6 A) @ -5 V (8 A) @ +20 V (1 A) @ -5 V							H7420 H744 H745 H746
H754	+20, -5 V Regulator	(H742)																H754
H933-C	Mounting Panel (H803 blocks)	SU																H933-C
H933-D	Mounting Panel (H808 blocks)	SU																H933-D
H960-C H960-D	Cabinet Cab (1 drawer)	FS FS	72 X 21 X 30 72 X 21 X 30	X X	120 300													H960-C H960-D
H960-E H961-A KE11-A KG11-A	Cab (2 drawers) Cab w/o side pan Ext. Arith. Elem. Comm Arith Unit	FS FS SU SPC	72 X 21 X 30 72 X 21 X 30	X X	470 120													H960-E H961-A KE11-A KG11-A
KW11-L KW11-P LA30 LC11-A	Line Clock Programmable Clock DECwriter LA30 Control	MOD SPC FS SPC	single ht 31 X 21 X 24															KW11-L KW11-P LA30 LC11-A
LP11-F LP11-J LP11-R LPS11	Printer (80 col) Printer (132 col) Ptr (heavy duty) Lab Periph System	SPC + FS SPC + FS SPC + FS PAN	46 X 24 X 22 46 X 48 X 25 48 X 49 X 36 5 1/2		200 575 800 80													LP11-F LP11-J LP11-R LPS11-S
LS11 LT33 LV11 M105	Line Printer Teletype Electrostatic Ptr Adrs Select Module	SPC + TT FS SPC + FS MOD	12 X 28 X 20 34 X 22 X 19 38 X 19 X 18 single ht		155 60 160													LS11 LT33 LV11 M105
M783 M784 M785 M792	Bus Transmitter Bus Receiver Bus Transceiver Diode ROM	MOD MOD MOD SPC	single ht single ht single ht															M783 M784 M785 M792
M795 M796 M920 M930	Word Count Bus Control Bus Jumper Bus Terminator	MOD MOD MOD MOD	double ht															M795 M796 M920 M930
M1501 M1502 M1621	Bus Input Interface Bus Output Interface DVM Data Input Interface	MOD MOD MOD	single ht double ht quad ht															M1501 M1502 M1621
M1623 M1710 M1801	Instrument Remote Control Interface Unibus Interface Foundation 16-Bit Relay Output Interface	MOD MOD & SPC MOD	quad ht quad ht quad ht														opt	M1623 M1710 M1801

Model Number	Description	MECHANICAL						ENVIRONMENTAL		POWER			PROGRAMMING		UNIBUS			Model Number
		Mounting Code	Size (H X W X D) (inches)	Cab Incl	Weight (lbs)	Power Harness		Oper Temp (°C)	Rel Humid (%)	Cur needed/(supplied)		Power Dis (W)	1st Reg Address	Int Vector	BR Level	NPR	Bus Loads	
						Early	New			+5 V	115 Vac/ Other (amps)							
M7820 M7821 M9301(-YA), (-YB), (-YD)	Interrupt Control Interrupt Control Bootstrap Terminator	MOD MOD Unibus Slot	single ht single ht Double Ht							2						1	M7820 M7821 M9301(-YA), (-YB), (-YD)	
ME11-L MF11-L MF11-LP MF11-U	Core Memory (8K) Core Memory (8K) Parity Memory (8K) Core Memory (16K)	PAN 2 SU 2 SU 2 SU	5 1/4			Note 7 Note 7 Note 9	Note 8 Note 8 7009535	0-50 0-50 0-50	10-90 10-90 10-90	3.4 4.9 4.5	5 6 A @ -15 V 6 A @ -15 V 3.5 A @ 20 V 0.5 A @ -5 V	125 125 125 120					1 1 2 1	ME11-L MF11-L MF11-LP MF11-U
MF11-UP MM11-L MM11-LP MM11-U MM11-UP	Parity Memory (16K) Core Memory (8K) Parity Memory (8K)  Parity Memory (16K)	2 SU (MF11-L) (MF11-LP)  (MF11-UP)				Note 9	7009535	0-50 0-50 0-50	0-90 10-90 10-90	6 1.7 1.7 4.5 4.5	3.4 A @ 20 V 0.5 A @ -5 V 0.5 A @ -15 V 0.5 A @ -15 V 0.5 A @ 20 V 0.5 A @ -5 V 0.5 A @ 20V 0.5 A @ -5 V	120 125 125					2 1 1	MF11-UP MM11-L MM11-LP MM11-U MM11-UP
MR11-DB MS11 PC11 PDM70	Bootstrap Semiconductor Mem Paper Tape Programmable Data Mover	2 SPC (11/45) SPC + PAN TT	10 1/2 5 1/4 X 19 X 23		50 55			0-50 13-38 0-40	10-80 20-95 10-95	0.6 1.5		350 250 250	772 100 777 550	114 070,074	4		2 1 1	MR11-DB MS11 PC11 PDM70
PR11 RC11-A RF11-A RK05	Paper Tape (rdr) Disk & Control Disk & Control Disk Drive	SPC + PAN PAN PAN + PAN PAN	10 1/2 10 1/2 16 + 16 10 1/2		50 115 500 110			13-38 17-50 17-33 15-43	20-95 20-80 20-55 20-80	1.5	3 2.2 6.5 2	350 250 750 160	777 550 777 440 777 460	070 210 204	4 5 5		1 1 1	PR11 RC11-A RF11-A RK05
RK11-D RP03 RP11-C RS11	Disk & Control Disk Drive Disk & Control Disk Drive	SU + PAN FS CAB + FS PAN	10 1/2 40 X 30 X 24 16	X X	250 415 740 100	7008992	7009562	15-43 15-33 15-33 17-33	20-80 10-80 10-80 20-55	7.5	2 6 A @ 230 Vac 7 2	200 1300 2100 200	777 400 776 710	220 254	5 5	X X	1 1	RK11-D RP03 RP11-C RS11
RS64 RT01 RT02	Disk Numeric Data Entry Terminal Alphanumeric Data Entry Terminal	PAN TT TT	10 1/2 6.5 X 12.5 X 15 6.3 X 14.4 X 16	X X	65 12 14			17-50 0-40 0-40	20-80 10-90 10-90		2.2	250 30 50 50						RS64 RT01 RT02
TA11 TC11-G TM11 TU10 TU56	Cassette DECtape & Control Magtape & Control Magtape Transport DECtape Transport	SPC + PAN PAN + PAN PAN + PAN PAN PAN	5 1/4 10 1/2 + 10 1/2 26 + 10 1/2 26 10 1/2	X X X	250 500 450 80			10-40 15-27 15-27 15-27 15-27	20-80 40-60 40-60 40-60 40-60	1.5	1 9 9 9 3	120 870 1000 1000 350	777 500 777 340 772 520	260 214 224	6 6 5		1 1 1	TA11 TC11-G TM11 TU10 TU56
UDC11 VR01 VR14 VT01 VT05	I/O Subsystem Display Display Display Alphanum Terminal	CAB PAN PAN TT TT			30 75 50 55			5-50 10-50 10-50 0-50 10-43	10-90 10-90 10-90 10-80 8-90		15 1 4 2.2 2	1700 120 400 250 130	771 774	234	4,6		2	UDC11 VR01 VR14 VT01 VT05

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