HP 1000 A990
20-Slot System/Computer
Installation and Service Manual

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Safety and Regulatory Information

For your protection, this product has been tested to various national and international regulations and standards. The scope of this regulatory testing includes electrical/mechanical safety, radio frequency interference, ergonomics, acoustics, and hazardous materials. Where required, approvals obtained from third-party test agencies are shown on the product label. In addition, various regulatory bodies require some of the information under the following headings.

USA (Radio Frequency Interference)

The United States Federal Communications Commission (in 47CFR Subpart J, of Part 15) has specified that the following notice be brought to the attention of the users of this product:

Warning   **This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.**

Japan (Radio Frequency Interference)

The following notice is for users of this product in Japan:

この装置は，第一種情報装置（商工業地域において使用されるべき情報装置）

で商工業地域での電波障害防止を目的とした情報処理装置等電波障害自主規制

協議会（VCCI）基準に適合しております。

　従って，住宅地域またはその隣接した地域で使用すると，ラジオ，テレビジ

ョン受信機等に受信障害を与えることがあります。

　取扱説明書に従って正しい取り扱いをして下さい。

Japanese Radio Frequency Interference

United Kingdom (Telecom Declaration)

This product is approved under approval number NS/G/1234/J/100003 for indirect connection to public telecommunication systems within the United Kingdom.

Europe (Data Communications)

The remote support interface conforms to CCITT Recommendations V.24 and V.28. For connection to a public telecommunications network, use only a modem complying with local regulations.

Germany (Acoustics)

Laermangabe (Schalldruckpegel L_pA) gemessen am fiktiver Arbeitsplatz bei normalem Betrieb nach DIN 45635, Teil 19: $L_pA < 70$ dB

Acoustic Noise (A-weighted Sound Pressure Level L_pA) measured at the bystander position, normal operation to ISO 7779: $L_pA < 70$ dB

Safety Considerations

GENERAL – This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.

⚡ Indicates hazardous voltages.

⏚ Indicates earth (ground) terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

Explanation of Caution

Caution   The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Explanation of Warning

Warning   The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

Printing History

The Printing History below identifies the edition of this manual and any updates that are included. Periodically, update packages are distributed which contain replacement pages to be merged into the manual, including an updated copy of this printing history page. Also, the update may contain write-in instructions.

Each reprinting of this manual will incorporate all past updates; however, no new information will be added. Thus, the reprinted copy will be identical in content to prior printings of the same edition with its user-inserted update information. New editions of this manual will contain new information, as well as all updates.

To determine what manual edition and update is compatible with your current software revision code, refer to the Manual Numbering File or the Computer User's Documentation Index. (The Manual Numbering File is included with your software. It consists of an "M" followed by a five digit product number.)

First Edition .... Feb 1992 ....

Preface

The *HP 1000 A990 20-Slot System/Computer Installation and Service Manual*, part number 02959-90002, describes the procedures for configuring, installing, and servicing, the HP 2959A A990 Computer and the HP 2999A A990 System. This manual is written for systems and field service engineers.

Chapter 1 – Introduction

Includes environmental and electrical specifications plus site preparation, unpacking, and loss or damage claims procedure information.

Chapter 2 – Installation

Gives configuration information and describes the procedures for installing the A990 computer.

Chapter 3 – Service

Describes maintenance and troubleshooting requirements and procedures, power supply checks, power-on self-tests, and definitions of LED indicators. Also describes procedures for removing and replacing assemblies and reconfiguring the power supply.

Chapter 4 – Replaceable Parts

Lists and illustrates replaceable parts for the A990 computer.

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1

Introduction

This chapter describes environmental specifications, site preparation procedures, and procedures for unpacking and inspecting the supplied materials for the HP 1000 A990 Computer (HP 2959A) and the HP 1000 A990 System (HP 2999A). The HP 2959A Computer product consists of an A990 CPU Card in a 20-slot card cage with power supply, and appropriate manuals. The HP 2999A System Processor Unit (SPU) consists of an A990 CPU card in a 20-slot card cage with power supply, HP-IB or SCSI Interface, RTE-A Primary System software, diagnostic software, appropriate manuals, and on-site installation assistance and checkout by a Hewlett-Packard Service Engineer.

Site Preparation

When you prepare the site for the computer or system, be sure you include provisions for environmental considerations, power requirements, and type of mounting. The computer or system operates at a nominal 115 Vac or, optionally, at 230 Vac. The system may be table mounted or rack mounted.

Environmental Considerations

Table 1-1 describes the environmental requirements for the A990. When you set up your computer or system, be sure you take into account environmental requirements or limitations imposed by all peripheral devices and components in the same location.

Power Requirements

The HP 2959A and HP 2999A are shipped with the power supply configured for a single-phase power source of 86 Vac to 138 Vac (standard) or 178 Vac to 276 Vac (option 015).

Maximum power consumption of the HP 2959/99A is 750 watts (1400 VA). Refer to Chapter 3 for information on changing the power supply line configuration from 115 Vac to 230 Vac operation.

For the protection of your operating and service people, various safety codes require you to ground the instrument chassis, panels, and housing. You can satisfy this requirement by providing a grounded three-wire female power outlet at the computer location. This outlet should be checked by a qualified electrician to ensure that it furnishes the required voltage and current.

The computer or system also must be properly protected by fuses or circuit breakers of sufficient capacity to carry the current load specified for the computer or system. Refer to Figures 1-1 and 1-2 for descriptions of the various types of ac power cord configurations.

Cooling Requirements

No external cooling is required for the computer or system. The internal fans provide enough airflow as long as the computer or system is operated within the temperature limitations specified in Table 1-1 and the front and rear grills are not obstructed.

Four fans provide approximately 10.1 cubic meters per minute (360 CFM) front-to-rear airflow. Half of the airflow is used to cool the power supply, and half the airflow is directed through the card cage.

Mounting Considerations

You can use the computer either free-standing on a table, or mounted in a standard 483 mm (19-inch) equipment rack. If used in a mobile environment, install the computer in a shock-mounted equipment rack. Refer to Table 1-1 for physical dimensions of the computer. When mounting the A990 on a table, provide enough clear space at the front and back of the computer to permit an unimpeded intake and exhaust of airflow.

Table 1-1. Electrical and Environmental Specifications

ELECTRICAL SPECIFICATIONS

    AC Power Requirements

Line voltage:	86 to 138 Vac (115 Vac -25%/+20%) standard; 172 to 276 Vac (230 Vac -23%/+20%) option 015.
Line frequency:	47.5 to 66 Hz
Inrush Current (cold power-up):	20.0 Amps maximum (at 115 Vac) 40.0 Amps maximum (at 230 Vac)
Maximum Power Required:	750 Watts (1400 VA)

Power Supply

Output DC voltages and tolerances:	+5.1 V	±2%
	+12.0 V	+6/-3%
	-12.0 V	±6%
Available Backplane Power:	380 Watts, maximum. An additional 60 Watts of backplane power may be used if the input voltage range is limited to voltages between 104–138 Vac (standard) or 178–276 Vac (option 015).	

Table 1-1. Electrical and Environmental Specifications (continued)

Power Supply (continued)

Maximum output and current rating to I/O and memory cards:	+5.1 V 65.8 A	+5.0 V(M) 8.5 A	+12.0 V 5.4 A	-12.0 V 3.4 A

Note that combined current available from the 5.1 V and +5 V(M) power supplies is 70 A maximum

Short circuit protection: All dc power outputs are fault protected for short circuits The power supply will shut down if any output is short circuited when it receives power.

Optional DC Power (If an external battery is used, it must be charged from an external source):

+ EXT BAT Input: 15.0 V maximum
10.5 V minimum
12.6 V nominal

– EXT BAT Input: Ground

25 kHz AC VOLTAGE

Voltage: 19.5 V rms ± 8% (at 0.02 to 1.5 A), split phase (phase to common).

Current: 1.5 A maximum

Power: 50 W maximum

BATTERY BACKUP

HP 12157B Battery Backup: Battery backup provides from 15 to 90 minutes of memory sustaining power for up to four memory array cards, depending upon system configuration, state of charge, and temperature. Additional hold-up time can be achieved by connecting an external battery.

Battery type: Sealed lead-acid.

Table 1-1. Electrical and Environmental Specifications (continued)

PHYSICAL CHARACTERISTICS

Dimensions
Height:	266 mm (10.5 in)
Width:	483 mm (19 in)
Depth:	610 mm (24 in)

Weight: 29.5 kg   (65 lb)

Ventilation: Four fans provide approximately 10.1 cubic meters per minute (360 cfm) front-to-rear airflow, half through the card cage and half to cool the power supply.

ENVIRONMENTAL SPECIFICATIONS

Temperature
Operating: 0° to 55° C (32° to 131° F) up to 3048 meters (10,000 ft); Maximum temperature is linearly derated 2° C (3.6° F) for each 304.8 m (1000 ft) increase in altitude. The resulting temperature range is 0° to 45° C (32° to 113° F) at 4572 meters (15,000 ft).

Non-operating: −40° to 75° C (−40° to 167° F);
with optional battery backup: −40° to 60° C (−40° to 140° F)

Relative humidity
Operating: 5% to 95% with maximum wet bulb temperature not to exceed 40° C (140° F), excluding all conditions which may cause condensation.

Non-operating: 5% to 95% in non-condensing conditions.

Altitude
Operating: to 4.6 km (15,000 ft)

Non-operating: to 15.2 km (50,000 ft)

Vibration and Shock

Shock
Operating: 1.5 g peak, ½ sine, 6 to 9 ms duration, 45 Hz crossover

Non-operating: 7.0 g peak, ½ sine, 6 to 9 ms duration, 45 Hz crossover

Vibration
Operating:

Frequency (Hz)	Power spectral density (g^2/Hz)
5	0.002
5–15	−1/.5 dB/octave
15	0.0015
12–200	−6.0 dB/octave
200–350	0.00012
350–500	−6.0 dB/octave

Gravity, due to acceleration: 0.43 rms (approximate)

115/120 Vac

Male Nema (Molded)   Female CEE

Brown or Black (L)
Green/Yellow (E)
Light Blue or White (N)

(L) Brown or Black
(E) Green/Yellow
(N) Light Blue or White

Part No. 8120-5337 (2.2m)

220/240 Vac

Male CEE   Female CEE

Brown or Black (L)
Green/ Yellow (E)
Light Blue or White (N)

(L) Brown or Black
(E) Green/Yellow
(N) Light Blue or White

Part No. 8120-1860 (1.5m)

Note: Other countries such as Canada, Japan (100 or 200 volts), Mexico, Philippines, and Taiwan may use some of the above power cord sets. Consult your nearest HP Sales Office.

E   Earth or Safety Ground
N   Neutral or Identified Conductor
L   Line or Active Conductor

Figure 1-1. AC Power Cord Sets (USA)

220/240 Vac

East and West Europe

Female CEE

Light Blue (N)
Green/Yellow (E)
Brown (L)

(L) Brown
(E) Green/Yellow
(N) Light Blue

Part No. 8120-1689 (2.0m)

220/240 Vac

Australia, New Zeland

Female CEE

Light Blue or Black (N)
Green/Yellow (E)
Light Brown or Red (L)

(L) Light Brown or Red
(E) Green/Yellow
(N) Light Blue or Black

Part No. 8120-1369 (2.2m)

220/240 Vac

United Kindom, Cyprus, Nigeria, Singapore

Female CEE

Light Blue (N)
Green/Yellow (E)
Light Brown (L)

(L) Light Brown
(E) Green/Yellow
(N) Light Blue

Part No. 8120-1351 (2.2m)

Note: Other countries may use more than one of the above power cord configurations. For correct power cord set in your area, consult your nearest HP Sales Office.

E   Earth or Safety Ground
N   Neutral or Identified Conductor
L   Line or Active Conductor

Figure 1-2. AC Power Cord Sets (Non-USA)

Unpacking and Inspecting

Your A990 computer or system may be shipped in several containers. Verify the number of containers received against the carrier's paperwork. Inspect each container for damage that may have occurred during transit. If you find damage or water stains, request that an agent of the carrier be present when you open the container.

Open the shipping container marked "MANUALS AND ACCESSORIES" and locate the materials list. Compare it with your purchase order. Make sure it includes everything you have ordered. Unpack the shipping container(s) and inspect each item for external damage, such as broken controls and connectors, dented corners, bent panels, scratches, and loose components. Also check the rigid foam-plastic packing material (if used) for signs of deformation or cracking. Such signs may indicate rough handling in transit.

If you find damage to the computer or accessories, follow the damage claim procedure described below. Be sure you keep all shipping containers and packing materials. You may need them for settling a claim, or to repackage the computer or system.

Claims Procedure

If you need to make a claim, contact your nearest Hewlett-Packard Sales and Service Office. If the loss occurred in transit, notify the carrier as well as Hewlett-Packard, and also be sure you retain all shipping and packaging materials for inspection. Hewlett-Packard will arrange to repair or replace damaged or lost items even though claims against the carrier may not yet be settled.

Physical Inventory

Make sure all manuals listed in the bill of materials are included. Your computer's model and serial number is located on the identification label on the back of the chassis. The model and serial numbers should match those on the packing list. If they do not, immediately contact your Hewlett-Packard Sales and Service Office. If you have ordered I/O or memory cards with your computer or system, verify that the cards have been supplied as specified on your purchase order.

2

Installation

This chapter describes procedures for configuring and installing the A990 20-slot box computer and system.

Required Tools

Slot and Phillips head screwdrivers are the only tools you will need to install the computer or system. We strongly recommend the use of a wrist strap and ground cord when handling plug-in cards.

Configuration Requirements

Verifying the Power Supply Configuration

Warning To avoid damage to equipment or injury to people, any service, adjustments, or repair to the power supply must be performed only by qualified maintenance people.

The computer's ac line voltage configuration is determined by the position of the line configuration power connector. The power connector must be plugged into one of two connectors (P7 or P8) located at the left side of the power supply when viewing the computer from the front. See Figure 2-1 for a view of the power supply from the front, and Figure 2-2 for the location of connectors P7 and P8. For 115 Vac operation, the power connector must be plugged into socket P8. For 230 Vac operation, the connector must be plugged into socket P7.

