CDP-XI/PS MODEL 36
POWER SUPPLY
TECHNICAL MANUAL

california data processors

REVISIONS

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ILLUSTRATIONS

SECTION 1
INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual provides the information needed to understand, install and maintain the CDP-XI/PS Model 36 Power Supply when used with Drawing Package 21518011. The information in this manual is for the use of a skilled technician familiar with standard test equipment, solid-state logic theory, common maintenance practices and standard troubleshooting techniques. A basic knowledge of design principles and circuits used in power supplies is assumed, hence no tutorial material of this kind is included.

As a stand-alone publication, this manual has a good functional and physical description of the Model 36 power supply, providing the information needed to understand the capabilities and optional features of the power supply and to plan a system using it. The maintenance coverage of this manual is commensurate with the prerequisite skills and knowledge of the defined user, characteristics of the product and maintainability requirements established by Cal Data.

Users holding controlled copies will be provided with revisions and additions to this manual.

1.2 DOCUMENTATION

Cal Data products covered in this manual include:

85006-115	Power supply, 36-A output, 115 Vac input.
85006-208	Power supply, 36-A output, 208 Vac input.
85006-230	Power supply, 36-A output, 230 Vac input.
85006-230E	Power supply, 36-A output, 230 Vac input with European color coding on the power cable.

The following paragraphs define publications and conventions that support this manual.

1.2.1 Publications

Figure 1-1 illustrates the relationship between CDP-XI hardware elements and technical documentation. Controlled copies of documents, delivered in accordance with the terms of a purchase contract, are kept current for the life of the product.

For maintenance purposes, this manual is supported by Drawing Package 21518011, which contains theory of operation, schematic diagrams, assembly drawings and other required engineering drawings. The drawing package is updated with the latest revision of each drawing.

1.2.2 Abbreviations and Conventions

Table 1-1 lists the abbreviations found in this manual. Conventions used in the text of this manual include:

a. ZERO and ONE are used to express binary logic "0" and "1" states, respectively.
b. Signal names are capitalized for easy identification.

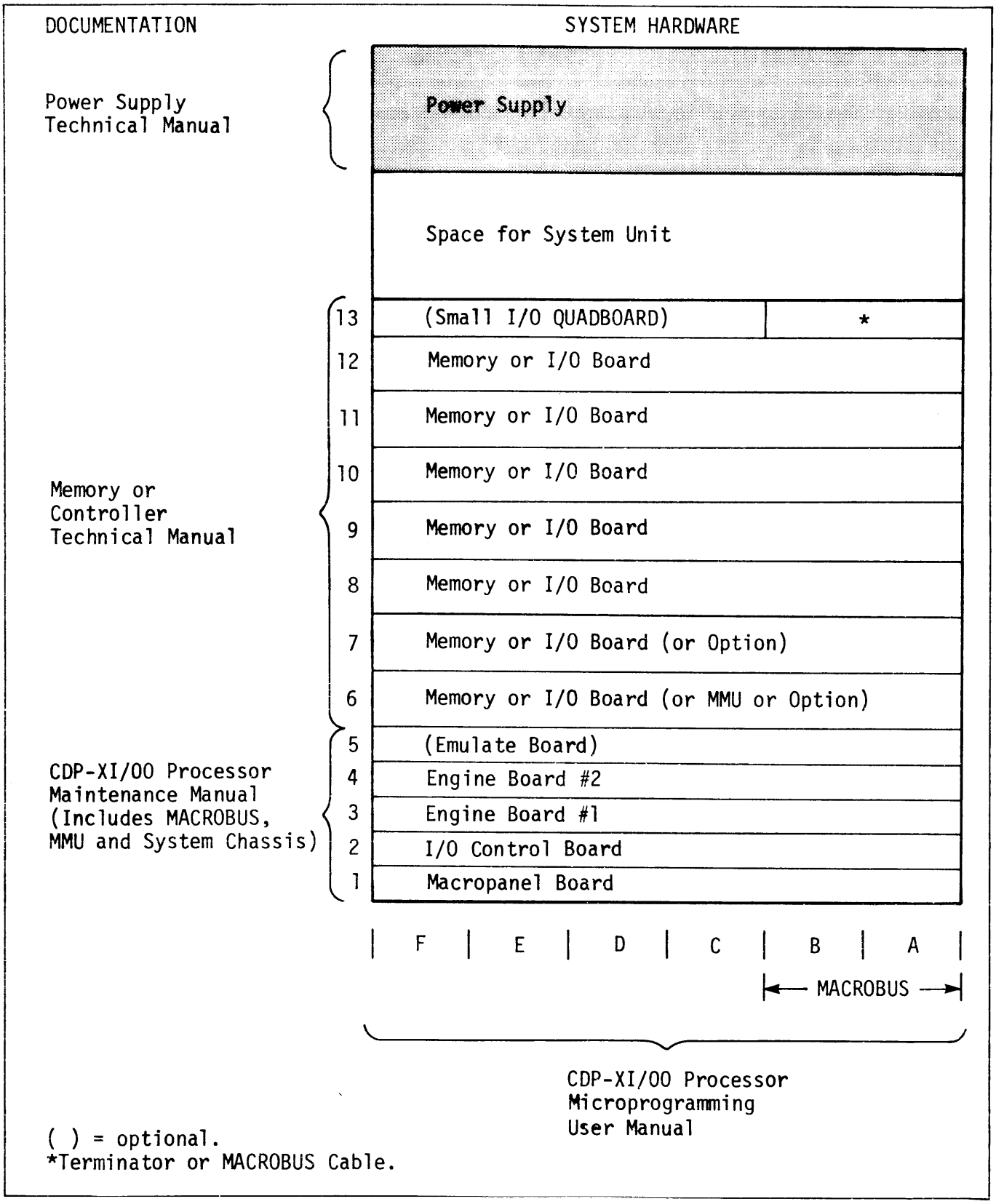

Figure 1-1. Relationship of CDP-XI System Documentation to Hardware

Table 1-1. Abbreviations

Abbreviation	Meaning
Cal Data or CDP	California Data Processors
ac	alternating current
dc	direct current
A	Ampere
mA	milliampere
V	Volt
Vac	Volt, alternating current
Vdc	Volt, direct current
Vrms	Volt, root-mean-square
Hz	Hertz
m	meter
cm	centimeter
kg	kilogram
ft	foot
lb	pound
µs	microsecond
ns	nanosecond
psi	pounds per square inch
cfm	cubic feet per minute
cmm	cubic meters per minute
awg	American wire guage
^{o}C	degrees, Celsius

SECTION 2
DESCRIPTION

2.1 OVERVIEW

The Model 36 power supply is a regulated, multiple-output dc supply providing all power requirements for the CDP-XI and PDP-11* series of computers. Except for power ratings and connectors, the Model 36 power supply is electrically and mechanically compatible with the DEC H720-E/F power supply.

Features of the Model 36 power supply include:

AC Input Compatibility. The Model 36 power supply is available in 115 Vac, 208 Vac and 230 Vac (American and European) input power configurations for use in all major countries of the world.

Regulated DC Outputs. Outputs of +5 Vdc at 36 A and -15 Vdc at 12 A are regulated to within three percent with low ripple and noise.

Circuit Protection. Both overvoltage and overcurrent protection circuits are included in the power supply.

In addition, a thermal circuit breaker is provided to prevent overheating of power semiconductors.

Power-Failure/Restart. As a standard feature, both low ac and dc levels are detected and signalled by the power supply.

Line-Frequency Signal. A square wave line-frequency signal is provided at levels compatible with standard logic elements.

There are four versions of the Model 36 power supply. One accommodates 115 Vac line input, and one 208 Vac line input. There are two 230 Vac line-input versions; one with cabling color-coded for European use, the other for U.S. applications.

2.2 FUNCTIONAL DESCRIPTION

Figure 2-1 is a block diagram of the Model 36 power supply. The power supply provides the following outputs required for CDP-XI applications as well as for compatibility with the DEC H720-E/F power supply:

+5 Vdc regulated.
-15 Vdc regulated.
+8 Vrms unregulated.
-22 Vdc unregulated.
Common ground for all dc voltages.
115 Vac switched unregulated service outlet with overcurrent protection (115 Vac model only).
LTCL line-frequency clock signal.

