HP 9000 Series 700*i* Workstations

Service Manual

Models 745*i* and 747*i* Industrial Workstations

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Printing History

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October, 1993

Safety Symbols and Conventions

The following conventions are used throughout this manual:

Note Notes contain important information set off from the text.

Caution Caution messages indicate procedures which, if not observed, could result in damage to equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Warning **Warning messages indicate procedures or practices which, if not observed, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.**

Regulatory Statements

FCC Regulations (U. S. A. Only)

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Turvallisuusyhteenveto (Finland Only)

Laserturvallisuus
Luokan 1 Laserlaite
Klass 1 Laser Apparat
HP 9000 Model 745/747 tietokoneeseen voidaan asentaa muistilaitteeksi laitteensisäinen CD-ROM-levyasema, joka on laserlaite. Tällöin myös päälaitteena toimiva tietokone katsotaan laserlaitteeksi.

Kyseinen CD-ROM-livyasema on käyttäjän kannalta turvallinen luokan 1 laserlaite. Normaalissa käytössä levyaseman suojakotelo estää lasersäteen pääsyn laitteen ulkopuolelle.

HP 9000 Model 745/747 tietokoneen on tyyppihyväksynyt Suomessa laserturvallisuuden osalta Työsuojeluhallitus, Työsuojeluhallituksen hyväksyntänumero TSH 222/6019/90. Laitteiden turvallisuusluokka on määritetty valtioneuvoston päätöksen N:o 472/1985 ja standardin SFS-IEC 825 mukaisesti. Tiedot CD-ROM-levyasemassa käytettävän laserdiodin säteilyominaisuuksista:

Aallonpituus 780 nm
Teho 0,4 mW
Luokan 1 laser

Finding Service Information

On the next page is a Service Information Locator. It shows where to find a variety of subjects dealing with servicing these products. To use this table, first find the type of information you need to reference in the left-hand column.Next, move to the right in that row to a referenced chapter number. Last, move up the column with the information's referenced chapter to the top. Across the top are manual titles and part numbers that have the information documented.

Chapter identifiers in the Locator use the following codes:

- **Chapter Number:** Numbers, such as 2. Inclusive chapters, such as 4-6.
- **Appendices:** A.
- **Entire Manual:** All
- **Varies:** (Check Table of Contents or Index.)

In some cases, two or more references will be shown for a given information type. You should check all references to be sure you get the specific information you need.

For example, suppose you need to find out what the Repair Philosophy is for the workstation. Locating "Repair Philosophy" in the left-hand column, and moving to the right in that row, you'll notice that this information is in "Chapter 1" of a manual. At the top of this column is the manual's abbreviated title. Chapter 7 in this manual lists manual titles and part numbers for service information.

Manuals identified in this locator are abbreviated by their initials as listed in the following table.

Related Manual
Abbreviations and Manual Titles

Abbreviation	Manual Title(s)
SM	Service Manual
SHB	Service Handbook
PI	Product Installation Note/Manual/Guide
OG	Owner's Guide
DM	Diagnostic Manuals

HP Computer Museum
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Service Information Locator.

Service Information	SM	SHB	PI	OG	DM
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Product Information

Product Descriptions

General Information

Hewlett-Packard's newest products for the Measurement Automation (MA) and Industrial Automation (IA) markets are these HP 9000 Series 700*i* products:

- Model 745*i*/50 and 745*i*/100 Industrial Workstation.
- Model 747*i*/50 and 747*i*/100 Industrial Workstation.

Based on a PA-RISC 7100 central processing unit (CPU) they provide a variety of interface, graphics, mass storage and accessory card configurations.

Two versions are available; each a different size and having different clock speeds and accessory card capabilities. Each is shown and its feature set listed as follows:

- Model 745*i*/50 and 745*i*/100, Figure 1-1 and Table 1-1.
- Model 747*i*/50 and 747*i*/100, Figure 1-2 and Table 1-2.

100 MHz workstations can be identified by this label on the system module's right side:

(hp) *9000*

700i/100

Figure PIX745 here.

Figure 1-1. Model 745*i* Industrial Workstation

Table 1-1. Model 745*i* Industrial Workstation Features

Feature	Functionality
Operating system	HP-UX
CPU	50 MHz PA-RISC 7100 in Models 745*i*/50 100 MHz PA-RISC 7100 in Models 745*i*/100
Time sources	Battery-backed Real-Time Clock Two 16-bit programmable timers One 32-bit programmable timer Bus error timer Watch-dog timer
Memory	4 slots 16 Mbytes total standard Model 745*i*/50 upgradeable to 128 Mbytes Model 745*i*/100 upgradeable to 256 Mbytes
Built-in interfaces	HP-IB, HP Parallel, SCSI, AUI LAN, HP-HIL, RS-232-C (two ports), speaker out, microphone in
Graphics	Depending on Monitor shipped with bundle, factory set to: ■ Color ■ 1280 by 1024 or 1024 by 768 resolution ■ 60 Hz or 72/75 Hz refresh rate ■ Local graphics enabled
Mass storage module	Up to three devices, including: ■ 525 Mbyte or 1 Gbyte hard disk drive ■ 2 Gbyte DDS tape drive; 4-8 Gbyte DDS tape drive with data compression ■ 3.5-in. flexible disk drive ■ CD-ROM drive
EISA module	Up to four EISA accessory cards
Power supply	One 350 watt power supply

Figure PIX747 here.

Figure 1-2. Model 747*i* Industrial Workstation

Table 1-2. Model 747*i* Industrial Workstation Features

Feature	Functionality
Operating system	HP-UX
CPU	50 MHz PA-RISC 7100 in Models 747*i*/50 100 MHz PA-RISC 7100 in Models 747*i*/100
Time sources	Battery-backed Real-Time Clock Two 16-bit programmable timers One 32-bit programmable timer Bus error timer Watch-dog timer
Memory	4 slots 16 Mbytes total standard Model 747*i*/50 upgradeable to 128 Mbytes Model 747*i*/100 upgradeable to 256 Mbytes
Built-in interfaces	HP-IB, HP Parallel, SCSI, AUI LAN, HP-HIL, RS-232-C (two ports), speaker out, microphone in
Graphics	HP-UX: Factory set to: ■ Color ■ 1280 by 1024 or 1024 by 768 resolution ■ 60 Hz or 72/75 Hz refresh rate ■ Local graphics enabled One SGC graphics card slot.
Mass storage module	Up to three devices, including: ■ 525 Mbyte or 1 Gbyte hard disk drive ■ 2 Gbyte DDS tape drive; 4-8 Gbyte DDS tape drive with data compression ■ 3.5-in. flexible disk drive ■ CD-ROM drive (HP-UX only)
EISA module	Up to two EISA accessory cards
VME module	Up to six VME accessory cards
Power supply	Two 350 watt power supplies

Rack Mounting Configurations

Both models will satisfy two rack mounting orientations, either front out or back out. Power switching has both front and back accessibility. Status and test LEDs are located on both front and back. Its mass storage module can be reversed. A rack-mount kit is supplied with each workstation.

These features allow the workstation to be operated from either the front or back, depending on how they are mounted. EISA and VME card cages are fixed and cannot be reversed.

Memory

Standard memory is 16 Mbytes of Error Checking and Correcting (ECC) RAM boards. 16 Mbytes is the minimum required for the HP-UX operating system. Each workstation has four RAM slots. Options may add more factory installed memory. Memory upgrades include:

- HP A2815A 8 Mbyte RAM Upgrade, two 4 Mbyte RAM boards.
- HP A2816A 16 Mbyte RAM Upgrade, two 8 Mbyte RAM boards.
- HP A2827A 64 Mbyte RAM Upgrade, two 32 Mbyte RAM boards.
- HP A2875A 128 Mbyte RAM Upgrade, two 64 Mbyte RAM boards.

Note 2 Mbyte RAM boards are not supported, nor is the HP A2200A 4 Mbyte RAM Upgrade.

16 Mbyte RAM boards are supported, but are not available as a pair in an upgrade.

64 Mbyte RAM boards are supported only in 100 MHz versions.

Mass Storage

Several factory-installed mass storage devices are used. One or two removable media devices may be installed. Model 745*i* mass storage devices are factory installed with the removable media drives accessed from the front. Model 747*i*'s have their removable media devices accessed from the back. Users may reconfigure devices to reverse the access. Hard disk drives are typically installed behind the removable media devices.

Mass storage devices are also available as these upgrades:

- HP A2640A 525 Mbyte Hard Disk Drive Upgrade.
- HP A2641A 1 Gbyte Hard Disk Drive Upgrade.
- HP A2642A 2 Gbyte DDS Tape Drive Upgrade.
- HP A2643A 4-8 Gbyte DDS (data compression) Tape Drive Upgrade.
- HP A2644A CD-ROM Disk Drive Upgrade.
- HP A2645A 3.5-in. Flexible Disk Drive Upgrade.

System Graphics

System Board Graphics

These products have system board graphics configurations factory set. They can be changed by users. Table 1-3 and Table 1-4 list the monitors supported. Note that grayscale monitors are not supported.

Table 1-3. Supported Monitors for Model 745*i* and 747*i* Workstations

Product No.	Type	Resolution
HP D1195A	14-inch Color	1024 by 768
HP A1497A	17-inch Color	1024 by 768
HP A1097A	19-inch Color	1280 by 1024

Table 1-4.
Supported Monitors for Model 745*i*/100 and 747*i*/100 Workstations

Product No.	Type	Resolution
HP D1196A	14-inch Color	1024 by 768
HP A2287A	17-inch Color	1024 by 768
HP A1097A	19-inch Color	1280 by 1024

HP A1497A and A1097A monitors are not available as separate products.

SGC Graphics Slot

Only Model 747*i* Industrial Workstations have an SGC Graphics slot. Only HP-UX operating systems support SGC graphics accessory cards. Refer to Table 1-5 for supported SGC graphics upgrades. Individual SGC cards without monitors are not available. Monitors included are different than those shipped with standard bundles.

Table 1-5. Supported SGC Graphics Upgrades

Product Number	Product Name	Products Included
HP A2269A	Dual CRX/SGE Upgrade	One Dual CRX/SGE Color SGC Card Two 19-in. 1280 by 1024 Color Monitors
HP 98768A	CRX Color/SGC Upgrade	1 CRX Color SGC Card One 19-in. 1280 by 1024 Color Monitor

Built-In Interfaces

System Board Interfaces

The system board's built-in interfaces have ports on the connector panel as shown in Figure 1-3.

Figure CPNL here.

Figure 1-3. I/O Connector Panel

Small Computer Systems Interface (SCSI). A cable from the mass storage module connects to the system board's SCSI connector and must be connected for internal drives to operate. SCSI interface circuits use high-density, shielded connectors. The mass storage module has a separate SCSI connector for connecting external SCSI device cables. When the external SCSI interface connector is not used, a SCSI terminator should be plugged into the SCSI connector. The internal cable length is 1.8 metres (5.9 feet).

RS-232 Serial Interface. Two 9-pin RS-232 serial interface ports are provided, labeled A and B. Terminals and other RS-232 devices are supported on the RS-232 interface connectors. The A connector is used for the console.

HP Parallel Interface. A 25-pin HP Parallel interface port is provided for use with devices using the Centronics^{TM} interface protocols.

Hewlett-Packard Human Interface Loop (HP-HIL). The HP-HIL connector on the connector panel accepts a variety of HP-HIL input devices. Keyboards are normally connected here. Two keyboards are available and supported with the operating systems:

- HP 46021A ITF Keyboard.
- HP C1429B PC-101 Keyboard.

Other HP-HIL devices may also be connected to the keyboard or HP-HIL connector.

Local Area Network Interface. The IEEE 802.3 Ethernet Local Area Network (LAN) circuit on the system board has one interface port for an AUI transceiver or media attachment unit (MAU). No ThinLAN circuits or BNC connector is installed. Table 1-6 lists the supported LAN adapters and other network devices.

Table 1-6. Supported AUI LAN Adapters and Devices

LAN Adaptor	Network Devices
HP 28641A/B ThinLAN Transceiver	HP 28645A Multiport Repeater, 1 AUI/f, 3 30Base2/m
	HP 28648B LAN Bridge 2 AUI/f
	HP 28649A IEEE 802.3 LAN to 802.5 Token Ring Bridge
	HP 28683A Fiber Optic Transceiver
HP 28685A 10BaseT EtherTwist MAU	HP 28682A Fiber Optic Hub Plus
HP 30241A 10Base5 ThickLAN MAU	HP 28684A EtherTwist Hub

X-Terminals are also supported on LAN. Table 1-7 lists supported 700/RX Family X-Terminals.

Table 1-7. Supported 700/RX Family X-Terminals

Product Number	Product Name
HP C2701A	700/RX Mi Base Unit
HP C2702A	700/RX 19Mi X-Station
HP C2704A	700/RX Ci Base Unit
HP C2705A	700/RX 14Ci X-Station
HP C2706A	700/RX 16Ci X-Station
HP C2709A	700/RX Ca Base Unit
HP C2711A	700/RX 19Ca X-Station

Audio Interface. A voice-quality audio output may be used. An output connector for external speaker or headphones is on the rear panel. When used, the internal speaker is disabled when external device is connected. Its programmable audio output can be voice or tones. *Audio CD ROMs cannot output to the audio out connector.* An internal speaker is also used to output voice and tones.

Microphone input is provided by a microphone jack.

Instrument HP-IB Interface. Hewlett-Packard Interface Bus (HP-IB) is Hewlett-Packard's version of the IEEE 488 interface standard and is much like HP-IB implementations on other HP 9000 Series 200/300/400 computers. It is supported for instruments only with these workstations. Mass storage devices using HP-IB are not supported.

EISA Module

Model 745*i*'s have a 4-slot EISA module. A 2-slot EISA module is used in the Model 747*is*. Refer to Table 1-8 for supported EISA accessory cards.

Table 1-8. Supported EISA Accessory Cards

Product Number	Product Name	Quantity Supported	Notes
HP 25525A	Differential SCSI-II	1	
HP 25567A	IEEE 802 Thin/AUI LAN	4	
HP J2159A	PSI/X.25 Interface	4	
HP J2165A	802.5	4	
HP J2156A	FDDI	4	
	Danford 16-port MUX	1	3rd party support
HP 2070A	Instrument HP-IB	1	
	Analog Video In	1	3rd party support
	GPIO Interface Card	1	

VME Module

A variety of VME accessory cards can be installed in the Model 747*i*'s 6-slot VME module. The slots conform to the 6U form factor. Slot numbers from top to bottom are 2 through 7. VMEbus slot 1 is the internal VME converter board that is also the system controller.

Hardware Architecture

Hardware Architecture

Most of the functionality is on one assembly, the system board. The system board has the interface controllers, CPU circuits, memory controller and graphics/video circuits. RAM boards plug into sockets on the system board.

The VME or EISA card cage has its own interface converter board and accessory card backplanes. Test and function indicating LEDs along with some interface connectors are on the connector board which plugs into the system board. The mass storage module gets interface data through a cable connected to the system board.

Operating Systems

HP-UX

HP-UX 9.0 (or later) is supported on the Model 745*i* and 747*i* Industrial Workstations. It is booted from an internal hard disk drive factory installed with Instant Ignition. HP-UX may also be installed from external DDS or CD-ROM drives. If the workstation is a client on LAN, HP-UX can be booted over the LAN.

Table 1-9 lists the HP-UX operating systems and languages for the Industrial Workstations.

Table 1-9. HP-UX Operating Systems and Languages

Operating system:	HP-UX 9.0 or later. HP-UX complies with the UNIX System V Interface Definition X/Open and POSIX Specifications and will be fully compliant with Operating Systems Foundation (OSF).
ISU Test and Measurement Software	Standard Instrument Control Library (SICL) Rocky Mountain Basic/UX VEE
ISU Languages	C/ ANSI C FORTRAN 9000 Pascal HP C + + C + + Developer
ISU User Interface and Graphics Libraries	HP GKS X11R5 Motif 1.2 VUE 3.0 Architect 2.0

Product Identification

On the bottom, a label lists the product's serial number. Its information can be interpreted as shown below for an example serial number 6247A00001:

6247A00001

5-digit sequential identifying number.
Country of Manufacture Code:

A = U.S.A.

J = Japan

G = Germany

Introduction Date Code:

First 2 digits + 60 = last 2 digits of year.

Last 2 digits = number of week in year.

Technical Information

Note Technical information listed herein should not be interpreted as specifications. Official specifications are listed in the HP 9000 Series 700*i* Technical Data Sheet.

Electrical

Power consumption	Model 745*i*; 540 watts
	Model 747*i*; 1080 watts
Line voltage	90 - 132 Volts
	180 - 250 Volts
Line frequency	50 - 60 Hz

Listed below are the EISA and VME slot's available current in amps for each voltage supplied to their respective backplanes.

Table 1-10. VME and EISA Slot Power Availability

Accessory Slot	+12 V dc Amps	+5.1 V dc Amps	-5.2 V dc Amps	-12 V dc Amps
EISA, each slot	1.12	4.5	0.05	0.07
EISA, 4-slot module, total	4.5	18.0	0.2	0.3
EISA, 2-slot module, total	2.25	9.0	0.1	1.15
VME, each slot	0.8	7.0		0.3
VME, 6-slot module, total	4.8	42.0		1.8

Regulatory

Safety Specification:	UL 1950 at 55 C (supersedes spec UL478)
	CSA 950 (supersedes spec CSA220)
	IEC950/EN60950 with Notdic deviations at 55 C (supercedes specs IEC380 & IEC435)
Laser Safety:	European Harmonised document 194
	IEC 825
	VBG 93 (Germany)
	BS4803 Part II (UK)
	21 CFR Chapter 1 sub-chapter J (US)
Ergonomics:	ZH1-618
	VDU
Acoustics:	Tested to ISO 7779 and declaring according to ISO 9296

Environmental

Operating temperature	0° - 55° C (without mass storage)
	5° - 40° C (with mass storage)
Non-operating temperature	−40° - 71° C
Heat dissipation	Model 745*i*; 1,836 BTU, 464 Kcal/hr
	Model 747*i*; 3,672 BTU, 928 Kcal/hr
Humidity (non-condensing); operating	95% maximum at 40° C (without mass storage)
	80% maximum at 40° C (with mass storage)
Humidity (non-condensing); non-operating	5 - 95%
Maximum altitude, operating (to 47°C):	4570 metres (15,000 ft.)
Maximum altitude, non-operating:	15 240 metres (50,000 ft.)

Note Model 745*i* and 747*i* Industrial Workstations are to be operated only in an environment that is free from conductive pollution, including dry non- conductive pollution which could become conductive due to expected condensation.

Physical

Dimension	Model 745*i*	Model 747*i*
Rack mount units	4 high	7 high
Height:	177 mm (7-in.)	310 mm (12.25-in.)
Width:	425 mm (16.8-in.)	425 mm (16.8-in.)
Depth:	415 mm (14.8-in.)	415 mm (14.8-in.)
Weight:	18.6 kg (41 pounds)	29.1 kg (64.1 pounds)

Support

Support services and policies mentioned in this section are subject to change. Please consult your local Hewlett-Packard Sales and Service Office for the current support policies.

Hardware Support

Field Repair Philosophy

Field Repair Philosophy for these products is assembly, or board level. This means that when a failure occurs, the problem is diagnosed to the assembly having the failed part. That assembly is then replaced.

Some assemblies may be exchanged for rebuilt ones. Other assemblies are only available as new ones. Refer to Chapter 6, or the *Model 742/745/747 Service Handbook*, Chapter 8, for information on replacement parts.

Additional Technical Information

Additional technical information on these products can be found in the *HP 9000 Series 700i Model 745i and 747i Technical Reference Manual*. Detailed information about architecture is provided.

Schematics

In support of the repair philosophy, this manual contains information to the assembly level. Schematics are not available for these products except for those supplied in the *HP 9000 Series 700i Model 745i and 747i Technical Reference Manual*.

Supported Configurations

Only products with Hewlett-Packard approved parts, accessories, peripherals, operating systems and application programs are supported by Hewlett-Packard. Any product with other than HP approved hardware or software connected or installed must have the non-HP approved hardware and software removed by the customer before On-Site repair is accomplished.

Repair Services

Hewlett-Packard supports three repair services:

- Return to Hewlett-Packard Repair.

- On-Site Repair.
- Customer Repair.

For Return to Hewlett-Packard Repair, customer's return the product to their local HP Sales and Service Office, then an HP Bench Repair Engineer troubleshoots, and repairs the hardware to the assembly level. The defective assembly is replaced with a new or rebuilt assembly. The product is returned to the customer. This service is available through a service contract or a time-and-materials basis.

On-Site Repair is performed at the customer's site. This service is available through a service contract or a time-and-materials basis.

Customers have the option of repairing their own HP products. Contact your nearest Hewlett-Packard Sales and Service Office for information concerning service training, special tools and test equipment, and spare parts.

2

Assembly Replacement

Introduction

In this chapter, you'll learn how to replace assemblies in the Model 745*i* and 747*i* Industrial Workstations. This chapter is divided into three sections:

- **Common Modules**; explains how to replace these modules and assemblies that are removed and installed the same:
  - Mass storage module, including all mass storage devices.
  - Power supply module(s), including fan(s).
  - EISA module, including the:
    - EISA accessory cards.
    - EISA converter board.
    - EISA backplane. Note that the backplane is not interchangeable between the Model 745*i* and 747*i*, but are replaced using the same process.
  - System module, including the connector board, memory boards and the real-time clock battery.
  - Motherboard. Note that the motherboards are not interchangeable between the Model 745*i* and 747*i*, but are replaced using the same process.
- Model 747*i* Unique Parts; explains how to replace parts unique to the Model 747*i*.
  - SGC graphics accessory card.
  - VME card cage, including the:
    - VME accessory cards.
    - VME converter board.
    - VME backplane.
  - Other unique mechanical parts.

Tools Required

All field replaceable parts can be accessed with these tools:

- No. 1 Pozidriv screwdriver.
- Small flat-tipped screwdriver.
- Medium flat-tipped screwdriver.
- 9/32-in. nutdriver.
- 5.5mm nutdriver.

- Socketed surface-mount, 32-pin IC removal tool.

Safety Precautions

Electrical Precautions

As with any electrical/electronic product, certain safety precautions must be practiced. These safety precautions, when followed protect both you and the equipment from injury and possible permanent damage.

Caution Integrated circuit components in these products can be damaged by electro-static discharge. It doesn't make any difference whether the ICs are installed on a printed circuit board or laying on a table. Static charges can build up in people to a potential of several thousand volts by simply walking across a room.

Integrated circuits can be protected by using a static free workstation and wearing clothes that do not hold static charges before handling any of the workstation's PC boards.

When you need to remove or install a part, remove power from the product first. With the static free workstation in place, touch sheet metal with your fingers before touching the printed circuit assembly. If the assembly is not going to be re-installed, place the assembly in an anti-static bag and set it aside.

Following these precautions will extend the life of the computer products you maintain.

Overview and Parts References

Instructions are based on:

- The hardware orientation shown in Figure 2-1.
- Each section's:
  - Exploded views.
  - Parts references.
  - Access instructions.

Figure ORI here.

Figure 2-1. Models 745*i* and 747*i* Hardware Orientation

Common Modules

Three modules are identical between the Models 745*i* and 747*i*. They may be interchanged and have the same parts and optional assemblies. EISA modules cannot be interchanged between models, but have the same disassembly procedures. Figure 2-2 shows these modules.

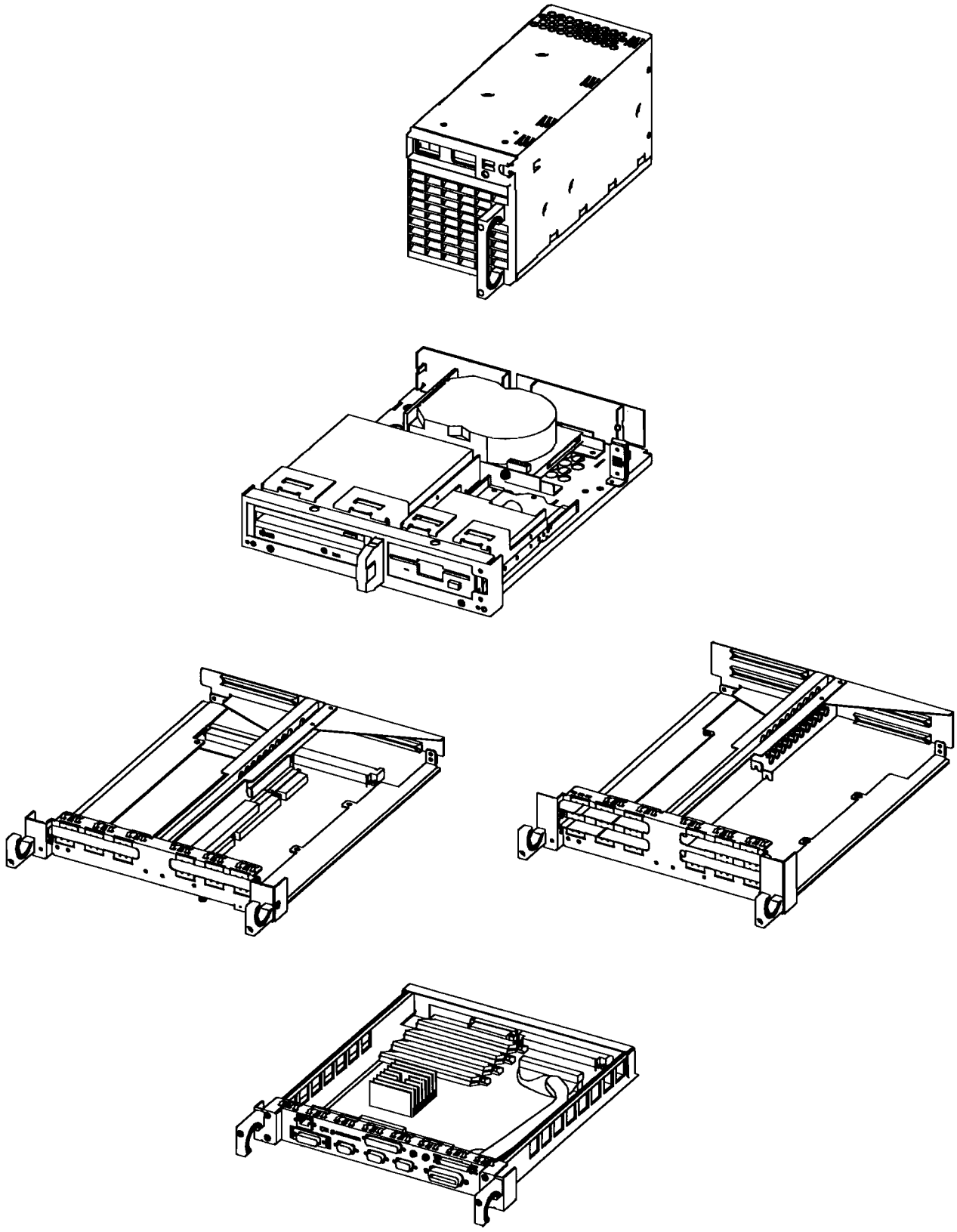

Figure 2-2. Common Modules

The next three subsections explain assembly replacement procedures for these modules.

Mass Storage Module

Removing the Mass Storage Module

Table 2-1. Mass Storage Module Parts References

Ref. No.	Part Name	Ref. No.	Part Name
1	3.5-in. flex disk drive	10	CD-ROM disk drive
2	flex drive bracket	11	CD-ROM drive bracket
3	flex drive bezel	12	Mass storage SCSI cable
4	Power converter cable	13	Mass storage power cable
5	DDS tape drive	14	Mass storage tray
6a	DDS drive bracket	15	Handle screw kit
6b	DDS drive right spacer	16	Large filler panel
6c	DDS drive left spacer	17	Small filler panel
7	DDS drive bezel	18	Filler panel support
8	Hard disk drive	19	SCSI terminator
9	Hard disk drive bracket		

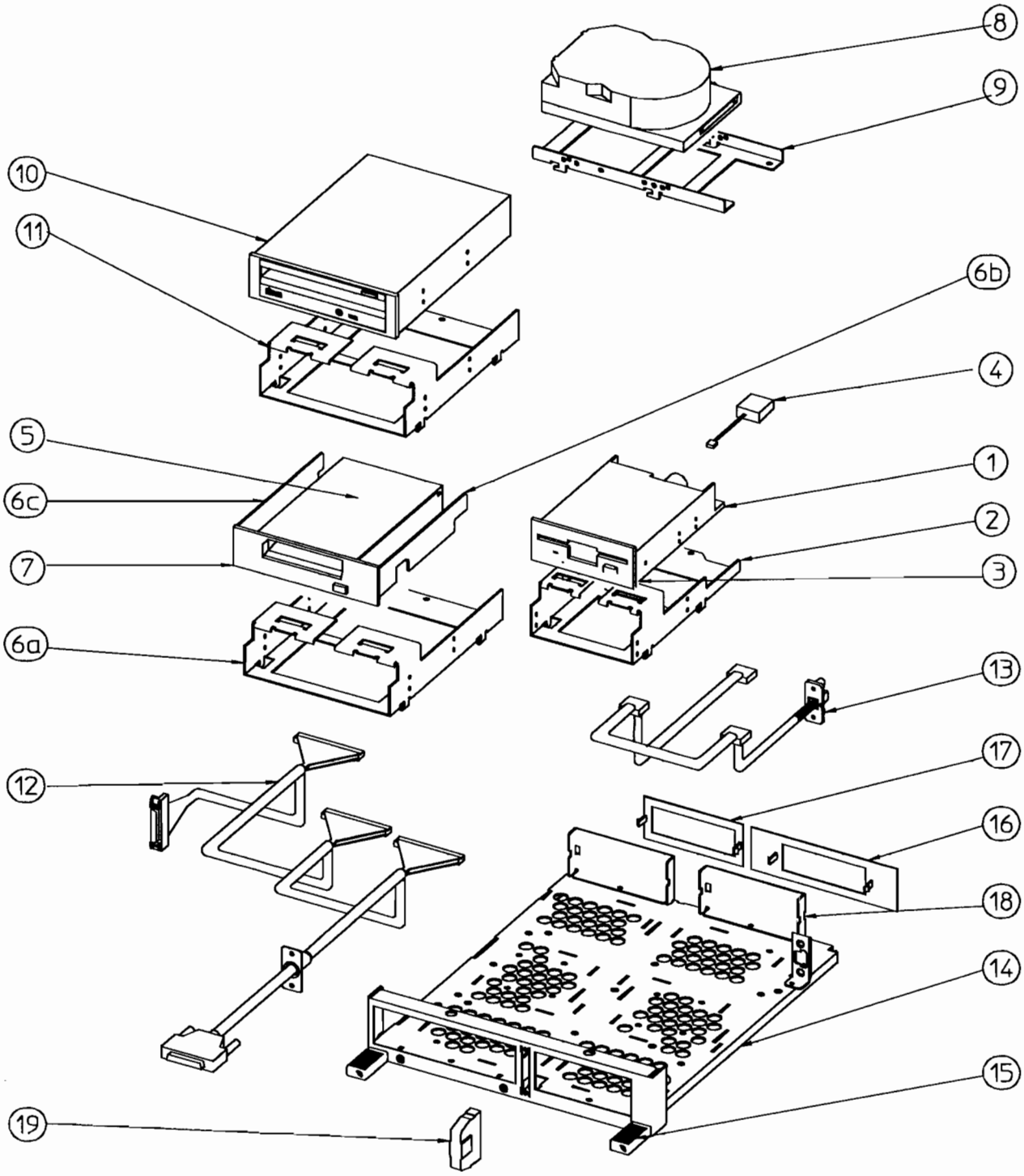

Figure 2-3. Mass Storage Module Exploded View

Preliminary Requirements. Before you remove the mass storage module:

1. Eject any removable media.
2. Shut down the operating system.
3. Turn OFF the workstation and remove the power cord(s).
4. Unplug the SCSI cables from the:
   a. System module.
   b. Mass storage module, if connected.

Removal and Replacement. Follow these steps to remove the mass storage module.

1 Insert a flat-tipped screwdriver into each handle's hole and loosen the captive screw about 7 turns.	Insert artwork here.
2 Remove the mass storage module by pulling it out.	Insert artwork here.

Mass storage devices may be installed in three locations. Depending on how they are used, removable media devices may be installed at either end of the mass storage tray.

Removing a Device

All installed mass storage devices are removed and replaced by about the same processes. Each device's power, interface and brackets are essentially the same.

Preliminary Requirements. Before you remove a device:

1. Eject the removable media.
2. Shut down the operating system.
3. Turn OFF the workstation.
4. Remove the mass storage module.

Removal and Installation. Installing devices is the reverse of removing them.