To check the position of the ac line configuration/fan power plug connector, remove the computer front panel and fan panel and inspect the position of the power line connector relative to sockets P7 and P8. The ac power cord is always connected to plug P9 regardless of how the line configuration connector is set. For step-by-step information on removing the front panel and fan panel, refer to Chapter 3 of this manual.
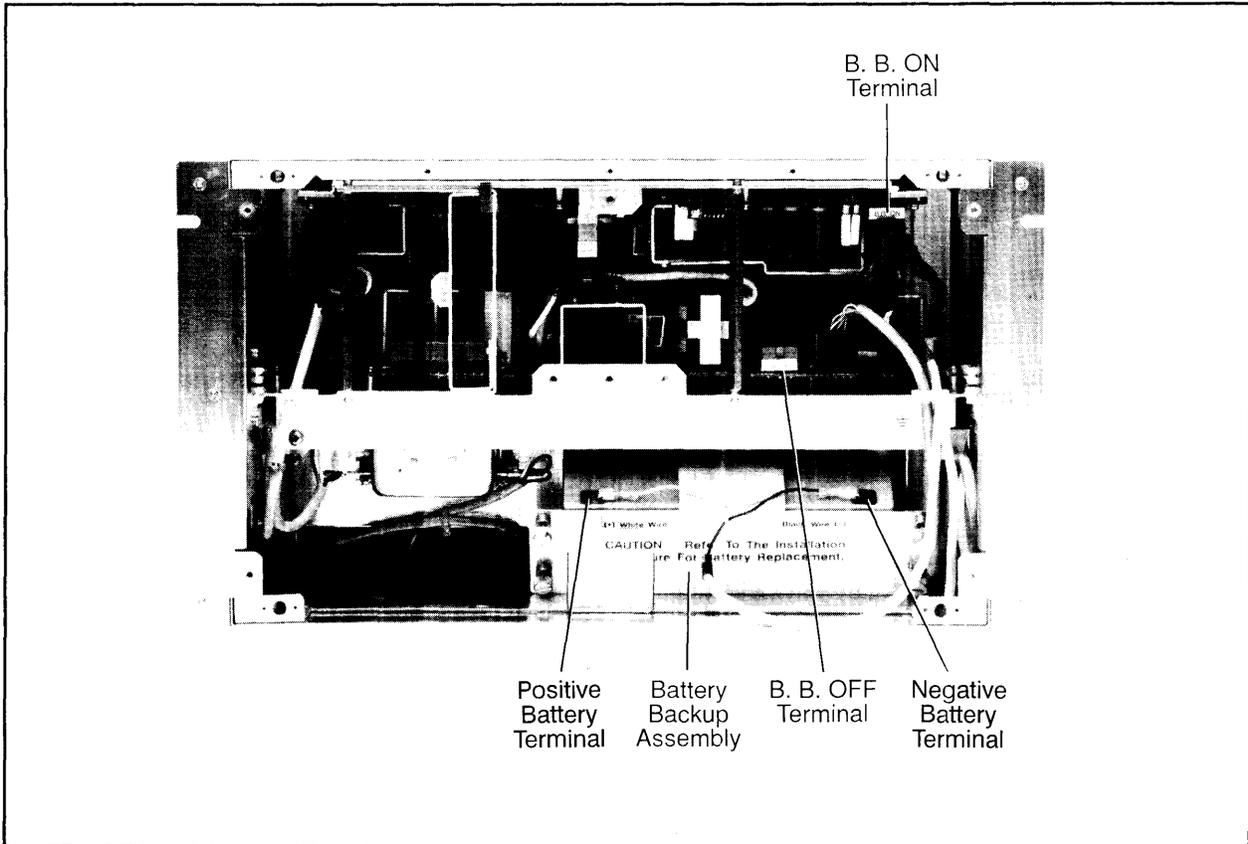
Figure 2-1. Front View of Chassis with Bezel and Fan Panel Removed

Battery Backup

The HP 12157B Battery Backup will sustain memory for 15 to 90 minutes, depending on the system configuration, state of charge, and temperature. Additional memory hold-up time can be achieved by connecting an external battery.

If Battery Backup is installed, set the Battery Enable switch on the back panel of the computer to ENABLE. The switch is shown in Figure 2-3. This switch should be set to the DISABLE position if the power is turned off and if memory backup is not required. The switch should also be set to DISABLE if cards are to be connected or disconnected from the backplane.

Refer to the *Battery Backup Installation* section later in this chapter for instructions on installing battery backup. Note that if batteries are not installed, the strapping connector from the terminal on the lower board of the power supply must be connected to B.B. OFF. (See Figure 2-1.) If batteries are installed, the strapping connector must be connected to B.B. ON.

Front of Power Supply
(Toward Fan Panel and Front Panel)

Connector	Description
P1	DC Output Connectors
P2	DC Output Connectors
P5	Battery Switch Connector
P6	Test Points and External Battery Connector
P7	230 Vac Line Configuration Connector
P8	115 Vac Line Configuration Connector
P9	AC Line Input Connector
P14	Battery Backup OFF Connector
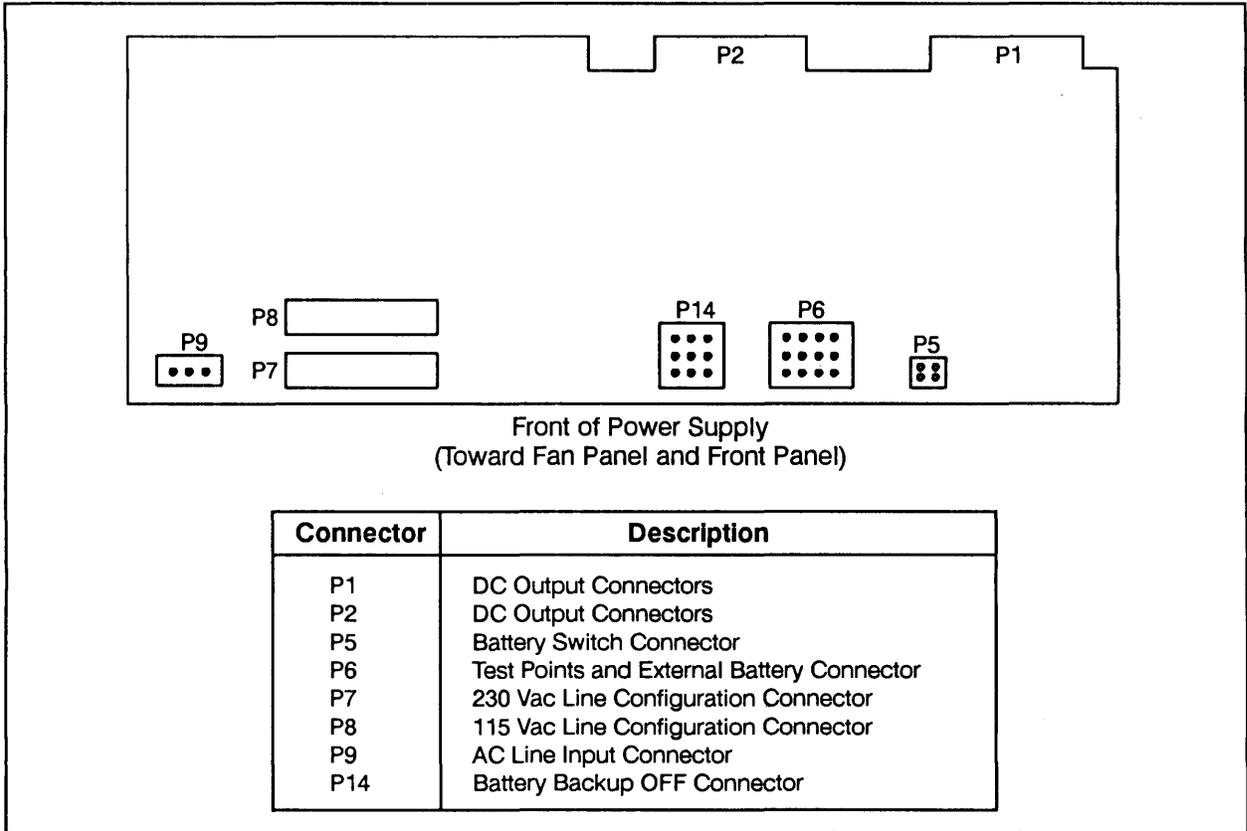
Figure 2-2. Power Supply Connector Diagram
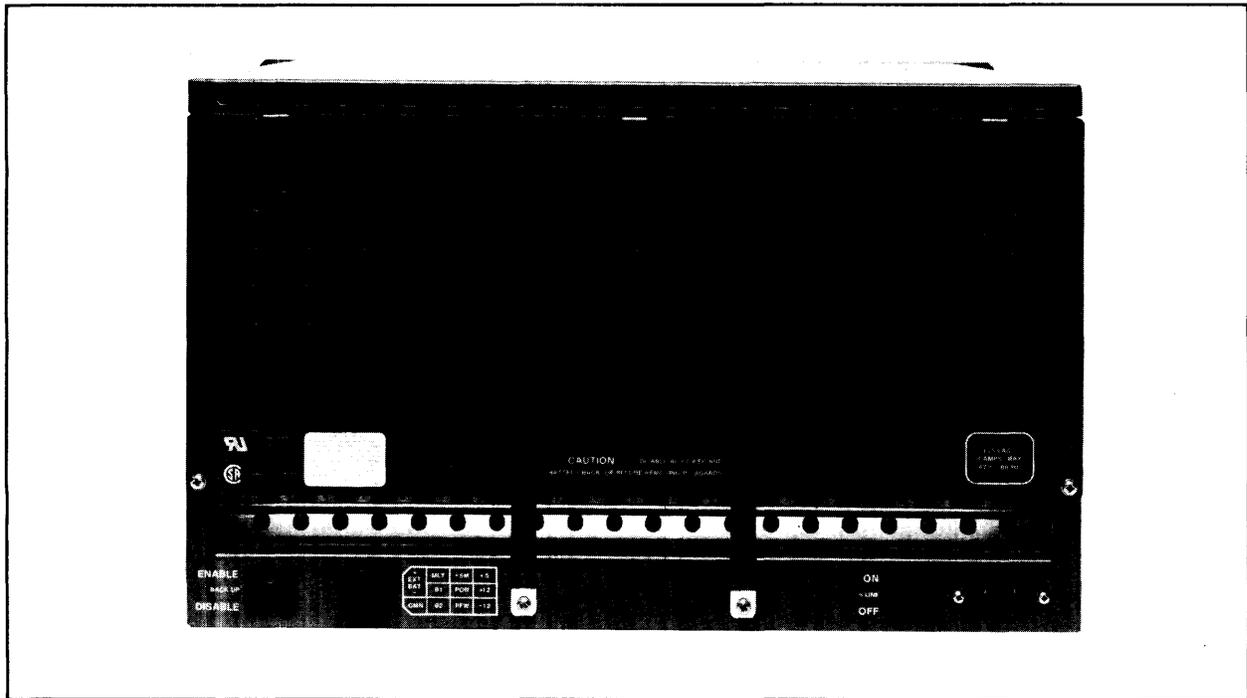
Figure 2-3. Computer Back Panel and Power Panel

A990 CPU Card Switches

The A990 CPU card contains two switches, SW1 and SW2 (see Figure 2-4). SW1 is a momentary action (push and release) reset switch that resets the A990 CPU card. SW2 is an eight-section DIP switch (see Figure 2-5) that controls the following functions:

1. BOOT SELECT, which selects computer operations at power-up.

2. Autorestart override (Memory Lost), which sets the conditions under which autorestart occurs.
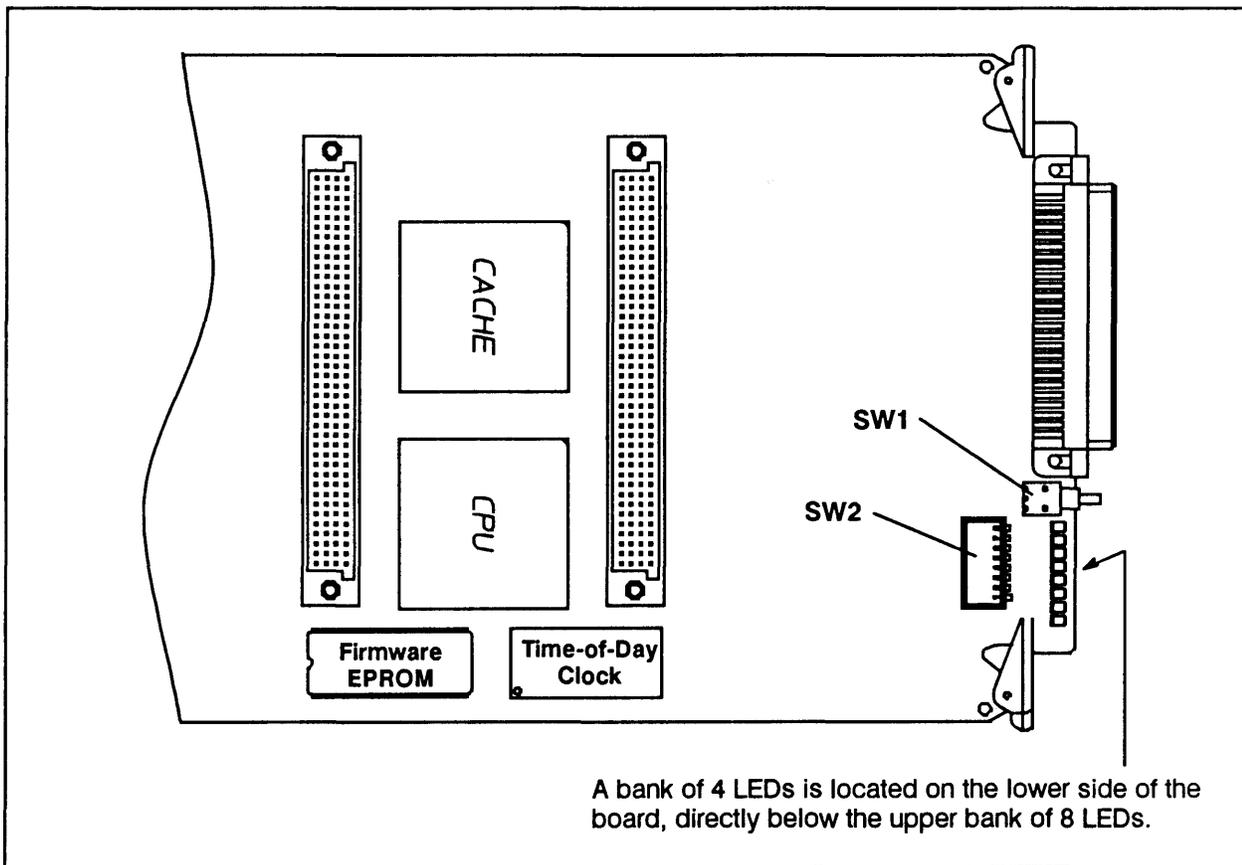
Figure 2-4. A990 CPU Card Switches SW1 and SW2

Startup Option Switches

There are eight switches, SW2-1 through SW2-8, that control the startup options. Table 2-1 specifies the available startup options and corresponding switch settings.

Autorestart Switch

Autorestart is controlled by switch SW2-8 (see Figure 2-5). The settings for switch SW2-8 are:

1. DOWN (on) - Autorestart is not enabled. Use this setting if you do not wish to use autorestart or if battery backup is not installed. When using the ON position for SW2-8, be sure you set the Battery Enable switch to DISABLE.

    When SW2-8 is ON, if power is lost, the autorestart feature will not restart the program that was running prior to the powerfail condition. Instead, the boot loader (or VCP routine) will execute.