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*The following are trademarks of Digital Equipment Corporation: PDP-11, UNIBUS, DEC.

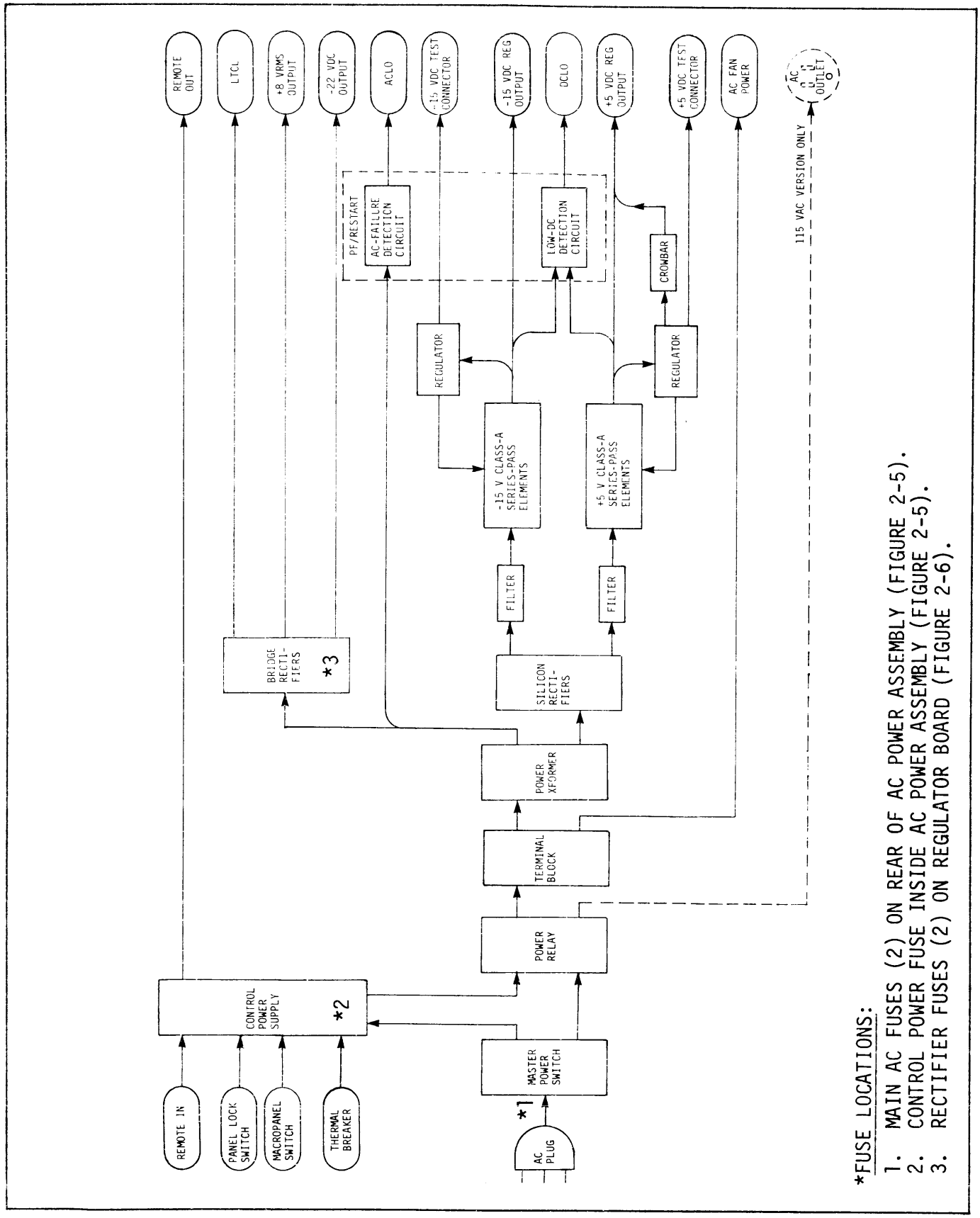


Figure 2-1. Model 36 Power Supply Block Diagram

ACLO line-voltage failure signal.
DCLO impending regulated-voltage failure signal.

The Model 36 power supply consists of:

a. Power supply metal chassis with cover.
b. AC power circuitry for 115 Vac, 208 Vac, 230 Vac U.S. or 230 Vac European operation.
c. Rectifier and regulator circuitry for +5 Vdc at 36 A.
d. Rectifier and regulator circuitry for -15 Vdc at 12 A.
e. Rectifier circuitry for the DEC-compatible +8 Vrms and -22 Vdc unregulated outputs.

2.2.1 Power Switching

A relay and separate 24-Vdc control power supply are used in conjunction with a remote power switch (e.g., on the macropanel) to control ac power to the supply, fans and auxiliary equipment. The relay is activated by grounding an input control line.

The power switching circuit is wired so that one power supply can be used to control another.

2.2.2 Circuit Protection

The power supply has overvoltage and overcurrent protection, and a thermal circuit breaker.

The power supply is designed so that should a momentary short at any output develop, either to ground or to another output, no internal component will be damaged. If a component fails, causing input overcurrent, the ac fuses interrupt input power.

A "crowbar" circuit prevents the +5 Vdc output from exceeding +6.8 Vdc, including transients. If the crowbar should be triggered by either a component failure or a high-voltage transient on the +5 Vdc output, the +5 Vdc output is electrically grounded. The power supply must be switched off, the fuses replaced, and then the supply switched on again to reset the crowbar.

The ac fuses limit the total current drawn by the supply, fans and equipment plugged into the auxiliary power outlet (115 Vac model only). A master power switch on the rear of the power supply chassis removes power from the entire supply.

The power supply has a thermal circuit breaker on the primary semiconductor heat sink. This breaker opens the power relay in case of loss of cooling air, thus maintaining semiconductor junction temperature at 75 percent of the rated maximum value.

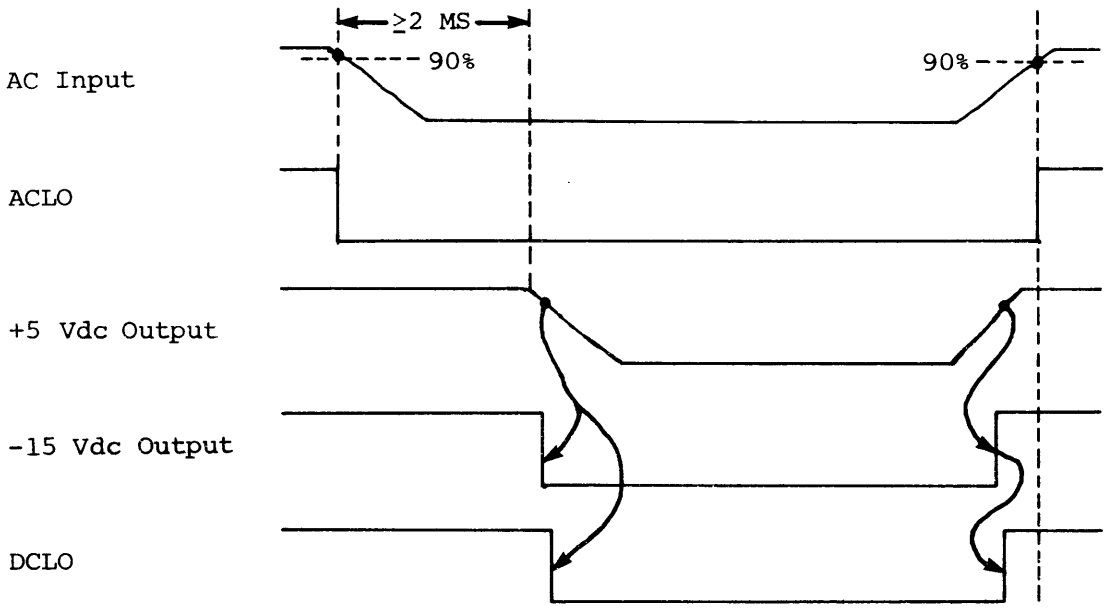
For human protection, voltages above 30 V are totally insulated.

The Model 36 power supply is designed to meet all Underwriters' Laboratories requirements.

2.2.3 Power-Failure/Restart

The Model 36 power supply contains integral power-failure detection circuits for both ac and dc. These circuits are designed so that during a power-down sequence, the dc levels do not fall until at least two milliseconds after ac power fails. During a power-up sequence, dc levels go high before the rising ac reaches its normal high level.