1 If you are removing the flexible disk drive, the hard drive behind the flexible disk drive must be removed first.	Insert artwork here.
2 Unplug the power and SCSI cables from the drives. If you are replacing a flexible disk drive, unplug the power cord from the drive's power cord extension, not the drive itself. Note the SCSI cable connectors as they are connected to the drives.	Insert artwork here.

3 Remove the screw from the rear of the drive bracket.	Insert artwork here.
4 Slide the bracket towards the back of the drive about 12 mm (0.5-in.) until the four bottom tabs are free from the module, then lift the drive assembly up.	Insert artwork here.

Caution Although mass storage devices are well-protected from physical shock when installed in the mass storage module, they are very easily damaged when removed. Avoid dropping or striking the device. Handle it gently at all times.

5 Remove the four drive mounting screws from the sides of the bracket, then remove the drive from the bracket.	Insert artwork here.
6 Note the configuration jumper/switch positions. The replacement drive must be configured the same.	Insert artwork here.
7 If you are replacing a: ■ Flexible disk drive, go to 'Flexible Disk Drive Procedures.' ■ DDS tape drive, go to 'DDS Tape Drive Procedures.'	Insert artwork here.

Note Flexible disk drives from Model 745*i* and 747*i* Industrial Workstations being exchanged must have the 26mm high bezel installed. A 42mm high bezel must be on the flexible disk drive before it's installed in the mass storage module. The next series of steps explains how.

1 Gently pry the old flexible disk drive's top cover off by inserting a small flat-tipped screwdriver under each side's catch at the rear of the drive.	Insert artwork here.
2 Lift up on the back of the cover, then pull it off of the drive.	Insert artwork here.

3 Remove the screw from the bottom of the drive that holds the bezel to the drive.	Insert artwork here.
4 Using a small flat-tipped screwdriver, gently press out on each of the two old drive's bezel tabs and pull the bezel off the drive.	Insert artwork here.
5 Gently pry the new flexible disk drive's top cover off by inserting a small flat-tipped screwdriver under each side's catch at the rear of the drive.	Insert artwork here.

6 Lift up on the back of the cover, then pull it off of the new drive.	Insert artwork here.
7 Using a small flat-tipped screwdriver, gently press in on each of the four bezel tabs and pull the bezel off the new drive.	Insert artwork here.
8 Place the bezel from the old drive in place on the new drive, then replace the screw to hold the old bezel to the new drive.	Insert artwork here.

9 Replace the new drive's top cover by inserting its front end into the drive, then snapping its back end down over the drive.	Insert artwork here.
10 Place the bezel from the new drive in place on the old drive, then press it in until it snaps into place.	Insert artwork here.
11 Replace the old drive's top cover by inserting its front end into the drive, then snapping its back end down over the drive. The old drive must have the 26mm high bezel installed before it is exchanged.	Insert artwork here.

Note DDS tape drives from Model 745*i* and 747*i* Industrial Workstations being exchanged must have the 5.25-in. wide bezel installed. A 3.5-in. wide bezel must be on the DDS tape drive when it is installed in a 3.5-in. wide location. The next series of steps explains how to remove and install the DDS tape drive bezels.

If the DDS tape drive already has a 5.25-in. wide bezel, its bezel does not have to be swapped.

1. If the DDS drive is installed in the 5.25-in. location, the left and right bracket spacers remain with the drive.

   If the DDS drive is installed in the 3.5-in. location, the left and right bracket spacers are not used.

2. Using a small flat-tipped screwdriver, gently pry up on the two top bezel catches and disengage them, then push in on the two bezel side catches to disengage them, then pull the bezel off the drive.

   Remove both the old and new drive's bezels this way.

3. Place the 3.5-in. wide bezel from the old drive in place on the new drive, aligning the eject button and light pipes with their drive locations, then gently press the old cover in place on the new drive.

   Place the 5.25-in. wide bezel on the old drive the same way.

Note After replacing a DDS tape drive, you must install firmware in the drive controller board's PROMs. Use the DDS Workstation Firmware Kit:

- For 2 Gbyte DDS tape drives, Rev. 9.47, HP part number C1503-89208.
- For 4 - 8 Gbyte DDS tape drives, Rev. 9.49, HP part number C1504-89207.

supplied with the replacement DDS tape drive. Follow the directions with the kit to download the firmware after reassembling the workstation.

Ejecting Media

Ejecting media is best done while the workstation is powered up. If you remove a drive that has media installed:

- DDS tapes can only be ejected while the workstation is operating.
- Flexible disks can be ejected without power to the drive.
- CD-ROM disc caddies can be ejected without power to the drive by:
  1. Removing the screw behind the CD-ROM's bezel. This screw is accessed through a hole in the CD-ROM bezel's lower left-hand area.
  2. Straightening a heavy paper clip and insert the paper clip end into the hole about 25mm (1 inch) against a small eject lever.
  3. Pushing in on the lever and the caddy will eject.

Mass Storage Power Cable

Preliminary Requirements. Before you remove the mass storage power cable:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove the mass storage module.

Removal. Installing a power cable is the reverse of removing it.

Follow these steps to remove the mass storage power cable.

1 Unplug the power cable from all drives. Note the 3.5-in. flexible disk drive's power extension cable stays with this drive.	Insert artwork here.
2 Squeeze the bracketed connector's upper and lower clips together.	Insert artwork here.

3 Pull the connector out of its bracket. Note the orientation of the connector in the bracket.	Insert artwork here.

Mass Storage SCSI Cable

Preliminary Requirements. Before you remove the mass storage SCSI cable:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove the mass storage module.
4. Remove these parts from the module that are next to the SCSI cable's plate:
   a. Mass storage device with bracket.
   b. Cover plate, if installed.

Removal and Installation. Installing the SCSI cable is the reverse of removing it.

Follow these steps to remove the mass storage SCSI cable.

1 Unplug the SCSI cable from all drives.	Insert artwork here.
2 Remove the two screws holding the module's external SCSI connector to the sheet metal, then remove the connector from the inside.	Insert artwork here.

3 Remove the two screws holding the cable plate to the sheet metal	Insert artwork here.
4 Work the SCSI cable out of the module from the bezel end.	Insert artwork here.

EISA Module

EISA modules in both the Model 745*i* and 747*i* are almost identical. The differences are:

- 4-slot backplane is used in Model 745*is*.
- 2-slot backplane is used in Model 747*is*.
- Card cages are different heights.

Later card cages have modified sheet metal around card ports. Earlier card cages will not accept FDDI card drive accessory cards. Any other EISA accessory card with a larger than normal connector may not fit into the connector opening in the module's front.

Table 2-2 lists the EISA module parts. Figure 2-4 and Figure 2-5 show exploded views of the modules.

Table 2-2. EISA Module Parts References

Ref. No.	Part Name	Ref. No.	Part Name
1	EISA converter board	9	Cover plate
2	4-slot backplane assembly	10	Screw
3	4-slot card cage	11	'E' RFI clip
4a	4-slot card clamp, right	12a	Single RFI clip
4b	4-slot card clamp, left	12b	Double RFI clip
5	2-slot backplane assembly	13	EISA card guide
6	2-slot card cage	14	Glide
7a	2-slot card clamp, right	15	Handle screw kit
7b	2-slot card clamp, left	16	Blank 4-slot cover
8	Insulator sheet		

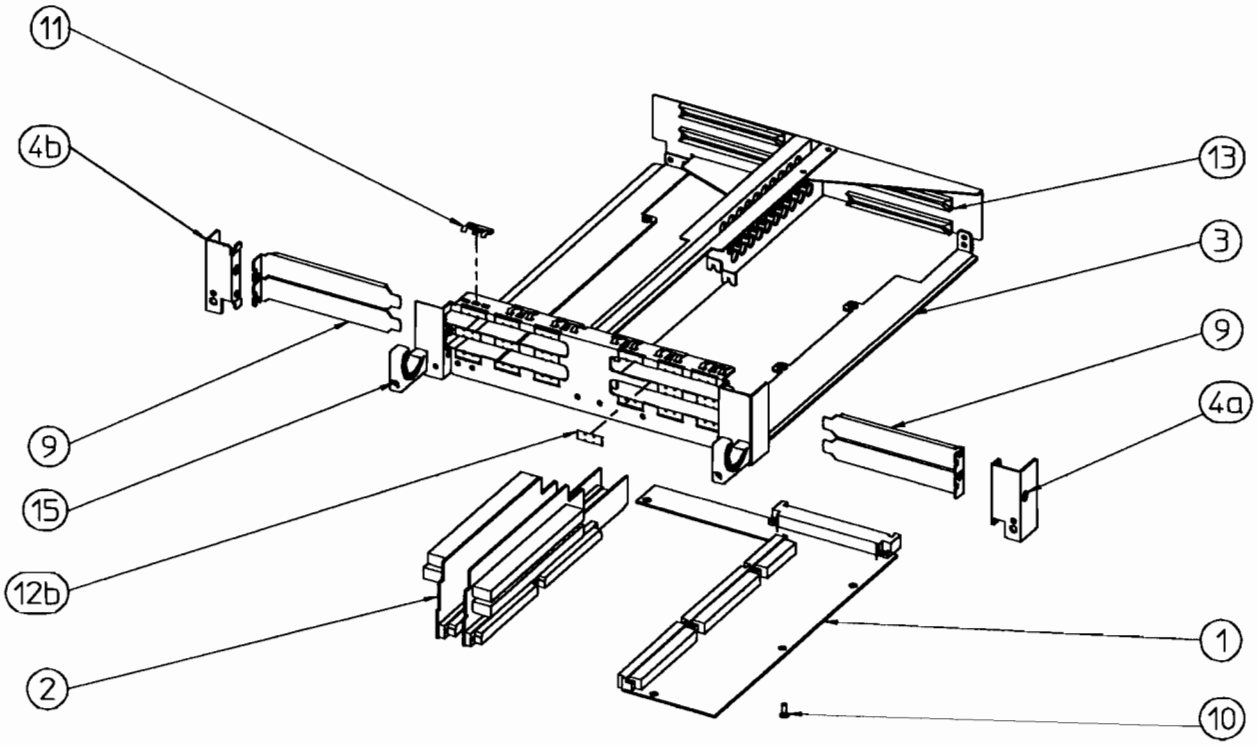

Figure 2-4. Model 745*i* Workstation EISA Module Exploded View

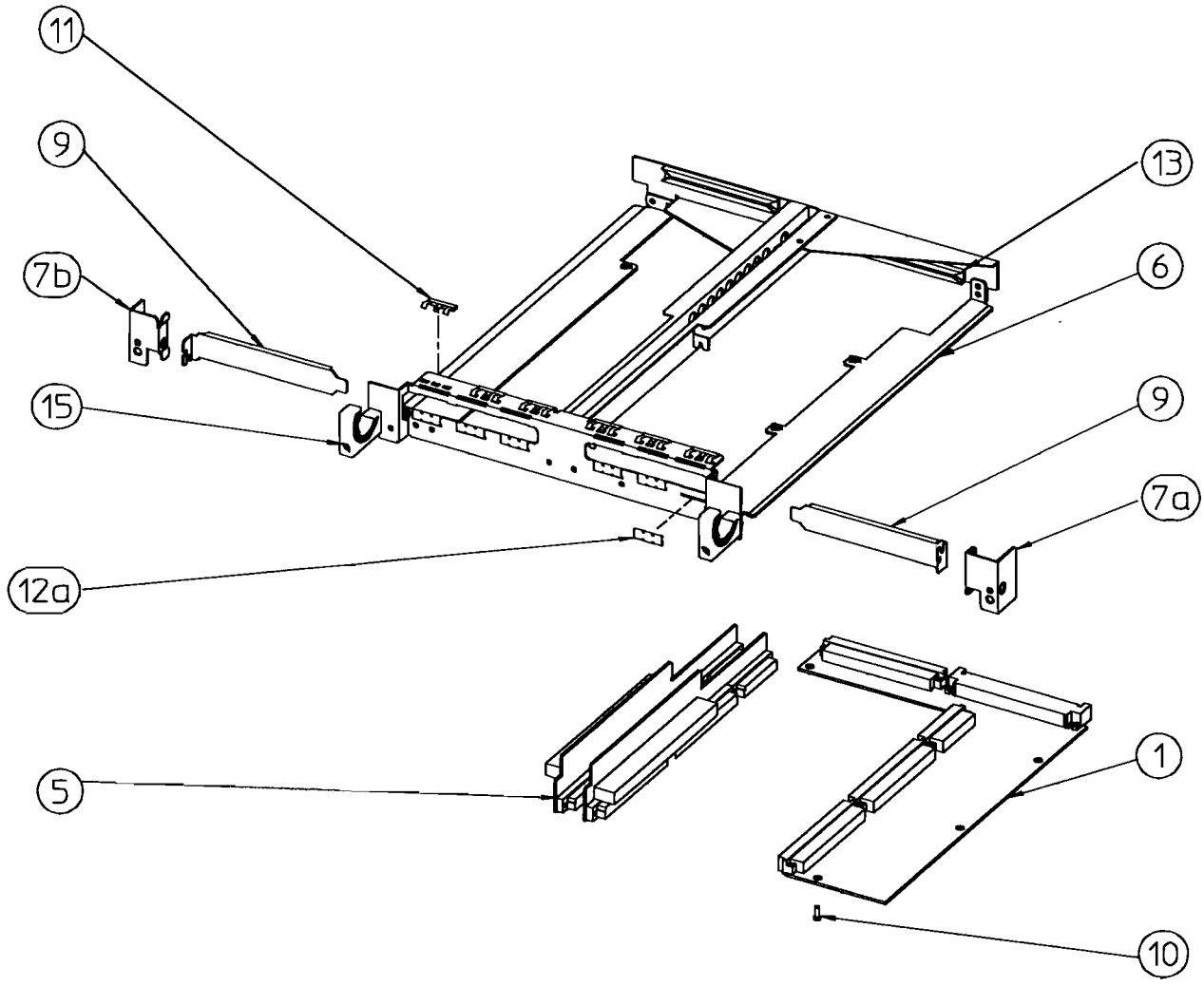

Figure 2-5. Model 747*i* Workstation EISA Module Exploded View

Removing the EISA Module

Preliminary Requirements. Before you remove the EISA module:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Unplug the SCSI cable from the system module.
4. Remove all cables attached to the EISA cards.

Removal and Replacement. Follow these steps to remove the EISA module.

1 Insert a flat-tipped screwdriver into each handle's top hole and loosen the captive screw about 7 turns.	Insert artwork here.
2 Pull the EISA module out of the workstation.	Insert artwork here.

EISA Accessory Cards

Preliminary Requirements. Before you remove an EISA card:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables attached to the EISA cards.
4. Remove the EISA module.

Removal and Replacement. Follow these steps to remove an EISA card from the EISA card cage.

1 For the accessory card(s) to be removed, loosen the captive screw inside the card clamp, then remove the card clamp. Note there is a card clamp on each side.	Insert artwork here.
2 Remove the EISA card by pulling it out of the EISA backplane.	Insert artwork here.

3 Note any configuration switches or jumpers on the EISA card. If another card of the same type will replace the one you removed, set its configuration the same as the card you just removed.	Insert artwork here.

EISA Converter and Backplane Board

Preliminary Requirements. Before you remove the EISA converter and backplane board:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove the EISA module.
4. Remove the EISA cards.

Removal and Replacement. Follow these steps to remove the EISA converter or backplane board.

1 Lay the EISA card cage upside down, then remove the four screws holding the EISA converter board to the card cage.	Insert artwork here.
2 Lift the converter board with attached backplane up from the card cage.	Insert artwork here.

3 Carefully separate the converter board from the backplane by pulling them apart.	Insert artwork here.

Power Supply Module

If a fan is defective, it can be replaced as a separate part. Otherwise, the entire power supply module is replaced as an assembly.

Table 2-3. Power Supply Parts References

Ref. No.	Part Name
1	Power supply
2	Fan

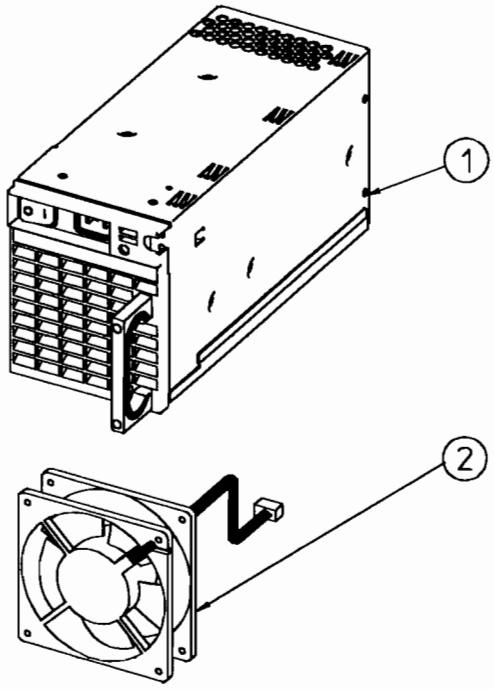

Figure 2-6.
Power Supply Module Exploded View

Removing a Power Supply Module

Preliminary Requirements. Before you remove a power supply module:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. If installed, remove the ground cables from the power supply.

Removal and Replacement. Follow these steps to remove the power supply module.

1 Use a screwdriver to turn the locking screw counter-clockwise.	Insert artwork here.
2 Pull the power supply module out of the chassis.	Insert artwork here.

Fan

If the fan is defective, it can be replaced without replacing the entire power supply.

Preliminary Requirements. Before you remove the power supply module's fan:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove the power supply module with the defective fan.

Removal and Replacement. Follow these steps to remove a fan. Replacement is the reverse of removing it.

1 Lay the power supply upside down, then remove the two cover screws.	Insert artwork here.
2 Remove the cover by lifting up on its front end, then removing it from the two tabs at the back. Note: When replacing the cover, its edge tabs must fit properly all along its edges to the chassis.	Insert artwork here.

3 Unplug the fan wire, then tilt the fan back and lift it up and out of the power supply. Note the airflow arrow; it must be pointing out when the fan is installed.	Insert artwork here.

System Module

Note If the system board has failed, the entire system module, less the RAM boards and EEPROM (U4), is exchanged as an assembly.

Some workstations may have custom boot ROMs installed. These custom boot ROMs must remain with the workstation.

Table 2-4. System Module Parts References

Ref. No.	Part Name
1	System module; 50 MHz
2	Connector board
3a	EEPROM (U4)
3b/c	Boot ROM (U5/6)
4	STI ROM, 60 Hz (U15)
5	Crystal, 60 Hz (Y2)
6	Real-Time Clock Battery
7	Memory board
8	Fuse
9	Connector panel

Ref. No.	Part Name
10	System board SCSI ribbon cable
11	Interconnector
12	System board side extrusion
13	System board strap
14	'E' RFI clip
15	Fan
16	Heat sink
17	Grill
18	Screw, heat sink & fan

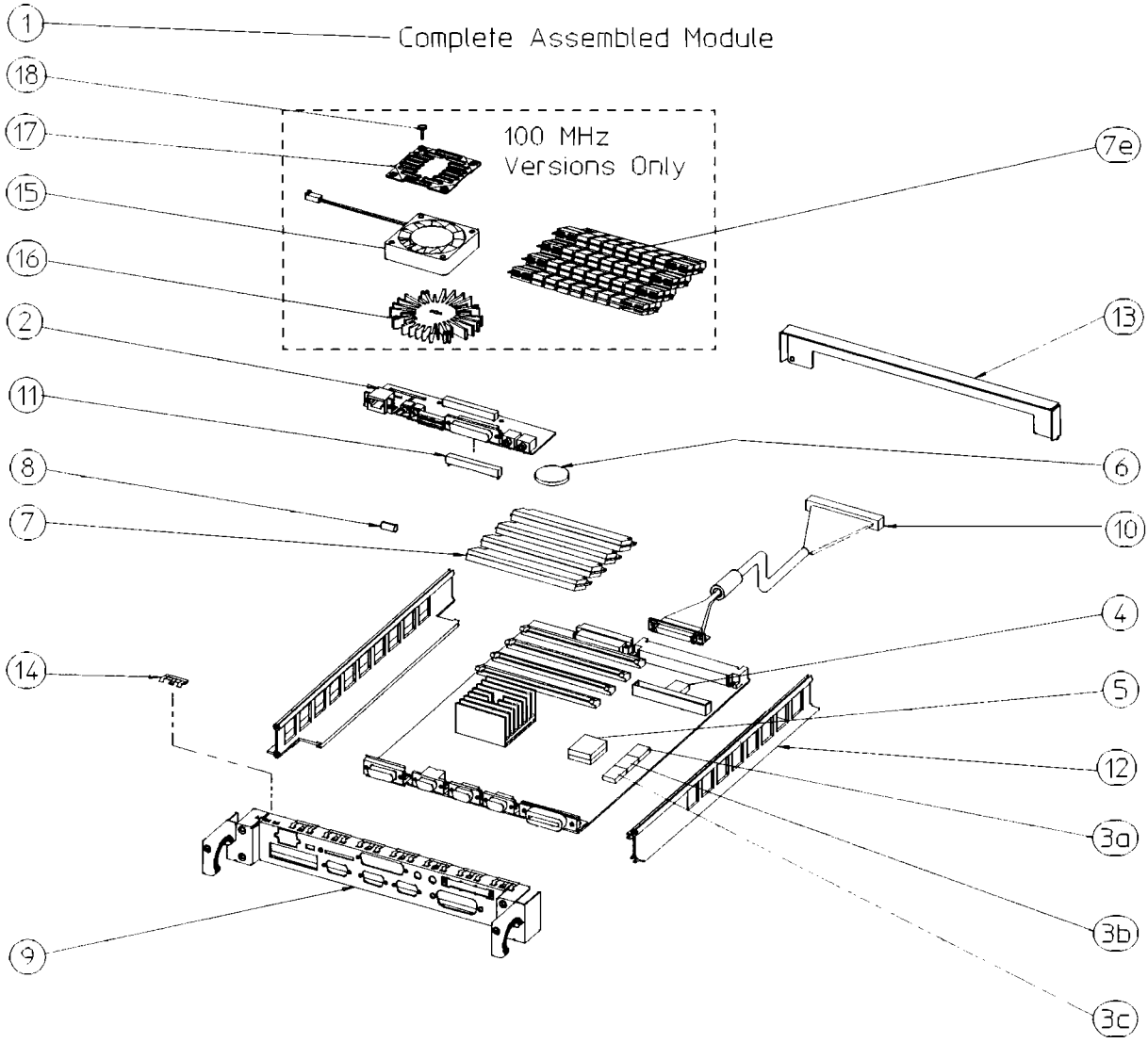

Figure 2-7. System Module Exploded View

Preliminary Requirements

Before you remove the system module:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables and cords connected to the system module.

Removal and Replacement

Follow these steps to remove or replace the system module.

1 Insert a flat-tipped screwdriver into each handle's top hole and loosen the captive screw about 7 turns.	Insert artwork here.
2 Pull the system module out of the workstation.	Insert artwork here.

3 Note the positions of the graphics configuration switches. The replacement system board must have its switches set the same.	Insert artwork here.
4 If the system module will be replaced, remove the EEPROM (U4) from the failed system board and exchange it with the new system board's EEPROM. This keeps the configuration information with the workstation. Some system boards may have custom boot ROMs (U5 and optional U6) installed that must remain with the workststation.	Insert artwork here.
5 If the system module will be replaced: 1. Refer to the section on removing RAM boards, and remove them, then reinstall the RAM boards in the new system board. 2. The system module's metal frame, connector board and panel remain with the system board as an exchange assembly.	Insert artwork here.

6 If it is determined that the EEPROM has failed and must be replaced, order a new EEPROM using Hot Line Procedures to your parts center. A new EEPROM should arrive in two days. Some system boards may have application specific custom boot ROMs (U5 and optional U6) installed that must remain with the workststation.	Insert artwork here.

Memory Boards

Preliminary Requirements. Before you remove the memory boards:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables and cords attached to the system module.
4. Remove the system module.

Removal.

Note Memory boards must be installed in their correct slots to be properly addressed. Refer to the memory configuration tables for instructions.

Follow these steps to remove the memory boards:

1 Release the memory board clips by spreading them out.	Insert artwork here.
2 Tilt the memory board to a vertical position, then lift it up and out of its connector.	Insert artwork here.

3 Remove the other memory boards the same way.	Insert artwork here.

Memory Board Installation Requirements. Memory board's must be installed in pairs; each board must be the same size for each slot pair. If two pairs are installed, either slot pair may have the largest size. 64 Mbyte memory boards are only supported in 100 MHz workstations.

Note

Each memory board in a pair must have the same part number. Some memory boards of a given size have different-speed RAM chips. For example, an 8 Mbyte memory board with 80-nanosecond RAM chips will have a different part number than the same-size board with 60-nanosecond RAM chips.

If a board pair has each board with different-speed RAM chips, memory errors will occur.

Follow these steps to install the memory boards:

1 Position the board vertically in the connector, aligning its edge notches with the connector.	Insert artwork here.

2 Tilt the memory board down and snap it in place in its socket.	Insert artwork here.

Real-Time Clock Battery

Preliminary Requirements. Before you remove the RTC battery:

1. Shut down the operating system.
2. Turn off the workstation.
3. Remove all cables and cords attached to the system module.
4. Remove the system module.

Removal and Replacement. Follow these steps to replace the RTC battery:

1 Raise the tab holding the battery in place and remove the battery. **Warning:** Lithium batteries may explode if mistreated. Replace battery with only a Matsushita Electric BR-2325 three-volt lithium battery (HP part number 1420-0314). Use of any other battery may cause fire or explosion.	Insert artwork here.
2 Install the new battery with its '+' side up. **Warning: Do not put lithium batteries in fires, try to recharge or disassemble them.**	Insert artwork here.

Fuse

Preliminary Requirements. Before you remove the system board's fuse:

1. Shut down the operating system.
2. Turn off the workstation.
3. Remove all cables and cords attached to the system module.
4. Remove the system module.

Removal and Replacement. Follow these steps to replace the system board's fuse.

1 Locate the fuse, F2, next to the connector board.	Insert artwork here.
2 Pull out the fuse, then replace it with a new one.	Insert artwork here.

Connector Board

Preliminary Requirements. Before you remove the connector board

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables and cords attached to the system module.
4. Remove the system module.

Removal and Replacement. Follow these steps to remove the connector board.

1 Remove all interface connector screws from the interface ports on the connector board and system board.	Insert artwork here.
2 Remove two screws on each side of the connector panel holding it to the side metal extrusions	Insert artwork here.

3 Remove the connector panel.	Insert artwork here.
4 Remove the connector board by lifting it up, unplugging it from the system board.	Insert artwork here.

System Module Fan

100 MHz workstations have a cooling fan over their CPU chip. This fan may be replaced if it fails.

Preliminary Requirements.

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables and cords attached to the system module.
4. Remove the system module.

Removal and Replacement. Fan replacement is the reverse of removing it.

Follow these steps to remove the system module fan:

1 Unplug the fan's connector wires from its pins on the system board.	Insert artwork here.
2 Remove two screws holding the fan to the CPU chip, then lift out the fan.	Insert artwork here.

STI ROMs and Graphics Crystals

50 MHz workstations have graphics crystals (Y2) and STI ROMs (U15) for 60 Hz or 70 Hz display refresh rates. These may need to be replaced should the replacement system module not have the correct ones installed. Replacement crystals and STI ROMs are packaged with exchange system modules.

These parts must be kept as a set. Table 2-5 lists the crystal and ROM combinations for 100 MHZ workstations.

Table 2-5. STI ROM and Graphics Crystal Combinations

Refresh Rate	STI ROM Part Number	Graphics XTAL Part Number
60 Hz	1818-5470	1813-0428
70 Hz	1818-5347	1813-0940

Preliminary Requirements.

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables and cords attached to the system module.
4. Remove the system module.

Removal and Replacement. STI ROM and graphics crystals both are socketed. Replacement is the reverse of removing it.

Follow these steps to remove the STI ROM or graphics crystal:

1 Remove the graphics crystal Y2 with a small screwdriver. Remove the STI ROM U15 with a surface-mount, 32-pin IC removal tool.	Insert artwork here.
2 Replace the STI ROM U15 and graphics crystal Y2 as a set.	Insert artwork here.

Chassis Parts

Chassis; Model 745*i*

Table 2-6. Model 745*i* Chassis Parts References

Ref. No.	Part Name	Ref. No.	Part Name
1	Motherboard	6	Model label
2	Chassis	7	'E' RFI clip
3	Wall	8	Front bezel
4	Power switch assembly		
5	Side trim		

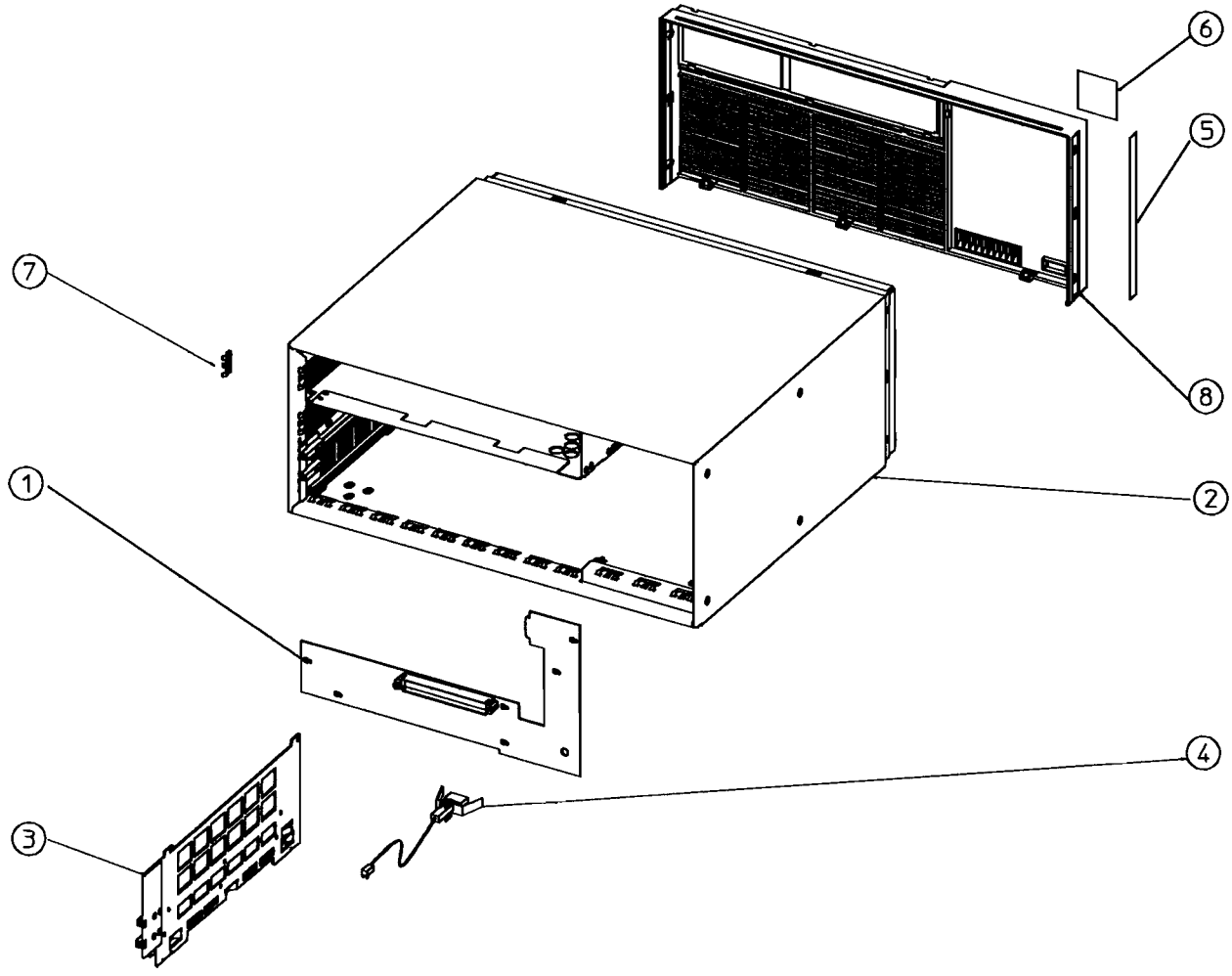

Figure 2-8. Chassis; Model 745*i* Exploded View

Chassis; Model 747*i*

Table 2-7. Model 747*i* Chassis Parts References

Ref. No.	Part Name
1	Motherboard
2a	Dual SGC card
2b	Single SGC card
3	Chassis
4	Wall
5	Power switch assembly
6	Side trim

Ref. No.	Part Name
7	Model label
8	'E' RFI clip
9	Front bezel
10	SGC slot cover
11	SGC slot cover captive screw
12	SGC slot cover RFI clip

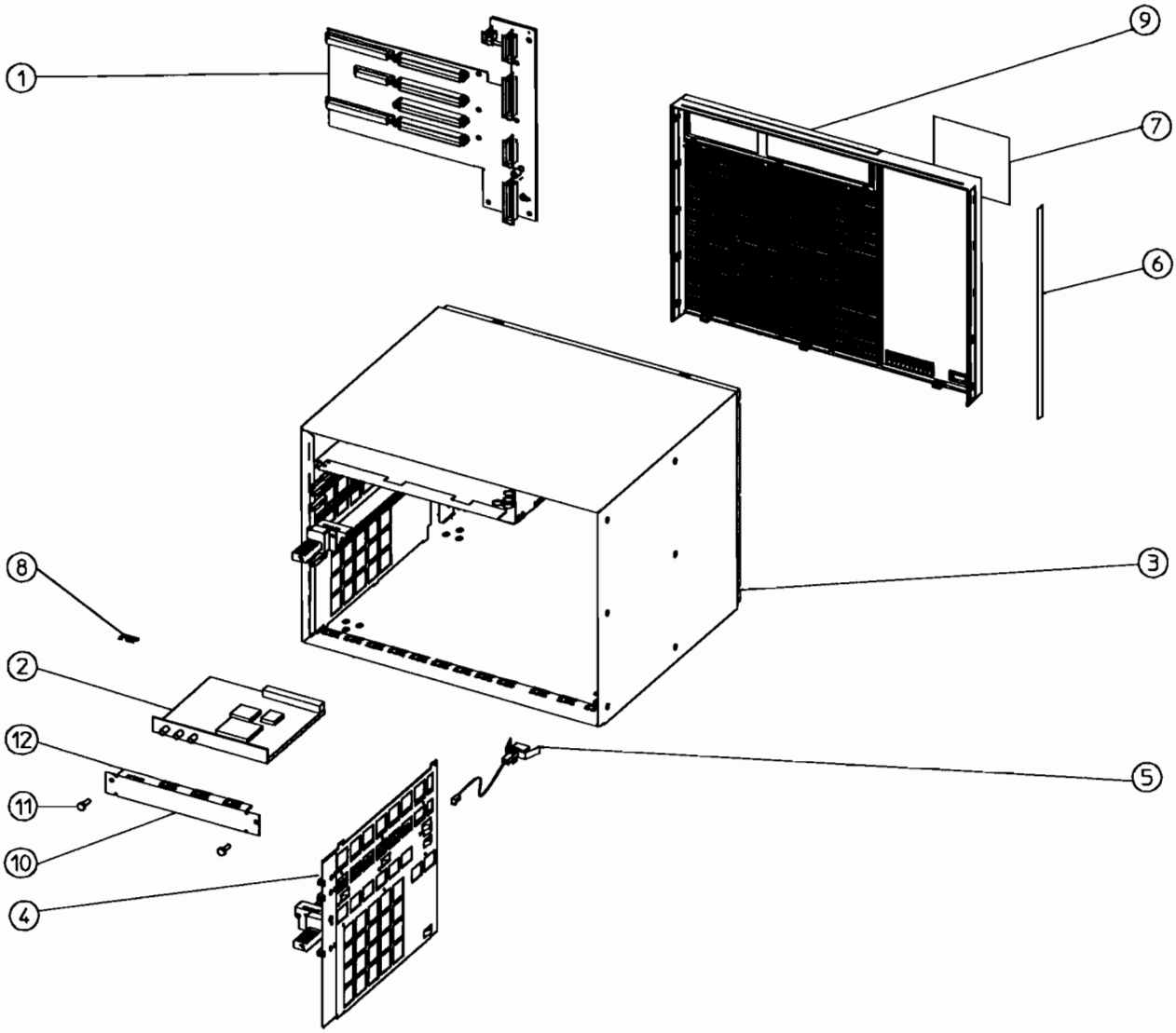

Figure 2-9. Chassis; Model 747*i* Exploded View

Motherboard

Each product has a motherboard:

- Small one is used in Model 745*is*.
- Large one is used in Model 745*is*.