2. UP (off) - Autorestart is enabled if battery backup is installed and the Battery Enable switch is set to ENABLE. If power is lost and memory was sustained, autorestart will automatically restart the program that was running prior to the powerfail condition. With no battery backup installed, you will get a self-test error when you switch the computer on.
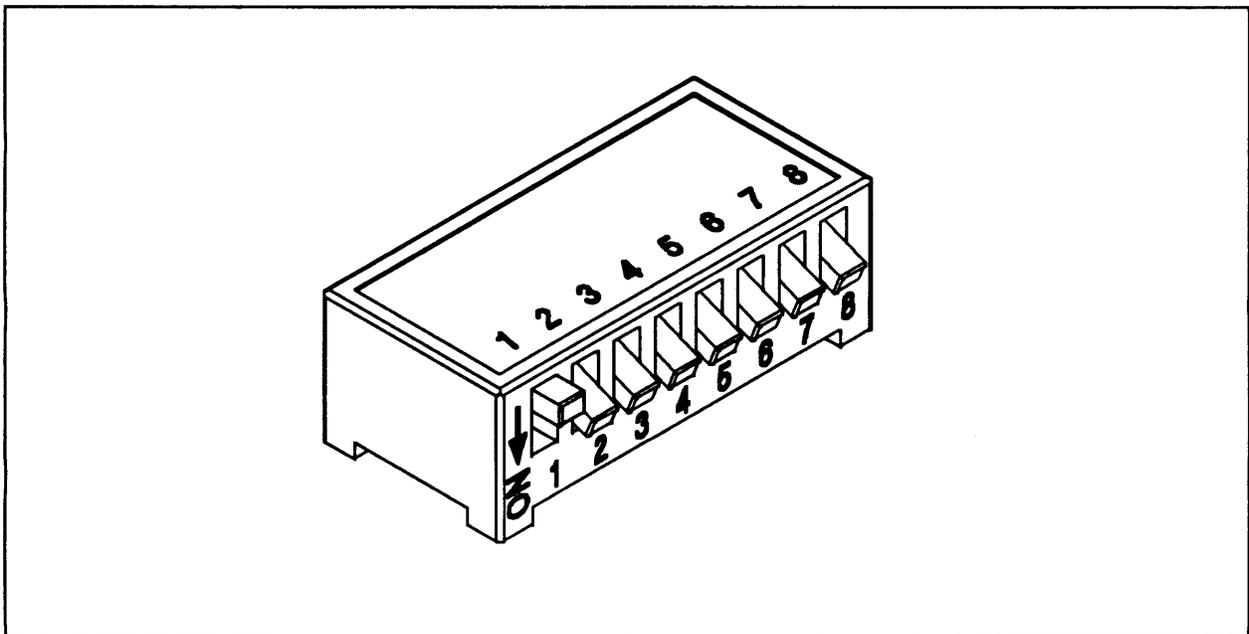
Figure 2-5. Switch SW2 in Default Configuration

Table 2-1. SW2 Start-Up Switch Settings

Computer Action	Switches*							
	S1	S2	S3	S4	S5	S6	S7	S8
Loop on self-test Test 2 regardless of error.	D	D	D	D	z	y	D	M
Loop on self-test Test 2 and stop on error.	D	D	U	D	z	y	D	M
Run Virtual Control Panel (VCP) routine on completion of self-test.	D	U	U	D	z	y	D	M
For the following switch settings, the computer action indicated will occur if memory is lost, otherwise, the program is restarted (JMP 4B). If the autorestart feature is disabled (switch SW2-8 down), the program cannot restart and VCP will execute. When a loader finishes an autoboot, it starts execution of the loaded program at location 02.								
Run VCP.	U	D	D	D	z	y	D	M
Speed sense and run VCP. See Notes 2 and 3.	U	U	D	U	z	y	D	M
Execute program from PROM card. In order to autoboot from PROM, the card must have select code 22. This is equivalent to the loader command %BRM. **	U	D	U	D	z	y	D	M
Load and execute the program via the HDLC or LAN card. To autoboot via the HDLC or LAN card, the card must have select code 24. This is equivalent to loader command %BDS. **	U	U	D	D	z	y	D	M
Load and execute program from the first file of the disk (via HP-IB or SCSI). To autoboot via HP-IB or SCSI, the interface card must have select code 27; and, for HP-IB, the disk drive must have HP-IB address 2 or, for SCSI, address 6. This is equivalent to the loader command %BDC. **	U	U	U	D	z	y	D	M
Execute bootstring from the time-of-day clock RAM (non-volatile RAM) on the A990 CPU card.	D	D	D	U	z	y	D	M

*   D = Down (On); U = Up (Off)

** Refer to the *HP 1000 A990 Computer Reference Manual*, part number 02959-90001.

    y = D, normal mode, system console uses ENQ-ACK handshaking.
    y = U, system console does not use ENQ-ACK handshaking.
    z = D, normal mode, break enabled.
    z = U, break disabled (but not halts).
    M = D, disable autorestart (battery backup not installed).
    M = U, enable autorestart (battery backup installed).

Notes: 1. Do not use any switch combination that is not specified above.
          2. Use this switch configuration for normal computer operation.
          3. Speed sense allows VCP to execute at any baud rate supported by the 8-channel MUX.

Interface Card Switches

Assign each I/O interface card to be installed in the computer a unique select code by setting the select code switches on the interface cards. Refer to the appropriate interface card reference manuals for select code switch information and for information on any other card switches that must be set.

Virtual Control Panel (VCP) Configuration

If you are installing a Virtual Control Panel (VCP), assign *one* of your MUX (HP 12040D), ASIC (HP 12005B), LAN (HP 12076A), or HDLC (HP 12007B Modem or HP 12044A Direct Connect) cards as the VCP interface card.

Set switch U1S1 on that card to ON (closed) to designate it as the VCP interface card.

Memory Configuration

Several memory configurations, using 768 Kbyte, 3 Mbyte and/or 8 Mbyte memory array cards, can be installed in the A990. Refer to Figure 2-6 for an illustration of minimum and maximum memory configurations. All three array sizes may be used together in the same system provided that the largest memory card is closest to the A990 CPU card. Up to four memory array cards can be installed in the A990 computer. Refer to Table 2-2 for the available memory array cards and frontplane connectors. Refer to the *Memory Installation* section in this chapter for instructions on installing memory.

Minimum A990 Memory Configuration			
slot #		slot #	
11	Available for I/O Card	1	A990 CPU Card
12	Available for I/O Card	2	12220A 768 KB Memory Array Card
13	Available for I/O Card	3	12009A HP-IB Interface Card
14	Available for I/O Card	4	Available for I/O Card
15	Available for I/O Card	5	Available for I/O Card
16	Available for I/O Card	6	Available for I/O Card
17	Available for I/O Card	7	Available for I/O Card
18	Available for I/O Card	8	Available for I/O Card
19	Available for I/O Card	9	Available for I/O Card
20	Available for I/O Card	10	Available for I/O Card

Maximum A990 Memory Configuration			
slot #		slot #	
11	Available for I/O Card	1	A990 CPU Card
12	Available for I/O Card	2	12221B 8 MB Memory Array Card
13	Available for I/O Card	3	12221B 8 MB Memory Array Card
14	Available for I/O Card	4	12221B 8 MB Memory Array Card
15	Available for I/O Card	5	12221B 8 MB Memory Array Card
16	Available for I/O Card	6	12009A HP-IB Interface Card
17	Available for I/O Card	7	Available for I/O Card
18	Available for I/O Card	8	Available for I/O Card
19	Available for I/O Card	9	Available for I/O Card
20	Available for I/O Card	10	Available for I/O Card

Figure 2-6. A990 Memory Configurations

Table 2-2. Memory Array Cards and Frontplanes

Description	Part Number
12220A 768 KByte Memory Array Card	12220-60001
12221A 3 MByte Memory Array Card	12221-60001
12221B 8 MByte Memory Array Card	12221-66001
Connector for 1 Memory Card	12230-60001
Connector for 2 Memory Cards	12230-60002
Connector for 3 Memory Cards	12230-60003
Connector for 4 Memory Cards	12230-60004

I/O Priority Assignment

Each peripheral device in the system must be connected to the computer system through an interface card installed in the card cage. A priority chain connects all interface cards in series to prioritize simultaneous DMA requests and interrupt requests from two or more peripherals. The priority of an interface card is determined by the slot the card occupies, with the slot directly after the last memory card having the highest priority and slot 20 having the lowest priority. See Figure 2-7 for an illustration of the I/O priority assignments. Configuring I/O priority consists of installing interface cards in the desired order of priority.

I/O requests from a higher priority device inhibit lower priority requests by breaking the priority chain. To maximize system response time and efficiency, assign the higher priorities to high-speed peripherals. Consult the system manager to establish I/O device priority and install the interface cards accordingly.

Note	Correct computer operation requires that there be NO vacant slots between plug-in cards.
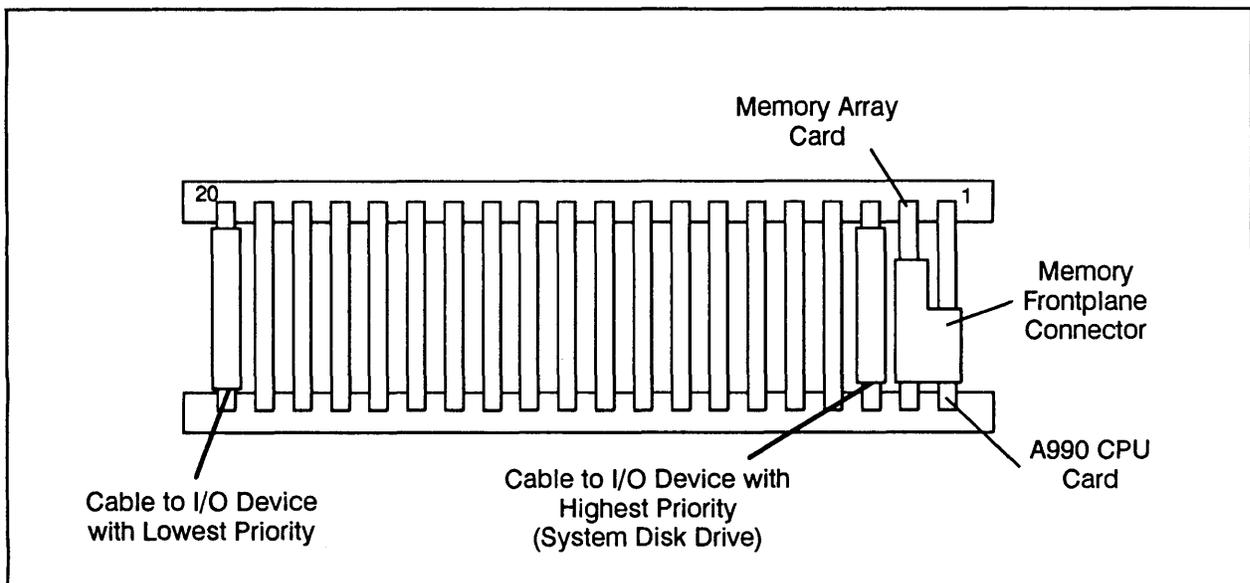
Figure 2-7. HP 2959/2999 Cards and I/O Priority Assignments

Installation Procedure

Battery Backup Installation

The A990 Computer or System accommodates an optional battery backup, which you can install in the power supply compartment. To install the battery backup:

1. Make sure that the ac power cord is not connected to the computer chassis and that the ac LINE switch is set to the OFF position. If you have not already done so, set the Battery Enable switch on the back of the chassis to DISABLE.

2. Remove the front panel, the fan panel, and the ac line configuration/fan power connector from the chassis. Note whether the connector is attached to P7 (230 Vac) or to P8 (115 Vac). Refer to Chapter 3 of this manual for instructions on removing these assemblies.

3. If the strapping connector is connected to the terminal on the lower board of the power supply marked "B.B. OFF", connect it to the terminal on the upper board marked "B.B. ON". See Figure 2-1.

4. Place the battery bracket over the battery. Align the negative (–) terminal of the battery with the label on the battery bracket that reads "Black Wire (–)". See Figures 2-8 and 2-9.

5. On the right side of the chassis, locate a pair of wires (a white covered wire and a black covered wire) in a gray sheath. Connect the terminal lug on the white wire to the positive (+) battery terminal and connect the terminal lug on the black wire to the negative (–) battery terminal. See Figure 2-9.

6. Place the battery, bracket, and attached wires in an upright position in the battery tray beneath the power supply. Place the assembly so the battery terminals are facing outward, not upward. See Figure 2-10. The fit is close, so you may have to maneuver the battery and bracket assembly under the power supply as you set it into place. Rotate the battery and bracket assembly so the battery terminals face upward. See Figure 2-11. Fasten the captive screws on the battery bracket.

7. Reinstall the fan panel and front panel. Remember to reconnect the line configuration connector to P7 or P8, as appropriate for your line power voltage. Refer to Chapter 3 for complete instructions.

Place bracket
over battery

© (+) White Wire

CAUTION: Refer to the Installation
Procedures for Battery Replacement

Black Wire (—) ©
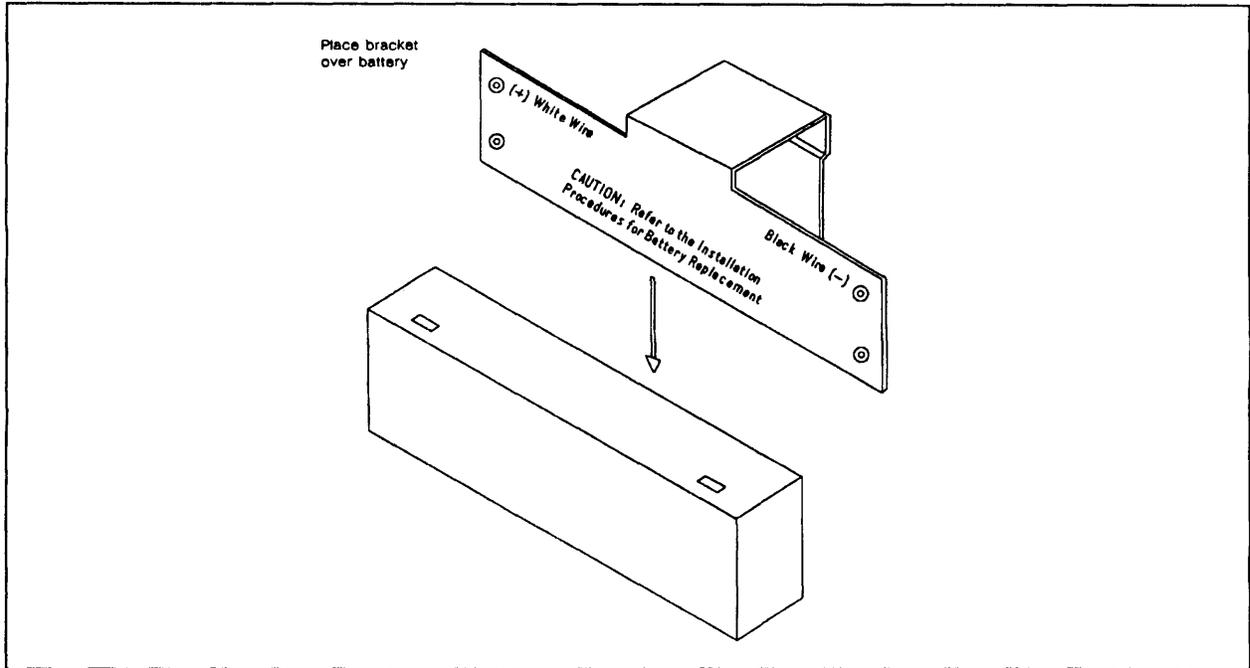
Figure 2-8. Backup Battery and Battery Bracket

Attach battery cable
terminal lugs onto
battery terminals.