These sequences are illustrated below:



2.2.3.1 AC Power-Failure Detection

The ac power-failure detection circuit provides an AC-Low indicator signal (ACLO) that is at +5 Vdc during normal power supply operation and line input.

When there is a power failure that reduces the ac line input by more than about 10 percent below the nominal value, ACLO switches to 1.0 Vdc maximum. ACLO can sink 60 mA for at least ten milliseconds after ac failure. There is a minimum of one volt hysteresis in the detection of low ac. ACLO can be ORed with ACLO from up to three other similar power supplies.

When ac power is re-established, ACLO returns to +5.0 Vdc.

2.2.3.2 DC Low-Power Detection

The dc low-power detection circuit provides a DC-Low indicator signal (DCLO) that is +4.0 Vdc minimum when both regulated dc supplies are within their normal operating ranges.

Whenever either regulated dc supply drops below its normal operating range, DCLO switches to 1.0 Vdc maximum. DCLO can sink 60 mA with or without ac line input to the power supply. DCLO can be ORed with DCLO from up to three other similar power supplies.

When the regulated dc supplies are again both within their normal operating ranges, DCLO returns to the high level. DCLO reaches the high level before ACLO reaches the high level.

2.2.4 Line-Frequency Signal

The power supply provides a line-frequency signal (LTCL) that is a square-wave signal at input line frequency. The high level is +5.0 ±0.8 V. The low level is 0.0 ±0.8 V and is capable of sinking 20 mA. The noise component of LTCL above 120 Hz is less than one volt peak-to-peak under any load or input.

2.2.5 Input Power Variations

The 115, 208 and two 230 Vac versions of the power supply differ only in types of power cable, power plugs, fan connections and the configurations of the jumpers on the input power terminal strip (and the ac outlet that appears only on the 115 Vac supply).

2.2.6 Fan Power

The fans operate on 115 Vac in all versions of the power supply. In the 115 Vac supply, the two pairs of fans are connected in parallel. In the 208 and 230 Vac supplies, the two pairs of fans are connected in series.

2.3 PHYSICAL DESCRIPTION

The Model 36 power supply housing (Figure 2-2) measures 16.5 by 5.5 by 9.32 inches (41.91 by 13.97 by 23.67 cm) and fits in the rear of a CDP-XI or compatible chassis. The power supply weighs approximately 37 pounds (16.8 kg).

Figure 2-3 is an exploded view of the assemblies that make up the power supply. Connector pin assignments are given in Appendix A.

2.3.1 Chassis Assembly

The chassis of the Model 36 power supply consists of a metal housing with the power transformer and five large capacitors mounted on it (Figure 2-4). The assemblies described below are mounted on the chassis.

2.3.2 AC Power Assembly

The ac power assembly (Figure 2-5) contains the ac plug, cable, input connector and fuses. It also has two connectors for remote control of the power supply, the master power toggle switch, and the panel-lock slide switch. All of these are accessible from the rear of the power supply.

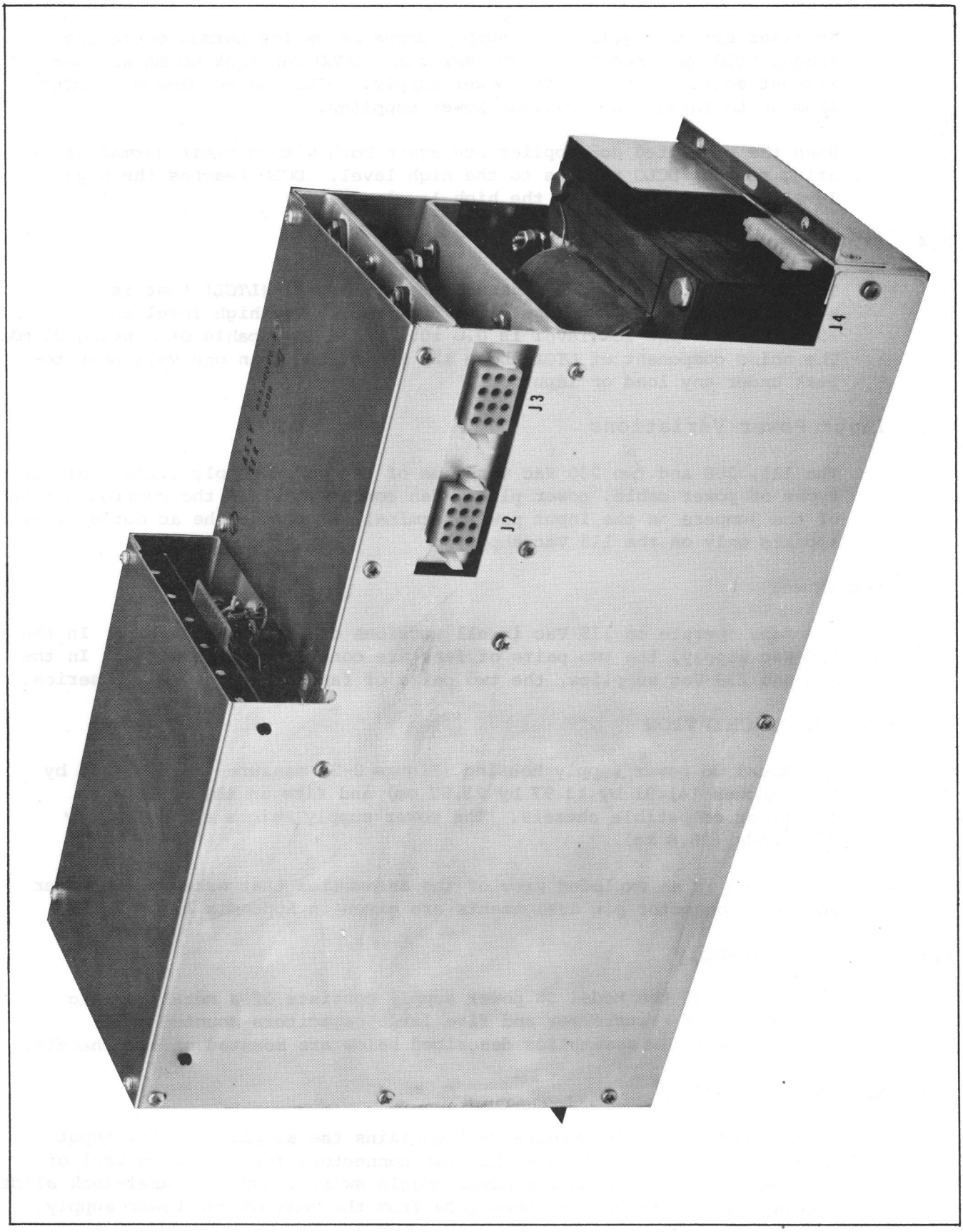
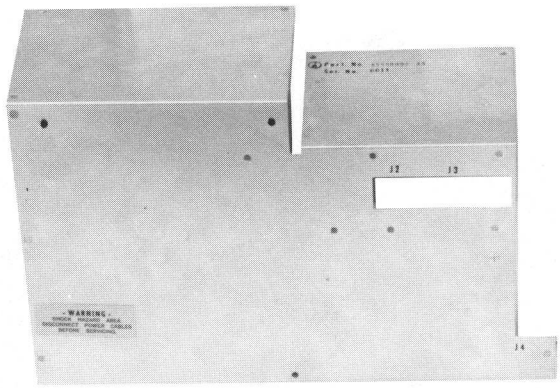
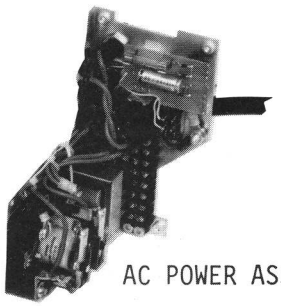