The same procedures are used to replace a motherboard.

Preliminary Requirements

Before you remove the motherboard:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove:
   a. All cables and cords.
   b. Power supply module(s).
   c. System module.
   d. Mass storage module.
   e. EISA module.
   f. VME module from a Model 747*i*.
   g. SCG card from a Model 747*i*.

Removal and Replacement

Follow these steps to remove the motherboard.

1 Remove the support wall by moving its bottom towards the right side, then pulling it down and out of the workstation.	Insert artwork here.

2 Unplug the power switch wire connector from the motherboard.	Insert artwork here.
3 Loosen the motherboard's captive screw. Both products have this screw in the same place.	Insert artwork here.
4 Slide the motherboard to the right aligning its keyholes with the chassis locks, then pull the motherboard out.	Insert artwork here.

Power Switch Assembly

The power switch assembly is replaced as a single part, including switch, clip and wires to the motherboard connector.

Preliminary Requirements

Before you remove the power switch assembly:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove:
   a. All cables and cords.
   b. Power supply module(s).
   c. System module.
   d. Mass storage module.
   e. EISA module.
   f. VME module from a Model 747*i*.
   g. SCG card from a Model 747*i*.

Removal and Replacement

Follow these steps to remove the power switch assembly:

1 Unplug the power switch wire connector from the motherboard.	Insert artwork here.

2 Using a screwdriver, pry the power switch clip clear of its notches in the chassis, then remove the power switch assembly.	Insert artwork here.

Model 747*i* Unique Parts

Model 747*i*'s have several modules and parts that are unique to them:

- VME Converter Board.
- VME Backplane.
- SGC Card (if installed).

The next three subsections explain assembly replacement procedures for these modules.

VME Module

Table 2-8 lists the VME module parts and Figure 2-10 shows an exploded view of the parts.

Table 2-8. VME Module Parts References

Ref. No.	Part Name	Ref. No.	Part Name
1	VME converter board	6	Cover plate
2	VME backplane board	7	'E' RFI clip
3	VME card cage	8	Handle screw kit
4	VME card guide		
5	RFI cover assembly		

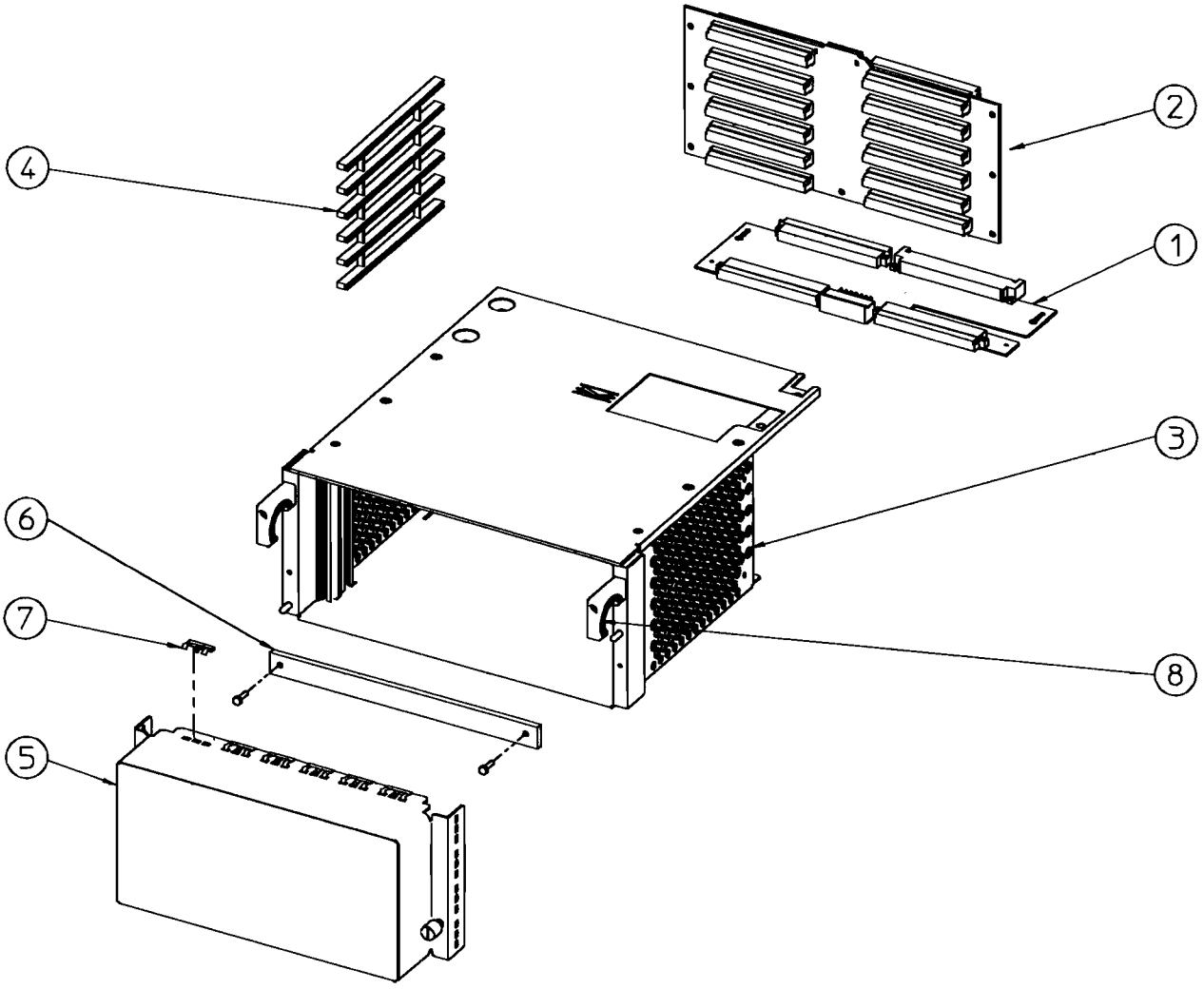

Figure 2-10. VME Module Exploded View

VME Accessory Cards

Preliminary Requirements. Before you remove a VME accessory card:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cords.
3. Remove the cables from the RFI cover connectors.
4. You may remove the VME module, if needed.

Removal and Replacement. Follow these steps to remove a VME accessory card.

1 **Caution:** Short extension cables may be installed between VMEbus accessory cards and the RFI cover. Remove the RFI cover from the VME module, then disconnect the extension cables from the VME accessory cards.	Insert artwork here.
2 Remove the RFI cover.	Insert artwork here.

3 Loosen the screws holding the VME card in the VME module. Pull the VME card out of its slot. Some VME cards may have ejector levers at the top and bottom; pulling them will eject the card from the VME backplane.	Insert artwork here.

VME Module

Preliminary Requirements

Before you remove the VME module:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cords.
3. Remove the cables from their RFI cover connectors.
4. You may leave the VME accessory cards in the VME module, but they must be removed to access the converter board or backplane.

Removal and Replacement

Follow these steps to remove the VME module:

1 Insert a flat-tipped screwdriver into each handle's top hole and loosen the captive screw about 7 turns.	Insert artwork here.
2 Pull the VME module out of the workstation.	Insert artwork here.

VME Converter Board

Preliminary Requirements. Before you remove the VME converter board:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cords.
3. Remove all cables attached to the VME module's RFI cover.
4. Remove the VME module.

Removal and Replacement. Follow these steps to remove the VME converter board.

1 Remove the two screws holding the converter board to the module.	Insert artwork here.

2 Pull the VME converter board back to disconnect it from the VME backplane board and align its keyholes with the keys.	Insert artwork here.
3 Lift the VME converter board up and out of the module.	Insert artwork here.

VME Backplane

Preliminary Requirements. Before you remove the VME backplane:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cords.
3. Remove all cables attached to the RFI cover.
4. Remove all VME accessory cards.
5. Remove the VME module.
6. Remove the VME converter board.

Removal and Replacement. Follow these steps to remove the VME backplane.

1 Remove the seven screws holding the VME backplane to the VME module.	Insert artwork here.
2 Remove the VME backplane.	Insert artwork here.

SGC Accessory Card

Preliminary Requirements

Before you remove the SGC card from a Model 747*i*:

1. Shut down the operating system.
2. Turn OFF the workstation and remove the power cord(s).
3. Remove all cables attached to the SGC card.

Removal and Replacement

Follow these steps to remove the SGC card:

1. Loosen the SGC card's screws holding it to the card cage.

   Note the straight handles are part of the chassis and are not removed.
2. Remove the SGC card by pulling it out of the card cage.

3

Functional Description

Overview

Model 745*i* and 747*i* industrial workstations have the field replaceable assemblies listed in Table 3-1. Each replaceable assembly has its quantities listed.

Table 3-1. Field Replaceable Assemblies vs. Product

Assembly	Model 745*i*	Model 747*i*
Power supply	1	2
System board	1	1
Connector board	1	1
RAM boards	2 or 4	2 or 4
Large motherboard		1
Small motherboard	1	
4-slot EISA backplane		1
2-slot EISA backplane	1	
6-slot VME backplane		1
SGC accessory card		1
VME accessory cards		up to 6
Removable media mass storage	1 or 2	1 or 2
Fixed media mass storage	1 or 2	1 or 2

Figure 3-1 and Figure 3-3 show the relative positions of each functional assembly. Functional block diagrams are shown in Figure 3-2 and Figure 3-4.

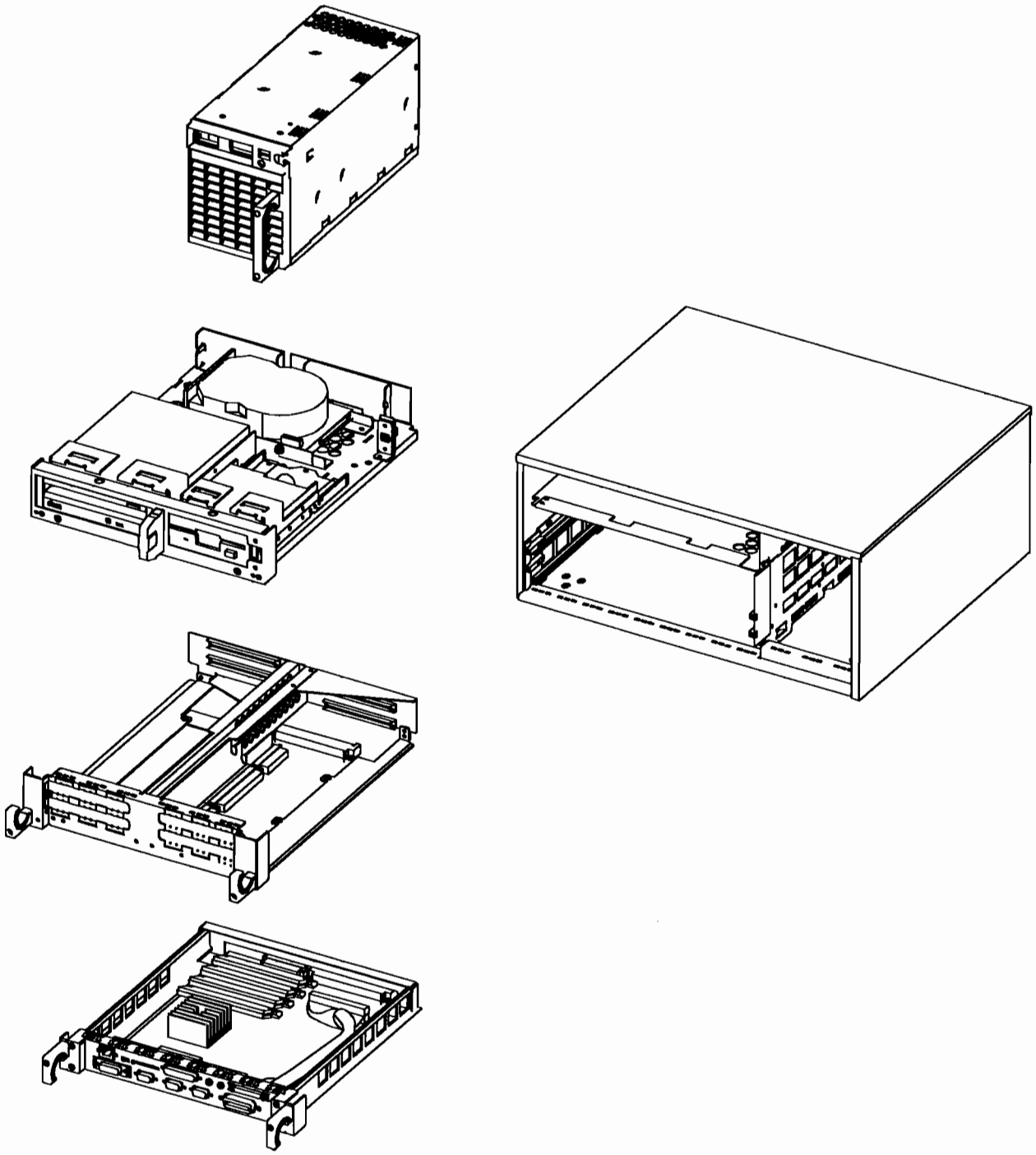

Figure 3-1. Model 745*i*'s Functional Assemblies

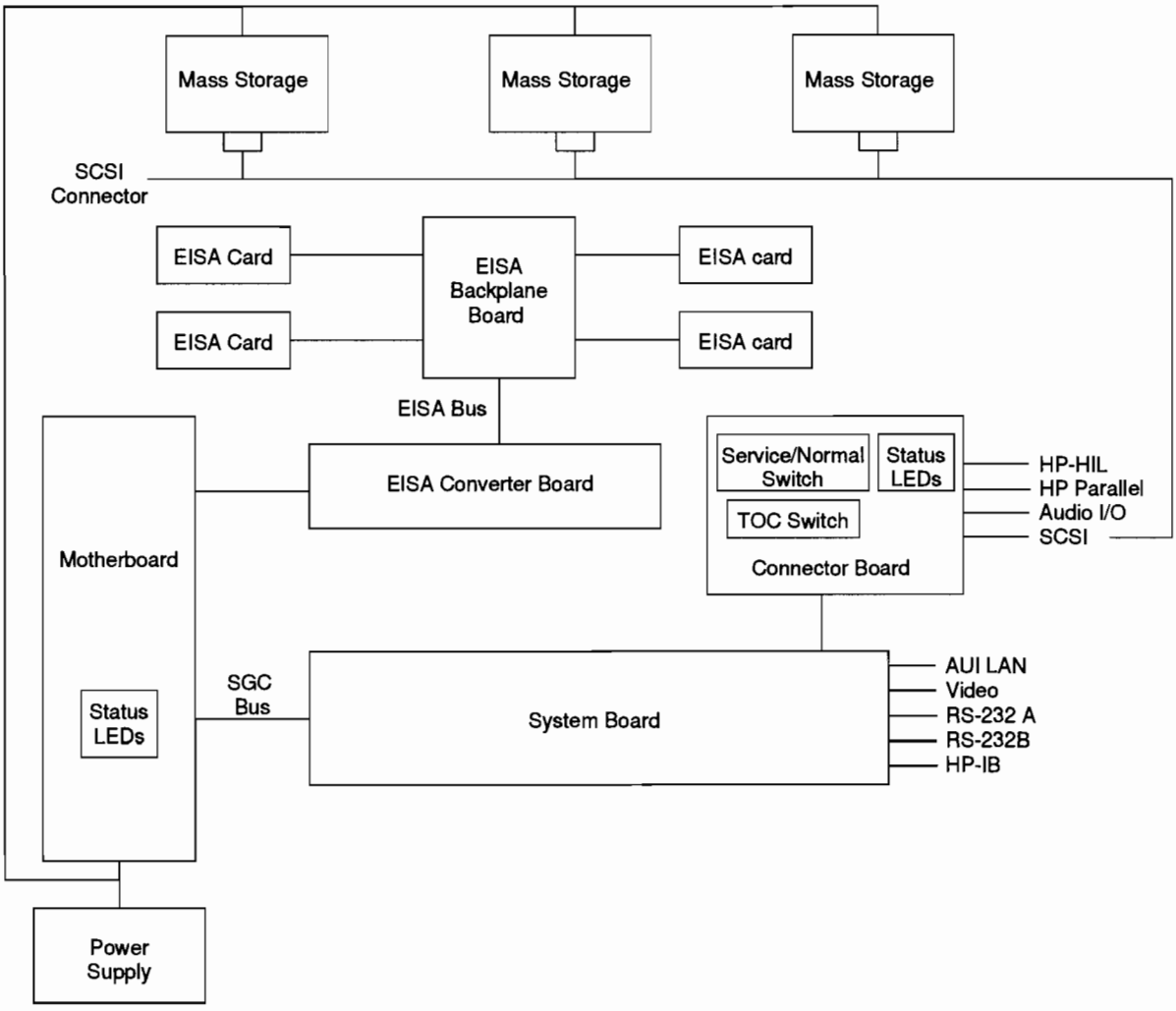

Figure 3-2. Model 745*i*'s Functional Block Diagram

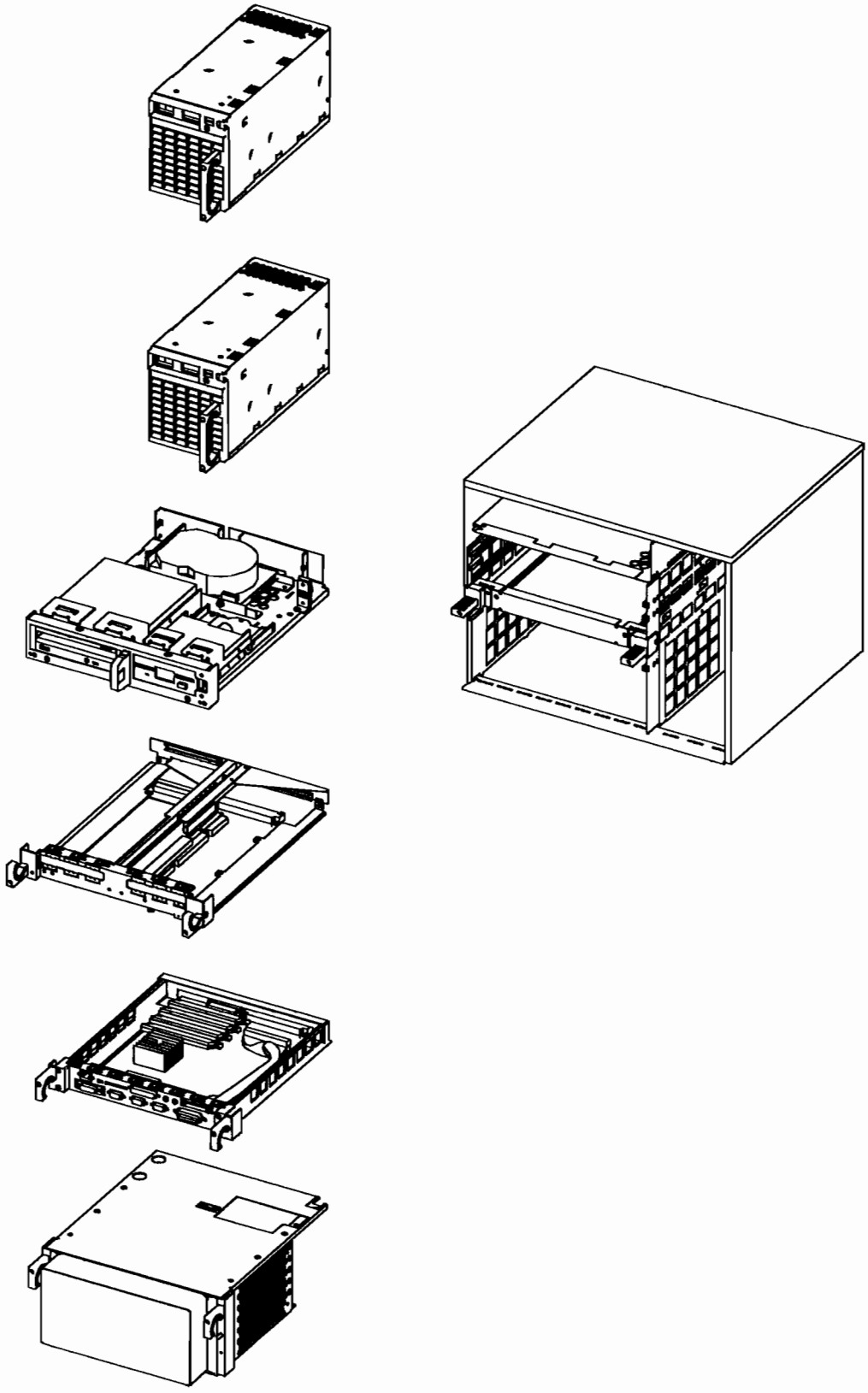

Figure 3-3. Model 747*i*'s Functional Assemblies

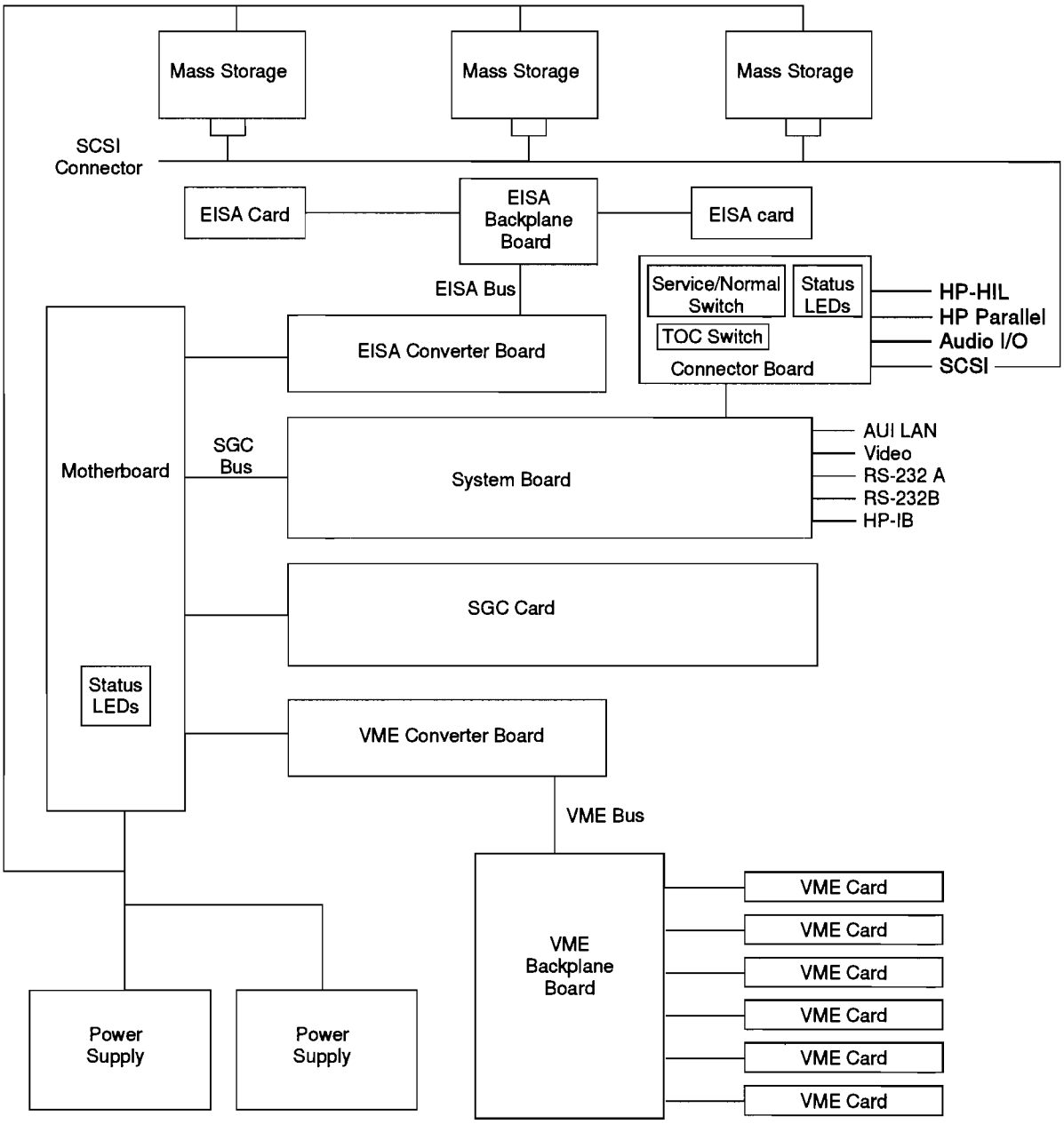

Figure 3-4. Model 747*i*'s Functional Block Diagram

System Board

The system board has most of the functionality, including:

- CPU.
- Boot ROMs.
- Graphics.
- Memory controller.
- I/O controller, which controls these interface circuits:
  - LAN.
  - SCSI.
  - HP Parallel.
  - HP-IB.
  - HP-HIL.
  - Audio.
  - RS-232.
  - EISA converter board through the motherboard.
  - VME converter board through the motherboard (Model 747*i* only).

Figure 3-5 and Figure 3-6 are pictures of the system boards.

CPU Circuit

A Hewlett-Packard proprietary PA-RISC 7100 CPU chip is the heart of the CPU circuit. It executes instructions and controls the other circuits. Primary features include:

- 745*i*/50 and 747*i*/50 has a 50 MHz clock speed that provides:
  - 69 SPECmark '89.
  - 36 SPEC int92.
  - 72 SPEC fp92.
  - 62 MIPS/13 MFLOPS.
- 745*i*/100 and 747*i*/100 has a 100 MHz clock speed that provides:
  - 136 SPECmark '89.
  - 81 SPEC int92.
  - 138 SPEC fp92.
  - 115 MIPS/13 MFLOPS.
- Built-in coprocessor.
- 2-way superscalar.
- Improved external cache performance:
  - 50 MHz versions:
    - 64 Kbyte external instruction cache, 15ns access time.
    - 64 Kbyte external data cache; 15ns access time, 20 ns cycle time.
  - 100 MHz versions:
  - 256 Kbyte external instruction cache, 15ns access time.
  - 256 Kbyte external data cache; 15ns access time, 20 ns cycle time.

Figure SYSBD50 here.

Figure 3-5. 50 MHz System Board

Figure SYSBD100 here.

Figure 3-6. 100 MHz System Board

Data, status and control information for the CPU is transferred on the CPU bus with these circuits:

- I/O Controller.
- Graphics Circuit.
- Memory Controller.

Boot ROM Circuit

The Boot ROM circuits has the Boot ROM containing 256 Kbytes of information required to:

- Start the CPU functions.
- Self-test the workstation's main circuits.
- Search for and boot an operating system.
- Manage the internal interface configurations.

Some users have custom boot ROMs in their workstations. These custom bootROMs were developed by Hewlett-Packard for specific applications. Replacement custom boot ROMs are provided by the customer. Boot ROM U5 is standard in all workstations. An optional Boot ROM, U6, may or may not be installed.

An EEPROM stores information for:

- Internal interface configurations.
- LAN ID number.

Note The workstation's LAN ID number's last 6 characters are labeled on the EEPROM. The first group of digits are typically `0800091`. If the system board or EEPROM is replaced, the system administrator needs the complete LAN ID number to reconfigure the networked system.

A Program Timer Module contains the system clock. All timing is based on the system clock.

Because the Boot ROM circuits involve several important boot and configuration functions, they are explained in detail in Chapter 4 and Chapter 5.

LED Displays

On the system module, as well as the front panel, there are ten LEDs. These LEDs indicate power, test and status information. Front panel LEDs are actually on the motherboard but have a light pipe to make them visible from the front panel holes. LEDs on the front panel are labeled as listed in Table 3-2. System module LEDs are read from left to right in the same manner.

Table 3-2. LED Indicator Labeling and Meaning

Mode	S	A	B	C	D	E	F	G	H	P
Test	Service Mode	2_3	2_2	2_1	2_0	2_3	2_2	2_1	2_0	Power
Normal						Status	Status	Status	Status	Power

When power is on, the P (green) LED is on. If the Service/Normal switch is set to Service, the S (green) LED lights.

During test modes, amber LEDs A through H represent two hexidecimal numbers. These numbers are used in troubleshooting as they represent error codes:

- A B C D are the most significant hexidecimal number.
- E F G H are the least significant hexidecimal number.
- Example - o o ●o ●●●o would be $2E_{16}$.

In normal operation, D E F G indicate certain system activity:

- E = operating system running.
- F = disk access in progress.
- G = network receive in progress.
- H = network transmit in progress.

Graphics Circuit

A graphics circuit has the display RAM and can be configured for several types of monitors. Table 3-3 lists these configurations.

Table 3-3. Graphics Configurations

Function	Configuration
On-board graphics	Enabled; graphics sent to video connector. Disabled; on-board graphics disabled, accessory graphics card provided video
Refresh rate	60/70; for monitors with 60 Hz or 70 Hz refresh rate 72/75; for monitors with either 72 Hz or 75 Hz refresh rate
Resolution	1024 by 768 1280 by 1024
Display type	Color; RGB video out Grayscale; not supported

Four graphics configuration switches are used to set the graphics configuration. Table 3-4 lists these switches and their settings.