© (+) White Wire

CAUTION: Refer to the Installation
Procedures for Battery Replacement

Black Wire (—) ©

White wire

Black wire
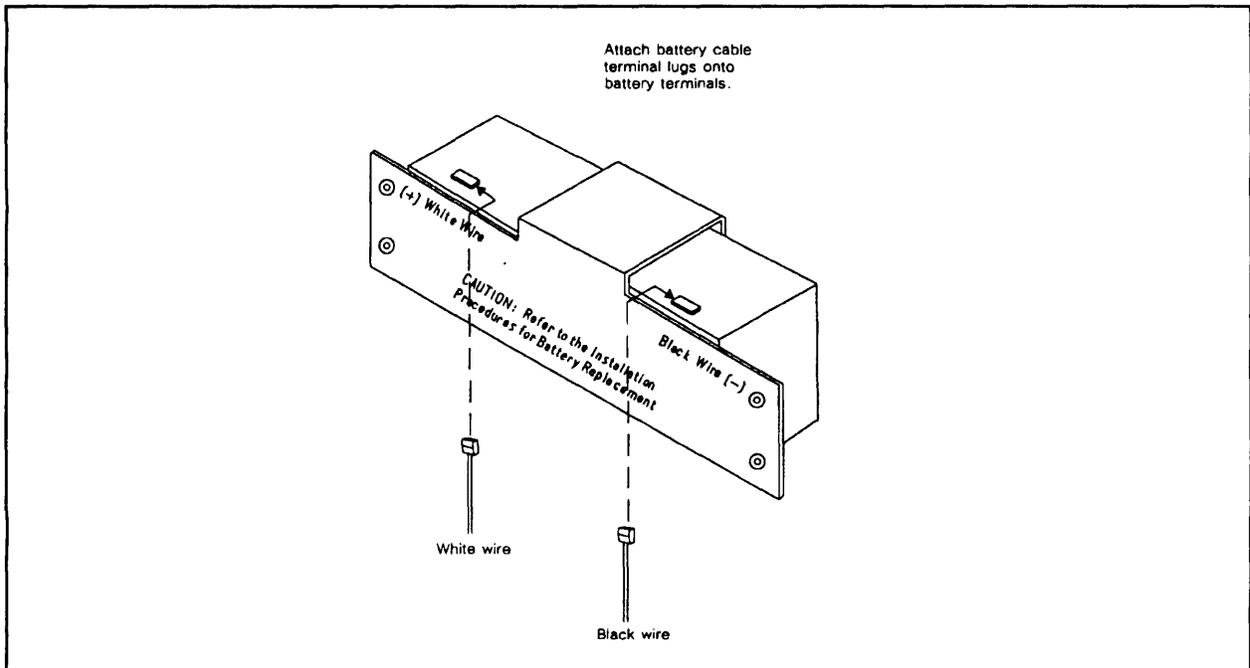
Figure 2-9. Backup Battery Installed in Battery Bracket

Battery
Assembly

Battery
Terminal
(Negative)
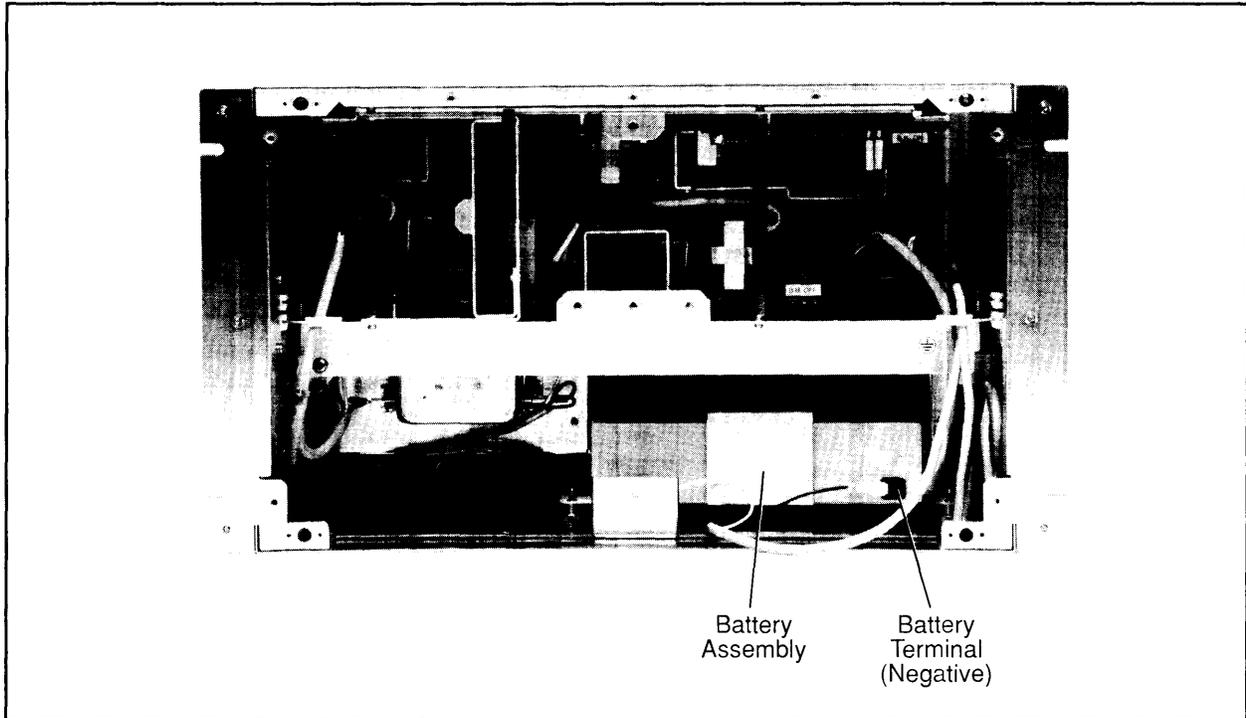
Figure 2-10. Battery Assembly in Initial Position

B. B. ON
Terminal

(+) White Wire

Black Wire (-)

CAUTION: Refer To The Installation
ure For Battery Replacement.

Positive
Battery
Terminal

Battery
Backup
Assembly

B. B. OFF
Terminal

Negative
Battery
Terminal
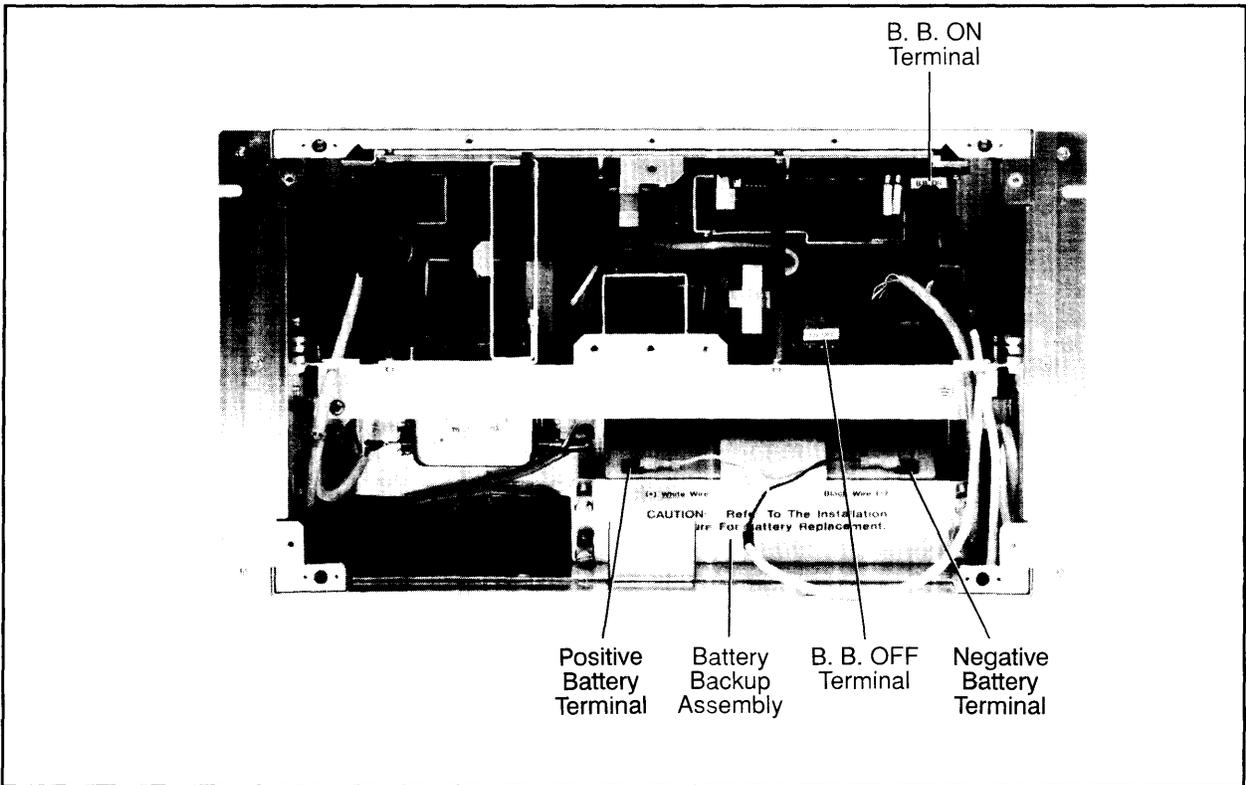
Figure 2-11. Battery Assembly in Final Position

Memory Installation

Caution

STATIC SENSITIVE DEVICES - To avoid damage to equipment, before you install or remove memory cards, you *must* set the Battery Enable switch to DISABLE. Also, make sure the LINE switch is set to OFF and the ac power cord is not connected to the ac power mains. Wear an antistatic wrist strap connected to a ground wire.

You can install from one to four memory array cards in the A990 card cage. With available memory cards, you can install up to 32 Mbytes of memory. The A990 supports only the A900 ECC memory array cards. The memory frontplane connectors, however, are unique to the A990. A900 memory frontplane connectors cannot be used with the A990. Table 2-2 lists the available types of memory array cards and frontplanes.

Install the first memory array card in the slot immediately to the left of the CPU card, the second immediately to the left of the first, and so on. Do not leave an empty backplane slot between the CPU card and a memory array card or between any memory array cards. If you have memory array cards of different capacities, place the largest capacity card(s) nearest the A990 CPU card.

Install the appropriate frontplane connector using one of the four supplied with your computer. Attach the small connector of the frontplane to the CPU card and the other connector(s) to the memory array card(s). Be sure you use a frontplane that matches the number of memory array cards you have installed. For example, if you have installed four memory array cards, the frontplane must have five connectors.

I/O Card Installation

Install I/O cards the same way you installed the CPU and memory cards. DMA and interrupt priorities for I/O cards are related to their placement relative to the CPU card. The closer to the CPU card, the higher the priority. Install all cards contiguously (no empty slots between cards).

Self-Test Check

The self-test for the processor automatically executes every time the computer is powered on. It is recommended that you run the self-test to ensure that the CPU is operating correctly. This check must be made with all plug-in cards installed in the computer. To verify the self-test operation, proceed as follows:

1. Set the LINE switch to the OFF position and connect the power cord to a power outlet. If battery backup is installed, set the Battery Enable switch to DISABLE.

2. Remove the rear cover for observation of the processor LEDs.

3. Set the power switch to ON. Observe the eight LEDs on the top of the A990 CPU card. If the computer passes the self-test, the LEDs will display one of the following values within 20 seconds. Any other LED display indicates a self-test failure. Refer to Chapter 3 for troubleshooting information.

000001★1 – VCP program is running; VCP console is connected.
000000★0 – VCP program is running; VCP console is not connected, that is, VCP is waiting for the VCP console to respond to the first Enq/Ack handshake.
00000001 – Loader is running.
00000000 – User software is running.
10000000 – Loader error. Probably a checksum error; change media on loading device.

where: 1 = LED lit; 0 = LED unlit; ★ = LED blinking

Computer Mounting

Table Mounting

The computer may be used as a freestanding instrument in a land-based environment. The only considerations are that adequate space should be allowed at the front and rear to ensure full intake and exhaust of ventilating air, and that all covers are installed. Also, a minimum of 38 centimeters (15 inches) of clearance behind the computer is required when removing and installing plug-in cards.

Rack Mounting

You can mount the A990 Computer in any standard 19-inch cabinet, such as the HP 29429A or HP 29431G. The usual location for the computer is at the bottom of the cabinet. Refer to the manuals supplied with your cabinet for specific information on installing mounting rails, installing the computer chassis, and grounding requirements.

When installing the HP 2959A CPU or the HP 2999A SPU in a cabinet, connect one end of the ac power cord to the ac power socket in the chassis and the other end to the Power Distribution Unit (PDU) mounted on the back door of the cabinet. To access the PDU, make sure the Main Power switch is set to OFF, then remove the four screws that secure the PDU access panel.

System Console (Terminal) Installation

Except for the cabling information given in this section and in Figure 2-12, refer to the documentation supplied with your terminal for all other installation information. For information on configuring the console interface as the Virtual Control Panel (VCP) interface, refer to the *Virtual Control Panel Configuration* section in this chapter.

Use one of the following interfaces for your system console:

    HP 12005B Asynchronous Serial Interface (ASIC) Card

    HP 12040C/D Multiplexer Interface (MUX) Card

Use the following procedure to connect your terminal to the interface card:

1. Set the system power switch to OFF and, if battery backup is installed, set the Battery Enable switch to DISABLE.

2. Remove the computer card cage rear cover.

3. If you connect the terminal with an electrical cable (instead of a fiber optic cable), connect the cable's hooded connector to the interface card, with the cable extending down. Connect the ground lug from the hooded connector to the computer chassis.

4. If you connect the terminal with a fiber optic cable (to the HP 12005B ASIC card only), connect the gray connector on the cable to the gray transmitter on the interface card and the blue connector on the cable to the blue receiver on the interface card.

If an HP 12040 MUX is used as the VCP interface, the VCP terminal must be connected to Port 0 of the MUX.

If your terminal is connected to an ASIC card or to revision C of the HP 12040 MUX card, you must configure the terminal for 9600 baud rate.