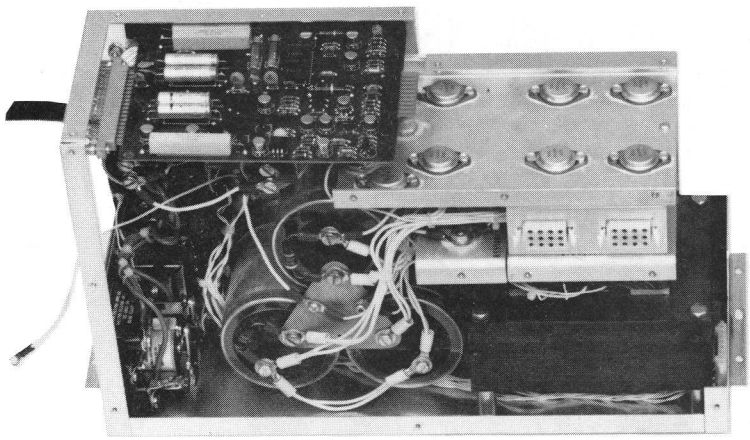
Figure 2-2. Model 36 Power Supply



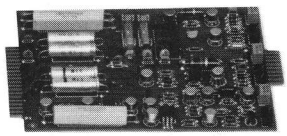
COVER PLATE



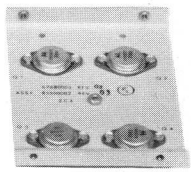
AC POWER ASSEMBLY



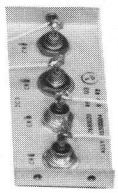
ASSEMBLED POWER SUPPLY



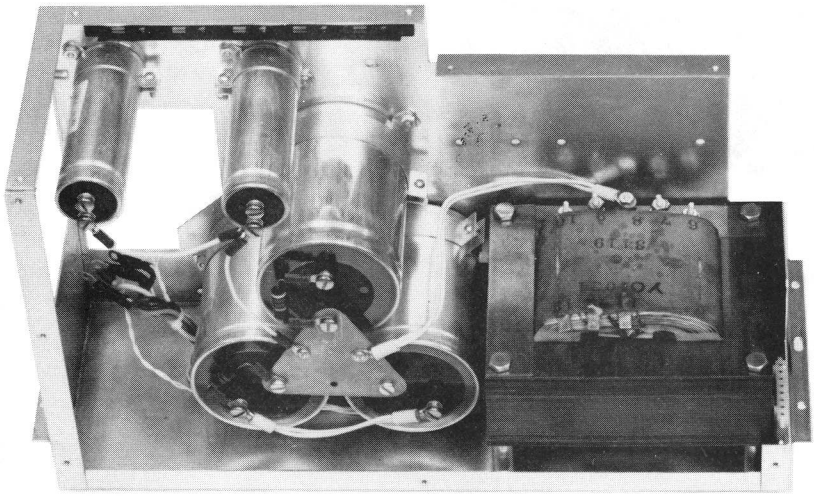
REGULATOR BOARD



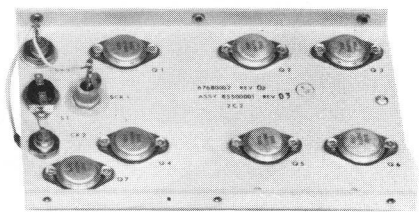
-15-VDC HEAT-SINK ASSEMBLY



RECTIFIER HEAT-SINK ASSEMBLY



CHASSIS ASSEMBLY



+5-VDC HEAT-SINK ASSEMBLY

Figure 2-3. Model 36 Power Supply Assemblies

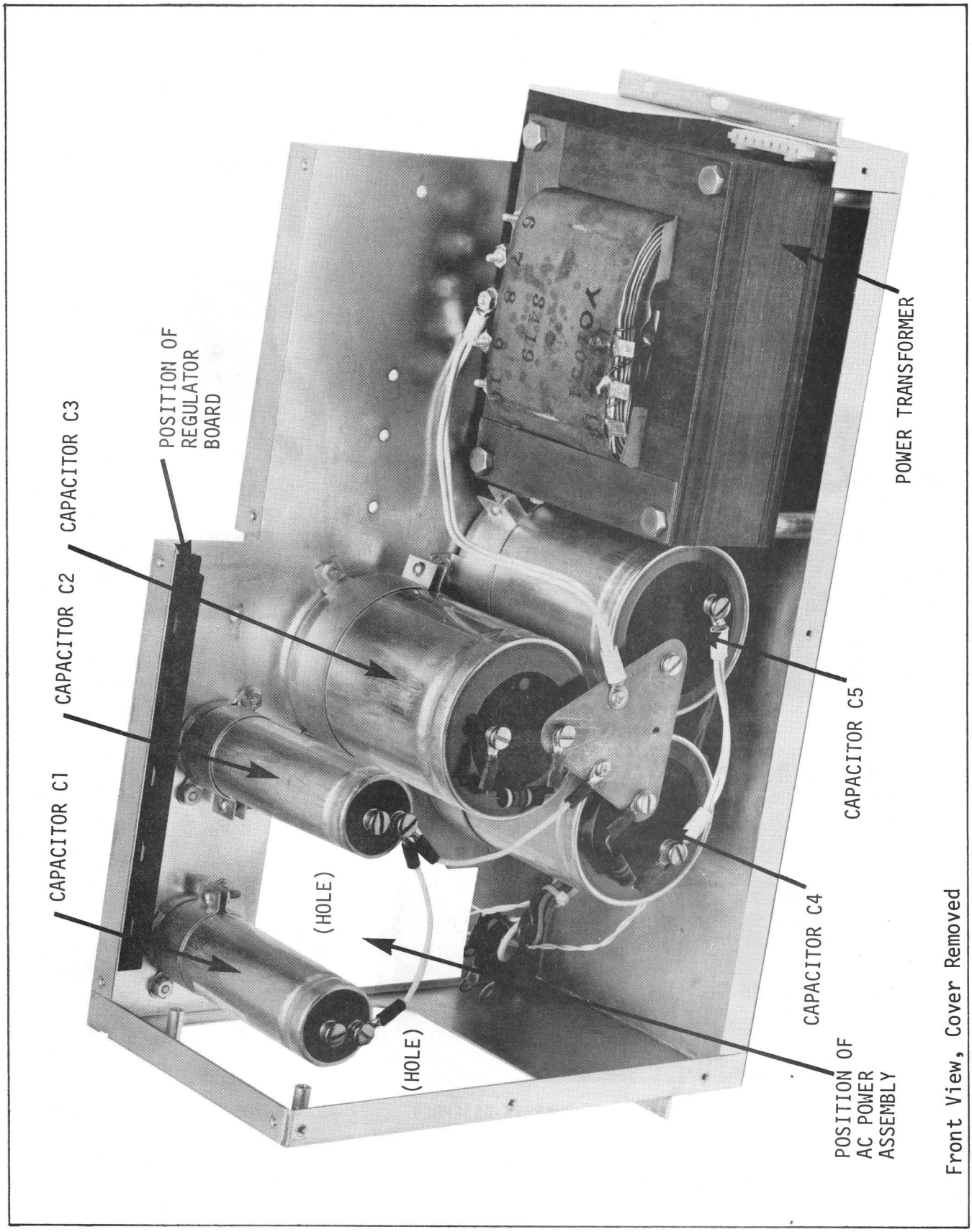
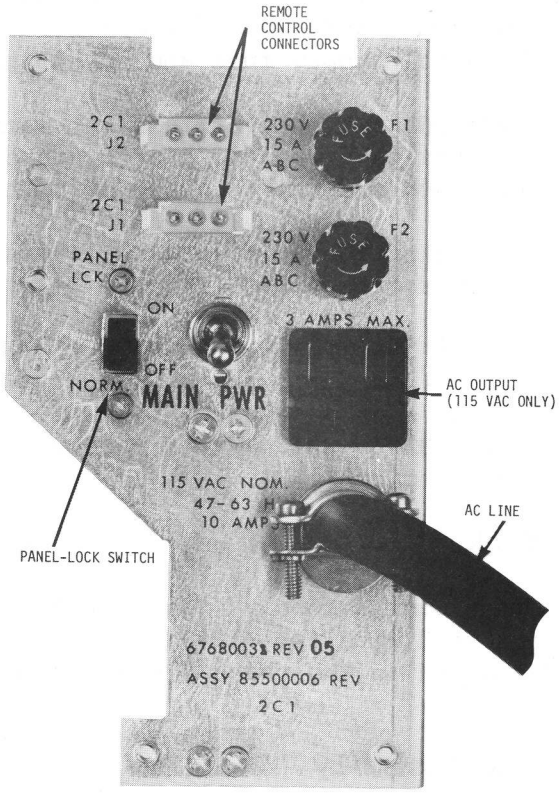
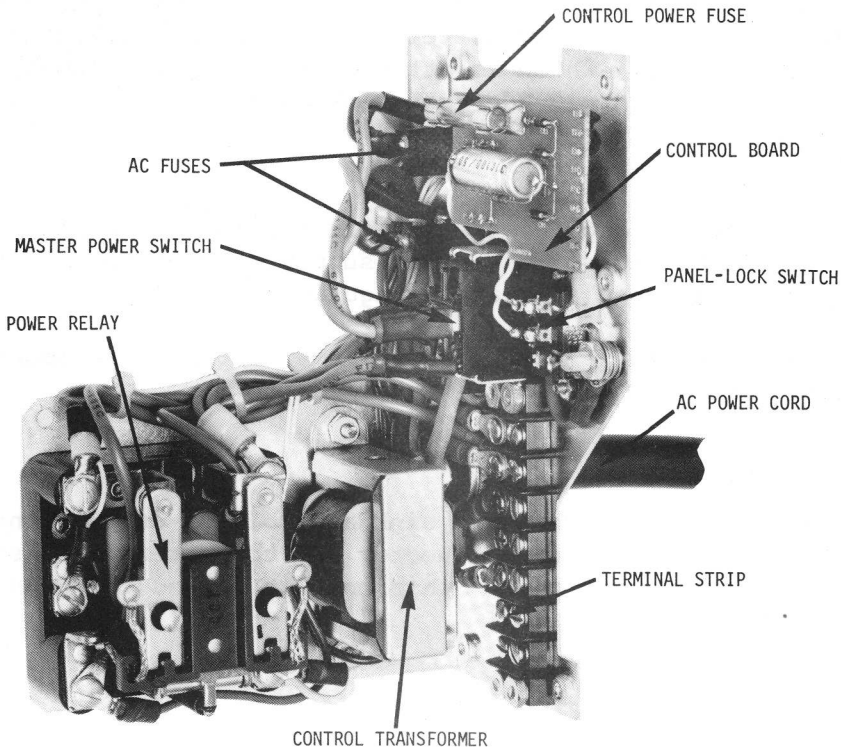