Table 3-4. System Board Graphics Configuration Switches

Function	Sys. Bd. Graphics	Hz	Horizontal Resolution	Type
Switch	1	2	3	4
Open:	Enable	60/70	1280	Color
Closed:	Disable	72/75	1024	N/A

Video connector pinouts are shown in Figure 3-7 and Table 3-5.

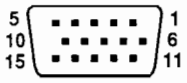

Figure 3-7. Video Connector

Table 3-5. Video Connector Pinouts

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	Red	6	Ground	14	V Sync
2	Green	7	Ground	16	Ground
3	Blue	8	Ground	17	Ground
5	Ground	13	H Sync		

Memory Controller Circuit

Memory is managed by the memory controller circuit. Up to 128 Mbytes of RAM may be installed in the workstation. An Error Checking and Correcting (ECC) chip checks memory word read/write operations. Both single-bit and double-bit errors are detected. If a single-bit error is detected, it will be corrected. Double-bit errors are detected but not corrected. Triple and quadruple bit errors are grouped in nybbles. A 64-bit memory bus is used.

Four connectors each accept one of these Single Inline Memory Module (SIMM) memory boards:

- 4 Mbyte RAM board, two in HP A2815A 8 Mbyte Memory Upgrade.
- 8 Mbyte RAM board, two in HP A2816A 16 Mbyte Memory Upgrade.
- 32 Mbyte RAM board, two in HP A2827A 64 Mbyte Memory Upgrade.
- 64 Mbyte RAM board, two in HP A2875A 132 Mbyte Memory Upgrade.

Note

2 Mbyte RAM boards are not supported, nor is the HP A2200A 4 Mbyte RAM Upgrade.

16 Mbyte RAM boards (A2576-60001) are supported, but are not available as a RAM Upgrade.

64 Mbyte RAM boards (A2628-66006) are supported only in 100 MHz versions.

RAM boards must be installed in pairs, but any size pair can be in either slot pair. The first pair of slots is labeled RAM PAIR 0; its slots are labeled 0A and 0B. The second pair of slots is labeled RAM PAIR 1 with its slots labeled 1A and 1B. Each pair represents a memory block.

The first pair, or memory block in RAM PAIR 0, starts at address 00000000_{16}. RAM PAIR 1, the second memory block, starts at the next address after the memory block in RAM PAIR 0. Memory addresses are shared between each board in a pair. Within that board pair, or block, memory addresses whose least significant digit is:

- F, E, D, C, 7, 6, 5, or 4 are on the A board.
- B, A, 9, 8, 3, 2, 1, or 0 are on the B board.

Table 3-6 lists several examples of memory address versus memory block for the Model 745*i* and 747*i* having different amounts of memory. Each block of workstation memory is shown as:

- `RAM PAIR 0` having the top, or upper memory block.
- `RAM PAIR 1` having the bottom, or lower memory block.
- If only one block is used, it can be in either `RAM PAIR 0` or `RAM PAIR 1`.

Note

Each memory board in a pair must have the same part number. Some memory boards of a given size have different-speed RAM chips. For example, an 8 Mbyte memory board with 80-nanosecond RAM chips will have a different part number than the same-size board with 60-nanosecond RAM chips.

If a board pair has each board with different-speed RAM chips, memory errors will occur.

Table 3-6. Examples of Memory Addresses vs. Memory Blocks

Total RAM	Address Ranges Upper to Lower	16 MB Total	48 MB Total	48 MB Total	64 MB Total	96 MB Total	96 MB Total	128 MB Total	192 MB Total	256 MB Total
16 MB	00000000-00FFFFFF	Two 8 MB	Two 16 MB	Two 8 MB	Two 16 MB	Two 16 MB	Two 32 MB	Two 32 MB	Two 32 MB	Two 64 MB
24 MB	01000000-017FFFFF	not used		Two 16 MB						
32 MB	01800000-01FFFFFF									
40 MB	02000000-027FFFFF		Two 8 MB		Two 16 MB	Two 32 MB				
48 MB	02800000-02FFFFFF									
56 MB	03000000-037FFFFF		not used	not used						
64 MB	03800000-03FFFFFF									
72 MB	04000000-047FFFFF				not used		Two 16 MB	Two 32 MB	Two 64 MB	
80 MB	04800000-04FFFFFF									
88 MB	05000000-057FFFFF									
96 MB	05800000-05FFFFFF									
104 MB	06000000-067FFFFF					not used	not used			
112 MB	06800000-06FFFFFF									
120 MB	07000000-077FFFFF									
128 MB	07800000-07FFFFFF							not used		Two 64 MB
160 MB	08000000-09FFFFFF									
192 MB	10000000-11FFFFFF								not used	
224 MB	12000000-13FFFFFF									
256 MB	14000000-15FFFFFF									

I/O Controller

All I/O functions are managed by the system board's I/O controller. These functions include:

- Control and management of these connector panel interfaces:
  - SCSI.
  - AUI LAN.
  - HP Parallel.
  - HP-HIL.
  - HP-IB.
  - Audio; MIC in and SPKR out.
  - RS-232 A and B.
- Interfacing with the EISA converter board.
- Interfacing with the VME converter board (Model 747*i* only).
- Control of the graphics circuit.
- Exchange of Boot ROM and EEPROM data with the CPU.

SCSI Interface Circuit

The primary function of the SCSI interface circuit is to take data from the CPU bus, translate it to SCSI format, and transmit it down the SCSI bus to an external mass storage device, and vice versa. A secondary function is to keep track of the status of the SCSI bus and inform the CPU of the status.

SCSI Bus Termination

SCSI circuits must have terminating resistors installed on them. Here is how the two configurations are terminated:

External Configuration. When using the external SCSI configuration, you must use an active SCSI terminator at the last external device on the SCSI bus. All other devices, external or internal, must not be terminated. If your workstation contains the external cable but you have no external devices, the terminator must be installed in the rear-panel SCSI connector. Use only HP K2291 terminators to ensure reliable system operation.

Recommended SCSI mass storage device bus addresses are listed in Table 3-7. Mass storage device upgrades have these addresses factory set.

Table 3-7. Recommended SCSI Bus Addresses and Device Usage

Application	Unit or Mass Storage Device	Recommended Bus Address
High Use/Priority	CPU	7
	Root Hard Disk Drive	6
	Most Used Hard Disk Drive	5
	Least Used Hard Disk Drive	4
Other devices	DDS Tape Drives	3
Medium Use/Priority	CD ROM Disk Drives	2
Low Use/Priority	Flexible Disk Drives	0

SCSI interface technical information is listed in Table 3-8.

Table 3-8. SCSI Interface Technical Information

Function	Data
Type:	SCSI-I (ANSI X3.131-1986), single-ended
Data rate:	Synchronous - 5 Mbytes/second Asynchronous - 1.5 Mbytes/second
Device limits:	6 external devices
Connector type:	SCSI II, ALT-1 50-pin high-density thumbscrew
Maximum cable length: (Internal plus external length, unit and all devices)	4.6 metres (15 feet)

Note Snap-on SCSI cable connectors should not be used.

SCSI Connector Pin-Out

Figure 3-8 and Figure 3-9 identifies the workstation's SCSI connector and the SCSI cable connector. Table 3-9 lists the workstation's SCSI connector's and cable's pin numbers and signals.

Table 3-9. SCSI Interface Pin Assignments

Signal Name	Fixed Connector	Cable Connector		Cable Connector	Fixed Connector	Signal Name
GROUND	1	1		2	26	DB(0)
GROUND	2	3		4	27	DB(1)
GROUND	3	5		6	28	DB(2)
GROUND	4	7		8	29	DB(3)
GROUND	5	9		10	30	DB(4)
GROUND	6	11		12	31	DB(5)
GROUND	7	13		14	32	DB(6)
GROUND	8	15		16	33	DB(7)
GROUND	9	17		18	34	DB(P)
GROUND	10	19		20	35	GROUND
GROUND	11	21		22	36	GROUND
RESERVED	12	23		24	37	RESERVED
OPEN	13	25		26	38	TERMPWR
RESERVED	14	27		28	39	RESERVED
GROUND	15	29		30	40	GROUND
GROUND	16	31		32	41	ATN
GROUND	17	33		34	42	GROUND
GROUND	18	35		36	43	BSY
GROUND	19	37		38	44	ACK
GROUND	20	39		40	45	RST
GROUND	21	41		42	46	MSG
GROUND	22	43		44	47	SEL
GROUND	23	45		46	48	C/D
GROUND	24	47		48	49	REQ
GROUND	25	49		50	50	I/O

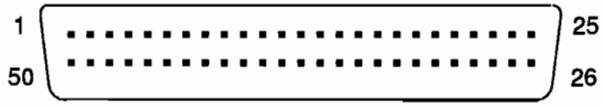

Figure 3-8. Workstation Fixed SCSI Connector

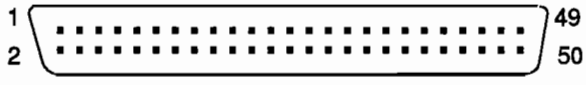

Figure 3-9. SCSI Cable Connector

HP Parallel Interface Circuit

In common with many personal computers, the HP Parallel interface circuit uses a Centronics™ interface standard. It provides an interface with external devices. Using an 8-bit direct memory addressing routine, up to 300 Kbytes per second transfer rates may be achieved. The HP Parallel interface circuit connects to the HP Parallel connector on the connector board.

Technical information for the HP Parallel interface is listed in Table 3-10.

Table 3-10. HP Parallel Interface Technical Information

Function	Data
Type:	Centronics™, ACK, BUSY and HP ScanJet handshakes.
Data rate:	>300 Kbytes/second with DMA 200 Kbytes/second sustained
Device limit:	1
Connector type:	25-pin D-sub female; PC standard

HP Parallel Connector Pin-Out

Figure 3-10 identifies the HP Parallel connector pins. Table 3-11 lists the HP Parallel connector's pin numbers and signals.

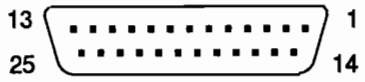

Figure 3-10. HP Parallel Interface Connector

Table 3-11. HP Parallel Connector Pinouts

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	NSTROBE	10	NACK	19	Ground
2	DATA0	11	BUSY	20	Ground
3	DATA1	12	PE	21	Ground
4	DATA2	13	SLCT	22	Ground
5	DATA3	14	A F XT	23	Ground
6	DATA4	15	NERROR	24	Ground
7	DATA5	16	NINIT	25	Ground
8	DATA6	17	NSCT IN	26	Ground
9	DATA7	18	Ground	27	Ground

HP-HIL Interface Circuit

An Hewlett-Packard Human Interface Link (HP-HIL) is used for interfacing the workstation to human input devices. Asynchronous serial communications protocol enables you to select a set of input devices, connect them to your workstation or system, and work with many application programs.

A link control circuit controls the HP-HIL interface. Each HP-HIL device has an circuit to interface information to and from that device.

Limitations for the HP-HIL interface are:

- Up to seven devices can be on the link.
- Maximum distance between devices is 2.4 metres, total link maximum length is 16.8 metres. This does not include the 15 or 30 metre extensions.
- Maximum link current is 1 A.

Caution When configuring HP-HIL devices to these workstations, care must be used to ensure the total power drawn by all devices does not exceed 1 A.

Either of two keyboards connect to the rear panel HP-HIL connector:

- HP 46021A Integrated Terminal Format (ITF) Keyboard
- HP C1429B PC-101 Keyboard

The PC-101 Keyboard is supported only with the Basic operating systems.

Technical information for the HP-HIL Interface is listed in Table 3-12.

Table 3-12. HP-HIL Interface Technical Information

Function	Data
Type:	HP Serial Desktop Bus
Device limit:	7; some devices may count as more than one device, e.g. Knob Box
Connector type:	AMP SMD; 4-pin; 1 pin provides up to 1 amp of + 12 V dc to the loop

HP-IB Interface Circuit

Note The HP-IB interface is supported for instrument use only.

Hewlett-Packard Interface Bus (HP-IB) is HP's version of the IEEE 488 interface standard. HP-IB on this board is much like HP-IB implementations on other HP 9000 Series 200/300 products. It uses a TMS9914 HP-IB controller which allows data transfer rates up to 450 Kbytes/second. The TMS9914 is a memory-mapped I/O device which is multiple-mapped within a 64 Kbyte internal I/O device.

Two registers control hardware which can generate an interrupt as a result of a HP-IB device responding to a parallel poll. It has the ability to generate an interrupt from a parallel poll response. For this feature, two registers external to the TMS9914 are used. These registers are in addition to the two external registers that exist for internal HP-IB interfaces in other Series 200, 300 and 400 products.

All registers associated with the HP-IB are multiple mapped within a 64 Kbyte block of memory in the internal I/O address range.

Information on the TMS9914A and its registers can be found in the *TMS9914A General Purpose Interface Bus (GPIB) Controller* Data Manual.

Technical information for the HP-IB interface is listed in Table 3-13.

Table 3-13. HP-IB Interface Technical Information

Function	Data
Type:	IEEE-488 standard based; HP-IB instruments only.
Data rate:	350 Kbytes/second
Device limit:	14 nominal
Connector type:	Standard HP-IB

HP-IB Connector Pin-Out

Figure 3-11 identifies the HP-IB connector pins. Table 3-14 lists the HP-IB connector's pin numbers and signals.

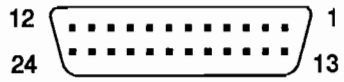

Figure 3-11. HP-IB Connector

Table 3-14. HP-IB Connector Pinouts

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	DIO1	10	SRQ	19	Ground
2	DIO2	11	ATN	20	Ground
3	DIO3	12	Shield	21	Ground
4	DIO4	13	DIO5	22	Ground
5	EOI	14	DIO6	23	Ground
6	DAV	15	DIO7	24	LGND
7	NRFD	16	DIO8	25	Ground
8	NDAC	17	REN	26	Ground
9	IFC	18	Ground		

Audio Interface Circuit

An audio interface is provided that is supported only on HP-UX. Both input and output functions are used.

Dual input functions include audio from a high-impedance microphone or audio output from another device. The input circuitry automatically matches the impedance for proper functioning with either high or low input devices. A miniature phone jack on the connector board accepts the input. Input audio is converted to digital information then sent to a static RAM through a gate array. When storing audio information on the hard disk drive, the gate array sends audio data to the CPU. The CPU then sends audio data to the hard disk drive through the SCSI interface.

HP-UX can control whether one, both or none of the audio output devices are active.

The output function is designed to feed an 8Ω to 40Ω device. A voice-quality output of up to 8 KHz lets users use voice messages for applications. *Audio from the internal CD ROM disk drive cannot be sent to the* Audio OUT *connector.* Audio digital data is transferred from the static RAM through the gate array to the audio OUT connector. When reading audio information from the hard disk drive, the drive sends audio data to the CPU through the SCSI interface. Audio data is then sent to the gate array on the CPU bus.

Technical information for the audio interface is listed in Table 3-15.

Table 3-15. Audio Interface Technical Information

Function	Data
Type:	Voice quality, up to 8 KHz.
Microphone in:	Standard stereo 1/8-in microjack.
Speaker out:	Standard stereo 1/8-in. microjack. >20Ω per output.
Device limit:	1

RS-232 Interface Circuit

A utility chip is the center of the RS-232 serial interface circuit. It is connected to two 25-pin connectors on the rear panel labeled A and B. Terminals may be used with these workstations.

Unlike other RS-232 interface circuits in other Series 300 or Series 400 computers, its configurations cannot be changed.

Table 3-16 lists technical information for the RS-232 interface.

Note Technical information listed herein should not be interpreted as specifications. Official specifications are listed in the HP 9000 Series 700*i* Model 745/747 Technical Data Sheet.

Table 3-16. RS-232 Interface Technical Information

Function	Data
Type:	RS-232-C
Baud rate:[1]	50 to 230,4000
Word:[1]	5 to 8 bits
Parity[1]	Odd, even, one, zero, none
Device limit:	1 per interface connector
Connector type:	9-pin male
[1] Configurable in boot administration mode.	

Another part of the RS-232 circuit is the Real-Time Clock (RTC). When the controller is turned off, a replaceable lithium battery powers the clock.

Warning **Lithium batteries may explode if mistreated. Do not put lithium batteries in fires, try to recharge or disassemble them.**

Replace battery with only a Matsushita Electric BR-2325 three-volt lithium battery (HP part number 1420-0314)! Use of any other battery may cause fire or explosion.

RS-232 Connector Pin-Out

Figure 3-12 identifies the RS-232 connector pins. Table 3-17 lists the RS-232 connector's pin numbers and signals.

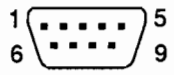

Figure 3-12. RS-232 Interface Connector

Table 3-17. RS-232 Connector Pinouts

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	DCD	4	DTR	7	RTS
2	RXD	5	Ground	8	CTS
3	TXD	6	DSR	9	RI

LAN Circuit

LAN circuits use the Ethernet/IEEE 802.3 standard interface. Only the Attachment Unit Interface (AUI) version is used; no BNC connector is provided for ThinLAN. The shared memory area has the memory controller circuits, 16 Kbytes of RAM, 64 nybbles of nonvolatile storage of the node address, and control, status, and ID registers. Multiplexing of CPU bus information and the LAN chip set is also part of the controller circuit.

Frontplane circuits include the LAN chip set, timer, and the transceiver chip. The LAN chip set serves the dual function of a DMA controller and an Ethernet/IEEE 802.3 controller. Encoded data from the serial interface adaptor (SIA) is transmitted by the transceiver chip. Data from the network is sent by the transceiver chip to the SIA.

The AUI connector enables connections to an external MAU. Supported adapters for various networks are listed in Table 3-18.

Table 3-18. Supported AUI LAN Adapters and Devices

LAN Adaptor	Network Devices
HP 28641A/B ThinLAN Transceiver	HP 28645A Multiport Repeater, 1 AUI/f, 3 30Base2/m
	HP 28648B LAN Bridge 2 AUI/f
	HP 28649A IEEE 802.3 LAN to 802.5 Token Ring Bridge
	HP 28683A Fiber Optic Transceiver
HP 28685A 10BaseT EtherTwist MAU	HP 28682A Fiber Optic Hub Plus
HP 30241A 10Base5 ThickLAN MAU	HP 28684A EtherTwist Hub

The LAN interface technical information is listed in Table 3-19.

Table 3-19. LAN Interface Technical Information

Function	Data
Type:	IEEE 802.3, Ethernet 1.0
Data rate:	10 Mbits/second
Connector type	AUI LAN - 15-pin

LAN AUI Connector Pin-Out

Figure 3-13 identifies the LAN AUI connector pins. Table 3-20 lists the LAN AUI connector's pin numbers and signals.

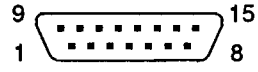

Figure 3-13. LAN AUI Interface Connector

Table 3-20. LAN AUI Connector Pinouts

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	CI-S	7	CO-A	13	VP
2	CI-A	8	CO-S	14	VS
3	DO-A	9	CI-B	15	CO-B
4	DI-S	10	DP-B	16	Ground
5	DI-A	11	DO-S	17	Ground
6	Vc	12	DI-S		

Connector Board

The connector board has these switches, indicators and interface connectors:

- HP-HIL connector.
- Service/Normal switch.
- TOC (Transfer of Control) switch.
- Service, test/status and power LEDs.
- HP Parallel.
- Speaker.
- Microphone.
- SCSI.

Connections are made to the system board by an interconnector.

There are no functional components or circuits on the connector board.

Figure 3-14 shows the connector board.

Figure CONNBD here.

Figure 3-14. Connector Board

RAM Boards

Models 745*i* and 747*i* use Single In-line Memory Modules (SIMM). Figure 3-15 shows a typical RAM board.

Figure RAM here.

Figure 3-15. RAM Board

Standard memory is 16 Mbytes. Factory-installed upgrades can make total memory of 24, 32, 72, 80 or 128 Mbytes. Three customer installable upgrades include RAM boards as follows:

- HP A2815A; two 4 Mbyte RAM boards that add an 8 Mbyte block of memory.
- HP A2816A; two 8 Mbyte RAM boards that add an 16 Mbyte block of memory.
- HP A2827A; two 32 Mbyte RAM boards that add a 64 Mbyte block of memory.

16 Mbyte RAM boards (A2575-60001) may be used, but are not available as an upgrade.

RAM boards must be installed in pairs, but the largest pair may be in either `RAM PAIR 0` slots or `RAM PAIR 1` slots.

Refer back to the section titled 'Memory Controller Circuit' for memory mapping and addressing information.

Motherboards

A motherboard is mounted vertically in the front of the main chassis. It distributes power from the power supplies to all functional assemblies, including converter boards and accessory cards. Data busses also connect between the system board's edge connector and other modules.

The front panel power switch connects to the motherboard. Motherboard traces connect the power switch functions to the power supplies. Both the front panel and power supply power switches must be on to power-up the workstation. Either may be turned off to shut it down.

Ten LEDs indicate the same functions as the system module's LEDs. A light pipe sends their illumination to the front panel. Signals to the LEDs come from the system board and are the same for both sets of LEDs.

Motherboard; Model 745*i*

Model 745*i* industrial workstations have a small motherboard. It connects the system board to the EISA converter board.

Motherboard; Model 747*i*

Model 747*i* industrial workstation's have a large motherboard. It connects the system board to the EISA and VME converter board, as well as the SGC graphics board.

A circuit connecting the power supplies allows only one power supply's power switch to be turned off to shut down the other power supply.

Power Supply

A modular power supply is used in these workstations. Two are used in Model 747*i* workstations. LEDs on the power supply indicate:

- Green; power on.
- Amber; power failure.

Power distribution from the supply through the motherboard to functional assemblies are:

- Model 745*i* has all assemblies powered from its single supply.
- Model 747*i*:
  - VME module, including the VME converter board and VME backplane, receive power from the bottom power supply.
  - All other assemblies receive power from top power supply.
  - Both power supplies must be installed for them to operate.

Note Power supplies used in Model 745*i* and 747*i* Industrial Workstations are auto-ranging. Pressing any power switch off, either power supply or front panel, will shut down the workstation. Model 747*i*'s have two power supplies.

VMEbus and VME Converter Board

A VMEbus converter board connects to the motherboard. VME information from the system board is converted to the backplane's six slots. VMEbus slot numbers are:

- VMEbus Slot 1; the VME converter board.
- VMEbus Slot 2 through 7; top slot down through the bottom slot.

VMEbus slots in the VME module's backplane board do not have switches.

Insert artwork here.

Figure 3-16. VME Converter Board

Insert artwork here.

Figure 3-17. VME Backplane Board

A History and Overview of the VMEbus

In the late 1970's, Motorola developed the 68000 microprocessor. EXORmacs, a development system for this new microprocessor, was co-developed. This development system contained a new bus called the VERSAbus. With the popularity of the development system, it was decided to develop a line of board products called VERSAmodules. To encourage third parties to develop boards for this system, initial bus documentation was produced and distributed. Over the next several years, the documentation improved and became widely accepted. Motorola's European Microsystems group proposed that a new product be developed based on the Eurocard board size. This was accepted and the bus for this new product was called VERSAbus-E.

The popularity of these new buses caused Motorola to license both Mostek (Carrolton, Texas) and N.V. Philips/Signetics (Sunnyvale, California) to second source the 68000 and co-develop support chips for this processor. Since both companies wanted to produce board products, Motorola invited them to help co-develop a supporting bus. As a result of their efforts, the VMEbus was born. Over the next several years, efforts to make this new bus a standard resulted in the IEEE P1014 and ICE 821 standards. The current IEEE standard is often referred to as the Rev. C standard. Currently, much effort is aimed at creating the Rev. D standard that will add 64-bit support and several other enhancements to the VMEbus.

VMEbus is very popular in Europe and growing in popularity around the world as the need for effective standards is recognized.

One spin-off of the VMEbus is the VXIbus. The VXIbus is the VMEbus with user-defined signal lines assigned to instrument control signals. HP was a major initiator of the VXIbus

standard. For an overview of the VXIbus, get a copy of the document "Feeling Comfortable with VXIbus", HP part number 5952-3080.

The next generation of bus standards will most likely be the FutureBus+ (Future Bus Plus) standards being developed now. Due to the large number of VMEbus users, VMEbus is expected to be used for many years to come.

VMEbus Architecture

VMEbus uses Master-Slave architecture with central arbitration. Masters are boards containing CPUs or DMA engines that control data flow. Masters read from or write to slaves. Slaves are all other boards, including I/O, memory and peripheral boards. The slot-01 system controller board is a master with the additional requirements of providing central arbitration, system clock, power monitor, bus timer and IACK daisy-chain driver. The slot-01 board must be physically located in slot one of the card cage. Dual-capability master-slave boards are supported.

VMEbus Synchronization

Rev. C. VMEbus is asynchronous and non-multiplexed. Data transfers are not even synchronized with the system clock. With Rev. D, the bus is still asynchronous, but data is now multiplexed on the address lines to provide D64 (64-bit data) operation without adding signal lines. A proposal for synchronous serial transfer operation (SST) is also being considered.

VMEbus Bandwidth

VMEbus is a 40 megabyte/second bus. This maximum bandwidth is achieved with 256-byte block transfers of 32-bit words. This is currently considered a fast bus. With Rev. D, the multiplexing of data on the address lines for D64 operation provides 80 megabyte/second operation. This maximum bandwidth is achieved with 2048-byte block transfers of double long-word (64-bit) aligned addresses. Normal (non-block mode) transfers, sometimes called compelled mode transfers, move data at a slightly slower speed.

VMEbus Crate

The VMEbus crate can support between two and 21 boards. The boards are located on 0.8-inch centers in the backplane. Repeaters allow multiple crate configurations. Note that only 6 VMEbus slots are in the Model 747*i*.

Size of VMEbus Boards

There are two standard VMEbus card sizes and one non-standard card size in use:

- Single Height 160 x 100 mm Eurocard - Uses P1/J1 signal lines only. This allows up to 24-bit addresses and 16-bit data transfers. No 32- nor 64-bit support. 3U boards are supported in 6U crates.
- Double Height 160 x 233 mm Eurocard - Uses P1/J1 and P2/J2 signal lines and supports 32- (and with Rev D), 64-bit operation.
- Triple Height. These boards use three connectors. The third connector is used for proprietary signals. This configuration is not supported by VMEbus. Most Sun Microsystems™ VMEbus implementations use this non-standard format.

Dynamically Assigned Address/Data Bus Widths

Rev. C VMEbus allows address widths of 16-, 24-, and 32-bits. This is called A16, A24 or A32 operation, respectively. Rev. D adds 64-bit addresses called A64 operation. Address size is dynamically defined by the address modifier bits AM0 through AM5. This allows older technologies to work with the newer technologies.

Rev. C supports 8-(Odd bytes only), 8-(Odd or Even bytes), 16-, 24-, and 32-bit data widths. This is called D08(O), D08(OE), D16, D24 and D32 operation, respectively. Rev. D adds 64-bit data widths called D64 operation. Data size is dynamically defined. This allows older technologies to work with the newer technologies. If a slave can not run a specific cycle, the respective master can retry the operation with a different address modifier.

VMEbus Interrupts

VMEbus supports seven levels of interrupt. The interrupt acknowledge signal line is daisy-chained. Each board receives Interrupt Acknowledge In and can pass the signal to the following board with Interrupt Acknowledge Out. If two boards with the same interrupt priority generate an interrupt at the same time, the board closest to the Slot 01 System Controller board will be granted the bus.

VMEbus Reference Materials

More information about the VMEbus can be found in these books:

- *VMEbus System Magazine*, From VMEbus Systems, 25875 Jefferson, St. Clair, MI 48081. Free if requested on company stationary with statement that requestor deals with or is considering VMEbus.
- *The VMEbus Handbook*, Second Edition, by Wade D. Peterson, VFEA International Trade Association, 10229 N. Scottsdale Road, Suite B, Scottsdale, AZ 85253. Excellent and readable discussion of the bus. Cost is approximately $50.00. Recommend for those needing further basic VMEbus information in an easy to read format.
- *The VMEbus User's Handbook*, by Heath, 1989, CRC Press. Cost is approximately $50.00. A very good book.
- *The VMEbus Specification*, VFEA International Trade Association, 10229 N. Scottsdale Road, Suite B, Scottsdale, AZ 85253. This is the IEEE specification.

VME Module RFI and ESD Requirements

Caution To meet regulatory requirements for emitted radio frequency interference (RFI) and electrostatic discharge (ESD) protection, an extension cable must be made and installed between VMEbus accessory card cable connectors and the VME module's RFI cover. The RFI cover is the RFI and ESD protection for the workstation and needs to be installed while operating the workstation. Peripheral devices cables will then plug into the cable connector on the RFI cover.

As Hewlett-Packard does not know what VMEbus accessory cards you may use, you need to have these extension cables made locally. For example, if a VMEbus accessory card has a SCSI connector, a short extension cable with a SCSI male connector on the accessory card end and a SCSI female chassis

connector on the other end. A connector port must be drilled or milled into the RFI cover at a location suitable for the extension cable. The chassis connector is installed on the RFI cover and the accessory card connector is plugged into the VMEbus accessory card. After putting the RFI cover back on the VME module, connect the peripheral's cables. Steps 7 through 10 show an example of how this is done.

If you elect not to install an extension cable between the VMEbus accessory card and the RFI cover, RFI and ESD performance will likely be inadequate.

VMEbus Connector Pinouts

Table 3-21 and Table 3-22 lists the VMEbus connector pinout information.

Table 3-21. VME P1/J1 Pin Assignments and Signal Mnemonics

Pin No.	Row A	Row B	Row C
1	D00	BBSY	D08
2	D01	BCLR	D09
3	D02	ACFAIL	D10
4	D03	BG0IN	D11
5	D04	BG0OUT	D12
6	D05	BG1IN	D13
7	D06	BG1OUT	D14
8	D07	BG2IN	D15
9	GROUND	BG2OUT	GROUND
10	SYSCLOCK	BG3IN	SYSFAIL
11	GROUND	BG3OUT	BERR
12	DS1	BR0	SYSRESET
13	DS0	BR1	LWORD
14	WRITE	BR2	AM5
15	Ground	BR3	A23
16	DTACK	AM0	A22
17	Ground	AM1	A21
18	AS	AM2	A20
19	Ground	AM3	A19
20	IACK	Ground	A18
21	IACKIN	SERCLK(1)	A17
22	IACKOUT	SERDAT(1)	A16
23	AM4	Ground	A15
24	A07	IRQ7	A14
25	A06	IRQ6	A13
26	A05	IRQ5	A12
27	A04	IRQ4	A11
28	A03	IRQ3	A10
29	A02	IRQ2	A09
30	A01	IRQ1	A08
31	-12Vdc	+5VSTDBY	+12Vdc
32	+5Vdc	+5Vdc	+5Vdc

Table 3-22. VME P2/J2 Pin Assignments and Signal Mnemonics

Pin No.	Row A	Row B	Row C	Pin No.	Row A	Row B	Row C
1	User defined	+5Vdc	User defined	17	User defined	D19	User defined
2	User defined	Ground	User defined	18	User defined	D20	User defined
3	User defined	Reserved	User defined	19	User defined	D21	User defined
4	User defined	A24	User defined	20	User defined	D22	User defined
5	User defined	A25	User defined	21	User defined	D23	User defined
6	User defined	A26	User defined	22	User defined	Ground	User defined
7	User defined	A27	User defined	23	User defined	D24	User defined
8	User defined	A28	User defined	24	User defined	D25	User defined
9	User defined	A29	User defined	25	User defined	D26	User defined
10	User defined	A30	User defined	26	User defined	D27	User defined
11	User defined	A31	User defined	27	User defined	D28	User defined
12	User defined	Ground	User defined	28	User defined	D29	User defined
13	User defined	+5Vdc	User defined	29	User defined	D30	User defined
14	User defined	D16	User defined	30	User defined	D31	User defined
15	User defined	D17	User defined	31	User defined	Ground	User defined
16	User defined	D18	User defined	32	User defined	+5Vdc	User defined

EISA Converter Board and Backplane

Connected to the motherboard, the EISA converter board manages the interface between installed EISA accessory cards and the system board. The main interface bus on the motherboard is converted to the EISA bus by the EISA converter board. An EISA backplane connects to the EISA converter board. Two EISA backplane slots are used in the Model 747*i* and four slots are used in the Model 745*i*.

Table 3-23 and Table 3-24 lists the pinouts.