If you are using revision D of the HP 12040 MUX card, the computer is automatically configured to operate at the baud rate of your HP terminal. You must have your terminal configured for the ENQ/ACK protocol and 8 data bits with no parity or 7 data bits with 0's parity. Baud rates 300, 1200, 2400, 4800, 9600, and 19.2k are supported for terminals connected to an HP 12040 MUX.

You may also use one of the following I/O interfaces as your VCP interface for remote VCP download and boot capabilities:

    HP 12076A LAN/1000 Link Interface Card

    HP 12007B or HP 12044A HDLC Interface Card

If you want to use the LAN card as your VCP interface, refer to the *RTE-A System Generation and Installation Manual,* part number 92077-90034, for information on remote VCP.

If you want to use an HDLC card as your VCP interface, your remote system must be running either NS-ARPA/1000 or DS/1000-IV software. If your remote system is running NS-ARPA/1000, refer to the *NS-ARPA/1000 Generation and Initialization Manual,* part number 91790-90030, for information on remote VCP. If your remote system is running DS/1000-IV software, refer to the *DS/1000-IV Theory of Operation and Troubleshooting Manual,* part number 91750-90014, for information on remote VCP.

Interface Cabling

Refer to the manuals supplied with your interface cards and peripherals for information on connecting devices to I/O cards. After all interface cables have been assembled, use the following procedure to install the interface cables:

1. Set the power switch to OFF and, if battery backup is installed, set the Battery Enable switch to DISABLE. Remove the rear panel.

2. Connect the hooded connector of each cable to the edge connector of the appropriate interface card, with the cable extending to the bottom of the card cage. Connect the cable ground wire, if present, to the grounding strip.

3. Connect the other end of each cable to the appropriate peripheral device. Reinstall the rear panel.
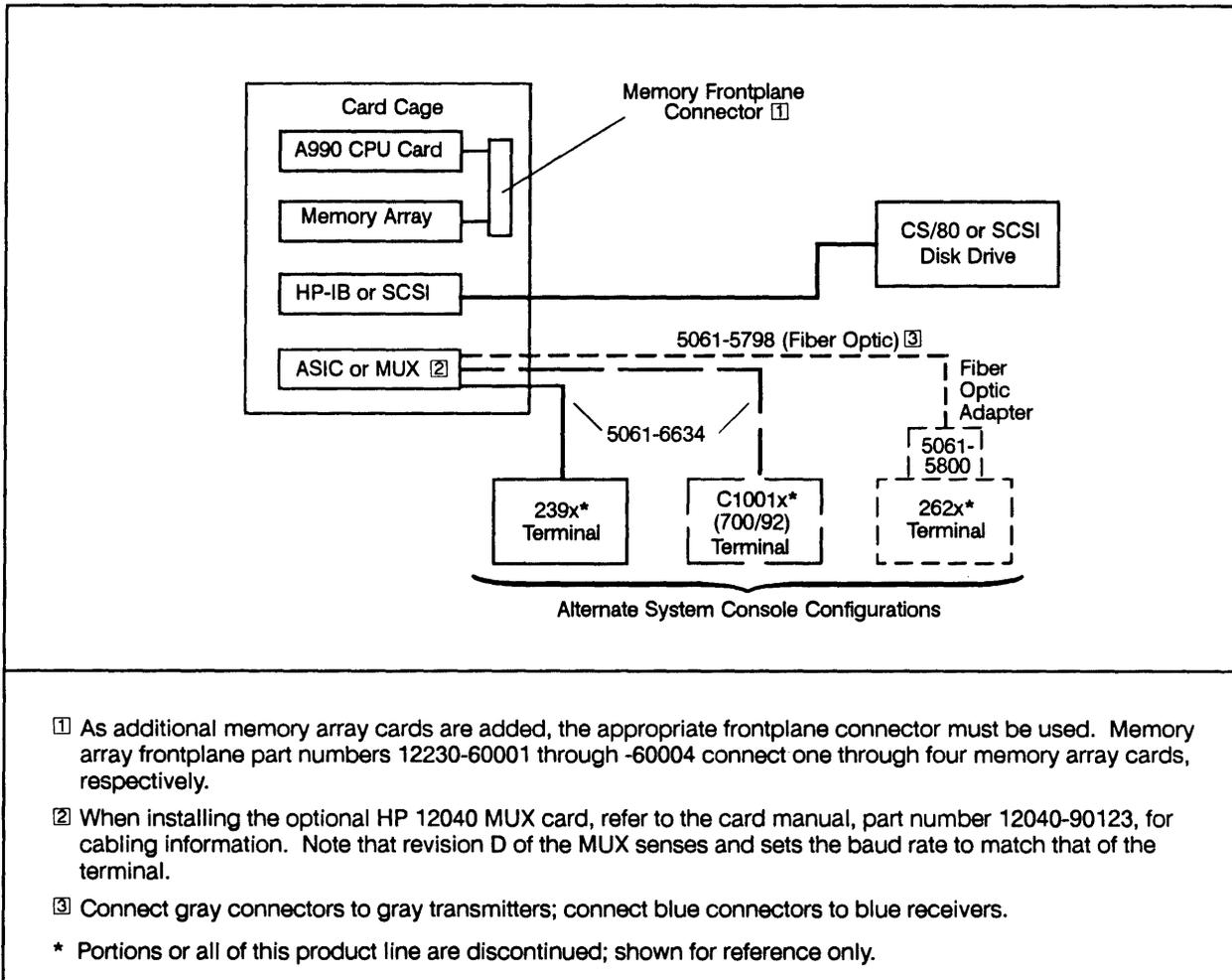
Figure 2-12. System Cabling Diagram

Disk Drive Installation

A variety of disk drives are available for use with A990 computers and systems. Except for installing the HP-IB or SCSI cable, refer to the installation manual supplied with your disk drive for installation information. Use the following instructions to install your disk drive cabling:

Note Where both standard and high-speed disk drives are used in a multiple drive installation, assign one HP-IB Interface Card to each class of drive.

---

1. Set the system power switch to OFF and remove the rear panel of the computer.

2. Connect the HP-IB or SCSI connector on the disk drive cable to the HP-IB or SCSI connector on the back of the disk drive.

3. Connect the hooded connector on the disk drive cable to the HP 12009A HP-IB Interface Card or HP 12016A SCSI Interface Card, with the cable extending to the bottom of the card cage.

4. Install the rear panel.

Powering Up the System and Booting

Use the following procedure to complete the installation and power up the system:

1. Set the terminal Power switch to ON; then set the system Power switch to ON. If battery backup is installed, set the Battery Enable switch to ENABLE. A blinking cursor will appear on the terminal screen after approximately 15 seconds. Press carriage return to get the VCP power-up message which displays the following:

   ● I/O table with the select code, ID number, and revision of each installed I/O card

   ● Pretest errors, if present

   ● CPU identification

   ● Amount of memory installed

   ● Contents of selected registers

   Table 2-3 gives the ID number for each A-Series interface card.

The following is an example VCP power-up message for a system with an HP 12009A HP-IB card at select code 27 and an HP 12005B ASIC card at select code 20 and designated as the VCP interface:

```
Installed I/O Cards
  ID   Rev    SC
  004   0     27
  000   1     20     <-  VCP

  (Pretest Error Message)        (this message appears only if an error was detected;
                                 refer to Chapter 3, A990 Self-Test Programs)

HP 1000 A-Series     ? for Help
 A990 CPU       8192KB MEMORY

P 00000    M  00000    T  000000    RW  000000
 A 000002   B  004022    X  000003     Y  000000    E  0    0  0
VCP>
```

Note that the A-Register contains the number of I/O cards found by VCP; the B-Register contains the revision of the VCP code; and the X-Register contains the revision number of the A990 firmware EPROM.

2. Boot up the RTE-A Primary System using the instructions given in the *RTE-A Primary System Software Installation Manual*, part number 92077-90038.

Verifying Computer Operations

You can use the diagnostic programs supplied with the HP 24612A Diagnostic Package (Revision 5270 or later) to verify the installation and operation of your A990 CPU. Complete documentation is supplied with the package.

Primary System Backup

Use the appropriate backup utility to back up the Primary System. Refer to the *RTE-A Utilities Manual*, part number 92077-90004.

Table 2-3. A-Series I/O Interface Card ID Numbers

ID Number	Rev. Number	Interface Card	
000	0	HP 12005A*	Asynchronous Interface Card
000	1	HP 12005B	Asynchronous Interface Card
001	0	HP 12006A	Parallel Interface Card
002	0	HP 12043A	Multi-Use Programmable Serial Interface
002	0	HP 12092A	Data Link Master Interface Card
003	0	HP 12008A	PROM I/O Card
003	0	HP 12155A	A700 PROM Control Store Card
004	0	HP 12009A	HP-IB Interface Card
005	0	HP 12010A	Breadboard Card
006	0	HP 12041B	Multi-Use 8-Channel MUX Interface Card
022	0	HP 37222A	Integral MODEM Interface Card
023	0	HP 12022A	Integrated Disk Interface Card
025	0	HP 12065A	Color Video Interface Card
040	0	HP 12060A*/B	High Level Analog Input Card
**	**	HP 12061A	Analog Multiplexer Expansion Card
044	0	HP 12062A	Digital-to-Analog Card
060	0	HP 12153A	A700 Writable Control Store Card
061	0	HP 12205A	A900 Writable Control Store Card
102	0	HP 12007B	HDLC (Modem) Card
102	0	HP 12044A	HDLC (Direct Connect) Card
102	0	HP 12042A	Programmable Serial Interface (Modem) Card
102	0	HP 12042B	Programmable Serial Interface (Direct Connect) Card
102	0	HP 12073A	DS/1000-IV Modem Interface to HP 3000
102	0	HP 12075A	LAP-B Network Interface Card
102	0	HP 12082A	DS/1000-IV Direct Connect Interface to HP 3000
106	0	HP 12040B*/C/D	8-Channel Multiplexer Interface Card
115	0	HP 12016A	SCSI Interface Card
126	0	HP 12076A	LAN Interface Card
141	0	HP 12063A	16IN/16OUT Isolated Digital Card
143	0	HP 12072A	Data Link Slave Interface Card
177	7	HP 12100A	A400 Processor Card On-Board I/O (not an I/O card)

* Discontinued product; shown for reference only.
** Has no I/O master or ID number.

Repackaging for Shipment

If you need to return any part or all of your computer or system to the factory, you can use the same shipping materials originally used by the factory or you can obtain new shipping packages from Hewlett-Packard Sales and Service Offices. Alternatively, you can use commercially available materials.

Shipment Using Original Packaging

When returning an item in its original or factory supplied packaging, use the following procedure:

1. Attach a tag to the item clearly describing the type of service needed or why you are returning the item; include the item's model number and serial number on the tag.

2. Mark the container "Fragile" to assure special handling (although this is no substitute for proper packaging).

3. In correspondence dealing with an item, please refer to it by both model and serial numbers.

Shipment Using New Packaging

The following instructions should be used as a guide when packaging the computer with commercially available materials:

1. Wrap the computer in Aircap film or foam. If shipping the computer back to Hewlett-Packard, first attach a tag to the computer with your return address and indicate the type of service required. Include the computer model number and full serial number.

2. Use a strong shipping container large enough to hold the item and enough shock absorbing material to cushion the item and prevent movement inside the container. A double-wall carton made of 2.41 MPa (350-psi) test material is adequate.

3. Seal the shipping container securely and mark it "Fragile".

4. In any correspondence dealing with the computer, be sure you refer to it by its model number and serial number.

Service

This chapter describes periodic maintenance procedures, troubleshooting information for isolating malfunctions to the assembly level, and procedures for removing and replacing various computer assemblies.

Electrical Safety

Before proceeding with any maintenance or service on the computer which requires physical contact with electrical or electronic components, be sure that either power is removed or that safety precautions are followed to protect against shock. Heed all "WARNING" signs on equipment and in this manual. All service work must be done by qualified personnel.

Periodic Maintenance

Warning	High voltages are present in the system equipment. Always disconnect power before performing any maintenance. Failure to do this could result in serious injury.

Maintenance schedules should be set up according to the quality of the environment in which the computer is operating. A computer in a clean and air-conditioned atmosphere requires less periodic maintenance than one that is located in an atmosphere laden with dust, smoke, moisture, or other particulate matter. Consult the service manuals for any peripherals for the procedures required for a preventive maintenance schedule.

Perform the following steps as often as necessary:

1. Clean the cabinet exterior and interior.

2. Check the ventilating fans for proper operation. The fans have sealed bearings and need no lubrication.

3. Clean the computer air filter by washing it in a solution of warm water and mild soap. Dry the filter thoroughly before you re-install it.

Caution	To ensure that the computer remains free of dust, you must clean the air filter periodically. Inspect it as often as your computer environment dictates, and clean it as soon as the first signs of dirt appear. Failure to keep the filter clean can result in permanent damage to the computer.

Troubleshooting

System malfunctions can be isolated to the assembly level by performing the following tests:

1. Power supply check.

2. Self-tests.

3. Diagnostics.

When a test procedure indicates a faulty component, you can usually correct the problem by replacing the assembly in which the indicated faulty component is located. After identifying the problem, contact your nearest Hewlett-Packard Sales and Service Office for instructions regarding obtaining a new assembly and returning the faulty one. Assembly removal and replacement procedures are given in this chapter.

Power Supply Check

Warning	To avoid damage to equipment or injury to people, any service, adjustments, or repair to the power supply must be performed only by qualified maintenance people.

Before working on the power supply, you must set the computer's ac Power Switch (LINE switch) to OFF and disconnect the ac power cord. Before working on the system, turn off the power at the system Main Switch, on the rear door of the cabinet, and disconnect the ac power cord. If the computer or system is equipped with battery backup, set the Battery Enable switch to DISABLE.

To verify power supply operation, use a voltmeter to verify that the signal values at the rear panel test connector (near the Battery Enable switch) are the same as those listed in Table 3-1. The MLT- signal is generated by battery backup and may not be within tolerance if battery backup is not installed.

Table 3-1. Power Supply Test Voltages

Test Conn. Pin No.	Test Point	Nominal Voltage
1	+5	+5.1 V ±0.10 V
2	+12	+12.0 V +0.72 V, -0.36 V
3	-12	-12.0 V ±0.72 V
4	+5M	+5.1 V ±2%
5	PON+ (Power ON)	+3.7 V ±1.3 V
6	PFW – (Power Fail Warning)	+3.7 V ±1.3 V
7	MLT – (Memory Lost)	+3.7 V ±1.3 V if battery backup is installed
		0.4 V ±0.4 V if battery backup is not installed
8,9	$\phi1, \phi2$	19.5 Vrms +1.95, -2.3 Vrms (at 0 to .02 Amps)
		19.5 Vrms ±1.6 Vrms (at .02 to 1.5 Amps)
12	Common	

If any of the voltages are out of tolerance, perform the following steps to identify the malfunction:

1. Set the ac Power Switch (LINE switch) to OFF, the Battery Enable switch to DISABLE (if battery backup is installed), and disconnect the ac power cord. Wait 90 seconds before proceeding to the following steps.