Figure 2-4. Model 36 Power Supply Chassis Assembly.



Exterior View



Interior View

Figure 2-5. Model 36 Power Supply AC Power Assembly

The ac power assembly also contains the 24-V control power supply and the power relay used by this supply. The control power supply comprises a control transformer and a control board that holds the control rectifier diodes, control supply fuse and connectors.

The panel-lock slide switch overrides the macropanel (or remote) control switch. The master power toggle switch, in turn, overrides the slide switch. Thus, there are three levels of control on the power supply.

Fans are connected to the ac power supply via a cable to connector J4 near the main power transformer (Figure 2-2).

2.3.3 Rectifier Heat Sink Assembly

The rectifier heat sink assembly (Figure 2-3) is a small assembly that holds rectifiers CR1 to CR4. It is mounted on the chassis next to the -15-Vdc heat sink assembly.

2.3.4 -15-Vdc Heat Sink Assembly

The -15-Vdc heat sink assembly (Figure 2-3) holds four transistors that are associated with the -15-Vdc regulated-output circuitry. The assembly is mounted on the chassis next to the rectifier heat sink assembly.

2.3.5 +5-Vdc Heat Sink Assembly

The +5-Vdc heat sink assembly (Figure 2-3) holds seven transistors that are associated with the +5-Vdc regulated-output circuitry. The components of the "crowbar" circuit (paragraph 2.2.2) are also located on this assembly, which is attached to the power supply chassis above the rectifier and -15-Vdc heat sink assemblies.

2.3.6 Regulator Board

The regulator board (Figure 2-6) is a printed circuit board that is located in the top of the power supply. It contains circuitry associated with both the regulated and unregulated outputs.

The fuses for the -22 Vdc and +8 Vrms circuits are located on the regulator board.

2.3.7 Subassembly

The +5-Vdc and -15-Vdc heat sink assemblies, output connectors J2 and J3, the regulator board connector and the wiring harness are mounted on the chassis as a unit. This unit is called the power supply subassembly.

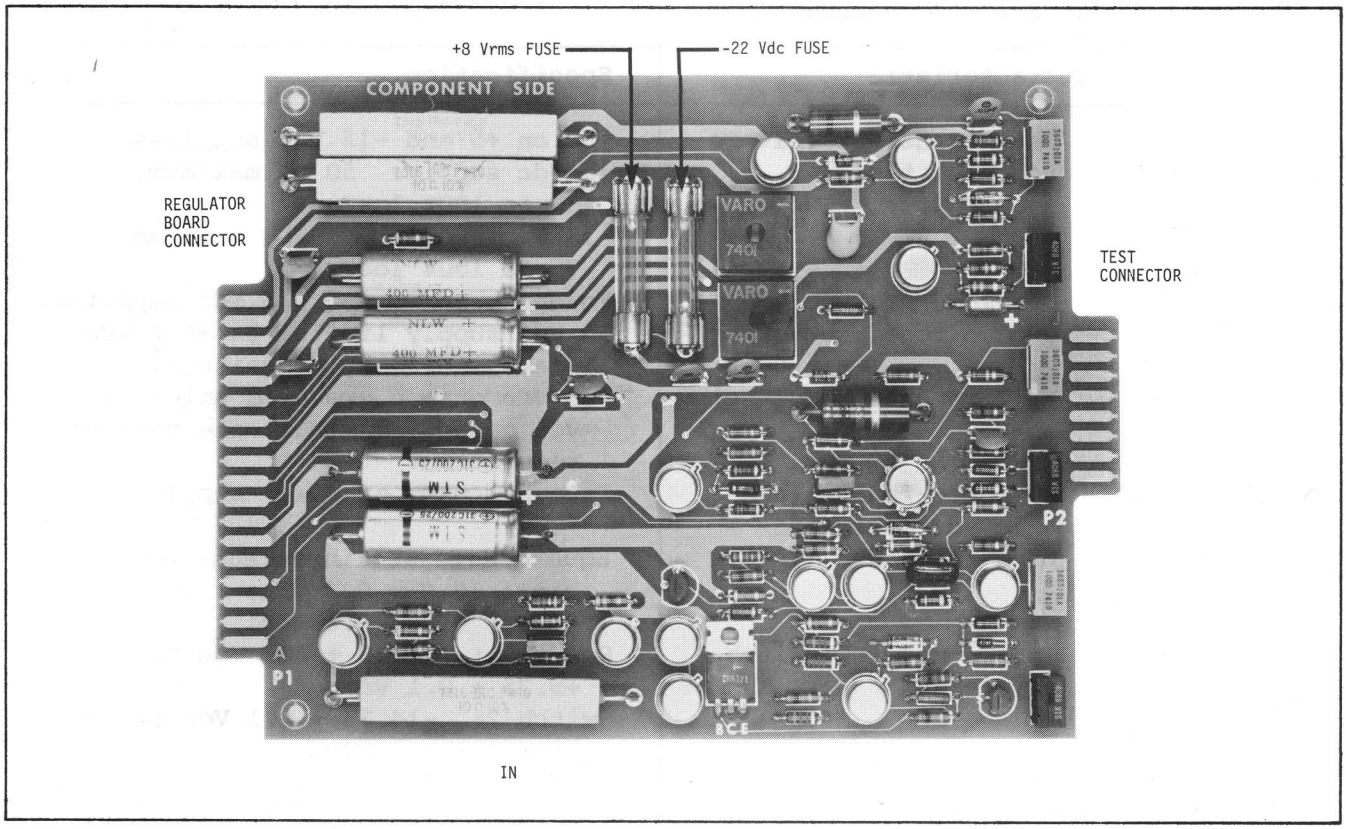


Figure 2-6. Model 36 Power Supply Regulator Board

2.4 SPECIFICATIONS

General specifications for the Model 36 power supply are given in Table 2-1.

Table 2-1. CDP-XI/PS Model 36 Power Supply General Specifications

Characteristic	Specification
ELECTRICAL	
AC input	115, 208 or 230 Vac ±10%, 47 to 63 Hz.
AC output	One standard outlet (115 Vac model only).
DC outputs	
Unregulated	-22 Vdc ± 25% at 1.5 A; +8 Vrms ±25% at 1.5 A.
Regulated	+5 Vdc ±3% with ±5% adjustment at 36 A, maximum; -15 Vdc ±3% with ±5% adjustment at 12 A, maximum.