Table 3-23. Long EISA Connector Pinouts

Pin No.	Row F	Row B	Row E	Row A
1	Ground	Ground	CMD*	IOCHK*
2	+ 5 V	RESDRV	START*	D<7>
3	+ 5 V	+ 5 V	EXRDY	D<6>
4		IRQ<9>	EX32*	D<5>
5		- 5 V	Ground	D<4>
6	(Key)	DRQ<2>	(Key)	D<3>
7		- 12 V	EX16*	D<2>
8		NOWS*	SLBURST*	D<1>
9	+ 12 V	+ 12 V	MSBURST*	D<0>
10	M-IO	Ground	W-R	CHRDY
11	LOCK*	SMWTC*	Ground	AENx
12	Reserved	SMRDC*	Reserved	SA<19>
13	Ground	IOWC*	Reserved	SA<18>
14	Reserved	IORC*	Reserved	SA<17>
15	BE*<3>	DAK*<3>	Ground	SA<16>
16	(Key)	DRQ*<3>	(Key)	SA<15>
17	BE*<2>	DAK*<1>	BE*<1>	SA<14>
18	BE*<0>	DRQ<1>	LA*<31>	SA<13>
19	Ground	REFRESH*	Ground	SA<12>
20	+ 5 V	BCLK	LA*<30>	SA<11>
21	LA*<20>	IRQ<7>	LA*<28>	SA<10>
22	Ground	IRQ<6>	LA*<27>	SA<9>
23	LA*<26>	IRQ<5>	LA*<25>	SA<8>
24	LA*<24>	IRQ<4>	Ground	SA<7>
25	(Key)	IRQ<3>	(Key>	SA<6>
26	LA<16>	DAK*<2>	LA<15>	SA<5>
27	LA<14>	T-C	LA<13>	SA<4>
28	+ 5 V	BALE	LA<12>	SA<3>
29	+ 5 V	+ 5 V	LA<11>	SA<2>
30	Ground	OSC	Ground	SA<1>
31	LA<10>	Ground	LA<9>	SA<0>

Table 3-24. Short EISA Connector Pinouts

Pin No.	Row H	Row D	Row G	Row C
1	LA<8>	M16*	LA<7>	SBHE*
2	LA<6>	IO16*	Ground	LA<23>
3	LA<5>	IRQ<10>	LA<4>	LA<22>
4	+ 5 V	IRQ<11>	LA<3>	LA<21>
5	LA<2>	IRQ<12>	Ground	LA<20>
6	(Key)	IRQ<15>	(Key)	LA<19>
7	D<16>	IRQ<14>	D<17>	LA<18>
8	D<15>	DAK*<0>	D<19>	LA<17>
9	Ground	DRQ<0>	D<20>	MRDC*
10	D<21>	DAK*<5>	D<22>	MWTC*
11	D<23>	DRQ<5>	Ground	D<8>
12	D<24>	DAK*<6>	D<25>	D<9>
13	Ground	DRQ<6>	D<26>	D<10>
14	D<27>	DAK*<7>	D<28>	D<11>
15	(Key)	DRQ<7>	(Key)	D<12>
16	D<29>	+ 5 V	Ground	D<13>
17	+ 5 V	MASTER16*	D<30>	D<14>
18	+ 5 V	Ground	D<31>	D<15>
19	MAKx*		MREQx*	

Mass Storage Devices

525 Mbyte and 1 Gbyte Hard Disk Drives

These hard disk drives are random access mass storage devices that contains a 3.5-inch nonremovable disk media. They use a rotary actuator to move read/write heads over the media. Read/write heads are used for reading data from and writing data to the disk. The heads also read embedded servo information on the data tracks to maintain head alignment during changes in operating temperature.

Figure 3-18 shows a 525 Mbyte and 1 Gbyte hard disk drive. One of two makes may be used, They are identical in functionality but have different configuration jumper functions.

Figure GBHDD here.

Figure 3-18. 525 Mbyte and 1 Gbyte Hard Disk Drive

An attached controller PC board with a single-ended Small Computer System Interface (SCSI) interface is part of the drive.

Capacity and formatting information is listed in Table 3-25.

Table 3-25. 525 Mbyte and 1 Gbyte Hard Disk Drive Formatted Capacity

Hard Disk Drive	Formatted Capacity in Bytes	Track Density	Disks	Max. Record Density	Heads Per Unit
1 Gbyte	1,050,000,000	2,290 tpi	14	36,700 bpi	14
525 Mbyte	525,000,000	2,290 tpi	7	36,700 bpi	14

Note Technical information listed herein should not be interpreted as specifications. Official specifications are listed in the HP 9000 Series 700*i* Model 745/747 Technical Data Sheet.

Performance

Buffer to SCSI Bus Data Transfer Rate.

Synchronous burst:	10.0 Mbytes/second
Asynchronous burst:	5.0 Mbytes/second

SCSI Bus to Buffer Data Transfer Rates.

Minimum:	2.41 Mbytes/second
Maximum:	4.67 Mbytes/second

Maximum Error Rates.

Unrecoverable error:	1 errors per 10^{14} bits read
Seek:	10 errors per 10^{7} seeks

Functional.

Rotational speed:	4,500 RPM
Average seek time, including settling:	25 ms
Single-track seek:	3 ms
Full-stroke seek:	25 ms
Average rotational latency:	6.7 ms

Environmental Requirements

Ambient Temperature.

Operating:	5°C to 50°C (41°F to 122°F) 20°C/hr (36°F/hr gradient)
Non-operating	−40°C to 65°C (−40°F to 140°F) 20°C/hr (36°F/hr gradient)

Altitude.

Operating:	Minimum −61 metres (−200 ft.) Maximum 3 000 metres (10,000 ft.)
Non-operating:	Minimum −61 metres (−200 ft.) Maximum 12 000 metres (40,000 ft.)

Ambient Relative Humidity.

Operating:	20% to 80% (noncondensing)
Non-operating:	8% to 85% (noncondensing)
Maximum wetbulb temperature:	26°C (79°F)

3.5-in. Flexible Disk Drive

The 3.5-in. flexible disk drive is a random access mass storage device that uses a removable 3.5-inch double/high-density disk media. The flexible disk drive uses a rotary actuator to move read/write heads over the media. Read/write heads are used for reading data from and writing data to the disk. The heads also read embedded servo information on the data tracks to maintain head alignment during changes in operating temperature.

Figure 3-19 shows a flexible disk drive.

Figure FDD here.

Figure 3-19. 3.5-in. Flexible Disk Drive

Both 1.44 Mbyte and 2 Mbyte 3.5-in. formats may be used. Capacity and formatting information is listed in Table 3-26.

Table 3-26. 3.5-in. Flexible Disk Drive Formatted Capacity

Media Density	Formatted Capacity	Unformatted Capacity
High	1.474 Mbytes	2.0 Mbytes
Low	720 Kbytes	1.0 Mbytes

An attached controller PC board with a single-ended Small Computer System Interface (SCSI) interface connects your drive to your computer's SCSI interface cable. Power is supplied through a flexible disk drive power cable connected to the SCSI power distribution cable. The flexible disk drive's power connector is different than the other mass storage devices used in many other products.

Technical Information

Note Technical information listed herein should not be interpreted as specifications. Official specifications are listed in the HP 9000 Series 700*i* Model 745/747 Technical Data Sheet.

Performance

	High Density
Data transfer rate:	
Drive to SCSI	500 Kbits/sec
SCSI to host capacity	500 Kbits/sec
Disk performance:	
Rotational speed	300 RPM ±2%
Start time	500 msec max.
Average latency	100 msec max.
Media specification:	
Density	2S/HD
Sides	2
Cylinders	80
Track construction:	
Tracks per side	80
Tracks per disk	160
Density	135 tpi
Inner bit density	17,434 bpi
Positioning error	± 15 μm
Access times:	
Track-to-track	3 msec max.
Seek settling time	15 msec max.
Index detection:	
Detection cycle	198.6 - 203.0 msec
Timing error	±500 μsec
Window margin:	300 nsec min.

Environmental Requirements

Temperature.

Operating:	4°C to 50°C (39°F to 122°F)
Non-operating (storage):	−22°C to 60°C (−8°F to 140°F)

Altitude.

Operating:	Minimum 0 metres (0 ft.) Maximum 5 000 metres (16,500 ft.)
Non-operating:	Minimum 0 metres (0 ft.) Maximum 12 000 metres (40,000 ft.)

Humidity.

Operating:	20% to 80% relative humidity (noncondensing) max. wetbulb temperature 29°C (84°F)
Non-operating:	10% to 90% relative humidity (noncondensing) max. wetbulb temperature 40°C (104°F)

CD ROM Disk Drive

Your HP A2074A CD ROM Drive is a random access read-only mass storage device that uses removable CD ROM disks. A semi-conductor laser is used for reading data optically. Computer data is sent from the drive through a single-ended Small Computer System Interface (SCSI). An audio jack on its front panel accepts a standard 3.5mm miniature stereo headphone jack for optional listening to audio compact discs. The drive has configuration switches for setting the device SCSI bus address, arbitration, parity and test mode.

Figure 3-20 shows a CD ROM disk drive.

Figure CDD here.

Figure 3-20. CD ROM Disk Drive

Caution Do not open the shutter manually. Opening the shutter will expose the disk's data surface to dust and damage. If the data surface gets too much dust or damage, its readability by the laser read head will be reduced.

CD ROM disks are identical to audio compact discs except they store computer data. Both audio compact discs and CD ROM disks may be used in the drive. Disks are 120 mm (4.7-in.) in diameter and use one data surface. Up to 599 Mbytes of data or 74 minutes of audio can be stored on a disk. Pits and flat spots are arranged in a spiral track on the data surface. A laser beam is reflected off of the pits and spots as they are rotated at a constant speed. These reflections are decoded as digital data. Data is sent out on the SCSI interface for use in your computer. In audio mode, the digital data is converted to analog information and supplied to the headphone jack.

A rigid plastic caddy holds and protects the disk. The caddy with installed disk is inserted into the disk port and data is read through a shutter in the caddy. When you eject the caddy, the shutter closes to protect the disk's data surface.

Extra disk caddies are available by ordering part number C2293-80001.

Most Hewlett-Packard CD ROM software comes in a 'jewel case' like the audio compact discs are packaged in. You must remove the CD ROM from the jewel case and insert it into the caddy before you use it in your CD ROM drive.

Caution The HP A2074A CD ROM Drive's disk caddy is not interchangeable with the HP C1707A CD ROM Drive's disk caddy. You can exchange the CD ROMs between these caddies. Refer to your computer's *Owner's Guide* for instructions.

Technical Information

Note Technical information listed herein should not be interpreted as specifications. Official specifications are listed in the HP 9000 Series 700*i* Model 745/747 Technical Data Sheet.

Computer Data Transfer Rate (asynchronous)

Average:	153 kilobits/second
Maximum:	1400 kilobits/second

Access Time (including latency)

Track-to-track:	1 ms
Average random:	350 ms
Maximum:	700 ms

Functional

Load time:	6 seconds
Unload time:	3 seconds
Motor spin-up time:	1 second
Rotational speed[1]	530 to 200 rpm

[1] Decreases from inner track diameter to outer track diameter to maintain constant linear velocity at read head.

Media

Diameter:	120 mm (4.7-inches)
Number of read surfaces:	1
Computer data format type:	*Yellow Book*
Data capacity Mode 1:	599 Mbytes
Data capacity Mode 2:	683 Mbytes
User data per block mode 1	2,048 bytes
User data per block mode 2	2,336 bytes
Blocks per disk	292,500
Maximum audio playing time:	74 minutes (approximately)

Environmental Requirements

Temperature.

Operating:	5°C to 45°C (41°F to 113°F)
Non-operating	−10°C to 65°C (14°F to 149°F)

Altitude.

Operating	Minimum −305 metres (−1000 ft.) Maximum 12 500 metres (41,600 ft.)
Non-operating	Minimum −305 metres (−1000 ft.) Maximum 12 500 metres (41,600 ft.)

DDS Tape Drive

Two sizes of DDS tape drives are supported:

- HP C1503C 2 Gbyte DDS Tape Drive.
- HP C1504C 4 to 8 Gbyte DDS Tape Drive.

HP C1503/4C DDS drives use a data compression storage technique that allows more data on the tape. Depending on the type of data, between 2 and 8 Gbytes of data can be stored.

The DDS Tape Drive is a sequential access streaming tape device that stores data on removable DDS cassettes. It is a mass storage device used to store large quantities of information. Data is stored in Digital Data Storage (DDS) format. The DDS tape drive includes an imbedded controller with a single-ended Small Computer Systems Interface (SCSI). The DDS drive uses helical-scan technology like that used in video cassette recorders.

Although DDS cassettes are similar in some respects to cassettes used by DAT players in the audio industry, they are not interchangeable. There are two major differences:

- DAT tapes operate in streaming mode. That is, they are left in motion for long periods of time (several minutes, at least). Tapes used for data are continually starting, stopping and repositioning. But this is very stressful to the tape.

  DDS tapes are made rugged enough to stand this kind of treatment. Audio tapes are not expected to perform this well, and as a result fail very quickly in a data environment.
- DDS cassettes have a much tighter case dimension specification than DAT. As a result, DAT cassettes can get stuck in a DDS drive, requiring the drive to be disassembled to remove it.

Caution DAT audio tapes can cause your DDS tape drive mechanism to bind up and become inoperative. DAT audio tape cases do not have the close tolerances required by DDS tape drives. Only Hewlett-Packard supported DDS tape cartridges should be used.

Caution Do not attempt to force out a DAT cassette which is stuck in a DDS drive. You may damage the drive. Contact your local Hewlett-Packard Service Office to arrange for safely removing the cassette.

In order to provide this extra guarantee of quality and ruggedness for computer use, a new media standard was developed. Called DDS, it stipulates more stringent mechanical, environmental, reliability and durability specifications than the DAT standard.

For these reasons, it is imperative that you use only properly certified DDS tapes in your drive, not DAT tapes which are only satisfactory for audio use. Use of DAT tapes will void your warranty.

In order to identify data-grade tapes, look for one of these DDS logos on the cassette case shown in Figure 3-21.

Figure 3-21. DDS Logos

The logos may be used by any manufacturer whose tapes meet the DDS specification. Hewlett-Packard recommends that you use Hewlett-Packard DDS cassettes with your DDS-format drive. Hewlett-Packard cassettes have been designed and tested to give maximum reliability and durability.

DAT audio tapes cannot be used in the DDS tape drive to play audio.

A write-protect tab on the cassette allows you to protect data from being over-written.

Figure 3-22 shows a DDS tape drive.

Figure DDSTD here.

Figure 3-22. DDS Tape Drive

DDS Tape Drive LED Indicators

Two LED indicators on the drive's front panel indicate several operational and test states. Table 3-27 lists the LED symbols used in Table 3-28 which explains them.

Table 3-27. DDS Tape Drive LED Symbols

LED Symbol	Meaning
	Off
	Green
	Amber
	Pulse Green
	Pulse Amber
	Pulse Green/Amber

Table 3-28. DDS Tape Drive LED State Codes

States	Cassette	Drive	Meaning
Read/Write			Cassette (un)loading
			Cassette loaded/online
			Cassette loaded/Activity
			Cassette loaded/offline
Write-Protect			Cassette (un)loading
			Cassette loaded/online
			Cassette loaded/Activity
			Cassette loaded/offline
Error			Media wear (caution
			High humidity/No termination on SCSI bus
			Self-test (normal)
			Self-test (failure)

DDS Workstation Firmware Kit

When you replace a DDS tape drive, the new drive's controller board must have firmware loaded into its PROMs. A DDS Workstation Firmware Kit includes a tape with the data on it. After replacing a DDS drive with a new one, follow the instructions provided with the replacement drive and install the firmware.

Caring for DDS Cassettes

You will maintain your DDS data integrity and prolong the life of your DDS cassettes and your DDS drive by:

- Before using a new tape, ensure the tape media is tight on the spools. Otherwise, it may jam when the drive positions the tape.
- Keeping DDS cassettes away from appliances with magnetic fields, such as telephones or products with motors, transformers or magnets.
- Not leaving DDS cassettes in excessively dry or humid environments. Refer to the 'DDS Cassette Temperature Limits' section for requirements.
- Keeping DDS cassettes out of direct sunlight or other high temperature areas.
- Not opening the DDS cassette and touching the tape or trying to clean the tape or tape guides.
- Applying only one label to the DDS cassettes. Two or more labels can cause the cassette to jam in the DDS drive.
- Storing DDS cassettes in their plastic cases in a clean environment when not in use.
- Not using DDS cassettes beyond their useful life. Refer to the section on 'Media Warning and Tape Wear.'

DDS Cassette Temperature Limits

Note If you expose DDS cassettes to temperatures outside the operating limits, the temperature of the cassettes must be stabilized before they are used. To stabilize the temperature of a DDS cassette, leave the cassette in the operating temperature for a length of time equal to the time the cassette was outside the limits, up to a maximum of eight hours. Refer to the 'Technical Information' section for environmental requirements.

Media Warning and Tape Wear

Note The read/write head in your DDS drive should be cleaned with a DDS cleaning cassette after every ten hours of use. Doing this will maximum date integrity and prolong the life of the read/write head in your DDS drive.

Your DDS drive monitors the cassette's tape wear. The drive's busy light flashes a media warning when the tape is nearing the end of its useful life or when the tape heads are dirty. Do these steps when the busy lights indicate a media warning:

1. Follow the instructions on the DDS cleaning tape and clean the tape heads.
2. Repeat the operation that was being performed when the media warning occurred.
3. If the media warning is not repeated the tape heads were dirty. Normal use of the DDS cassette can be resumed.

   If the media warning is repeated, do these steps:

   a. Copy the data from the DDS cassette onto a hard disk drive.

b. Copy the data from the hard disk drive to a new DDS cassette.

c. Discard the old DDS cassette.

Technical Information

Note Technical information listed herein should not be interpreted as specifications. Official specifications are listed in the HP 9000 Series 700*i* Model 745/747 Technical Data Sheet.

Performance

Computer Data Transfer Rate (asynchronous)

Maximum sustained:	183 kilobits/second
Maximum burst:	1.58 Mbytes/second

Access Time (including latency)

Average random:	20 seconds

Functional

Load time:	25 seconds from cassette inserted until ready to perform first command.
Unload time:	10 seconds from wind tape to beginning of tape, unthread and eject cassette.

Media

Type:	90 metre (295 feet) DDS
Format:	Helical-scan digital audio tape.
Data capacity:	2 GBytes; 90 m tape, C1503A
	4 to 8 GBytes; 90 m tape, C1504A
Record size:	512 bytes

Environmental Requirements

DDS cassettes should only be used at temperatures between 5°C (40°F) and 45°C (113°F). Do not transfer data to or from the cassette if the temperature is changing more than 10°C per hour. DDS cassettes can be stored at temperatures down to −40°C (−40°F).

Temperature

Operating:	5°C to 40°C (41°F to 104°F)
Non-operating (storage):	−40°C to 70°C (−40°F to 154°F)

Altitude

Operating:	Minimum 0 metres (0 ft.) Maximum 4 600 metres (15,000 ft.)
Non-operating:	Minimum 0 metres (0 ft.) Maximum 15 240 metres (50,000 ft.)

Humidity

Operating:	20% to 80% relative humidity (noncondensing)
Non-operating (without tape):	15% to 95% relative humidity (noncondensing)
Maximum wetbulb temperature:	26°C (79°F)

4

Configuring the Models 745*i* and 747*i*

Introduction

Several configuration situations exist with these products. Each is explained in these sections:

- HP-UX 9.01 Diagnostic Patch
- Boot Console User Interface
- Keyboard Differences
- Mass Storage Devices
- Graphics Configuration
- EISA Accessory Cards
- Memory Boards

HP-UX 9.01 Diagnostics Patch

Introduction

Note *HP-UX version-related information in this section supersedes the information found in the following documents:*

- *Installation Guide — HP 9000 Series 700i Industrial Workstations*: part number A2261-90015
- *Installation Guide — HP A2628A System Module Upgrade*: part number A2628-90010.
- *Models 745/50, 745/100, 747/50, and 747/100 Owner's Guide for HP-UX Users*: part number A2628-90014.

Series 700i/100 systems are designed to run on HP-UX 9.01 with a patch tape included with bundled workstations and the HP A2628A System Module Upgrade. In this kit (B2910-67901), a DDS-Format tape with which you will need to update your HP-UX 9.01 for proper logfile operation. This patch also comprises a number of features and diagnostic tools, including the following:

- Diagnostic functionality allowing PSIDAD Diagnostic to report EEPROM version numbers correctly.
- The `iomap` utility, which can identify the configuration of the system and its I/O paths and devices as well as perform selftest and loopback diagnostics.
- SAM, disktab, and diagnostic support for the Seagate ST11200N 1 Gbyte disk drive. (To determine whether you have a Seagate drive, enter `/etc/ioscan -fb` at a shell prompt).

Note

- **As a general precaution, be sure to back up your system before you install this patch.**

Installation Procedure

To install this patch, follow the instructions given below. Refer to the manual *Installing and Updating HP-UX 9.0* when necessary.

1. Log into your system as `root`, and run your system in "single-user" state.
2. Turn on your DDS-Format tape drive and load the HP-UX 9.01 Diagnostics tape (`PHSS_XXXX`).
3. At a shell prompt (`#`) type `/etc/update` (Return).
4. In the update Main Menu, highlight the line to `Change Source or Destination ->` and select it by pressing (Return) or clicking on `Select Item`.
5. In the `Change Source or Destination` window, highlight the item `From Tape Device to Local System ...` and select it as before.

6. In the window `From Tape Device to Local System`, check that the `Source` field indicates the device file for your DDS-Format tape drive, which is usually `/dev/rmt/0m`.
7. Press `Done`.
8. From here on, follow the standard directions for Update found in the manual *Installing and Updating HP-UX 9.0*.

After the files are loaded, your system will reboot.

Boot Console User Interface

This section explains several configuration capabilities of the Boot ROM, including:

- Introduction
- Entering the Boot Administration Mode
- Exiting the Boot Administration Mode
- Getting Help for the Boot Console User Interface Commands
- Booting the Workstation
- Searching for Bootable Media
- Redisplaying the Results of a Search
- Displaying and Setting Paths
- Resetting the Workstation
- Displaying and Setting the Real-Time Clock
- Displaying and Setting the Autoboot and Autosearch Flags
- Displaying and Setting the Secure Boot Mode
- Displaying and Setting the Fastboot Mode
- Displaying the LAN Station Address

Introduction

There are times when you want to interact directly with the hardware of your workstation before it boots the operating system. Your workstation provides a boot console user interface to allow you to perform special tasks, display information, and set certain system parameters, even if the operating system is unavailable.

Special Tasks

Here are the special tasks that you can perform:

- Boot your workstation from any specified hardware device.
- Search for hardware devices that contain media from which your workstation can be booted.
- Reset the workstation.

Information Displayed

Here are some of the kinds of information that your system can display:

- A list of the commands you may issue from the boot console user interface.
- Real-time clock's time and date.
- Settings of the Autoselect.
- Status (on or off) of the secure boot mode.
- Station address for the built-in LAN interface.
- Primary and secondary boot path.
- Console path.

System Parameters

Here are some of the system parameters that you can set:

- Real-time clock time and date.
- Autoselect.
- Status (on or off) of the secure boot mode.
- Status (on or off) of the fastboot memory test.

- Primary and secondary boot path.
- Console path.

Using the Boot Console User Interface

To use the boot console user interface, follow these steps:

1. Shut down your workstation.
2. Turn off the workstation, for a few seconds. Then, turn it back on.
3. Press (ESC).

In a few seconds, this message appears:

```
Terminating selection process.
```

A short time later, this message appears and devices that can boot HP-UX are listed as they are found:

```
Searching for potential boot devices. To terminate search, press
and hold the ESCAPE key.

Device Selection    Device Path       Device Type and Utilities
------------------------------------------------------------

      P0            scsi.6.0          disk_drive_identifier
      P1            scsi.5.0          disk_drive_identifier
      P2            scsi.4.0          DDS-format_tape_drive_identifier
      P3            scsi.3.0          CD_ROM_drive_identifier
      P4            lan.123456-789abc cluster_server_identifier
```

If your workstation is a member of a cluster (a group of computers that share the file system of a host by means of a network connection), there may be no disks listed because your workstation has no disks directly attached to it.

This process may take several minutes. When the search ends, this list of actions appears as the Boot Console User Interface Menu:

```
b) Boot from specified device
s) Search for bootable devices
a) Enter boot administration mode
x) Exit and continue boot sequence
?) Help

Select from menu:
```

When you type in your entry, it appears to the right the prompt "`Select from menu:`"

Entering the Boot Administration Mode

To change system hardware parameters, you must enter the boot administration mode. *If your system has been switched into service mode, using the "Service/Normal" switch, it will automatically enter boot administration mode upon power-up.*

From within this mode, you may enter any of the commands used in the task descriptions that follow.

To enter the boot administration mode, type:

a (Return)

and the following prompt is displayed:

```
BOOT_ADMIN>
```

Exiting the Boot Administration Mode

To exit the boot administration mode, take one of the following actions, depending on your need:

- Type `exit` (Return) at the `BOOT_ADMIN>` prompt.

  This returns you to the boot console user interface menu.

- Type `reset`(Return).

  This restarts the workstation.

- Issue a boot command.

  See the section, "Booting the Workstation", for details.

- Turn off the workstation. There is no need to shut down the workstation with the special procedure described in Chapter 2, since the workstation has not yet been booted, and the file system has not been activated.

Getting Help for the Boot Console User Interface Commands

You may issue many different commands in the boot administration mode. For a complete listing, at the `BOOT_ADMIN>` prompt type one of these commands:

h (Return)

help (Return)

? (Return)

To get help for a particular command, type the following at the `BOOT_ADMIN>` prompt:

`help` *command_name* (Return)

where *command_name* is the name of one of the listed commands.

The displayed help information usually includes a description of the command, its options, and the format for parameters.

Booting the Workstation

Usually, you start your workstation in Normal Mode by turning it on and waiting for HP-UX to boot automatically. You may not want for the usual sequence to occur.

For example, you may want to start your workstation from an operating system that is stored on a device that is different from your usual boot device. If your normal operating system kernel or the disk on which it resides becomes damaged or unusable, you may wish to boot from a different disk or perhaps another type of device, such as a DDS-format tape drive.

Here are some situations and examples:

- If you know which device you want to boot from, and you know that it contains a bootable operating system, type the following at the `BOOT_ADMIN>` prompt:

  `boot` *device* (Return)

  where *device* is one of the following:

  The hardware path to the device, specified in Mnemonic Style Notation

  The *pn* designation of the device, as listed in the device search

  For example, if you wish to boot an operating system that is stored on a DDS-format tape in a drive that is located at `scsi.1.0` and is designated by the search as device `P2`, type one of the following commands at the `BOOT_ADMIN>` prompt:

  `boot scsi.1.0` (Return)

  `boot P2` (Return)

  

  The operating system on the specified device is used to start your workstation.

- If you wish to interact with the Initial System Loader (ISL) before booting your workstation, type the following at the `BOOT_ADMIN>` prompt:

  `boot` *device* `isl` (Return)

  This causes the ISL to be loaded from the specified device. After a short time, the following prompt appears on your screen:

  `ISL>`

  ISL is the program that actually controls the loading of the operating system. By interacting with ISL, you can choose to load an alternate version of the HP-UX operating system.

  For example, if the usual kernel (`/hp-ux`) on your root disk (`scsi.6.0`) has become corrupted, and you wish to boot your workstation from the backup kernel (`/SYSBCKUP`), type the following at the `ISL>` prompt:

  `hpux boot disk(scsi.6;0)/SYSBCKUP` (Return)

- If you do not know the locations of the bootable operating systems on the various media in your file system, you can find them with the search command.

* You may also boot the workstation from the main menu of the Boot Console User Interface by typing this command from the `Select from menu:` prompt:

`b` *device_path* (Return)

where *device_path* is a designator for the path to the device that contains a bootable file system.

Searching for Bootable Media

The initial search conducted by the boot console user interface locates devices that might contain bootable media. This search might find a DDS-format tape drive which actually does not contain a bootable tape. To check to see which devices actually contain bootable media, type the following at the `BOOT_ADMIN>` prompt:

`search` (Return)

This causes your workstation to search exhaustively for bootable media. It searches all types of I/O devices in the following order:

1. Built-in SCSI
2. Built-in LAN

The search may turn up more devices than there are lines on your display. If you are using a text terminal, you may control the progress of the search from your terminal's keyboard by performing one or more of the following steps:

- To hold the display temporarily, press (CTRL)-(S).
- To continue the display, press (CTRL)-(Q).
- To halt the search, press (ESC).

These flow-control commands do not work with a bitmapped display, but such a display can show more than forty lines of text, so you are unlikely to need them.

Note If the search discovers ten devices, the label in the Device Selection column for the tenth entry is labeled `P9`. Any subsequent entries are labeled `P*`.

`P*` cannot be used as a device designator for boot administration commands because it is ambiguous. To refer to a device labeled P* in a search, specify it by means of the entry in the Device Path column.

To search to see which devices of just one type actually contain bootable media, type the following at the `BOOT_ADMIN>` prompt:

`search` *device_type* (Return)

where *device_type* is one of the following:

- `scsi` is the built-in SCSI bus
- `lan` is all connections to the built-in LAN

You may also search for bootable media from the main menu of the Boot Console User Interface by using a command in one of the following forms:

`s` (Return)

`s` *device_type* (Return)

where *device_type* is the type of device (`scsi` or `lan`) for which you wish to search.

Redisplaying the Results of a Search

The list of bootable devices is stored until you conduct another search or you reboot your system. To see the list of devices again, type the following at the `BOOT_ADMIN>` prompt:

`show` (Return)

It is much faster to redisplay the list with show than it is to conduct the search again.

Displaying and Setting Paths

A path is the hardware address of a device that is attached to the I/O system of your workstation. The path command can set any of the paths shown in Table 4-1.

Table 4-1. System Paths

Path Type	Device
`primary` or `pri`	Your workstation's default boot device (usually the root disk)
`alternate` or `alt`	Your workstation's alternate boot device (usually a DDS-format tape device)
`console` or `con`	Your workstation's primary display device
`keyboard` or `key`	Your workstation's primary ASCII input device

To display the current settings for the system paths, type the following at the `BOOT_ADMIN>` prompt:

`path` (Return)

The paths are displayed in Mnemonic Style Notation as shown in Table 4-2.

Table 4-2. Mnemonic Style Notation

I/O Type	Specification Format
Built-in SCSI	`scsi.` *scsi_address.logical_unit_number*
Built-in LAN	`lan.` *server_address.init_timeout.io_timeout*
Built-in HIL	`hil`
RS-232 Port A	`rs232_a.` *baud_rate.word_length.parity_option*
RS-232 Port B	`rs232_b.` *baud_rate.word_length.parity_option*
SGC Graphics Slot	`graphics`
EISA slot	`eisa.eisa_slot.optional_info`

To display the current setting for a particular system path, type the following at the `BOOT_ADMIN>` prompt:

`path` *path_type* (Return)

where *path_type* is one of the path types listed in Table 4-1.

For example, to get the path to the primary boot device, type the following at the BOOT_ADMIN> prompt:

```
path primary (Return)
```

To set a system path to a new value, type the following at the BOOT_ADMIN> prompt:

```
path path_type path (Return)
```

where *path_type* is one of the path types listed in Table 4-1 and *path* is the specification of the path in Mnemonic Style Notation as described in Table 4-2.

For example, to set the console path to:

- RS-232 Port A,
- a baud rate of 4800,
- a word length of 7, and
- even parity,

type the following at the BOOT_ADMIN> prompt:

```
path console rs232_a.4800.7.even (Return)
```

For help in using the path command, type one of the following at the BOOT_ADMIN> prompt:

```
help path (Return)
help io_type (Return)
```

where *path_type* is one of the path types, except for HP-HIL and SGC, listed in Table 4-2. The help screens offer complete descriptions of all path options.

Resetting the Workstation

The act of resetting your workstation causes it to restart completely. It's similar to turning the workstation off and then back on again.

To reset your workstation, type the following at the BOOT_ADMIN> prompt:

```
reset (Return)
```

Displaying and Setting the Real-Time Clock

It is usually a good idea to set the real-time clock in your workstation with the HP-UX date command. That command contains special safeguards that can help you to avoid disruption of time-related processes (like those controlled by the cron command). But you may also set the clock from within the boot administration mode.

To display the current setting of the real-time clock, type the following at the BOOT_ADMIN> prompt:

```
date (Return)
```

Your workstation reports the information in this form:

```
Mon Jul 1 14:55:05 GMT (19:91:7:1:14:44:5)
```

To set the real-time clock, type the following at the BOOT_ADMIN> prompt:

`date` *century:year:month:day:hour:minute:second* Return

For example, to set the clock to July 1, 1991, 2:44:05 PM, GMT, type the following at the `BOOT_ADMIN>` prompt:

`date 19:91:7:1:14:44:5` Return

Note The boot administration mode's date command only understands Greenwich Mean Time (GMT). You must compute GMT relative to your own time zone to get the correct value for *hours*, and, in some time zones, *minutes*.