2. Remove the front panel and fan panel to uncover the power supply. Refer to the removal and replacement sections later in this chapter for instructions.

3. Verify that the ac line configuration/fan power plug is plugged into the correct connector on the power supply. Refer to Figure 2-2.

   a. For 115 Vac power sources, plug the configuration/fan power plug into connector P8.

   b. For 230 Vac power sources, plug the configuration/fan power plug into connector P7.

4. Reconnect the ac power cord and set the LINE switch on the rear panel to ON. If battery backup is installed, set the Battery switch on the power panel to ENABLE.

5. Using a voltmeter, verify that the signal values at the rear panel test connector are the same as those listed in Table 3-1.

   a. If a charged battery pack is installed and the MLOST– (memory lost) signal is not within tolerance, turn the power supply OFF for 90 seconds, then ON again. If the fault recurs, replace the power supply.

   b. If a charged battery pack will not sustain one memory array card for 60 minutes, or four memory array cards for 15 minutes, replace the power supply. Note that the battery pack must have been charged for 24 hours in order to sustain memory for the specified amounts of time.

   c. If the 25 kHz sine wave $\phi1$ and $\phi2$ signals are not within tolerance, turn the power OFF for 90 seconds, then back ON. If the fault recurs, replace the power supply.

d. If any of the remaining signals are not within tolerance, turn the power OFF for 90 seconds, then ON again. If the fault recurs, replace the power supply.

Caution

Set the Power switch to OFF and the Battery Enable switch to DISABLE before removing or inserting a plug-in card.

---

6. If the voltage checks in step 5 do not detect an out-of-tolerance voltage, remove all of the plug-in cards in the card cage. Repeat the voltage checks using the following voltage ranges (these ranges are slightly wider than those listed in Table 3-1 because there is no load on the power supply):

Voltage Point	Voltage Range
+ 12V	11V – 14V
–12V	–11V – –14V
+ 5.1V	4.75V – 5.5V
+ 5.1VM	4.75V – 5.5V
PON+	2.4V – 5.2V

a. If the voltages are within tolerance, one of the plug-in cards is defective. Install the cards one-by-one while making voltage checks to detect the defective card.

b. If any voltage is out of tolerance, this could mean a faulty power supply or backplane. First, replace the power supply. If the problem persists, replace the backplane.

A990 Self-Test Programs

The A990 self-test consists of two test programs (Test 1 and Test 2) that automatically execute each time you turn on the computer. You also can initiate these tests by pressing Reset Switch SW1 on the A990 CPU card. Test 1 (microcoded self-test) tests the processor at the circuit level. Test 2 (VCP pretest) tests the processor at the functional level. For example, Test 1 tests the hardware associated with the LIA instruction to ensure that the hardware works correctly. Test 2 executes the LIA instruction and checks the results to ensure that the instruction works correctly.

Successful completion of the tests is followed by execution of either a bootstrap loader, the Virtual Control Panel (VCP) program, or a program sustained in memory by optional battery backup. (Refer to the *A990 Computer Reference Manual*, part number 02959-90001, for information on bootstrap loaders and the VCP.) Which of these occurs depends on how the BOOT SELECT switches are configured. Refer to *A990 CPU Card Switches* in Chapter 2.

Test 1

Test 1 is stored as a microprogram in the firmware EPROM on the A990 CPU card. It executes immediately on power-up and checks all of the hardware on the card. On successful completion of Test 1, Test 2 is started. If Test 1 detects a failure, it stops executing and the LEDs on the CPU card display an error code.

The bank of four LEDs on the bottom of the CPU card displays a code that indicates which field replaceable unit failed. When Test 1 is finished, all four LEDs are extinguished. The bank of eight LEDs on the top of the CPU card is not used by Test 1 to indicate defective field replaceable units. Any pattern that is displayed on the bank of eight LEDs during Test 1 should be ignored. Table 3-2 lists the LED indications for Test 1 and their associated error codes.

Test 2

Test 2 is part of the VCP program also stored in the firmware EPROM on the A990 CPU card. It begins execution upon successful completion of Test 1. Test 2 can also be initiated by an operator command (%T) from VCP. Test 2 executes in two phases, and may take as long as 20 seconds to run, depending on the amount of memory installed.

The first phase of Test 2 checks the computer's basic instruction set, several internal flags, and the Boot RAM. When the entire Boot RAM has been successfully tested, each location of Boot RAM contains zeros.

The second phase of Test 2 tests main memory, the I/O Master of each interface card, and the computer configuration. The I/O Master of each interface card is checked to ensure that data transfer, flag, interrupt, and Direct Memory Access (DMA) functions are correctly processed.

If battery backup sustained main memory, phase two of Test 2 tests main memory in a non-destructive manner. If main memory is not sustained by battery backup, a destructive memory test is performed and main memory is effectively cleared (memory contains all zeros). On successful completion of Test 2, the LEDs will be lit with a specific pattern. This pattern depends on the startup configuration as selected by the BOOT SELECT switches (SW2). Refer to Table 3-3 for the LED displays that indicate self-test passed.

If Test 2 detects a failure, the error code is displayed on the upper 8 LEDs (the lower 4 LEDs are all off). If a failure is detected during *phase one* of Test 2, test execution stops and the LEDs indicate the type of failure by displaying a 1-byte static error code (see Table 3-2). If a failure is detected during *phase two* of Test 2, the VCP can still run if the VCP interface is functioning properly and a VCP console is installed. The failure causes the LEDs to flash the error code (in binary format) as well as display the error code in octal format in the message "Pretest Error xxx.xxx.xxx.xxx" on the VCP console.

Each error message for *phase two* of Test 2 consists of four bytes of information. The information is displayed on the LEDs using the scheme described in Figure 3-1. The first byte of the error code is the main error code (memory error, I/O interface error, or interrupt error) and the second byte is the subcode. Some of the error codes give additional information in bytes 3 and 4. For example, error code 300 203 000 022 indicates that an I/O error (300) has occurred and that the error was caused by duplicate select codes (203) and the duplicate select code was 22 (000 022). An error code of 340 201 000 000 indicates a memory error (340 201) in the first 32k block of memory (000 000). Table 3-4 shows the LED failure indications for Test 2.

Table 3-2. LED Indicators and Error Codes for Test 1 and Phase 1 of Test 2

Error Code *		Meaning
Bank of 4 LEDs	**Bank of 8 LEDs**	
1111	11111111	Initial power-on condition. All LEDs are turned on when PON signal is low. Incorrect indication may be caused by microcode load or execution problem, an A990 board failure, EPROM failure, or power system failure.
0001	XXXXXXXX	Failure caused by bad EPROM or bad A990 board.
0010	XXXXXXXX	Base set fatal error (also known as machine check error) has occurred after VCP was started. See LED indications below for fatal base set error codes.
0011	XXXXXXXX	Failure caused by bad jumper board.
0100	XXXXXXXX	Failure caused by bad memory frontplane connector.
0101	XXXXXXXX	Failure caused by bad memory array card.
0110	XXXXXXXX	Failure caused by bad time-of-day clock chip or bad A990 board.
0111	XXXXXXXX	Failure caused by bad A990 board (possibly caused by a bad processor ASIC chip).
1000	XXXXXXXX	Failure caused by bad A990 board (possibly caused by a bad cache ASIC chip).
1001	XXXXXXXX	Failure caused by bad A990 board.
1010	XXXXXXXX	Failure caused by bad A990 board.
1011	XXXXXXXX	Failure caused by bad A990 board.
1100	XXXXXXXX	Failure caused by bad A990 board.
1101	XXXXXXXX	Failure caused by bad A990 board.
1110	XXXXXXXX	Failure caused by bad A990 board.
1111	0000XXXX	Failure caused by bad EPROM or A990 board (board failure possibly caused by a bad processor ASIC chip).

The following LED indications are caused by fatal base set errors after the VCP program has started:		
0010	00000001	Control store parity error. May have been caused by bad hardware.
	00000010	Microcode stack overflow or underflow. May have been caused by an error in the base set microcode.
	00000100	Zap counter interrupt. May have been caused by an error in the base set microcode.
	00001000	Two consecutive micro-interrupts. May have been caused by bad hardware.
	00010000	A micro-interrupt occurred, but the micro-interrupt register did not contain a known error pattern. May have been caused by bad hardware.

The following are Test 2 Phase 1 LED indications:		
0000	11111110	Microcoded self-test (Test 1) passed but first memory fetch failed. Bad A990 board.
	11111100	Basic instruction test failed. Bad A990 board.
	11111000	Boot memory access failed. Bad EPROM or A990 board.
	11110000	TBG test failed. Bad A990 board.

* 1 = lit LED; 0 = unlit LED; X = don't care

Note	If a self-test error occurs, do not boot the operating system. The integrity of the system cannot be assured. Use the diagnostics to find and eliminate the cause of the error if you cannot identify a problem with the self-test.
👆	If the computer fails the self-test only when it is cabled to an A-Series I/O extender, make sure the extender is powered on. Also, when the computer is cabled to an HP 12025A/B I/O Extender, turning off the power to the extender causes a powerfail shutdown of the computer that may appear to be a computer failure.

Revision 4022 and later of VCP uses the following scheme to display the four-byte long error code on the 8 LEDs. Preceding each byte of information a "travelling" LED pattern is displayed to indicate which byte of information is going to be displayed. For example, the following LED sequence is displayed for the error code 302 201 023 021. See Table 3-4 for a definition of all the error codes.

Octal Code	LED Display
302	OOOOOOO● *One* travelling LED is displayed, then ●●OOOO●O *First* byte of error message is displayed
201	OOOOOO●● *Two* travelling LEDs are displayed, then ●OOOOOO● *Second* byte of error message is displayed
023	OOOOO●●● *Three* travelling LEDs are displayed, then OOO●OO●● *Third* byte of error message is displayed
021	OOOO●●●● *Four* travelling LEDs are displayed, then OOO●OOO● *Fourth* byte of error message is displayed

Figure 3-1. Sample Display of Self-Test Test 2 Error Code

Table 3-3. Self-Test Pass Indications

Octal Code	LED Display	Definition
007⇆005	000001*1	VCP program is running; VCP console connected and waiting for user input.
002⇆000	000000*0	VCP program is running; VCP console is not connected, that is, VCP is waiting for the VCP console to respond to the first ENQ-ACK handshake.
001	00000001	A boot loader is running.
000	00000000	User software is running.
200	10000000	Loader error. Probably a checksum error; change media on loading device.
020	00010000	Running Diagnostic Design Language (DDL) Program.
1 = lit LED; 0 = unlit LED; * = flashing LED		

Table 3-4. LED Indicators and Error Codes for Test 2

Octal Code *				Definition
Byte				
1	**2**	**3**	**4**	
360	360	xxx	xxx	TBG test failed. Third and fourth bytes (xxx xxx) indicate the address in the VCP code where the error was detected.
340	---	---	---	When the LEDs are in this static pattern the memory test is running and has not yet completed; this is not an error condition.
340	200	000	000	No memory found or missing frontplane connector.
340	2nn	xxx	xxx	Main memory failed. nn = 01b to 12b depending on where in the VCP code the error was detected. Third and fourth bytes (xxx xxx) indicate the 32-KByte block of failed memory.
341	000	377	377	ECC memory detected in A400/A600; ECC memory is not supported in an A400/A600. (This error should never occur on an A990.)
300	200	000	000	No I/O cards in the card cage.
300	201	0yy	0xx	More than one card has VCP enabled; yy and xx are the select codes of the enabled cards.
300	202	0yy	0xx	Broken I/O chain; yy is the number of I/O cards found by polling; xx is the number found by priority scan; the break will usually be found at slot xx + 1.
300	203	000	0xx	Duplicate select codes; more than one card has the select code xx.
300	204	000	0xx	An I/O card at select code xx has a select code of less than 20b.
300	205	000	000	No I/O card has been enabled as the VCP interface.
300	206	000	000	Unexpected TBG interrupt.
300	207	000	000	Unexpected Memory Protect interrupt.
300	210	000	000	Unexpected UIT interrupt.
300	211	000	000	Invalid ID number or select code for A400 On-board I/O. (This error should never occur on an A990.)
300	213	000	000	VCP Speed Sense failed.
300 . . 300	220 277	xxx xxx	xxx xxx	} An I/O card at select code 20 through 77 failed self-test. xxx xxx is the address in VCP where the error was detected.

* The error codes for phase 2 of Test 2 are displayed on the upper 8 LEDs as 4 bytes of information using the scheme illustrated in Figure 3-1.

Diagnostics

You can use the diagnostics in the HP 24612A Diagnostics Package (Revision 5270 or later) for testing the computer when you cannot identify a problem with the self-test. You will find instructions for running the diagnostics in the manuals included with the diagnostics package.

Memory Card LEDs

Memory array cards are equipped with a green LED indicator. If the LED is off, it indicates that a multiple-bit error has occurred on that card since the time you switched the computer on. Single-bit errors are automatically corrected. Multiple-bit errors cause the computer to execute a jump to memory location 05.

Assembly Removal and Replacement

Warning	**Hazardous voltages are present inside the system mainframe. Heed all WARNING – HAZARDOUS VOLTAGE labels.**
	To avoid damage to equipment or injury to people, any service, adjustments, or repair to the power supply must be performed only by qualified maintenance people.

Caution	The contents of memory will be lost when ac line voltage is OFF and battery backup (if installed) is disabled. Before shutting down the computer, be sure to save and store the contents of memory.

The following paragraphs describe procedures for removing and replacing the various computer assemblies. Refer to Chapter 4 for exploded views of the computer. If your computer is rack mounted, read the entire assembly removal procedure. If you cannot carry out a procedure with the computer mounted in the rack, do the following:

1. Set the power switch (LINE) to OFF and disconnect the power cord. If battery backup is installed, set the Battery Enable switch to DISABLE.

2. Disconnect all I/O cables from the computer interface cards.

3. Remove the computer from the rack. Refer to the manuals supplied with the rack for mounting and dismounting information.

Fan Panel

Removal

Remove the fan panel as follows:

1. Set the power switch (LINE) to OFF, the Battery Enable switch to DISABLE, and disconnect the power cord.

2. Remove the front panel by grasping it at the indentations on the sides of the panel and pulling the panel away from the chassis.

3. Remove the eleven screws on the front of the chassis.

4. Grasp the fan panel by its right and left edges and carefully tilt it away from the chassis. Do not pull it out too hard or too far. Note that the fan panel is connected to the power supply and chassis by the ac line configuration/fan power connector.

5. Disconnect the ac line configuration/fan power connector from the power supply, noting whether the connector is in P7 or P8. See Figure 2-2. Remove the fan panel.

Replacement

Replace the fan panel by reversing the removal procedure. Note that when reconnecting the ac line configuration/fan power connector to the power supply, use connector P7 if the ac line voltage is 230 Vac, or connector P8 if the ac line voltage is 115 Vac.