(Continued)

Table 2-1. (Continued)

Characteristic	Specification
Peak transient voltage	±5% on +5 and -15 Vdc supplies.
Response time	+5 Vdc supply: 50 µs maximum, 50 to 100% load; -15 Vdc supply: 50 µs maximum, 75 to 100% load.
Overload protection	Foldback on +5 and -15 Vdc supplies.
Overvoltage protection	+5 Vdc supply limited to +6.8 Vdc peak, including transients.
Voltage level sequencing	-15 Vdc output grounded unless +5 Vdc output is within one volt of regulation.
AC power-failure and low-dc detection	Integral part of power supply.
Line-frequency signal	Square-wave at line frequency: high: +5.0 ± 0.8 Vdc; low: 0.0 ± 0.8 Vdc.
Test connector switch voltages	Switch 1: +4.75 ± 0.1 Vdc to +5.25 ± 0.1 Vdc; Switch 2: -14.25 ± 0.1 Vdc to -15.75 ± 0.1 Vdc.
MECHANICAL	
Size	16.5 by 5.5 by 0.32 inches (41.91 by 13.97 by 23.67 cm).
Weight	Approximately 37 lb (16.8 kg), net.
Cooling	External fans in the CDP-XI chassis providing air at a minimum of 60 cfm (1.68 cmm) installed.
Mounting	In rear quarter of CDP-XI chassis.
Connectors	
AC input	Three-wire, 14 awg, 6 ft (1.83 m), fixed and strain-relieved line, with standard three-prong 115, 208 or 230 Vac plug.
AC output	Standard three-receptacle (115 Vac model only).
DC and logic	Two connectors.
Fans	One connector.
Remote power control	Two connectors enabling one power supply to control another via a cable.
ENVIRONMENTAL	
Storage temperature	-20° to +75° C.
Operating temperature	0° to +50° C.
Humidity	5 to 90% relative humidity, without condensation.

SECTION 3
INTERFACES

3.1 OVERVIEW

The Model 36 power supply interfaces with a standard ac line as a source and provides all outputs necessary for compatibility with CDP-XI or PDP-11 systems. Appropriate output interface connectors are provided.

3.2 INPUT INTERFACE

The input to the supply is a standard grounded plug for 115, 208 or 230 Vac, according to the version ordered.

3.3 OUTPUT INTERFACE

Connectors J2 and J3 are for dc and logic output (Figure 2-2), J4 is for ac to the fans (Figure 2-2), and J1 and J2 are for remote power control (Figure 2-5). In addition, on the 115-Vac power supply, there is a 115 Vac accessory outlet (Figure 2-5).

One power supply can be remotely controlled by another through a cable plugged into the remote power control connectors on each unit.

Pin assignments are given in Appendix A.

SECTION 4
INSTALLATION

4.1 GENERAL PROCEDURES

The Model 36 power supply is designed for direct installation in the CDP-XI computer or extension chassis, or in any application where a DEC H720-E/F power supply could be used.

4.1.1 Unpacking and Inspection

Each Model 36 power supply is shipped in an individual, padded shipping container for protection during transportation. This container can be saved for future use if the unit is returned for repair or reshipped separately with the associated computer system.

The following steps are recommended for unpacking and inspecting the power supply:

1. Prior to opening, inspect the box for obvious damage.
2. Cut the packing tape, open the box and remove the power supply. Remove the plastic wrapper and inspect the unit for physical damage.
3. Inspect all connectors and pins for any foreign matter and clean as necessary.

It is important to note immediately any physical damage that might have resulted from shipment. The carrier should be notified of such damage and given the opportunity to inspect the unit and container. This helps establish the validity of any claims for shipping insurance.

4.1.2 Handling

The Model 36 power supply is designed to withstand all normal shock and vibration encountered in shipping and when installed in a computer system. While not a fragile device, the unit is heavy and should be handled with reasonable care to avoid damage that might result in operational failure.

Removal of the power supply from a chassis installed in a rack is not recommended.

4.2 INSTALLATION IN A CDP-XI CHASSIS

Install the power supply in a CDP-XI chassis by sliding the supply into the rear of the chassis with the side rails of the power supply in the channels between the pairs of rails on the inside of the chassis (Figure 4-1). Slide the supply in until the six holes in the side rails are aligned with six holes in the chassis rails, and fasten it in place with six number 8-32 UNC by 3/8 socket-head cap screws (Figure 4-2).

Attach the white ground line from the power supply to the ground post on the upper rear crossrail of the chassis. (Figure 4-3).