Displaying and Setting the Autoselect Flag

Autoselect is a variable stored in your workstation's EEPROM that retains its contents even after power is turned off. If you reset this flag to new values, the change takes effect the next time you reboot the workstation.

To examine the state of the Autoselect flag, type the following at the `BOOT_ADMIN>` prompt:

`auto` Return

If Autoselect is set to "`on`", when your workstation is turned on in normal mode, it automatically attempts to boot the operating system. If it is set to "`off`", your workstation enters the boot console user interface instead.

To change the state of the Autoselect flag, type the following at the `BOOT_ADMIN>` prompt:

`autoboot` *state* Return

where *state* is "`on`" or "`off`".

If Autoselect is set to on, when your workstation enters the boot console user interface, a search for all potential bootable devices takes place.

To change the state of the Autoselect flag, type the following at the `BOOT_ADMIN>` prompt:

`autosearch` *state* Return

where *state* is `on` or `off`.

Note Set Autoselect to "`on`" if you wish to have your system boot automatically from the first device it finds in its search. If you wish to have your system come up in the Boot Console User Interface, set Autoselect to "`off`".

Hewlett-Packard does not recommend setting Autoselect to any other values.

Displaying and Setting the Secure Boot Mode

In Normal Mode, there may be circumstances in which you would not wish to allow anyone to attempt to boot your workstation from a device other than the device you have specified, nor to control the system from any console other than the one you have designated. This can be an important consideration in secure installations.

If you set up your system in such a way that it is physically impossible for unauthorized persons to disconnect it from its designated boot device, you can guarantee that the boot console user interface cannot be used to boot the system from an unauthorized device or to change the console path. If the secure boot mode is set to on, the boot console interface

cannot be activated; thus, you are assured that your system's security cannot be compromised through interaction with that interface.

To check the status of the secure boot mode, type the following at the BOOT_ADMIN> prompt:

```
secure (Return)
```

The status "on" or "off" is displayed.

To change the value of the secure boot mode, type the following at the BOOT_ADMIN> prompt:

```
secure state (Return)
```

where *state* is on or off.

Caution Once the secure boot mode is set to on, the only way to turn it off is to disconnect the boot device. When you turn on your workstation after isolating it from its boot device, the boot console interface reappears. You can then turn the secure boot mode off, turn off your workstation, reconnect the boot device, and turn the system back on.

Displaying and Setting the Fasttboot Mode

When fastboot is enabled (set to "on"), your workstation does a quick check of the memory during its power-on self-tests. This enables your workstation to complete its boot process quicker. When fastboot is disabled (set to "off"), more extensive memory testing is performed during the self-tests causing the boot process to take significantly longer. The default factory setting is for fastboot to be enabled ("on").

If your workstation has a large amount of memory installed, the power-on tests may take several minutes to complete with fastboot set to OFF.

To display the status of fastboot, type the following at the BOOT_ADMIN> prompt:

```
fastboot (Return)
```

To disable fastboot, type the following at the BOOT_ADMIN> prompt:

```
fastboot off (Return)
```

To enable fastboot, type the following at the BOOT_ADMIN> prompt:

```
fastboot on (Return)
```

Displaying the LAN Station Address

The LAN station address of your workstation is the label that uniquely identifies the LAN connection for your workstation at the link level (the hardware level). It is sometimes necessary for you to supply this address to other users. For example, if your workstation is to become a member of a cluster, the cluster administrator needs to know your LAN station address in order to add your workstation to the cluster.

To display your workstation's LAN station address, type the following at the BOOT_ADMIN> prompt:

```
lan_addr (Return)
```

The LAN station address is displayed as a thirteen-digit number in hexidecimal notation, like the following:

```
LAN Station Address:  123456-789abc
```

Changing the LAN Station Address

If the EEPROM is replaced, the old EEPROM's LAN address must be reprogrammed into the EEPROM so the workstation will function on the network at the same LAN address. These procedures can be used to change the LAN station address for other reasons as needed.

Follow these steps to change the LAN station address:

1. Set the Service/Normal switch to Service mode.
2. Reboot the workstation to Service Mode.
3. Press (Esc) to get the BOOT_ADMIN> prompt.
4. To see the existing LAN station address, type:

   `lan_add` (Return)

   To change the LAN station address, for example to 080009159ED, type:

   `lan_add 08000-9159ED` (Return)

5. To verify the new LAN station address is correct, type:

   `lan_add` (Return)

   and the address `080009159ED` should be displayed.

ITF and PC-101 Keyboard Differences

There are two types of Hewlett-Packard keyboards available for use with Hewlett-Packard workstations:

ITF Keyboard	Also known as the HP 46021A/B Keyboard.
PC Keyboard	Also known as: PC-101 (HIL) Keyboard, "Enhanced Vectra" Keyboard, and the HP C1429B Keyboard.

Note For the HIL interface on your workstation, you should not attempt to use non-HP keyboard devices.

Aside from the obvious difference in the appearance of the ITF and PC keyboards due to the arrangement of the keys, there is also a difference in the keys and their output codes. Some keys on one keyboard (the ITF for example) may not exist on the other keyboard. These keys generate codes which also may not exist as output from the other keyboard (or may be generated by a different key). Codes that are generated when a key is press are called *keycodes*.

Some applications expect to use *keycodes* generated by keys existing on one of the keyboards (the ITF keyboard for example). Since the keys do not exist on the other keyboard (the PC keyboard for example), an accommodation must be made if the PC-101 keyboard is to be used. In most cases, it is still possible to use some other key that is equivalent (generates the same *keycode* from a different keycap). To do this, it is necessary to know which keys are equivalent on the two keyboards. The following tables will compare the "equivalent" keys of the ITF and PC-101 keyboards.

Note A similar table is available in Appendix B of the book *Using the X Window System*. The X windows chapter also tells how to change the key mapping using X commands (such as `XPCmodmap`, and `XHPmodmap`).

Keys not mentioned in either table have the same key symbols and keycodes.

PC-101 Keyboard to ITF Keyboard Equivalent Keys

PC Keycap Symbol	ITF Keycap Symbol
F9	blank1 (left)
F10	blank2
F11	blank3
F12	blank4 (right)
PrintScreen/SysRq	Menu
Scroll Lock	Stop
Pause/Break	Break/Reset
Page Up	Prev
Num Lock	System/User
End	Select
Page Down	Next
Enter	Return
Alt (left)	Extend Char (left)
Alt (right)	Extend Char (right)
No Equivalent Key	Clear line
No Equivalent Key	Clear display
No Equivalent Key	Insert line
No Equivalent Key	Delete line
No Equivalent Key	Print/Enter
No Equivalent Key	, (on number pad)
No Equivalent Key	Tab (on number pad)

The right Ctrl key on the PC-101 keyboard generates a keycode that has no equivalent on the ITF keyboard. This key has the same effect as the left Ctrl key by default.

Some keys perform the same function but may have slightly different keycap wording. The following table addresses these keys.

PC-101 Keyboard to ITF Keyboard Equivalent Keys

PC Keycap Symbol	ITF Keycap Symbol
Esc	Esc/Del
Insert	Insert Char
Home	↖
Delete	Delete Char
Caps Lock	Caps
Esc Shifted	Esc/Del Shifted
Pause/Break Shifted	Break/Reset Shifted
Num Lock Shifted	System/User Shifted
0/Ins (Numbers keypad)	0 (Numbers keypad)
1/End (Numbers keypad)	1 (Numbers keypad)
2/▼ (Numbers keypad)	2 (Numbers keypad)
3/Pg Dn (Numbers keypad)	3 (Numbers keypad)
4/◀ (Numbers keypad)	4 (Numbers keypad)
6/▶ (Numbers keypad)	6 (Numbers keypad)
7/Home (Numbers keypad)	7 (Numbers keypad)
8/▲ (Numbers keypad)	8 (Numbers keypad)
9/Pg Up (Numbers keypad)	9 (Numbers keypad)
./Del (Numbers keypad)	. (Numbers keypad)
Ctrl (left)	Ctrl
Ctrl (right)	No key

Mass Storage Devices

Standard SCSI Addresses

Mass storage devices are factory configured to the SCSI addresses listed in Table 4-3.

Table 4-3. Mass Storage Device SCSI Addresses

Mass Storage Device	SCSI Address
525 Mbyte Hard Disk Drive	6
1 Gbyte Hard Disk Drive	6
2 Gbyte DDS Tape Drive	3
4-8 Gbyte DDS Tape Drive	3
CD-ROM Disk Drive	2
3.5-in. Flexible Disk Drive	0

Configuring Hard Disk Drives

Caution Although the device is well-protected from physical shock when installed in the controller, it is very easily damaged when separate. Avoid dropping or striking the device. Handle it gently at all times.

Figure 4-1 shows you the configuration jumper locations. Address jumpers are the three at the left end of the jumper block.

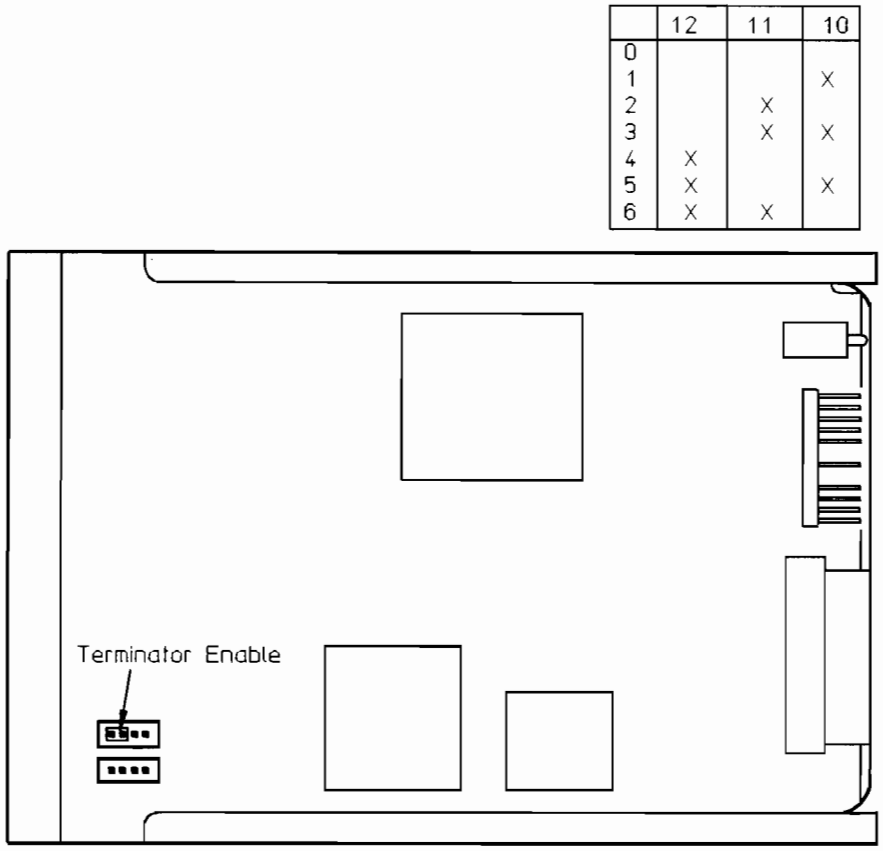

Figure 4-1. Hard Disk Drive Configuration Jumpers

Note Do not change the settings of other jumpers. They control functions set in manufacturing.

Configuring Flexible Disk Drives

Caution Although the device is well-protected from physical shock when installed in the controller, it is very easily damaged when separate. Avoid dropping or striking the device. Handle it gently at all times.

Figure 4-2 shows you the configuration jumper locations. Jumpers and their settings are explained in Table 4-4.

Note the flexible disk drive jumpers are installed as follows:

- Jumpers installed on pins = "in."
- Jumpers removed from pins = "out."

Caution Your flexible disk drive jumpers are used opposite to jumpers in your hard disk drives. For example, the three flexible disk drive bus address jumpers when set to bus address 0 are all 'in.' The same hard disk drive address jumpers set to bus address 0 are all 'out.'

Note Jumpers 0, 2DS and A through F are factory set and must not be changed.

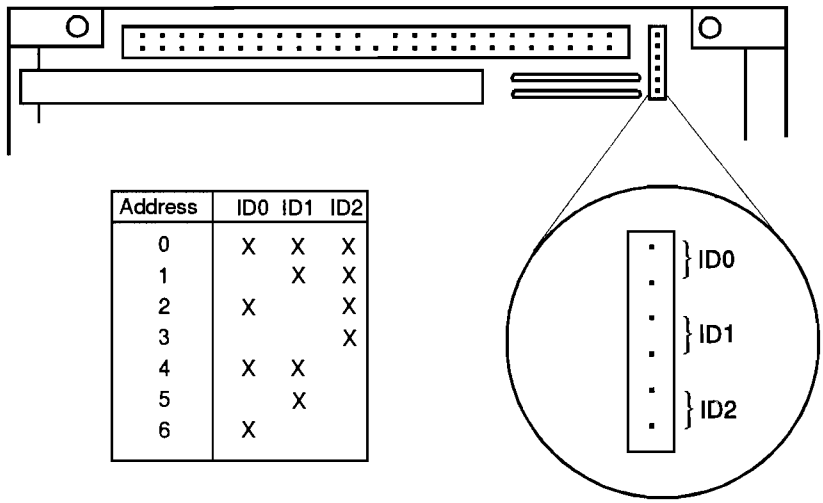

Figure 4-2. Flexible Disk Drive Configuration Jumper Locations

Table 4-4. Flexible Disk Drive Configuration Bottom Jumper Functions

Jumper Label	Function
ID2, ID1, ID0	SCSI Bus Address jumpers. ID2 is most significant bit. Default settings: Address 3. ID2 = out; ID1 = in; ID0 = in.

Function Jumpers

Only the SCSI address jumpers should be changed. You should not have to change the function jumpers. They should be left in their default condition.

SCSI Bus Address Jumpers

Your flexible disk drive must be set to a bus address that is different from other SCSI device bus addresses already used. The factory default setting is address 3. Use a pair of needle-nose pliers to remove and install the configuration jumpers. Set your drive's SCSI configuration jumpers for the SCSI bus address it will use.

Note that jumper ID 0 is next to the edge of the printed circuit board. For example, if you want to set your hard disk drive's address jumpers to address 5, you would set:

- Jumper ID 0 out.
- Jumper ID 1 in.
- Jumper ID 2 out.

Configuring the Operating System

Refer to your *Owner's Guide* or other operating system documentation to configure your operating system for the drive.

Configuring CD ROM Disk Drives

Figure 4-3 shows you the configuration jumper locations. Jumpers and their settings are explained in Table 4-5. Note the jumper positions that represent an 'out' and 'in.'

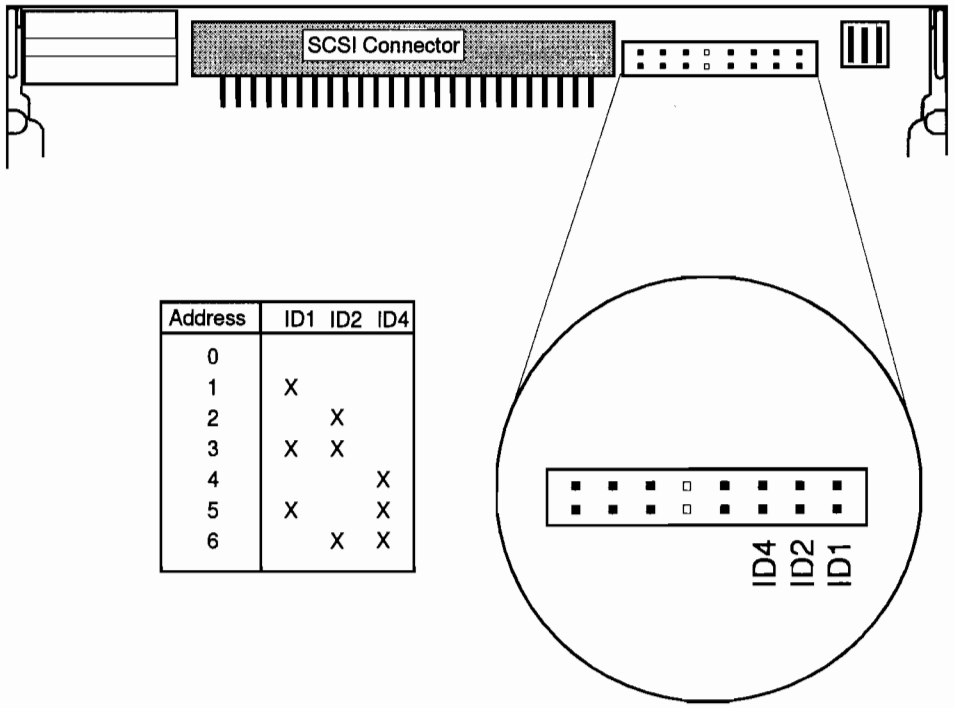

Figure 4-3. CD ROM Configuration Jumper Locations

Table 4-5. CD ROM Drive Configuration Jumper Functions

Jumper Label	Function
ID1,ID2,ID4	SCSI ID Address; Jumper ID1 is least significant bit. Shipped with address 2 set (default); jumper only on ID2

SCSI Bus Address Jumpers

Your CD ROM drive's SCSI ID jumpers must be set to the bus address it will use. Your CD ROM has bus address 2 factory set. Set your CD ROM's SCSI ID configuration jumpers for SCSI bus address you will use in the range of 0 through 6. Refer to Table 4-6 for bus address settings

Table 4-6. CD ROM SCSI ID Addresses and Switch Settings

SCSI Address	ID1	ID2	ID4
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

Audio Use

'Audio Only Mode' is not supported.

Configuring the Operating System

Refer to your *Owner's Guide* or other operating system documentation to configure your operating system for the drive.

Configuring DDS Tape Drives

You now have access to the mounting location for the new drive. This section contains instructions for configuring the new drive and installing it in the workstation.

SCSI Bus Address Jumpers

Choose the Device Address. It can be any unused number from 0 to 6. If you have no preference, use 2 unless it has been taken.

Locate the SCSI address jumpers on the drive. They are located directly behind the power connector. The address jumpers are the three in the middle. There are two pins to the left and one pin and an empty space to the right. The address jumpers have the values shown in Figure 4-4.

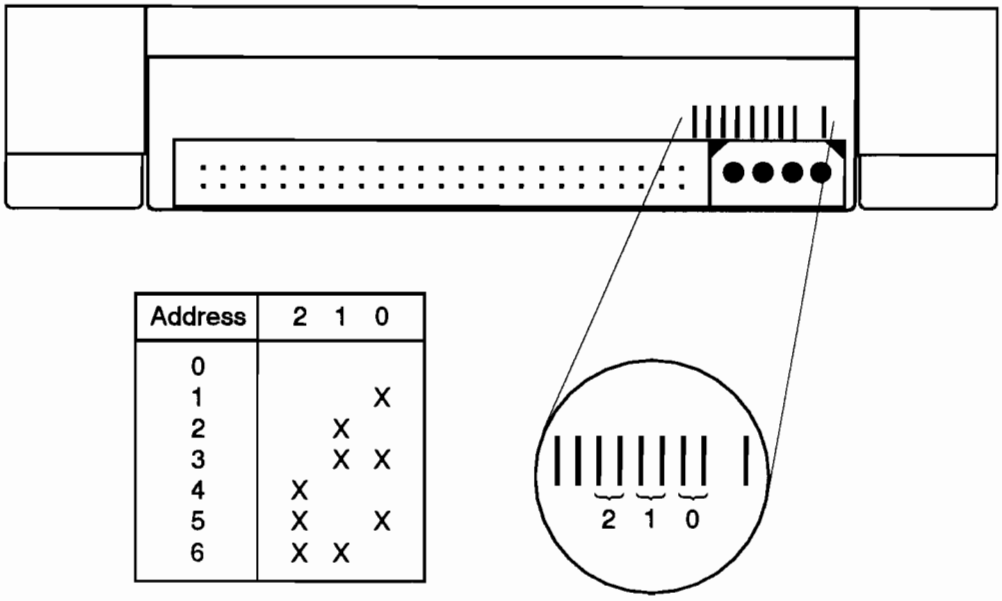

Figure 4-4. Setting the Address Jumpers

Move the jumpers to obtain the desired address.

Note Do not change the setting of the other two positions. Removing the jumper from the first position will result in no parity checking, and installing a jumper in the second position will result in a non-functional drive.

Write the Device Address here: _____

Data Compression Switches

Eight switches on the bottom of the HP C1504C 2-8 Gbyte DDS tape drives set the data compression configuration. These switches should be set as follows:

- Switch 1 to off.
- Switches 2 through 8 to on

These same switches on the HP C1503C 2 Gbyte DDS tape drive are not enabled.

Configuring the Operating System

Refer to your *Owner's Guide* or other operating system documentation to configure your operating system for the drive.

Graphics Configuration

On the system board, four switches near the edge are used to configure the graphics circuit for different situations. Table 4-7 lists each switch and what they configure.

Table 4-7. System Board Graphics Configuration Switches

Function	Sys. Bd. Graphics	Hz	Horizontal Resolution	Type
Switch	1	2	3	4
Open:	Enable	60/70	1280	Color
Closed:	Disable	72/75	1024	Gray

Settings for the supported monitors are listed in Table 4-8.

Table 4-8. Graphics Switch Settings vs Supported Monitors

Monitor	Switch 1	Switch 2	Switch 3	Switch 4
HP D1195A 14-in.	open	open	closed	open
HP D1196A 14-in.	open	open	closed	open
HP A1497A 17-in.	open	closed	closed	open
HP A1097A 19-in.	open	closed	open	open
HP A2287A 17-in.	open	closed	closed	open

EISA Accessory Cards

EISA accessory cards with thicker than normal connectors the fit through the front of the EISA module may not fit earlier workstations. These early workstation's EISA card cages may not let these cards be installed as the clearance on the accessory opening might be too small. Later versions have modified openings that will let these accessory cards be installed. FDDI cards are most likely to have interference. You may file the sheet metal away if the card cannot be installed.

Memory Boards

Note

Each memory board in a pair must have the same part number. Some memory boards of a given size have different-speed RAM chips. For example, an 8 Mbyte memory board with 80-nanosecond RAM chips will have a different part number than the same-size board with 60-nanosecond RAM chips.

If a board pair has each board with different-speed RAM chips, memory errors will occur.

5

Troubleshooting

Introduction to Troubleshooting

Troubleshooting information and procedures for the Model 747*i* and 745*i* workstations are divided into these sections:

- Introduction to Troubleshooting
- HP-UX 9.01 Diagnostics Patch
- Diagnostic Overview
- Boot ROM Self-Tests
- SupportWave Troubleshooting
- VME Diagnostics
- Power Troubleshooting

The flowcharts contained in this chapter are logically structured to point you in the right direction (run diagnostics, replace assemblies, and so on). The remainder of the information in this chapter supports the directions in the flowcharts. Follow the assembly replacement procedures in Chapter 2 if the flowchart calls for assembly replacements.

Diagnostic Philosophy

The diagnostic philosophy is to support the repair strategy. As a result, the goal of the troubleshooting process is to isolate a problem to a specific board or assembly. Several diagnostic methods may be used. When a system problem is traced to the workstation, the diagnostic is run to isolate the problem to the defective part. The defective part is then replaced.

Analytic Troubleshooting

Troubleshooting is the process of getting answers to these six questions:

- What is different now from what the workstation was before?
- What exactly is wrong, or what are the bad symptoms?
- Where are the bad symptoms appearing?
- When do the bad symptoms occur?
- How bad is the problem or to what extent does it occur?
- What actually caused the problem in the first place?

Getting the answers to these questions usually makes the troubleshooting process much more effective and less costly. When a failure in a computer system occurs, remember these questions and get the answers to each of them.

The troubleshooting strategy for these workstations is in the form of a bottom-up approach. That is, you note any error or status messages, and then you run the power-up Boot ROM diagnostics known as Self-Test. If the Self-Test diagnostics fail, replace the assembly that is indicated.

After you have all answers possible, decide what's the most probable cause of the problem. Sometimes you'll arrive at several choices for a cause. For each choice, qualify it against the answers to the questions above. The most probable cause is the one that logically justifies the correct answers to these questions.

Note any error or status messages, and then run the diagnostics. If the self-tests fail, replace the assembly that is indicated.

Troubleshooting Flowchart

This section provides a flowchart that route you through a series of standard troubleshooting procedures for Model 745*i* and 747*i* industrial workstations.

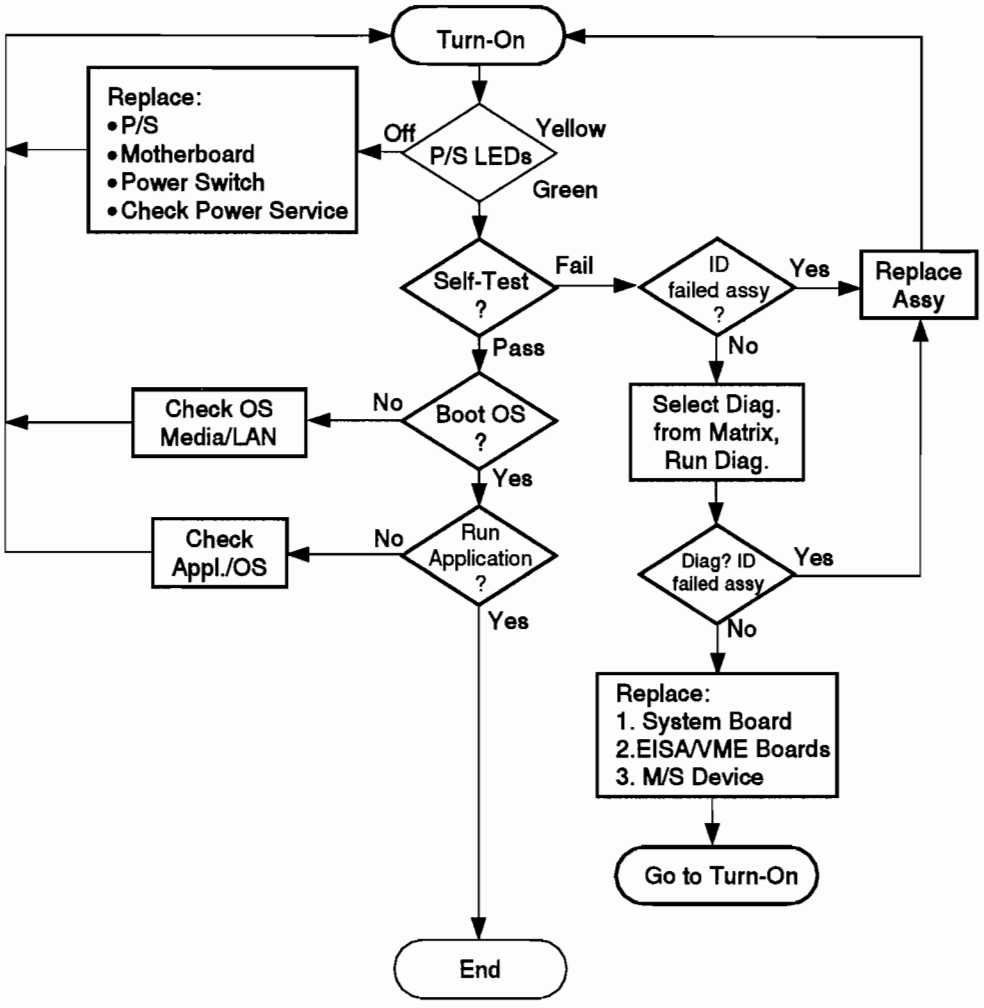

Figure 5-1. Troubleshooting Flowchart

HP-UX 9.01 Diagnostics Patch

Introduction

Note *HP-UX version-related information in this section supersedes the information found in the following documents:*

- *Installation Guide — HP 9000 Series 700i Industrial Workstations*: part number A2261-90015
- *Installation Guide — HP A2628A System Module Upgrade*: part number A2628-90010.
- *Models 745/50, 745/100, 747/50, and 747/100 Owner's Guide for HP-UX Users*: part number A2628-90014.

Series 700i/100 systems are designed to run on HP-UX 9.01 with a patch tape included with bundled workstations and the HP A2628A System Module Upgrade. In this kit (B2910-67901), a DDS-Format tape with which you will need to update your HP-UX 9.01 for proper logfile operation. This patch also comprises a number of features and diagnostic tools, including the following:

- Diagnostic functionality allowing PSIDAD Diagnostic to report EEPROM version numbers correctly.
- The `iomap` utility, which can identify the configuration of the system and its I/O paths and devices as well as perform selftest and loopback diagnostics.
- SAM, disktab, and diagnostic support for the Seagate ST11200N 1 Gbyte disk drive. (To determine whether you have a Seagate drive, enter `/etc/ioscan -fb` at a shell prompt).

Note

- **As a general precaution, be sure to back up your system before you install this patch.**

Installation Procedure

To install this patch, follow the instructions given below. Refer to the manual *Installing and Updating HP-UX 9.0* when necessary.

1. Log into your system as `root`, and run your system in "single-user" state.
2. Turn on your DDS-Format tape drive and load the HP-UX 9.01 Diagnostics tape (`PHSS_XXXX`).
3. At a shell prompt (`#`) type `/etc/update` (Return).
4. In the update Main Menu, highlight the line to `Change Source or Destination ->` and select it by pressing (Return) or clicking on `Select Item`.
5. In the `Change Source or Destination` window, highlight the item `From Tape Device to Local System ...` and select it as before.

6. In the window **From Tape Device to Local System**, check that the **Source** field indicates the device file for your DDS-Format tape drive, which is usually **/dev/rmt/0m**.
7. Press **Done**.
8. From here on, follow the standard directions for Update found in the manual *Installing and Updating HP-UX 9.0*.

After the files are loaded, your system will reboot.

Software Management

The customized script that update runs will move the original software to **/system/PHSS_NNNN/orig**. Hewlett-Packard recommends keeping this software there in order to facilitate recovery from any potential problems. It is also recommended that you move the **PHSS.text** file to **/system/PHSS_NNNN** for future reference.

Diagnostic Overview

Three types of diagnostics are available for the Models 745*i* and 747*i* Industrial Workstations:

- **Self-tests** are part of the Boot ROM code. They initialize and test the functional areas needed to boot the operating system.
- **Offline diagnostics** are on the Support Tape, a separate tape or CD-ROM media. They are ISL based and test the CPU, EISA, VME and I/O functions. Support Tape diagnostics include:
  - TDIAG.
  - IOMAP.
  - VMEDIAG.
  - EISADIAG.
- **Online diagnostics** are supplied with the operating system, but require the operating system to be booted. These diagnostics are called SupportWave and test the CPU, I/O and several peripherals.

Diagnostic Documentation

Table 5-1 lists manuals that provide complete information.

Table 5-1. Diagnostic Documentation

Manual Title	Part Number
Support Tools Manager User's Manual; HP 9000 Series 700 and 800	5961-1612
HP Apollo 9000 Series 700 Diagnostics Manual, Volume 1	09740-90041
HP Apollo 9000 Series 700 Diagnostics Manual, Volume 2	09740-90043
HP Apollo 9000 Series 700 Support Tape/CD-ROM User's Manual	B2380-90000
PA-RISC Support Tools Manual Licensed Users Volume 1, SPU	5960-3149
PA-RISC Support Tools Manual Licensed Users Volume 2, Device Adapters/MUXes	5960-3151
PA-RISC Support Tools Manual Licensed Users Volume 3, LAN	5960-3153
PA-RISC Support Tools Manual Licensed Users Volume 4, SCSI	5960-3155
PA-RISC Support Tools Manual Licensed Users Volume 5, Disks	5960-3157
PA-RISC Support Tools Manual Licensed Users Volume 6, Tapes/Printers	5960-3159
PA-RISC Support Tools Manual Licensed Users Volume 7, Utilities	5960-3161
PA-RISC Support Tools Manual Licensed Users Volume 8, ISL Support Tools	5960-3163
PA-RISC Support Tools Manual HP Employees	5960-3165

Diagnostic Matrices

Table 5-2 and Table 5-3 lists the workstation's functional areas with the diagnostics available for them. Notes in the table indicate exceptions.

Table 5-2. System Module Diagnostic Matrix

Assembly/ Circuit Function	Std. Self-Tests	Ext. Self-Tests	ISL T DIAG	ISL IO MAP	Supt-Wave
System Module Functions and Circuits					
CPU	•		•		•
I/D Cache	•		•		
Memory Control	•		•	•	
Floating point	•		•		•
Trans. lookaside buff.	•		•		
ROM checksum	•				
SCSI		•		•	
RS-232		•		•	
RS-232 (M/device)		•		•[1]	
LAN		•		•	•
LAN A/D loop		•		•	•
LAN ping					•
HP Parallel		•		•	
HP Parallel (device)		•		•[1]	
HP-IB		•		•	
Audio			•		
HP-HIL	•	•	•		
Clock and Timers		•	•		
RAM (destructive)	•		•		
RAM (non-destructive)	•			•[2]	•
Graphics	•	•			•[3]

[1] Loopback only.
[2] Limited diagnostics.
[3] GRTEST Exerciser.