Fans

Removal

Remove a fan as follows:

1. Set the power to OFF, disconnect the power cord, and set the Battery Enable switch to DISABLE. Remove the fan panel, as described previously.

2. Disconnect the fan power plug at the fan. Remove all four fasteners and the finger guard, then remove the fan.

Replacement

Replace the fan by reversing the removal procedure. Be sure you orient the fan so that the direction of the air flow is into the computer. Air flow direction is indicated on the fan housing.

Power Supply

Warning

Before removing the power supply, set the LINE switch to the OFF position and disconnect the power cord. Set the Battery Enable switch to the DISABLE position. Allow 90 seconds for high voltages on the power supply to discharge.

Removal

Remove the power supply as follows (refer to Figures 2-1 and 2-2):

1. Remove the fan panel, as described previously. Be sure you disconnect the 115 Vac/230 Vac line configuration connector from P7 or P8.

2. Disconnect the ac line input connector from P9.

3. Disconnect the test point/external battery connector from P6.

4. Disconnect the Battery Backup connector from the B.B. ON or B.B. OFF terminal, as required.

5. Disconnect the Battery Enable switch connector from P5.

6. Remove the two screws that secure the bottom bracket of the power supply.

7. Grasp the power supply by the front edge and pull the power supply away from the backplane.

Replacement

Replace the power supply by reversing the removal procedure.

Caution

Arrange all cables (ac line, test point/external battery, and Battery Backup) for the shortest possible run over the power supply, to prevent them from interfering with the fans.

When you connect the line configuration/fan power connector to the power supply, be sure you use connector P8 for a 115 Vac power source or connector P7 for a 230 Vac power source.

Battery Pack

Removal

Remove the battery pack as follows:

1. Make sure the power switch is set to OFF, disconnect the power cord, and set the Battery Enable switch to DISABLE.

2. Remove the fan panel, as described previously.

3. Unplug the wires from the battery terminals.

4. Loosen the battery assembly fasteners.

5. Rotate the battery assembly toward yourself and remove the battery assembly.

6. Remove the battery pack from the battery bracket.

Replacement

Replace the battery pack by following the instructions given in the *Battery Backup Installation* section in Chapter 2.

Plug-in Cards

Caution   STATIC SENSITIVE DEVICE. Use anti-static handling procedures when removing or installing a system plug-in card.

Removal

Remove a plug-in card from the card cage as follows:

1. Set the power switch to OFF and disconnect the power cord. If battery backup is installed, set the Battery Enable switch to DISABLE.

2. Remove the rear panel.

3. If applicable, remove the cable connector from the card and disconnect the ground lead from the chassis. Firmly pull outward on the card extractor levers to remove the card.

Replacement

Replace a plug-in card by reversing the removal procedure. Make sure you have set the switches on the card correctly. All plug-in cards must be installed with the component side facing towards the right. For the A990 CPU card, the side with the bank of eight LEDs must face towards the right.

EPROM and Time-of-Day Clock Chips

Caution   STATIC SENSITIVE DEVICE. Use anti-static handling procedures when removing or installing a chip on the A990 CPU card.

Removal

To remove the EPROM or time-of-day clock chip, set the power switch to OFF and remove the CPU card from the computer, placing it on a flat surface. While observing the anti-static handling precautions, carefully pull the chip from its mounting socket. Refer to Figure 3-2 for the chip locations.

Replacement

Replace the EPROM or time-of-day clock chip by reversing the removal procedure. When reinstalling the chip, be sure to note the orientation of pin 1 as illustrated in Figure 3-2.

A bank of 4 LEDs is located on the lower side of the board, directly below the upper bank of 8 LEDs.
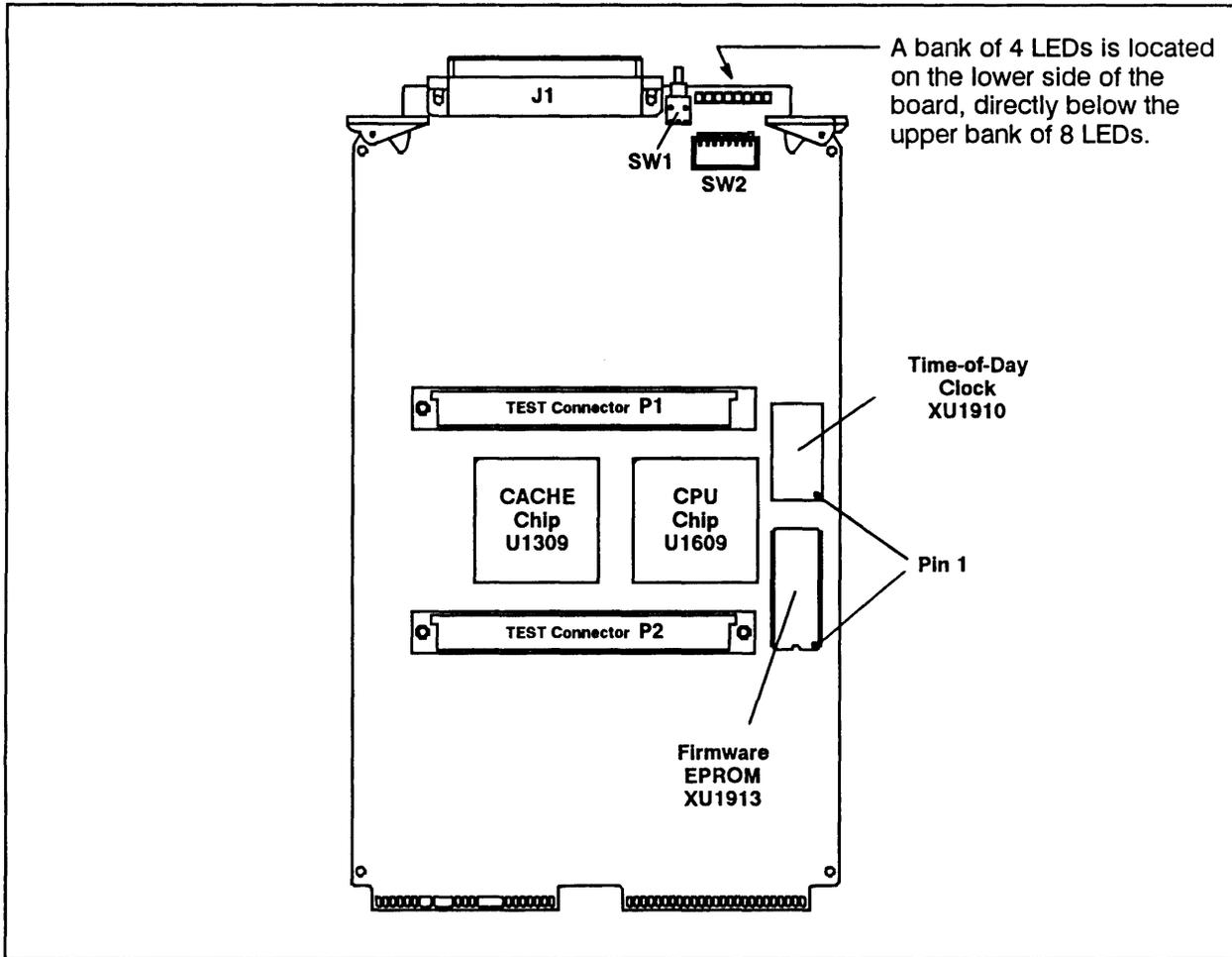
Figure 3-2. A990 CPU Card Chip Location Diagram

Backplane

Removal

Remove the backplane as follows:

1. Set the power switch to OFF and disconnect the power cord. If battery backup is installed, set the Battery Enable switch to DISABLE.

2. Disengage all plug-in cards from the backplane.

3. Remove the fan panel and power supply, as described previously.

4. Remove the connectors on the right-hand (primary) side of the line filter.

5. Loosen the battery assembly screws and remove the battery assembly.

6. Remove the four screws that retain the left guide mounting bracket and remove the left guide mounting bracket.

7. Remove the seven screws that hold the rear shield to the backplane and remove the rear shield.

8. Remove the seven screws that hold the backplane and remove it.

Replacement

Replace the backplane by reversing the removal procedure.

Caution   When you reconnect the wires to the line filter, be sure you connect the white wire to the top lug, the black wire to the bottom lug, and the green wire to the casing.

Line Filter

Removal

Remove the line filter as follows:

1. Make sure the power switch is set to OFF and disconnect the power cord. If battery backup is installed, set the Battery Enable switch to DISABLE.

2. Remove the fan panel and line filter connectors, as described previously.

3. Remove the four screws and washers that retain the line filter and remove the line filter.

Replacement

Replace the line filter by reversing the removal procedure. When you reconnect the wires to the line filter, be sure you connect the white wire to the top lug, the black wire to the bottom lug, and the green wire to the casing.

115/230 Vac Reconfiguration

Warning

⚡

Reconfiguring the computer to operate from 115 or 230 Vac line voltage must be done only by qualified personnel. Before changing from 115 Vac to 230 Vac configuration, or vice versa, set the power switch on the front of the box to OFF, the Battery Enable switch to DISABLE, and disconnect the power cord. Failure to observe this precaution can result in serious injury or in damage to the power supply.

The computer's ac line voltage configuration is determined by the position of the ac line configuration/fan power connector (refer to P7 and P8 in Figure 2-2). Carry out the following steps to change the position of the ac line configuration/fan power connector.

1. If you are reconfiguring the power supply from 115 Vac to 230 Vac operation, apply the 230 Vac label to the back panel of the computer.

    If you are reconfiguring the power supply from 230 Vac to 115 Vac operation, apply the 115 Vac label to the back panel of the computer.

2. Remove the front panel of the computer and the fan panel, as described previously.

3. Remove the ac line configuration/fan power connector by squeezing the tabs at the ends of the connector. Insert the connector in the appropriate plug (P8 for 115 Vac, P7 for 230 Vac).

4. Replace the fan panel and the front panel.

5. Be sure you use the correct ac power cord with the new configuration. Refer to Figures 1-1 and 1-2.

Power Distribution Diagram

Figure 3-3 is the power distribution diagram for the 20-slot box.
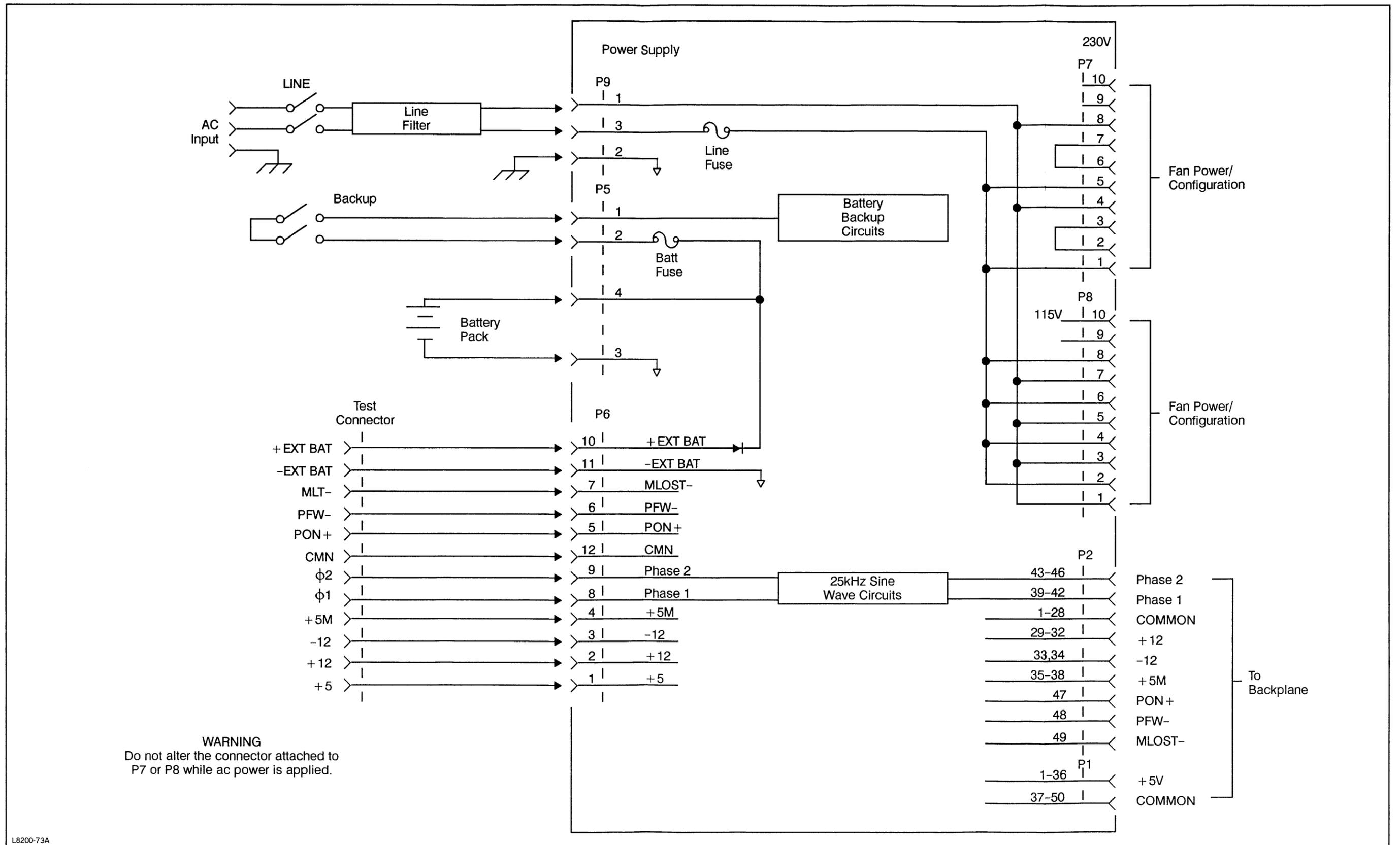
Figure 3-3. Power Distribution Diagram

L8200-73A

4

Replaceable Parts

This section provides a list of replaceable parts and illustrated parts breakdowns of the computer.

Replaceable Parts Table

Table 4-1 lists the replaceable parts shown in Figures 4-1, 4-2, and 4-3. Parts are referenced in the table and in the illustrations by index numbers. The columns in the table provide the following information for each part.

1. Index No. – The figure index number of the part as shown in Figure 4-1, 4-2, or 4-3.

2. Description – The description of each part.

3. HP Part No. – The Hewlett-Packard part number for each part.

Ordering Information

When ordering replaceable parts, address the order to the nearest Hewlett-Packard Sales and Service Office. Include the following information for each part ordered:

1. Complete model number and serial number of the computer.

2. HP Part number for each part.

3. Complete description for each part as provided in the replaceable parts list.

Parts Exchange Program

If you have a defective processor card, memory card, or power supply, you can exchange it for an operating assembly. For costs and other details of the exchange program, contact your nearest HP Sales and Service Office.