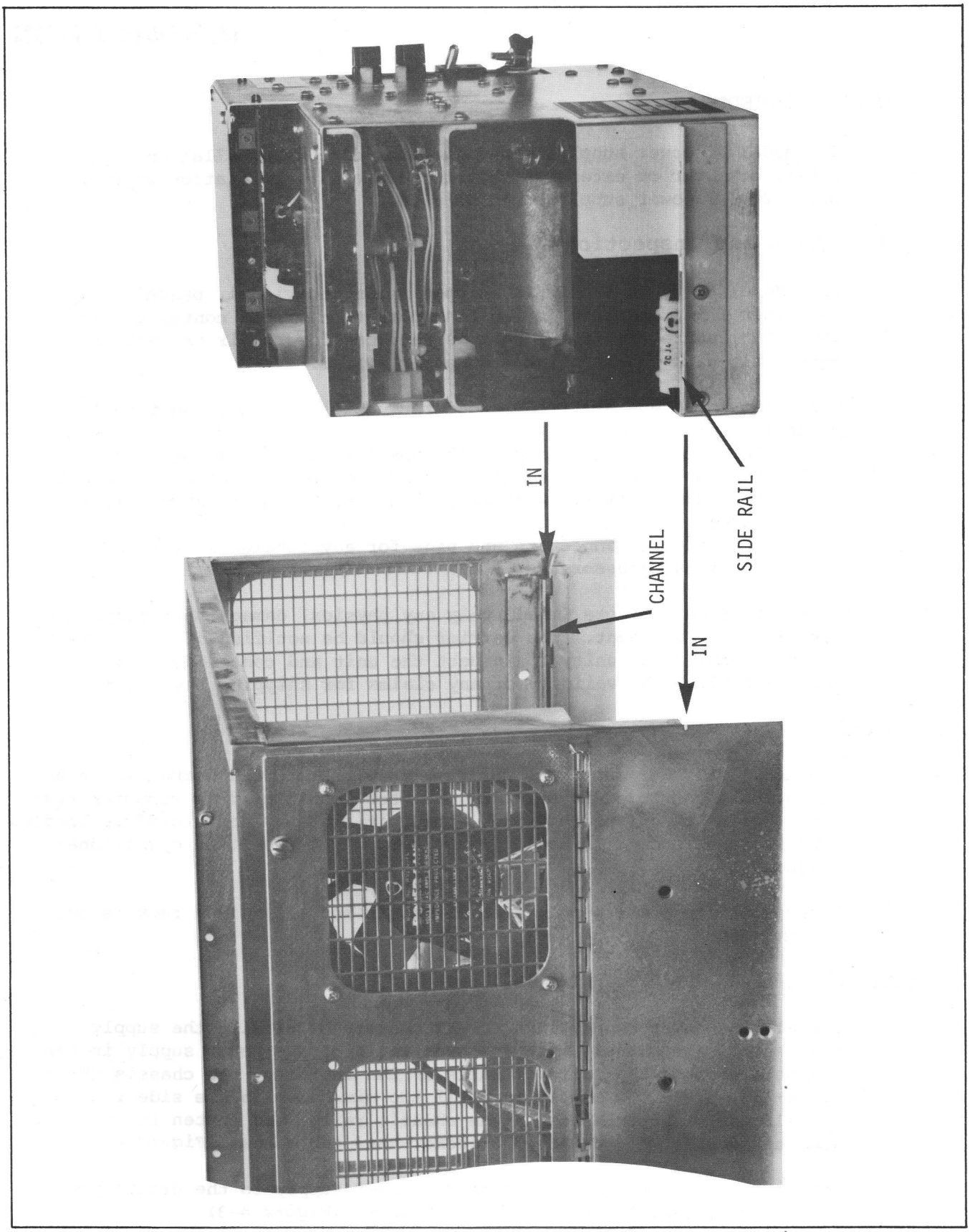


Figure 4-1. Installation of the Model 36 Power Supply in a CDP-XI Chassis

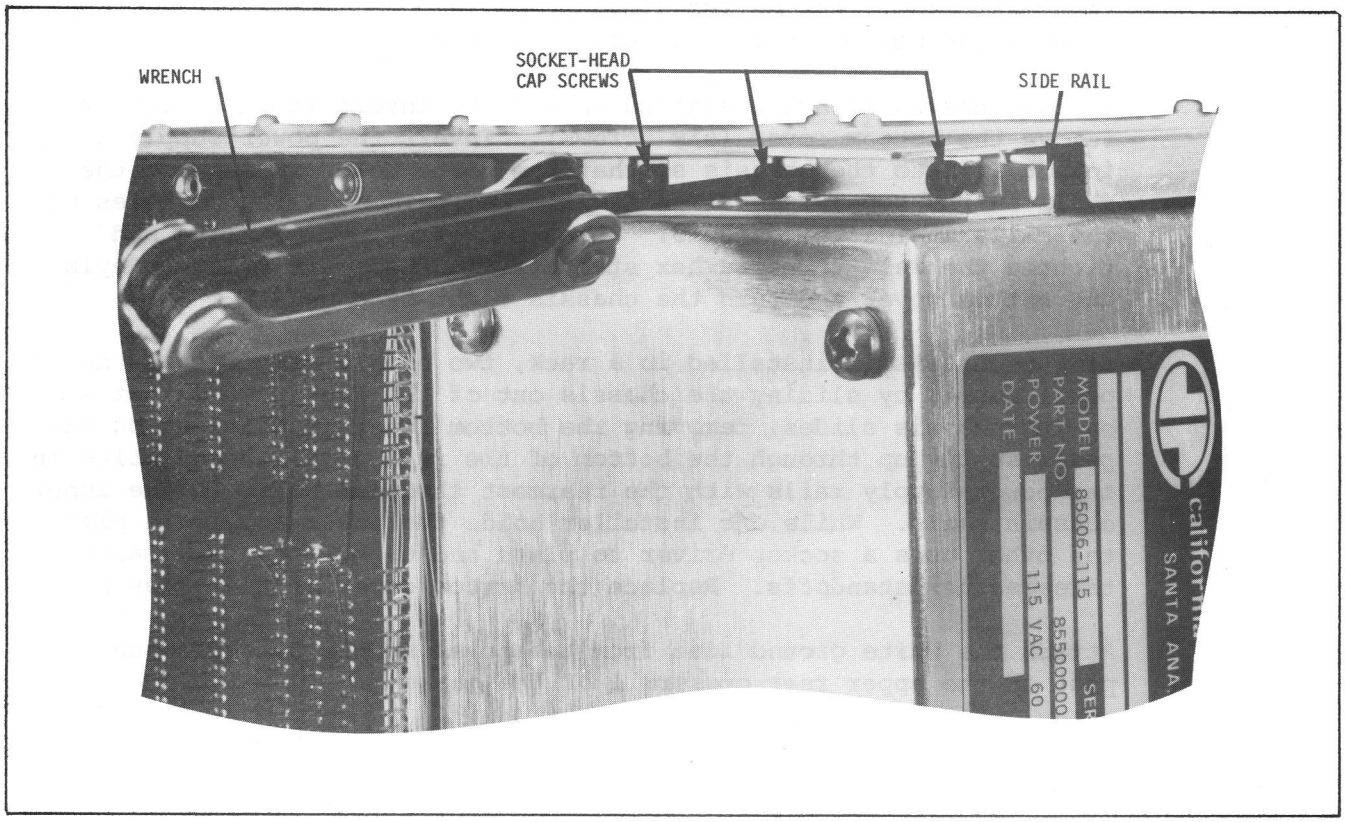


Figure 4-2. Fastening the Model 36 Power Supply in a CDP-XI Chassis

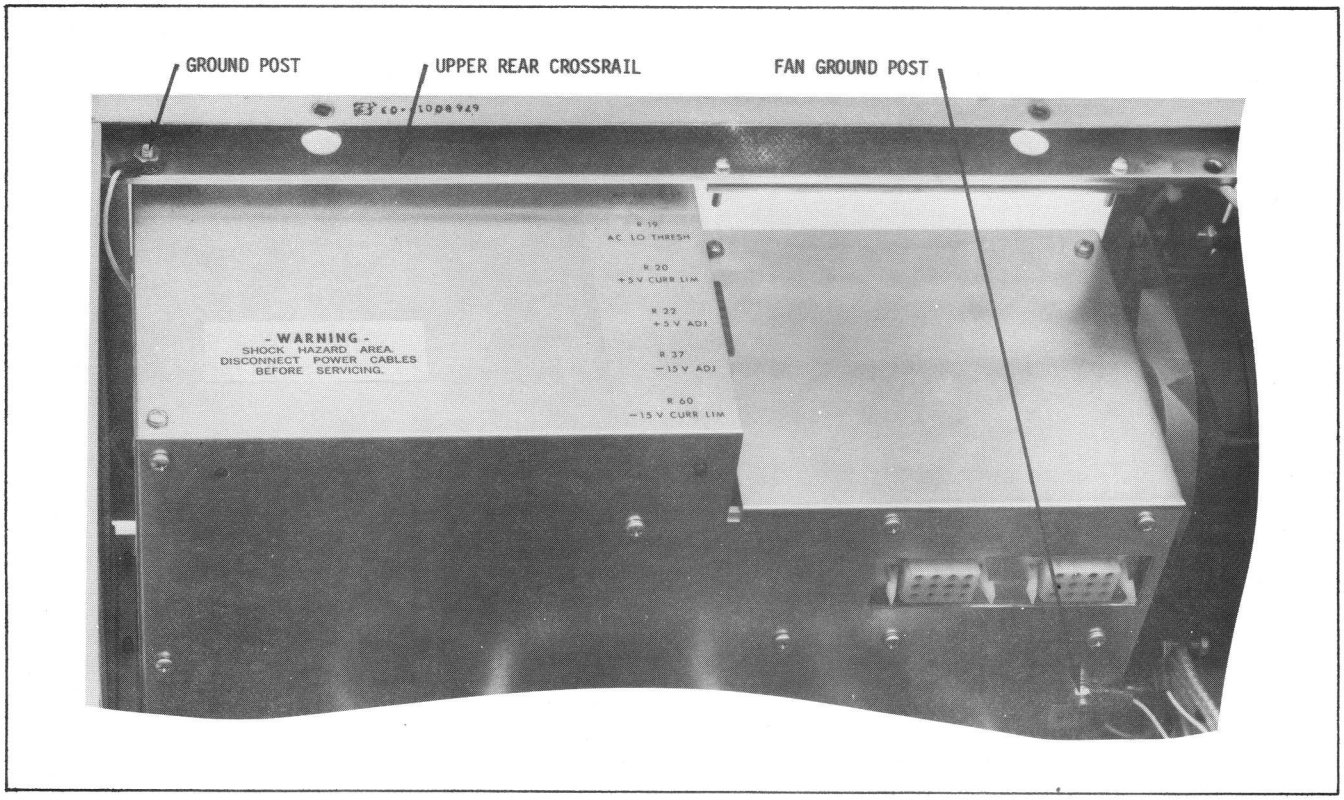


Figure 4-3. Attaching the Ground Line to the Upper Rear Crossrail of a CDP-XI Chassis

4.3 INSTALLATION IN A PDP-11 CHASSIS

The power supply can be installed in or removed from a PDP-11 chassis through the bottom of the chassis (Figure 4-4).

If the chassis is not installed in a rack, invert it on a table and remove the bottom cover (six screws). Invert the power supply and insert it into the chassis so that the three holes in each of the rails on the supply are aligned with the rearmost threaded holes of the rails inside the chassis. Use a socket driver to place and tighten the male-threaded hex standoffs in these six holes. Replace the bottom cover and turn the chassis right-side up.

If the chassis is installed in a rack, two people can install the power supply by sliding the chassis out of the rack to the last stop on the chassis slides, removing the bottom cover, and inserting the power supply up through the bottom of the rack to align the holes in the power-supply rails with the rearmost threaded holes in the inner chassis rails. While one installer holds the power supply in place, the other uses a socket driver to place and tighten the six male-threaded hex standoffs. Replace the bottom cover of the chassis.