Table 5-3. MS, EISA, SGC and VME Modules Diagnostic Matrix

Assembly/ Circuit Function	Std. Self-Tests	Ext. Self-Tests	ISL IO MAP	ISL VME DIAG	ISL EISA DIAG	SCSI DISK DIAG	Supt-Wave
Mass Storage Module Functions and Circuits							
SCSI (mass storage)		•	•[4]			•	•[5]
EISA Module Functions and Circuits							
EISA converter board	•				•		
EISA accessory card	•		•[6]		•[7]		•[8]
SGC Card Functions and Circuits							
SGC card	•	•					
VME Module Functions and Circuits							
VME conv. bd./backplane		•		•			

[4] IODC tests.
[5] Disk, CD-ROM, DDS and DASS.
[6] Card test only through IODC.
[7] Bus tester.
[8] LAN, FDDI and HP-IB cards.

Note When running ISL diagnostics, error messages will be easier to read if the workstation is in Normal Mode.

ISL Booting You can backup the HP-UX operating system from the ISL prompt. Type:

```
hpux boot /SYSBCKUP (Return)
```

and the backup operating system will boot.

Boot ROM Self-Tests

Self-tests are called by a bootstrap, then initialize and test the workstation hardware needed to find and boot an operating system. I/O portions for the console and boot path are tested by the I/O Dependent Code (IODC) for each I/O function. Self-test code is stored in the PDC ROM. It runs from PDC I/O address space except for some portions of the cache test, which downloads itself to memory. Self-test code is not accessible by users.

Users have some control as to what tests are executed at power-on or pressing the TOC switch. Users can also run specific self-tests using the Boot Console User Interface either by:

- Setting the workstation in Service Mode, then turning it on.
- Pressing (ESC) when asked for during Normal Mode boot.

Self-tests along with console and boot IODC verify that ISL/SYSBOOT can be loaded and ran. Depending on the mode, one of two things will happen should a test fail:

- In Normal Mode, all operations will stop.
- In Service Mode, an attempt is made to continue so that console commands (from a keyboard) can be executed.

Boot ROM self-tests are run on the following circuits:

- CPU, floating-point and TLB.
- I/O and memory controller.
- EISA I/O conversion.
- VME I/O conversion.
- PDC ROM checksum.

Since self-tests exercise key hardware parts, an error normally means the boot process stops. LED's indicate progress, status and errors. Self-test sequence, status and error LED codes are listed later in this section. A circuit is usually identified by the error and the field-replaceable unit having that circuit should be replaced.

The only performance limit is a reasonable amount of time is needed. From power-on to displaying the first console message for a 16-Mbyte workstation is about 20 seconds. Workstations with more memory require a longer time. Typical self-test times without failures are:

- Normal Mode with FASTBOOT, 32 Mbyte; less than 10 seconds.
- Service Mode, time varies as the user defines the self-tests to run.

When the workstation first powers up, the CPU starts executing Boot ROM code. Before code is executed to boot an operating system, several things need to be set up and tested. The Boot ROM has several code segments to manage these responsibilities.

Hardware Initialization Support

Some hardware, such as video circuit initialization and floating RAM positioning, which can not wait for a system to be booted, must be initialized at power-up as soon as possible to prevent improper operation.

Go/No-Go Self-Test Support

The primary objective is to tell user that the workstation is okay. This consists of indicating all such devices present and reporting all detectable failures.

Boot ROM self-tests are by no means guaranteed to handle all hardware failures correctly. Several things contribute to this. They include current hardware design, limited code space and the fact that testing for unknown or unexperienced failures is virtually impossible.

Failure Indications

As the self-test progresses, the LEDs display the current state. At the end of the test, a power-up with no errors is indicated by all LEDs turned off and by immediate entry into the boot scanner.

If a failure occurred during the self-tests, then that failure will be indicated on the LEDs at the end of the tests. If there was more than one failure, the highest priority failure will be indicated on the LEDs. All the LED values are listed below.

The power-up self-test runs automatically when the workstation is powered up. It calls a series of modules which test various parts of the workstation. Here is a list of the test modules:

- Early Self-Test.
- Read/Write Memory Test.
- Read-only Memory Test.
- Late Self-Test.

If an error occurs, an error code is displayed and execution halts. The meaning of the various error codes is explained later.

Here is a description of what each of these modules tests:

Early Self-Test

The Early Self-Test performs initialization and self-test functions which don't require memory. It operates on:

- CPU
- cache memory
- EISA interface
- memory interface
- I/O interface

Read/Write Memory Test

The read/write memory test configures and tests the memory sub-system using both writes and reads.

Read-Only Memory Test

The read-only memory test configures and tests the memory sub-system using reads only.

Late Self-Test

The late self-test tests functions which require memory or aren't needed to configure memory. It also "cleans up" after the self-test, setting registers to values suitable for normal operation.

Here are the tests performed by the late self-test:

- cache
- I/O bus interface

Error Codes

Here is an explanation of how to relate an error code to the defective assembly which caused it.

If the 1st 4 LEDs (A-D) are:	Hex	Defective assembly is:
○ ○ ○ ●	1	System board
○ ○ ● ○	2	System board
○ ○ ● ●	3	Try RAM boards first, then system board
○ ● ○ ○	4	System board
○ ● ○ ●	5	EISA converter board
○ ● ● ○	6	RAM boards
○ ● ● ●	7	RAM boards
● ● ● ○	E	System board

Extended Self-Test

The purpose of the extended self-test is to test those areas of the workstation which are not routinely tested by the power-up self-test. This includes VMEbus, HP-IB, the real-time clock and timers.

Extended self-test is called when the Service/Normal switch is in the Service position. Additionally, the Boot Console User Interface can be used to configure operation of the extended self-test.

The extended self-test tests these devices:

- Time of day clock (RTC)
- The three timers

- RS-232 ports A & B
- SCSI
- LAN
- SGC 1 (system board graphics) and 2 (SGC card)
- HP-HIL
- HP-IB
- VMEbus
- HP Parallel

Service Mode

Service mode is a facility provided by the Boot ROM which allows for intensive testing and diagnosis of the workstation's board set. It is invoked by setting the Service/Normal switch to the Service position and pressing the TOC switch. It can also be entered from the boot console user interface using the `RESET` command.

Differences

Under service mode, the boot process proceeds as usual, but with these additional features:

- All display information is sent to RS-232 Port A. A terminal needs to be connected to see the information.
- The console display expands to include four additional hex digits per operation (for a total of six hex digits).
- Execution continues even when an error occurs in self-test (unlike in Normal mode, where execution would cease).
- Extended self-test runs automatically after self-test finishes.
- The boot process stops in Boot Console User Interface mode after all self-tests are executed.
- The Boot ROM can be configured to eliminate individual self-tests.

Available Self-Tests and Test Commands

Table 5-4 lists the available self-tests and test commands in Service Mode or in Normal Mode when the `BOOT_ADMIN>` prompt is displayed. Note that some commands are not available in Normal Mode. These are displayed when the `?` command is executed along with other commands covered in Chapter 4, the Boot Console User Interface section.

Caution Using the `POKE` command without knowing exactly what the memory address is used for may cause your workstation to halt. The `POKE` command should only be used by qualified persons who know exactly what memory address their operating system or application program can have data written into it from the keyboard.

Table 5-4. Self-Tests and Test Commands

Normal Mode?	Service Mode?	Command	Function
Yes	Yes	`RESET`	Resets the system
No	Yes	`PEEK`	Read Memory I/O locations
No	Yes	`POKE`	Set Memory I/O locations
Yes	Yes	`TEST`	Control or execute self-tests

Help for each command is displayed when a `?` is typed after the command, except for `RESET`.

Execute Control Command

Execute control command is a routine in the BCH which allows you to run any test in the self-test and extended self-test.

To execute a Self-Test, type:

`TEST nn` (Return)

where nn is the test number of the test.

Test numbers are listed in Table 5-5. The selected self-test is repeated unitl the TOC switch is pressed or power is cycled. Test 7E (write-only RAM test) will not stop when TOC is pressed, but will repeat continuously.

Table 5-5. Boot ROM Tests and Test Numbers

Group	Test	No.
CPU	Diagnose Register	11
	Basic Functions	12
	ALU & Branch	13
	Bit Operations	14
	Arithmetic Operations	15
	Arithmetic Side Effects	16
	Control Registers	17
	External Interrupts	18
	Shadow Registers	19
	Test	1A
	Initialization	1B
Cache	Data Line	21
	Address Line	22
	Instruction Cache RAM	23
	Data Cache RAM	24
	Tag Compare	25
	Errors	26
	Configuration	27
	Flush	28
	Byte Transaction	29
	Instruction Cache Miss	2A
	Data Cache Miss	2B
	Cache Done	2C
Memory-I/O	EIR	31
	HPMC	32
	Memory Interface	33
	Invalid Address	34
	Single Bit Error	35
	Double Bit Error	36
	Diagnose Register	37

Group	Test	No.
Floating point	Registers	41
	Instructions	42
	Traps	43
EISA	EISA Initialization	51
	Address Test	52
	Address Test Failure	53
	Pattern Test	54
	Pattern Test Failure	55
	Bad EISA Jumper	56
	Bad SCSI Jumper	57
	ROM Checksum	5F
Memory	Write-only Test	7E
	Configuration & Test	7F
Extended	Real-time Clocks	E1
	Timers	E2
	RS-232 Port A	E3
	RS-232 Port B	E4
	SCSI	E5
	SGC 1	E6
	SGC 2	E7
	HP-HIL	E8
	HP-IB	E9
	VMEbus	EA

Error Codes and Messages

Table 5-6 lists LED error codes with LED symbols and hexidecimal equivalents. For each error code, one or two assemblies are listed as most probably cause of the error.

When a terminal is connected to RS-232 port A, and in Service Mode, error messages will be displayed on the terminal with a hexidecimal number to the right, for example:

```
RAM slot 0                                0x0000.60
```

means the board in slot 0 failed. In these workstations:

- `RAM slot 0` is slot 0A in RAM PAIR 0.

- `RAM slot 1` is slot 0B in RAM PAIR 0.
- `RAM slot 2` is slot 1A in RAM PAIR 1.
- `RAM slot 3` is slot 1B in RAM PAIR 1.

The numbers to the right of the decimal point represent the hexidecimal number of the error code displayed on the self-test LEDs. In the above example, the LEDs (A through H) would be:

o ● ● o o o o o

Numbers to the left of the decimal point are not important for field troubleshooting, except as noted in Table 5-6.

Table 5-6. LED Errors vs. Assembly to Replace

Self-Test LED Error Display	Hex Code	Assembly Replacement Priority
○ ○ ○ ● ○ ○ ○ ○ ⋮ ○ ● ○ ○ ● ● ● ●	10 ⋮ 4F	1. System board 2. Operating system
○ ● ○ ● ○ ○ ○ ● ⋮ ○ ● ○ ● ● ○ ○ ●	51 ⋮ 59	1. EISA converter board 2. Motherboard 3. System board
○ ● ○ ● ● ● ● ●	5F	1. EEPROM 2. System board
○ ● ● ○ ○ ○ ○ ○	60	1. RAM in slot 0A 2. System board
○ ● ● ○ ○ ○ ○ ●	61	1. RAM in slot 0B 2. System board
○ ● ● ○ ○ ○ ● ○	62	1. RAM in slot 1A 2. System board
○ ● ● ○ ○ ○ ● ●	63	1. RAM in slot 1B 2. System board
○ ● ● ● ○ ○ ○ ○ ⋮ ○ ● ● ● ● ● ● ●	70 ⋮ 7F	1. System board 2. RAM board 3. RAM configuration
● ○ ○ ○ ○ ○ ○ ●	81	1. System board 2. Mass storage device at address `n` in `0.0n00.81`.
● ○ ○ ○ ○ ○ ● ○ ⋮ ● ○ ○ ○ ○ ● ● ●	82 ⋮ 87	1. System board 2. If `0x0006.82` through `0x000A.82`, check cable or server. 3. If `0x002.83`, check keyboard. 4. Operating system
● ○ ○ ○ ● ○ ○ ○	88	1. SGC card 2. Motherboard
● ○ ○ ○ ● ○ ○ ●	89	1. EISA card in slot 1 2. EISA converter board
● ○ ○ ○ ● ○ ● ○	8A	1. EISA card in slot 2 2. EISA converter board
● ○ ○ ○ ● ○ ● ●	8B	1. EISA card in slot 3 2. EISA converter board
● ○ ○ ○ ● ● ○ ○	8C	1. EISA card in slot 4 2. EISA converter board

Table 5-6. LED Errors vs. Assembly to Replace (continued)

Self-Test LED Error Display	Hex Code	Assembly Replacement Priority
● ○ ○ ● ● ● ● ●	9F	1. Keyboard 2. System board
● ○ ● ○ ● ● ○ ○	AC	1. System board 2. VME converter board
● ○ ● ● ○ ○ ○ ●	B1	1. EEPROM 2. System board
● ● ○ ○ ○ ● ● ○	B6	1. RAM board 2. System board
● ● ○ ○ ● ○ ○ ●	B9	1. EEPROM 2. System board
● ● ● ○ ○ ○ ○ ● ⋮ ● ● ● ○ ○ ○ ○ ●	E1 ⋮ E7	1. System board 2. If `0x000D.E2`, set RTC clock or check battery. 3. OK if E7 and system board graphics are disabled. 4. Operating system
● ● ● ○ ● ○ ○ ○	E8	1. SGC card. If SGC not installed, ignore. 2. Motherboard 3. System board
● ● ● ○ ● ○ ○ ● ⋮ ● ● ● ○ ● ○ ● ○	E9 ⋮ EB	1. System board
● ● ● ○ ● ● ○ ○	EC	1. VME converter board 2. Motherboard

Support Tape Off-Line Diagnostics

Refer to the diagnostic manuals listed in Table 5-7 for complete information on off-line diagnostics.

Table 5-7. Support Tape Diagnostic Manuals

Title	Part Number
PA-RISC Support Tools Manual Licensed Users Volume 1, SPU	5960-3149
PA-RISC Support Tools Manual Licensed Users Volume 2, Device Adapters/MUXes	5960-3151
PA-RISC Support Tools Manual Licensed Users Volume 3, LAN	5960-3153
PA-RISC Support Tools Manual Licensed Users Volume 4, SCSI	5960-3155
PA-RISC Support Tools Manual Licensed Users Volume 5, Disks	5960-3157
PA-RISC Support Tools Manual Licensed Users Volume 6, Tapes/Printers	5960-3159
PA-RISC Support Tools Manual Licensed Users Volume 7, Utilities	5960-3161
PA-RISC Support Tools Manual Licensed Users Volume 8, ISL Support Tools	5960-3163
PA-RISC Support Tools Manual HP Employees	5960-3165

VME diagnostics are unique to the Model 747*i* workstation and are explained in the next section.

VME Diagnostics

Overview

VME Diagnostics are an Initial System Load (ISL) based diagnostic. The code is loaded from a mass storage device and is executed during the boot process. Its default operation executes all sections from 1 to 18 in sequence. Other sequences and options are possible.

Hardware and Software Requirements. The following hardware and software is required to perform this diagnostic:

- VME Test Card, part number 98577-66540, Rev. A3.
- VME ISL Diagnostic Software, part of Support Tape Diagnostics.

Installation Procedures

1. Remove all VMEbus accessory cards.
2. Set the VME Test Card in VME A24 address space at address 300000_{16} by setting its configuration switches shown in Figure 5-2 as follows:
   a. 20, 21 and AM set to open or high (position near card edge).
   b. All others set to closed or low (position away from card edge).

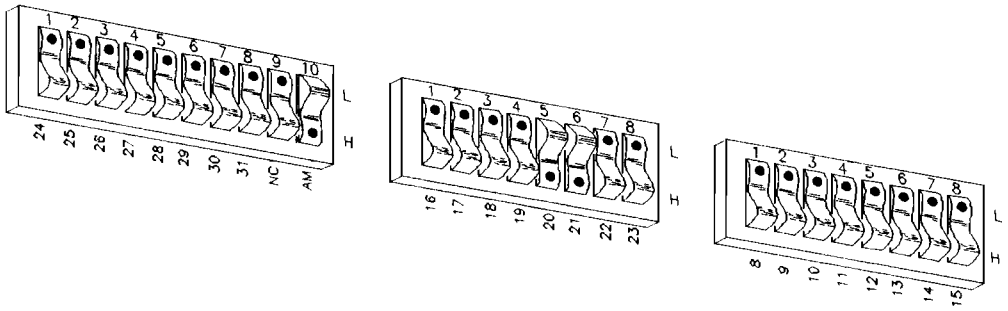

Figure 5-2. VMEbus Test Card Configuration Switches

3. Install the VME Test Card in slot 7 (bottom VMEbus slot).

Loading the Diagnostic

1. Turn on the workstation and enter boot administration mode. When the `BOOT_ADMIN>` prompt appears, type:

   `boot` *device* `i` (Return)

   where *device* is the the drive with the Support Tape media installed. The ISL environment will boot. When the ISL environment is booted, the prompt:

   ```
   ISL>
   ```

   will appear.

2. Load the VME diagnostic by typing:

   ```
   vmediag (Return)
   ```

3. A number of lines of text will appear on the display. These lines include the copyright message, two lines that inform the user that `HELP` and `INFORMATION` are available and a line that tell the user that this is the VME diagnostic. The prompt:

   ```
   VME>
   ```

   will indicate that the VME diagnostic has been loaded and is ready for use.

LEDs on the Test Card backplate are explained in Table 5-8.

Table 5-8. VME Test Card LEDs

Name	Function	Color	Comments
$\overline{\text{S FL}}$	System Fail	Red	Should blink during VME tests.
$\overline{\text{RST}}$	SysReset	Red	Blinks once during extension ROM tests; it may not be seen. Blinks once for each pass of VME tests.
$\overline{\text{M BR}}$	Error while Bus Master	Red	Usually off. Blink indicates a bus error while Test Card was bus master.
$\overline{\text{AS}}$	Address strobe	Yellow	On or flashing indicates bus activity. Off indicates bus translator card is disabled.
CLK	System Clock	Yellow	Must be on. Off indicates that clock is stuck low.
M MD	Bus master	Yellow	Flashing indicates when Test Card is bus master.
+5S	+5 V Standby	Yellow	Off unless a module supports the feature.
−12	−12 V monitor	Green	Must be on.
+12	+12 V monitor	Green	Must be on.
+5	+5 V monitor	Green	Must be on.

Running the Diagnostic

Default Operation. Executing the `RUN` command runs all sections 1 through 18 in sequence. It takes about one minute. As each section is run, its section number and test number within that section will be displayed with what is being tested.

When one cycle of all sections is complete and all sections passed when this message is displayed:

```
DIAGNOSTIC COMPLETE
```

If an error was detected, an error message may appear and the test will pause, waiting for an input. Refer to the Errors and Other Messages section for details.

User Selectable Test Sections. The `SECTION` command can be used to make section selections. Entering the `HELP` command will provide information on syntax. Syntax for this command is also listed in Table 5-9.

Table 5-9. SECTION Command Syntax

Syntax	Executes These Sections
`SECTION` *n*	*n* is a section number in decimal; that test section will be run.
`SECTION` *n n n*	Runs sections *n*, *n* and *n* in that order.
`SECTION` *n/n*	Runs sections *n* through *n* in that order.

Other User Commands. Other user commands are listed in this section.

Table 5-10. Execution Control Command Syntax

Syntax	Performs These Functions
LOOP *n*	*n* is the number of times you want the diagnostic to repeat.
RESUME	Resumes normal diagnostic execution after a pause.
RUN	Runs the diagnostic.
RESET	Resets the diagnostic to an initial condition.
EEPS	Enable Error PauSe. Pauses after error detection, then accepts any diagnostic command.
EIPS	Enable Isolation PauSe. Pauses after an isolation detection, then accepts any diagnostic command.
ENPS	Enable Non-error PauSe. Allows the operator to pause the diagnostic, then the diagnostic will accept any diagnostic command.
ERRPAUSE	A condensed version of EEPS;EIPS;EPS.

Table 5-11. Output Control Command Syntax

Syntax	Performs These Functions
EEPR	Enable Error PRint. Enables output of output error messages.
EIPR	Enable Isolation PRint. Enables output of isolation messages.
ENPR	Enable Non-error PRint. Enables output of non-error messages.
HARDCOPY	Forces all prints to the console to be duplicated to a second terminal connection to which a printer is connected.
ERRONLY	A shorthand version of EEPR;EIPR;ENPR.

Table 5-12. System Control Command Syntax

Syntax	Performs These Functions
`STATE`	Displays the state variables for the diagnostic system.
`STOP`	Upon exiting the diagnostic, stops the ISL from continuing the AutoBoot sequence.
`LISTIO`	Lists the I/O path to the primary and secondary boot devices, the console path and the printer path.
`INFORMATION`	Prints a diagnostic specific description of key test information. Includes hardware tested by each section, defaults and total number of sections.
`CHANGEIO`	`CHANGEIO` *path name [C,P,1,2]*. Changes the console (*C*), printer (*P*), and the UUTs (*1,2*) displayed by the `LISTIO` command. To permanently change the boot and console values in stable storage, you must return to ISL.
`HELP`	`HELP` *keyword*. Prints information about the diagnostic system command and semantics. If no keyword is provided, then the list of commands is output to the terminal. If a keyword is provided, information for that command is listed on the console. Diagnostic specific commands are keywords.
CTRL-Y	Breaks the execution of the diagnostic between steps. Any console command is valid at this point. The I/O associated with the console commands is not suppressible.

The VME diagnostic has two additional commands. They enable or suppress forced error reporting and are listed in Table 5-13.

Table 5-13. VME Diagnostic Control Command Syntax

Syntax	Performs These Functions
`EFEPR`	Enable Forced Error PRint. When this feature is enabled, some loops that contain a large number of forced errors are shortened to reduce the total number of error messages of a given type.
`SFEPR`	Suppress Forced Error PRint. Suppress all forced errors. This is the default and normal operating mode.

Errors and Other Messages

In some situations where a test section cannot be completed, the diagnostic will stop without displaying any error messages. The failing test section is the last one displayed.

The VME diagnostic reports error and non-error information in the same way as other ISL-based diagnostics. VME diagnostic conforms to a manufacturing error message standard. The standard calls for all error messages to begin with:

```
ERROR NO. ### DETECTED IN SECTION ###
```

The next and following lines will hold the text of the actual error message. The VME diagnostic will begin all error messages with the string VME to indicate that this is the VME that has failed.

All numbers used in displayed or printed messages are decimal unless they are preceded by `0x` which indicates that they are hexadecimal. When hex numbers do appear, they will be in one of three formats:

- `0x##.`
- `0x####.`
- `0x########.`

The number of hex digits shown is an indication of the width or size of the data. From this, it is possible to interpret the width or size of accesses to obtain the data. Most messages are worded like:

```
VME FIFO_ST_REG full bit is set not clear after RESET

VME_ERR_ADDR_REG is 0xFFC0001C not 0xFFC0014 after A16 access with mvmeberr

VME_CNTRL/ST_REG bus_tout set for 80 us R
```

In such messages, `is` indicates the actual value obtained from the hardware. The word `not` is used to indicate that the actual value is not equal to the expected value.

It the error message says that something is missing, it is saying that what ever is missing was expected and failed to take place. If the error message says that something is unexpected, it is saying that whatever was unexpected did take place and should not have.

Words and letters shown in capitals are used to designate logic term found in the hardware. Some logic terms in the hardware are given in lower case and when they are used in error messages by the diagnostic, they will remain in lower case.

VME Diagnostic Sections

VME diagnostics are divided into 18 sections. These sections provide tests of different circuit functionality. Table 5-14 lists the sections.

Table 5-14. VME Diagnostic Sections

Section	Test Description	If errors, first replace:[1]
1	VME ASIC Register Test	VME converter board
2	VME ASIC FIFO (PA Address)	VME converter board
3	mvmeberr, Size for VME Test Card & Test Its Registers	VME converter board
4	PA MASTER Access to VME A16 Space	VME converter board
5	VME MASTER MAP & A24 Access	VME converter board
6	VME MASTER MAP & A32 Access	VME converter board
7	VME Test Card Interrupt Registers	VME converter board
8	VME Interrupts	VME backplane
9	VME A16 MASTER With PA SLAVE (LM and FIFO)	VME converter board
10	VME A24 MASTER With PA SLAVE Access	VME converter board
11	VME A32 MASTER With PA SLAVE Access	VME converter board
12	VME MASTER With ROR and Friendly	VME converter board
13	VME Address PIPE	VME converter board
14	VME Bus Request Lines	VME backplane
15	VME Address Modifiers	VME converter board
16	VME Un-Aligned Transfers	VME converter board
17	VME A24/A32 Slave MAP Span	VME converter board
18	VME Address Only Cycles	VME converter board

[1] System board or motherboard failures can also cause VMEDIAG errors.

SupportWave Online Diagnostics

SupportWave is a troubleshooting tool supplied with the HP-UX operating system. As 'superuser' logged in as 'root,' you can access the Support Tools Manager while in a terminal window. If you are using HP VUE as the interface, you can also access the Support Tools Manager through the `sys_admin` directory.

Refer to the *Support Tools Manager User's Manual; HP 9000 Series 700 and 800*, part number 5961-1612, for complete information.

Power Troubleshooting

Power Supply

Two LEDs on the power supply indicate its status:

- Green LED indicates the power supply is operating normally.
- Yellow LED indicates the power supply has a malfunction and should be replaced.

If a fan is inoperative, the power supply can be removed and the fan replaced as a separate part.

System Board Fuse

A fuse on the system board may be replaced if it is blown. Protecting the +5 V dc circuits in an attached LAN transceiver, it is a plug-in fuse. If a transceiver has failed, this fuse may be the problem.

6

Parts Lists

Introduction

Field replaceable parts are listed in this chapter for the HP 9000 Series 700*i* Model 745*i* and 747*i* Industrial Workstations. Components, such as ICs, are not available for field repair.

New Parts

New parts are available direct from:

Support Materials Organization
Hewlett-Packard Company
8050 Foothills Boulevard
Roseville, California 95678 USA
Telephone: (916) 786-8000

Parts Center Europe
Hewlett-Packard GmbH
Wolf-Hirth Strasse 33
D-7030 Boblingen, Germany
Telephone: +41 7031 14-2253

Exchange Parts

Exchange parts are available for some items at a reduced cost. When an exchange part is ordered, your account will be charged for a new part.

Place failed exchange parts in anti-static bags and package them securely in a sturdy container. It's a good idea to save the containers and static-free bags you receive parts in and use them to ship parts in. Please return failed exchange parts to your exchange parts source as soon as possible. Customers have 15 days to return the failed part to receive credit for the difference between a new and exchange part.

Exchange only parts are available direct from:

Support Materials Organization
Hewlett-Packard Company
8050 Foothills Boulevard
Roseville, California 95678 USA
Telephone: (916) 786-8000

Support Material & Services Europe
Hewlett-Packard Ltd.
Filton Road - Stoke Gifford
Bristol BS12 6QZ United Kingdom
Telephone: +44 272 799910

Local Hewlett-Packard Office

Parts may be ordered through your local Hewlett-Packard Sales and Service Office. Write the address and telephone number of your local Hewlett-Packard Office in the spaces below. Refer to this information for getting parts.

Name: _____

Address: _____

City, State ZIP: _____

Telephone No. _____

Common Module Parts

Power Supply Module

Table 6-1. Power Supply Module Parts List

Ref. No.	New Part Number	Description	Notes
1	0950-2303	Power supply	includes fan
2	3160-0843	Fan	

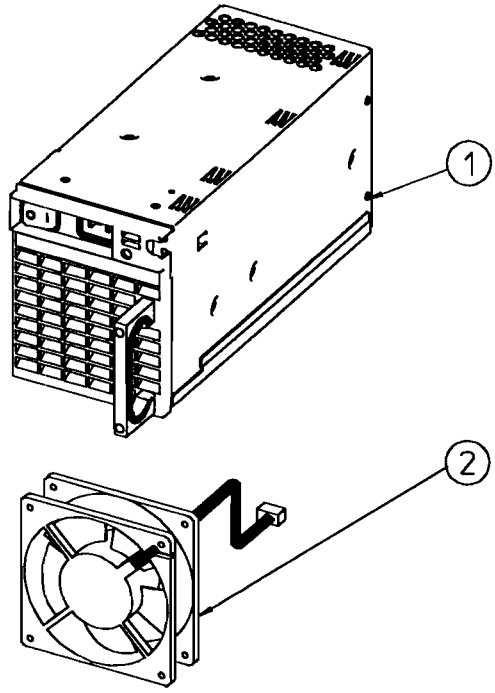

Figure 6-1. Power Supply Module Exploded View

Mass Storage Module

Table 6-2. Mass Storage Module Parts List

Ref. No.	Exchange Part Number	New Part Number	Description	Notes
1	A1094-69007	A1094-60007	3.5-in. flex disk drive	
2		A1499-00016	flex drive bracket	
3		A2261-40015	flex drive bezel	42mm high
4		A1499-62020	Power converter cable	
5a	C1503-69201	C1503-67201	2 Gbyte DDS tape drive	
5b	C1504-69201	C1504-67201	4 - 8 Gbyte DDS tape drive	Data compression
6a		A1499-00015	DDS drive bracket	5.25-in. wide
6b		C1503-00007	DDS drive right spacer	
6c		C1503-00008	DDS drive left spacer	
7a		C1503-60100	DDS drive bezel	3.5-in. wide
7b		C1503-60200	DDS drive bezel	5.25-in. wide
8a	A2084-69002	A2084-60002	1 Gbyte hard disk drive	
8b	A2084-69001	A2084-60001	525 Mbyte hard disk drive	
9		A1499-00017	Hard disk drive bracket	
10		1150-1895	CD-ROM disk drive	
11		A1499-00015	CD-ROM drive bracket	
12		A2261-61602	Mass storage SCSI cable	
13		A2261-61603	Mass storage power cable	
14		A2261-00008	Mass storage tray	
15		A2261-00020	Handle screw kit	Screw, spring and spacer. Tray includes handles.
16		A2261-40007	Large filler panel	
17		A2261-40005	Small filler panel	
18		A2261-00027	Filler panel support	
19		A1658-62016	SCSI terminator	
		004853-017	Screw (drive to bracket)	CD-ROM, hard drives and bracket to tray

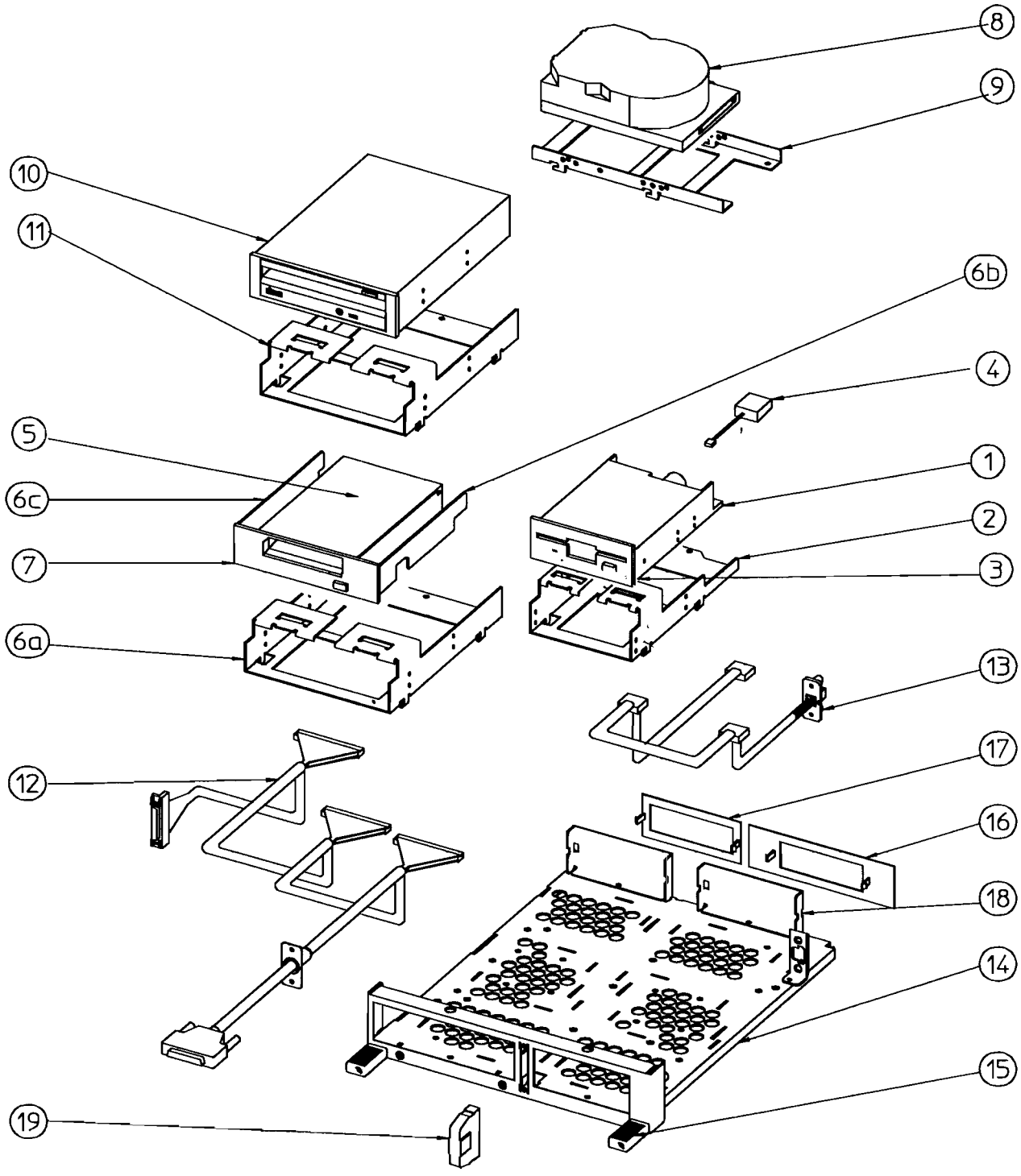

Figure 6-2. Mass Storage Module Exploded View

System Module

Table 6-3. System Module Parts List

Ref. No.	Exchange Part Number	New Part Number	Description	Notes
1a	A2261-69010	A2261-66010	System module; 50 MHz	
1b	A2628-69010	A2628-66010	System module; 100 MHz	
2		A2261-66003	Connector board	
3a		A2261-80001	EEPROM (U4)	Hot Line Order
3b/c			Boot ROM (U5/6)	Hot Line Order
4a		1818-5470	STI ROM, 60 Hz (U15)	50 MHz
4b		1818-5347	STI ROM, 70 Hz (U15)	50 MHz
5a		1818-0428	Crystal, 60 Hz (Y2)	50 MHz
5b		1813-0940	Crystal, 70 Hz (Y2)	50 MHz
6		1420-0314	Real-Time Clock Battery	See warning
7a	98236-69522	98236-66522	4 Mbyte memory board	
7b	98236-69524	98236-66524	8 Mbyte memory board	
7c	A2576-69001	A2576-60001	16 Mbyte memory board	
7d	A2575-69001	A2575-60001	32 Mbyte memory board	
7e	A2826-69006	A2826-66006	64 Mbyte memory board	100 MHz
8		2110-0520	Fuse	
9		A2261-00001	Connector panel	
10		A2261-61604	System board SCSI ribbon cable	
11		1252-5196	Interconnector	
12		A2261-00022	System board side extrusion	
13		A2261-00023	System board strap	
14		A2261-00035	'E' RFI clip	
15		A2261-66110	Fan	100 MHz
16		A2628-00003	Heat sink	100 MHz
17		A2628-00002	Grill	100 MHz
18		2360-0208	Screw, heat sink & fan	100 MHz
		0380-0643	HP-IB jackscrew	
		2190-0407	HP-IB lock Washer	
		0380-2018	RS-232/Prll/Video jack screw	
		5180-1344	SCSI jack screw	
		0515-2292	Screw, M3X0.5	
		2190-0409	Washer, internal tooth	
		7121-0850	Label, antistatic	
		A2628-84002	Label, HP 9000 700i/100	
		0624-0408	Extrusion screw	
		A2089-00003	Heat sink (50 MHz)	

Warning **Replace battery with only a Matsushita Electric BR-2325 three-volt lithium battery (part number 1420-0314)! Use of any other battery may cause fire or explosion.**

Lithium batteries may explode if mistreated. Do not put lithium batteries in fires, try to recharge or disassemble them.