Table 4-1. List of Replaceable Parts

GENERAL PARTS		

Index No.	Description	HP Part No.
1	Chassis	12151-60026
2	Rack Ear	12151-00032
3	Battery Support	12210-00020
4	–	–
5	Front Deflector	12210-00009
6	Fan Panel	5061-6642
7	Rear Shield	12210-00022
8	Guide Mounting Bracket	12210-00013
9	Right Inner Rack Ear	12151-00039
10	Left Inner Rack Ear	12151-00038
11	Fan Cable	12151-60009
12	AC Filter Cable	12151-60006
13	AC Power Cable	12151-60007
14	Line Filter	9135-0312
15	Fan	3160-0315
16	Fan Guard	3160-0092
17	Card Guide, Narrow	0403-0436
18	Grommet	0400-0370
19	Terminal	0360-1263
20	Rivet, Blind	0361-1072
21	Flat Washer, #6	3050-0228
22	Flat Washer, #8	3050-0139
23	Lock Washer, #6	2190-0851
24	Screw, PH, 6-32 x 1.875	2360-0318
25	Screw, PH, 6-32 x 0.375	2360-0359
26	Screw, PH, 6-32 x 0.625	2360-0203
27	Screw, PH, 8-32 x 0.375	2510-0103
28	Screw, PH, 8-32 x 0.25	2510-0099
29	Screw, PH, 8-32 x 0.375	2510-0195
30	Screw, FH, 6-32	2360-0333
31	Location Pin	12210-20001
32	–	–
33	Lock Washer, #8	2190-0073
34	Power Panel	12210-00038
35	Ground Bracket	12210-00031
36	Backplane	12210-60002
–	Diode, Zener, 5V PD	1902-0939
–	Diode, Zener, 12V PD	1902-0941
37	Test Point Cable	12151-60008

Table 4-1. List of Replaceable Parts (continued)

GENERAL PARTS		
Index No.	**Description**	**HP Part No.**
38	Flat Washer, #6	3050-0228
39	Screw, PH, 6-32 x 0.374	2360-0359
40	Screw, 8-32 x 0.375	2510-0045
41	Screw, FH, 6-32 x 0.312	2360-0116
42	Rear Panel	5061-6652
43	Power Switch	3101-0402
44	Power Receptacle	1251-4470
45	Front Panel	12151-40001
46	Grill, Flat	12210-00026
47	Front Panel Support	12210-00025
48	Air Filter (Foam)	4208-0405
49	Filter Retainer	12210-00027
50	Snap-in Plunger	1390-0365
51	Snap-in Grommet	1390-0366
52	Ball Stud	0510-1107
–	Battery Backup Cable	12151-60010
–	Battery Pack	1420-0304
–	Power Supply	0950-2100
–	Cable Retainer Hardware Kit	12151-60015
A990 CPU CARD AND MEMORY		
–	A990 CPU Card	12990-60202
–	Time-of-Day Clock Chip	1826-2068
–	Firmware EPROM Chip	12990-80106
–	768 KByte ECC Memory Array	12220-60001
–	3 MByte ECC Memory Array	12221-60001
–	8 MByte ECC Memory Array	12221-66001
–	Connector for 1 Memory Card	12230-60001
–	Connector for 2 Memory Cards	12230-60002
–	Connector for 3 Memory Cards	12230-60003
–	Connector for 4 Memory Cards	12230-60004
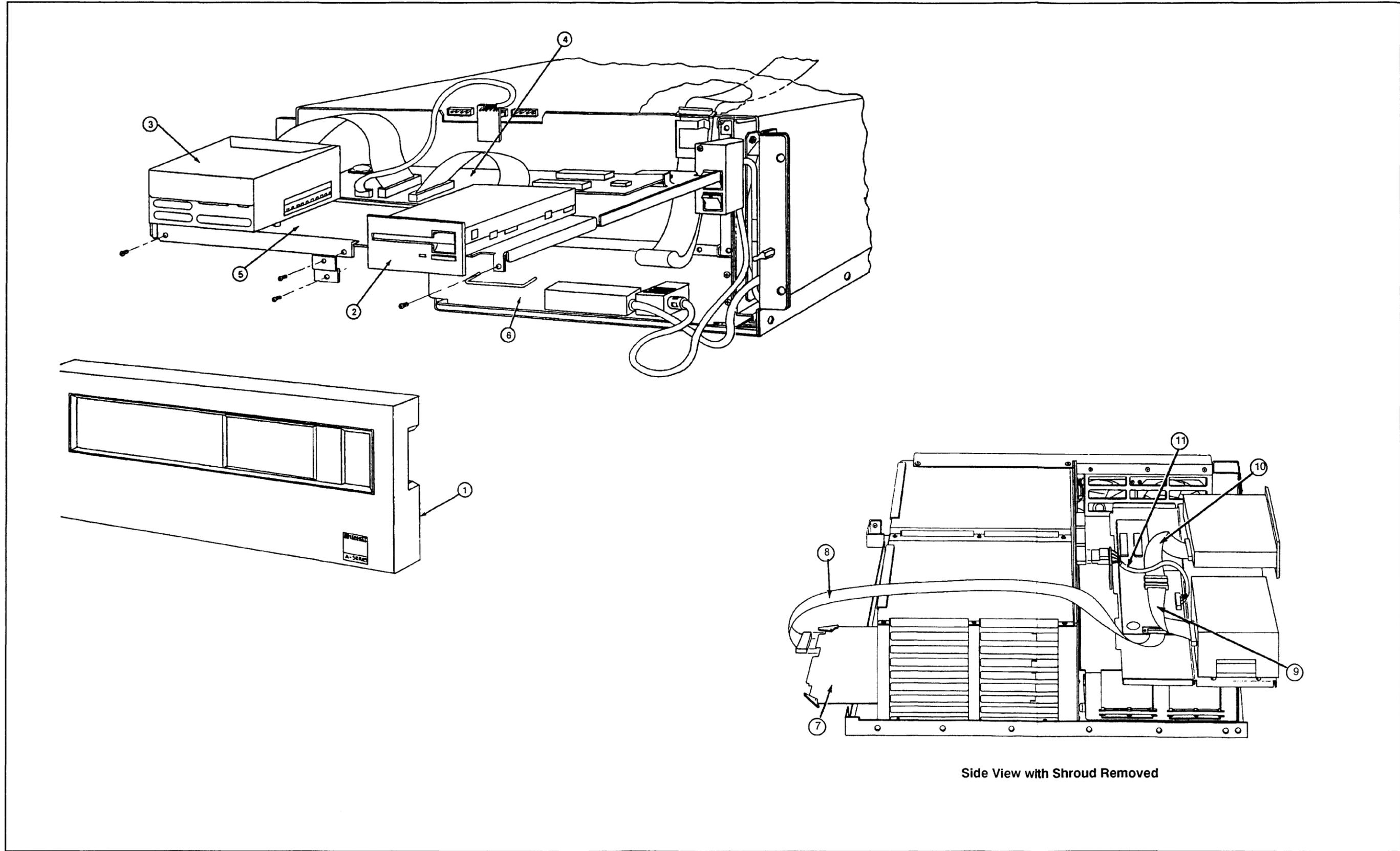
Side View with Shroud Removed
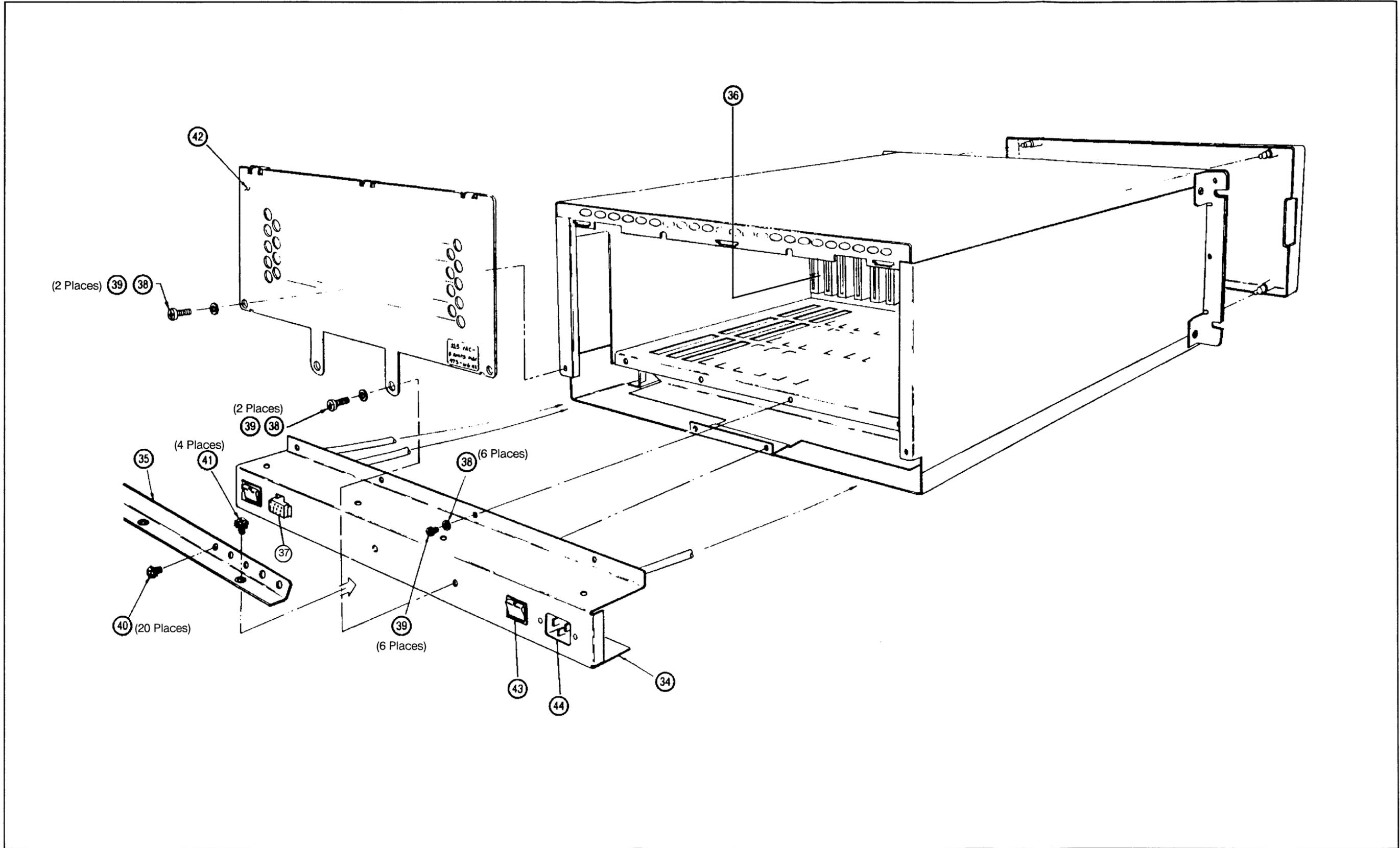
Figure 4-2. 20-Slot Box Exploded View
(Rear)
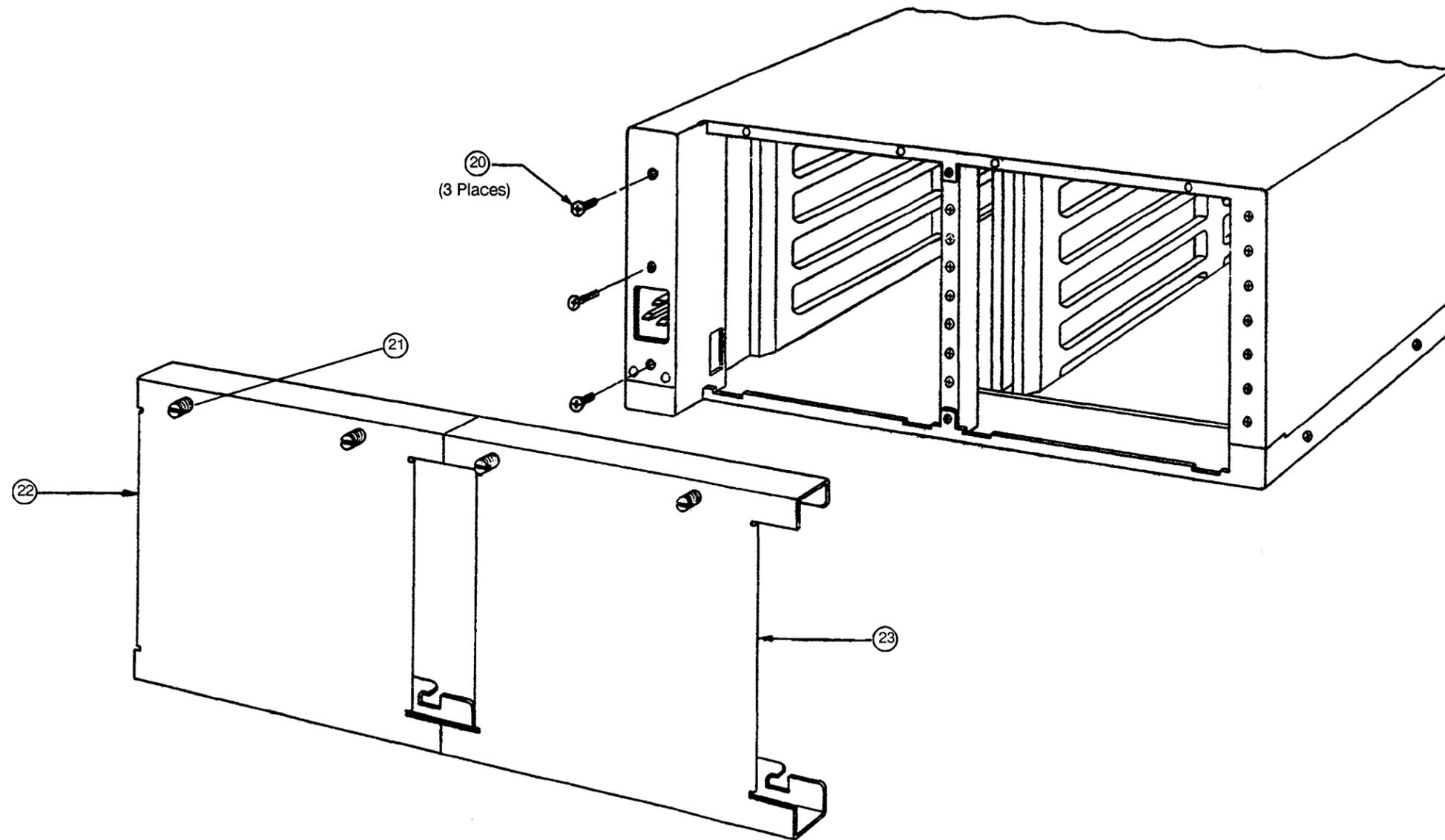
Figure 4-3. 16-Slot Box Exploded View
(Rear)

**HEWLETT
PACKARD**

Manual Part No.
02959-90002

**Manufacturing
Part No.
02959-96002**