Attach the white ground line from the power supply to the ground post on the upper rear crossrail of the chassis.

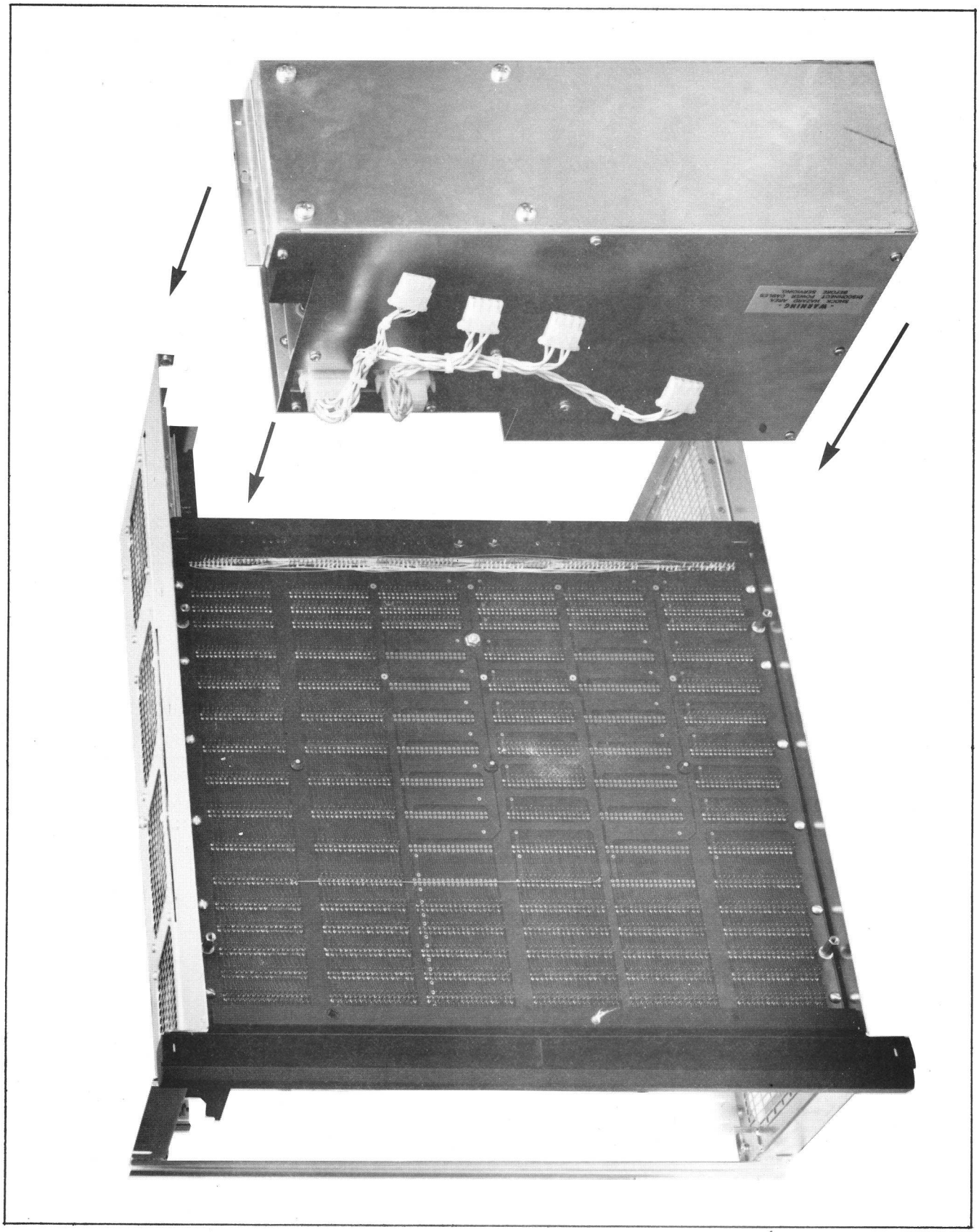


Figure 4-4. Installation of the Model 36 Power Supply in a PDP-11 Chassis

SECTION 5

MAINTENANCE

5.1 GENERAL

This section describes preventive and corrective maintenance procedures for the Model 36 power supply.

In general, corrective maintenance is limited to isolation of a fault to a specific assembly or major component, followed by replacement of the faulty item. Troubleshooting procedures can then be used to verify that the suspected assembly is malfunctioning and to help diagnose the specific problem. Repair should be conducted only at the factory or by an authorized Cal Data representative.

5.2 PREVENTIVE MAINTENANCE

The power supply is a reliable solid-state device designed to perform continuously for many years without degradation. Preventive maintenance consists of performing the following tasks every six months:

a. Inspect the power supply for damaged wires, components or other obvious defects.
b. Using a low-pressure source of air (75 psi one foot from board, or 5 kg/cm^2 30 cm from board), blow off accumulated dust and foreign matter.
c. Check that the power supply outputs are within tolerance.

5.3 CORRECTIVE MAINTENANCE

Repair or adjustment of the power supply in the field is not recommended. If there is a malfunction, replace the supply or faulty assembly with a spare known to be operating properly and return the malfunctioning part for repair to California Data Processors or an authorized representative. Malfunctions can be isolated with the aid of Table 5-1.

Table 5-1. Power Supply Fault Isolation

Fault	Possible Causes
No outputs	a. Power failure. b. AC line fuse open. c. Auxiliary power-supply fuse open. d. Regulator board disconnected.
Low +5 Vdc output (<+2 Vdc)	a. Overcurrent foldback. b. Overvoltage crowbar triggered.
Low -15 Vdc output (>-2 Vdc)	a. Overcurrent foldback. b. +5 Vdc output out of tolerance (power supply interlock).
No +8 Vrms output	a. Regulator board fuse open.
No -22 Vdc output	a. Regulator board fuse open.

APPENDIX A
CONNECTOR PIN ASSIGNMENTS

The tables in this appendix give the pin assignments for the power supply connectors.

Table A-1. DC Output Connectors J2 and J3

Pin	Signal	Name
1	+5 VDC	+5 Vdc
2	+5 VDC	+5 Vdc
3	-15 VDC	-15 Vdc
4	PWR GND	Power Ground
5	PWR GND	Power Ground
6	PWR GND	Power Ground
7	+8 VRMS	+8 Vrms
8	SIGNAL GND	Signal Ground
9	$\overline{\text{DCLO}}$	DC Low
10	-22 VDC	-22 Vdc
11	LTCL	Line-transition Clock
12	$\overline{\text{ACLO}}$	AC Low

Table A-2. Fan Power Connector J4

Pin	Signal	Name
1	PANEL SW	Macropanel Power Switch Return
2	PANEL LCK	Macropanel Lockout
3	FAN PWR A	Fan Power A
4	FAN PWR A	Fan Power Return A
5	FAN PWR B	Fan Power B
6	FAN PWR B	Fan Power Return B
7	PANEL SW	Macropanel Power Switch
8	LOCK RET	Macropanel Lockout Return

Table A-3. Remote Connector IJ1

Pin	Signal Name
1	Control Relay Coil
2	+24 Vdc Control Supply
3	Macropanel Switch

Table A-4. Remote Connector IJ2

Pin	Signal Name
1	+24 Vdc Return
2	Temperature Switch
3	Temperature Switch Return

Table A-5. Fan Power Connector J4

Pin	Signal	Name
1	PANEL SW	Macropanel Power Switch Return
2	PANEL LCK	Macropanel Lockout
3	FAN PWR A	Fan Power A
4	FAN PWR A	Fan Power Return A
5	FAN PWR B	Fan Power B
6	FAN PWR B	Fan Power Return B
7	PANEL SW	Macropanel Power Switch
8	LOCK RET	Macropanel Lockout Return

Table A-6. Regulator Board Test Connector P2

Pin	Signal	Name
1	-15 MAR H	-15.75 Vdc
2	-15 MAR I	-15.00 Vdc
3	-15 MAR L	-14.25 Vdc
5	+5 MAR H	+5.25 Vdc
6	+5 MAR I	+5.00 Vdc
7	+5 MAR L	+4.75 Vdc