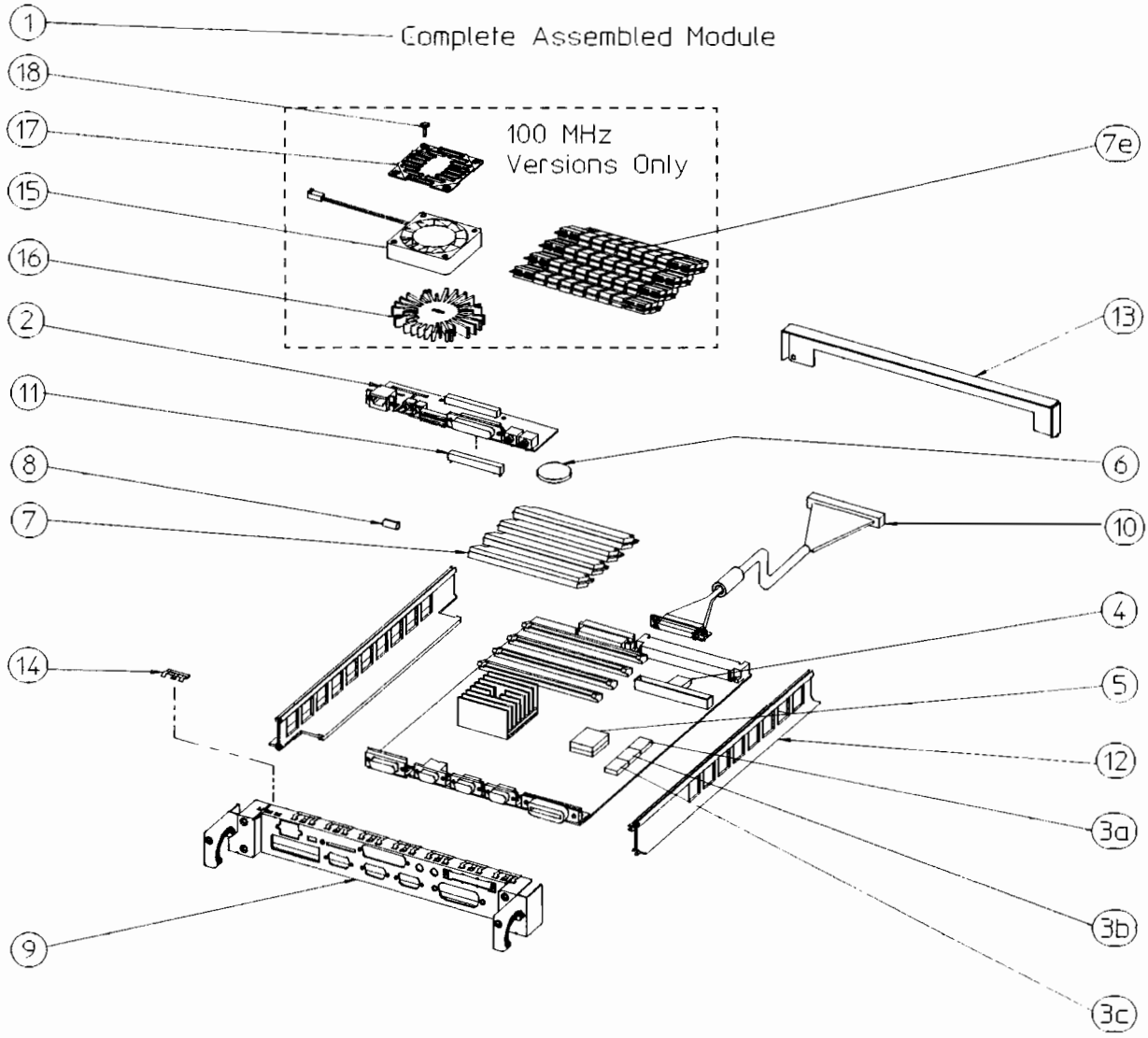

Figure 6-3. System Module Exploded View

VME Module

Table 6-4. VME Module Parts List

Ref. No.	New Part Number	Description	Notes
1	A2261-66013	VME converter board	
2	A2261-66015	VME backplane board	
3	A2261-00014	VME card cage	
4	1494-00744	VME card guide	
5	A2261-00015	RFI cover assembly	
6	5001-9023	Cover plate	
7	A2261-00035	'E' RFI clip	
8	A2261-00020	Handle screw kit	Screw, spring and spacer. Card cage include handles.

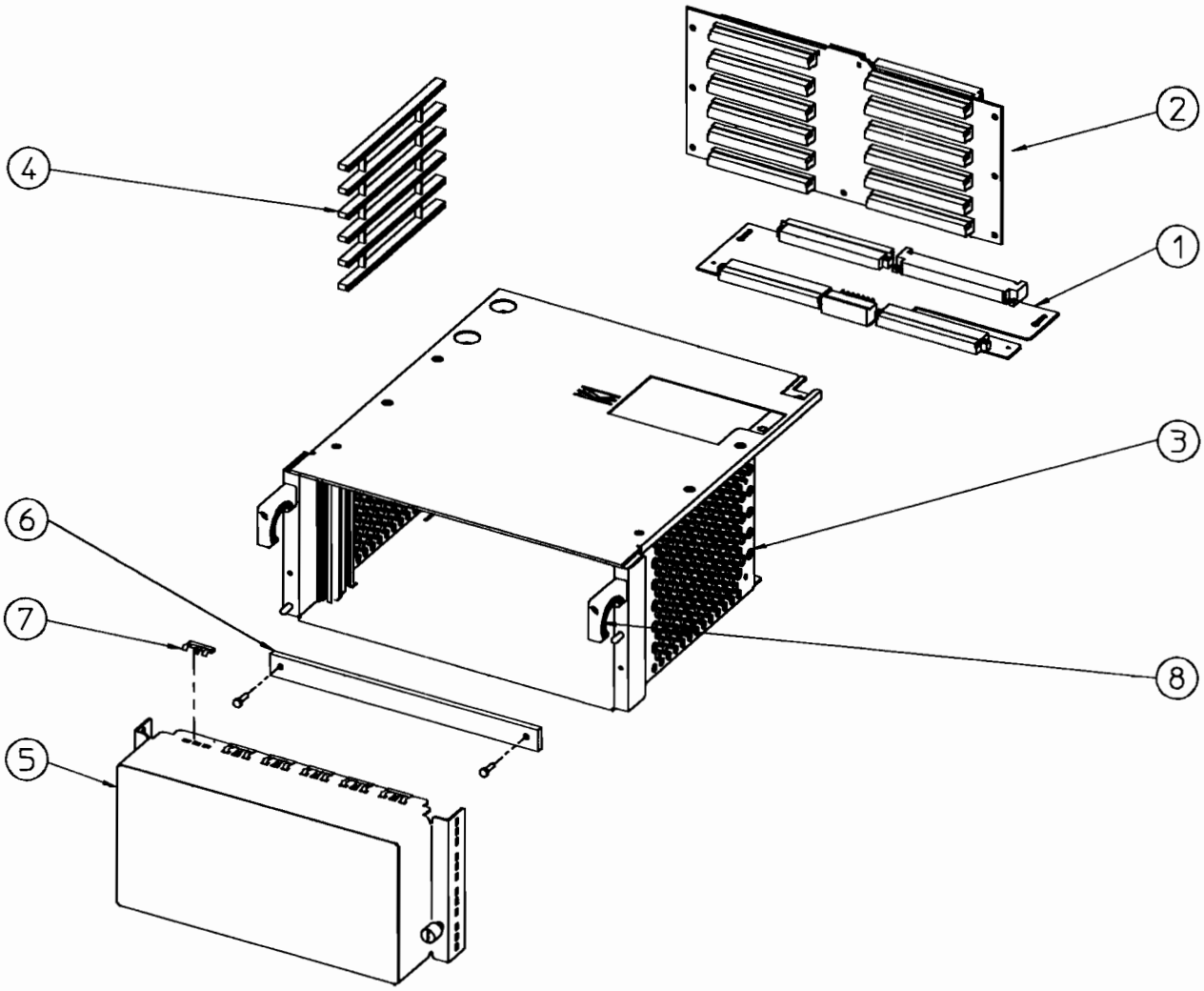

Figure 6-4. VME Module Exploded View

EISA Modules

Table 6-5. EISA Modules Parts List

Ref. No.	New Part Number	Description	Notes
1	A2261-66009	EISA converter board	
2	A2261-62009	4-slot backplane assembly	Model 745*i*
3	A2261-00013	4-slot card cage	Model 745*i*
4a	A2261-00032	4-slot card clamp, right	Model 745*i*
4b	A2261-00033	4-slot card clamp, left	Model 745*i*
5	A2261-62011	2-slot backplane assembly	Model 747*i*
6	A2261-00012	2-slot card cage	Model 747*i*
7a	A2261-00031	2-slot card clamp, right	Model 747*i*
7b	A2261-00030	2-slot card clamp, left	Model 747*i*
8	A2261-40017	Insulator sheet	
9	5001-7430	Cover plate	
10	2360-0333	Screw	
11	A2261-00035	'E' RFI clip	
12a	A2261-00028	Single RFI clip	
12b	5001-7425	Double RFI clip	Model 745*i*
13	0403-0542	EISA card guide	
14	A2261-40016	Glide	
15	A2261-00020	Handle screw kit	Screw, spring and spacer. Card cage include handles.
16	A2261-00034	Blank 4-slot cover	Model 745*i*

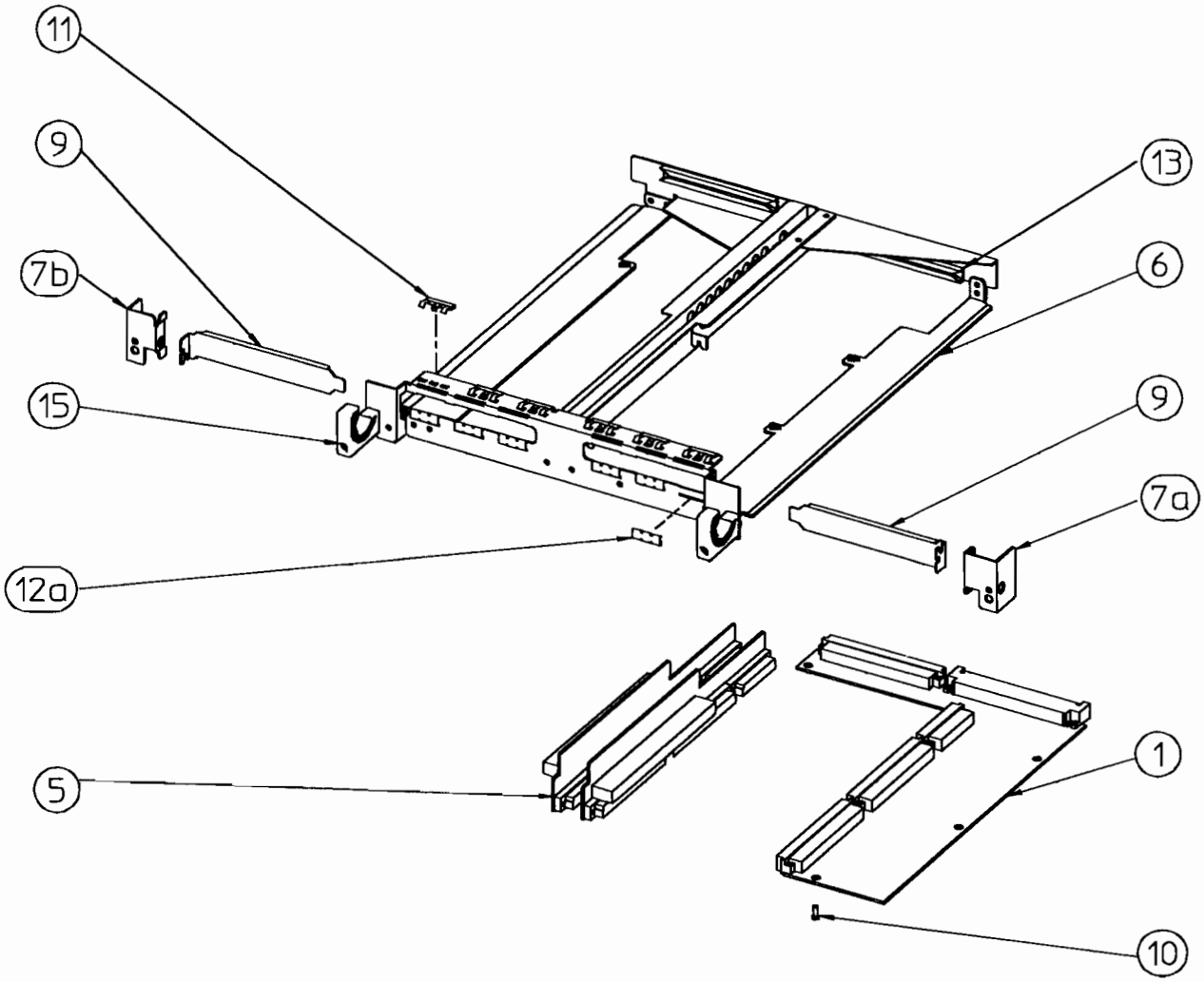

Figure 6-5. Model 747*i* EISA Module Exploded View

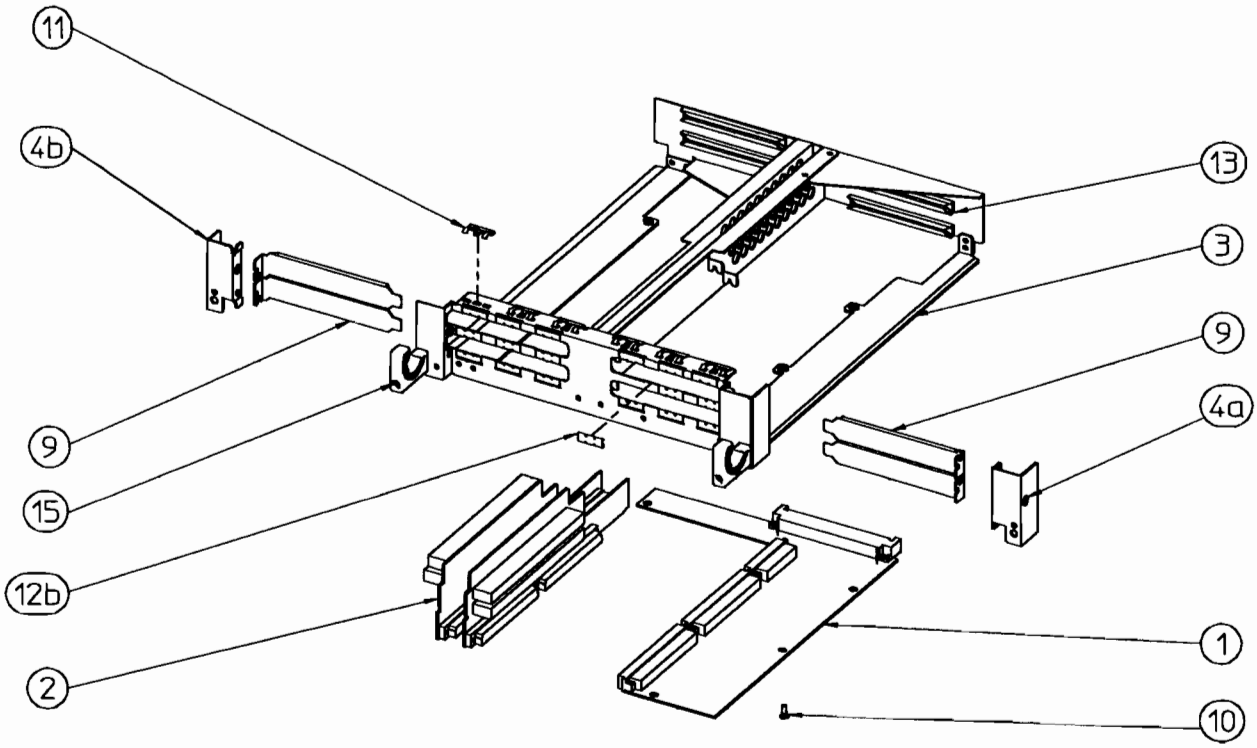

Figure 6-6. Model 745*i* EISA Module Exploded View

Chassis; Model 745*i*

Table 6-6. Chassis; Model 745*i*

Ref. No.	New Part Number	Description	Notes
1	A2261-66006	Motherboard	
2	A2261-00004	Chassis	
3	A2261-00005	Wall	
4	A1473-61601	Power switch assembly	
5	A2261-40018	Side trim	
6	A2261-84001	Model label	
7	A2261-00035	'E' RFI clip	
8	A2261-40002	Front bezel	
	A2261-40004	Light pipe	
	5041-8801	System II foot	

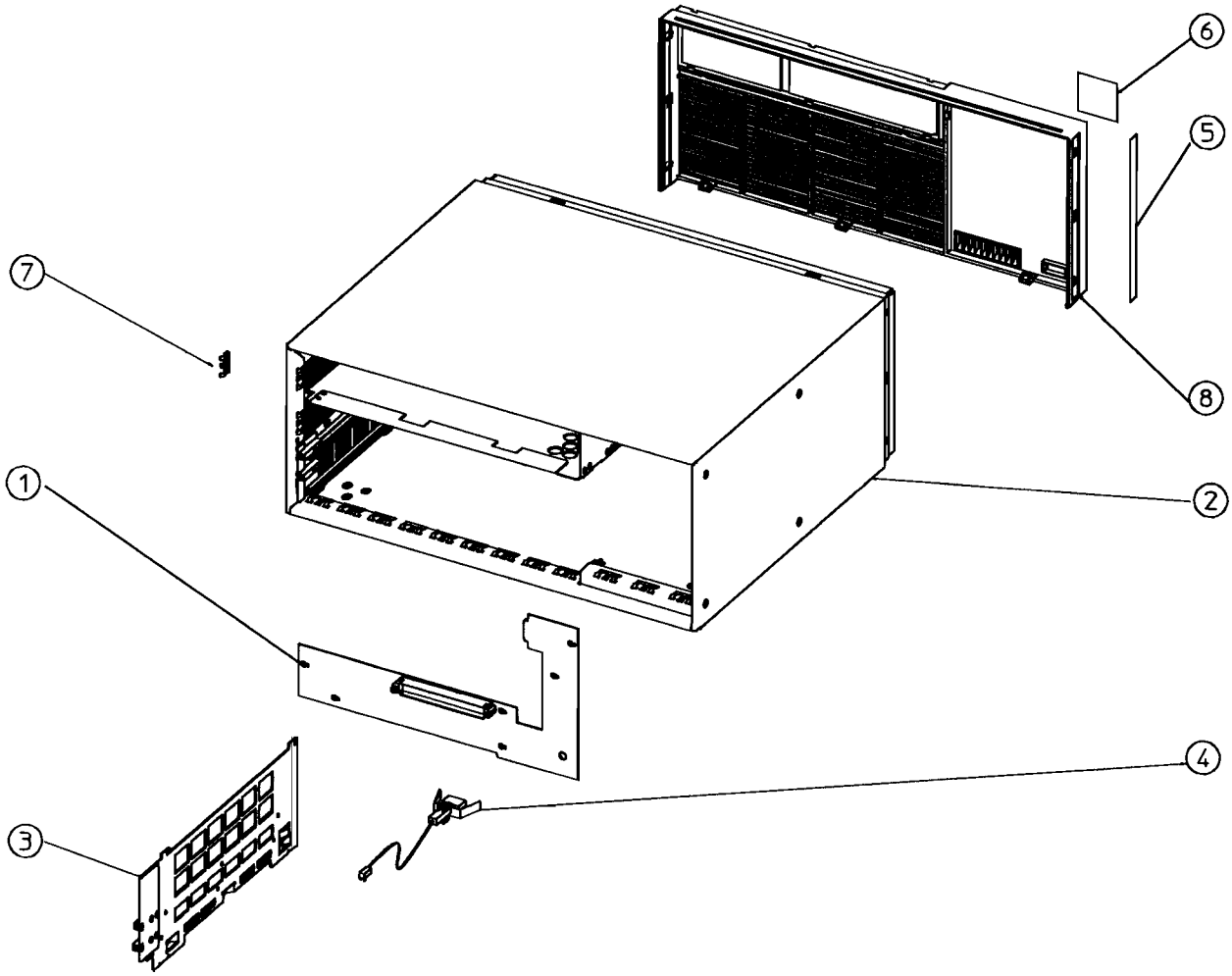

Figure 6-7. Chassis; Model 745*i* Exploded View

Chassis; Model 747*i*

Table 6-7. Chassis; Model 747*i*

Ref. No.	Exchange Part Number	New Part Number	Description	Notes
1		A2261-66007	Motherboard	
2a	A1659-69001	A1659-66001	Dual SGC card	
2b		A2269-66001	Single SGC card	
3		A2261-00006	Chassis	
4		A2261-00007	Wall	
5		A1473-61601	Power switch assembly	
6		A2261-40019	Side trim	
7		A2261-84001	Model label	
8		A2261-00035	'E' RFI clip	
9		A2261-40003	Front bezel	
10		98561-04104	SGC slot cover	without screws
11		1390-0849	SGC slot cover captive screw	
12		5180-0409	SGC slot cover RFI clip	
		A2261-40004	Light pipe	
		5041-8801	System II foot	

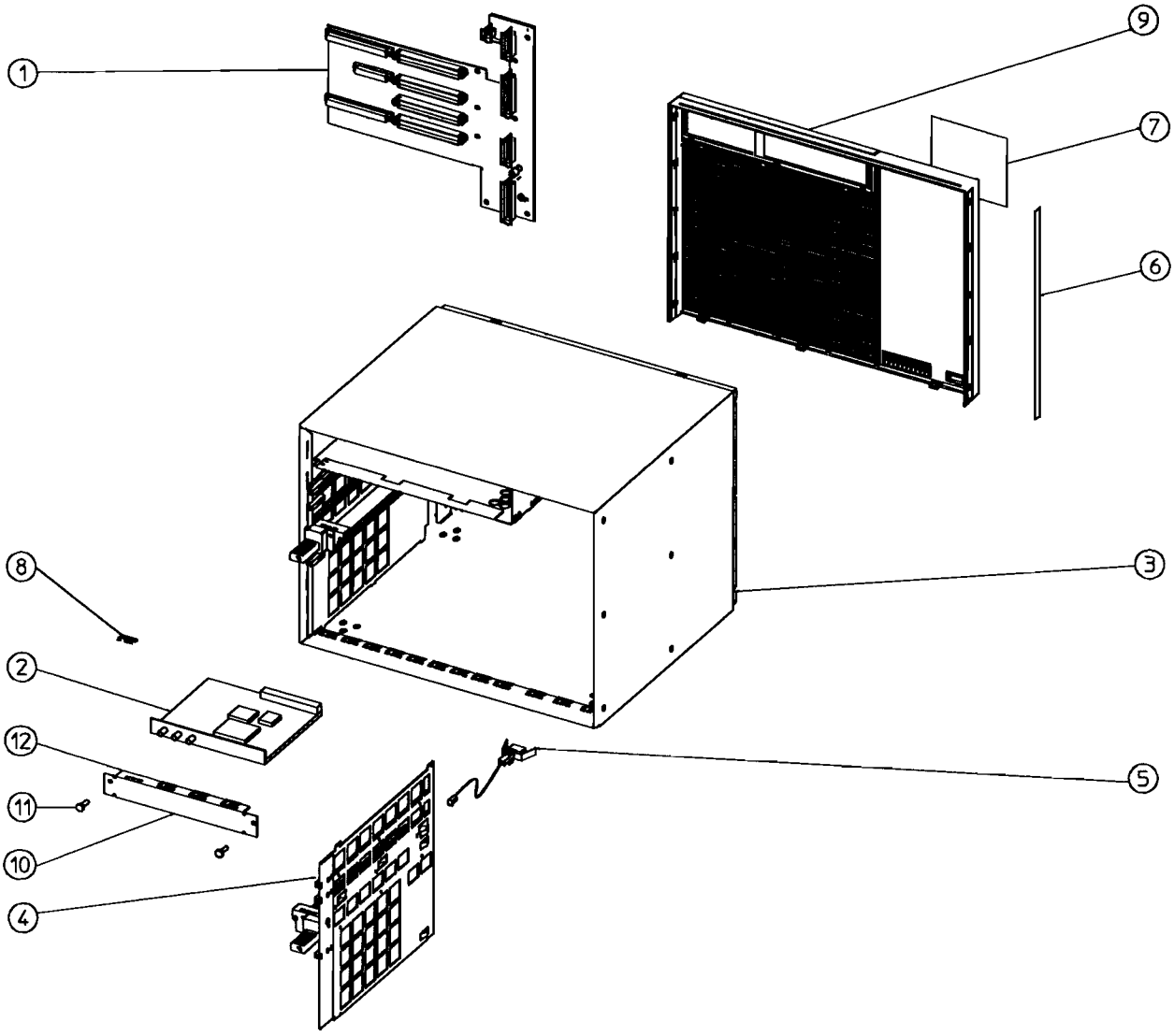

Figure 6-8. Chassis; Model 747*i* Exploded View

Rack Mounting Accessories

Table 6-8. Rack Mounting Accessories

Part Number	Description	Notes
5062-3978	Rack mount flange kit	for Model 745*i*
5062-3981	Rack mount flange kit	for Model 747*i*
5062-3984	Rack mount flange kit w/handles	for Model 745*i*
5062-3987	Rack mount flange kit w/handles	for Model 747*i*
HP 35199B	HP D1195A Monitor Rack Mount Kit	requires HP 12679C Rail Kit
HP 12679C	Rail kit	
HP E3902A	HP A1497A Monitor Rack Mount Kit	
HP 12131A	Keyboard rack mount kit	

Table 6-9. Keyboard and HP-HIL Devices

New Part Number	Description
46021-60201	ASCII Keyboard
46020-60001	Keyboard Cable
HP 46060A	HP Mouse
46081-61601	2.4-metre extension cable
46082-61601	Short audio cable
46082-61602	30-metre audio extension cable
46082-61604	15-metre remote cable
46083-61601	Short audio cable
46083-67901	Switch cap assembly
HP 46085A	Control dials
46085-85000	Overlay
QEDS-7099	RPG Pot assembly
5041-2416	RPG knob
HP 46084A	ID module
HP 46086A	Button box

7

Reference Documentation

Introduction

Information in this chapter should help you in various situations. The references include part numbers of many hardware documents relating to these workstations.

Service Documentation

Table 7-1. Related Service Documentation

Manual Title	Part Number
HP 9000 Series 700*i* Model 745*i* and 747*i* Industrial Workstations Service Manual	A2261-90031
HP 9000 Series 700*i* Model 742*rt* VME Board Computer, 745*i* and 747*i* Industrial Workstations Service Handbook	A2261-90040
HP D1182A 14-in. VGA Color Monitor Service Manual	D1182-90002
Servicing Hewlett-Packard Workstation Monitors (for HP C1497A 16-in Color Monitor)	5960-1511

Table 7-2. Diagnostic Documentation

Manual Title	Part Number
Support Tools Manager User's Manual; HP 9000 Series 700 and 800	5961-1612
HP Apollo 9000 Series 700 Diagnostics Manual, Volume 1	09740-90041
HP Apollo 9000 Series 700 Diagnostics Manual, Volume 2	09740-90043
HP Apollo 9000 Series 700 Support Tape/CD-ROM User's Manual	B2380-90000
PA-RISC Support Tools Manual Licensed Users Volume 1, SPU	5960-3149
PA-RISC Support Tools Manual Licensed Users Volume 2, Device Adapters/MUXes	5960-3151
PA-RISC Support Tools Manual Licensed Users Volume 3, LAN	5960-3153
PA-RISC Support Tools Manual Licensed Users Volume 4, SCSI	5960-3155
PA-RISC Support Tools Manual Licensed Users Volume 5, Disks	5960-3157
PA-RISC Support Tools Manual Licensed Users Volume 6, Tapes/Printers	5960-3159
PA-RISC Support Tools Manual Licensed Users Volume 7, Utilities	5960-3161
PA-RISC Support Tools Manual Licensed Users Volume 8, ISL Support Tools	5960-3163
PA-RISC Support Tools Manual HP Employees	5960-3165

System Installation and Getting Started Documentation

Table 7-3. System Installation and Getting Started Documentation

Manual Title	Part Number
Installation Guide; HP 9000 Series 700*i* Industrial Workstations	A2261-90015
Model 745*i* and 747*i* Owner's Guide for HP-UX Users	A2261-90014

Upgrade Documentation

Table 7-4. Upgrade Documentation

Manual Title	Part Number
HP A2628A System Module Upgrade Installation Guide	A2628-90010
HP A2640A 525 Mbyte and HP A2641A 1 Gbyte Hard Disk Drive Upgrade Installation Note	A2640-90010
HP A2642A and HP A2643A DDS Tape Drive Upgrade Installation Note	A2643-90010
HP A2644A CD-ROM Disk Drive Upgrade Installation Note	A2644-90010
HP A2645A 3.5-in. Flexible Disk Drive Upgrade Installation Note	A2645-90010

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