



RA8000 and ESA12000
Storage Subsystems

User's Guide

EK-SMCPR-UG. A01

387404-001

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Revision Record

This Revision Record provides a concise publication history of this guide. It lists the manual revision levels, release dates, and summary of changes.

The following revision history lists all revisions of this publication and their effective dates. The publication part number is included in the Revision Level column, with the last entry denoting the latest revision.

Revision Level	Date	Summary of Changes
EK-SMCPR-UG. A01	November 1998	Initial release

About This Guide

This section identifies the users of this guide and describes the contents and structure. In addition, it includes a list of conventions used in this guide and related documentation.

RA8000 and ESA12000 Storage Subsystems User's Guide

This guide provides a product description, set up, configuration, and maintenance information for the RAID Array 8000 (RA8000) and the Enterprise Storage Array 12000 (ESA12000) Storage Subsystems.

Visit Our Web Site for the Latest Information

Check our web for the latest drivers , technical tips, and documentation. We can be found in the technical area of our web page, <http://www.compaq.com/>

Intended Audience

This guide is intended for users who are responsible for installing, configuring, and repairing the RA8000 and ESA12000 Storage Subsystems.

Document Structure

This guide contains the following chapters:

Chapter 1: Product Description

Product Description provides a product overview of the RA8000 and ESA12000 Storage Subsystems. It also describes their components, features, and operating functions.

Chapter 2: Installing the RA8000 and ESA12000

Installing the RA8000 and ESA12000 describes how to install the subsystem. It includes site preparation, installing SBBs, and cable connections between the subsystem and the host. The chapter also describes how to install options and how to connect a master ESA12000 to an expansion enclosure.

Chapter 3: Configuring the Storage Cabinet

Configuring the Storage Cabinet describes how to connect the EMU communications bus and setting monitoring controls.

Chapter 4: Error Analysis and Fault Isolation

Error Analysis and Fault Isolation describes the errors, faults, and significant events that may occur during the enclosure's initialization and operation.

Chapter 5: Replacing Components

Replacing Components describes the procedures to remove and install the Field Replaceable Units (FRUs) in the subsystem.

Conventions

This guide uses the following conventions:

Style	Meaning
boldface type	For emphasis and user input.
<i>italic type</i>	For emphasis, manual titles, utilities, menus, screens, and filenames
<code>plain monospace type</code>	Screen text.

Related Documentation

For additional information on the RAID array controller, refer to the following StorageWorks documents:

Document Title	Document Part Number
HSG80 Array Controller ACS Version 8.x Configuration and CLI Reference Guide	EK-HSG80-RG/387402-001
HSG80 Array Controller ACS Version 8.x Maintenance and Service Guide	EK-HSG80-SV/355218-001
HSZ80 Array Controller ACS Version 8.x Configuration and CLI Reference Guide	EK-HSZ80-RG/388222-001
HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide	EK- HSZ80-SV/388221-001

1

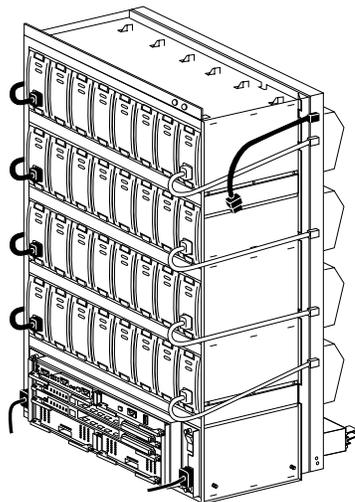
Product Description

This chapter describes the RA8000 and ESA12000 Storage Subsystems including the Ultra Small Computer System Interface (SCSI-3) connections (ports) for StorageWorks building block (SBB) shelves.

1.1 Subsystem Overview

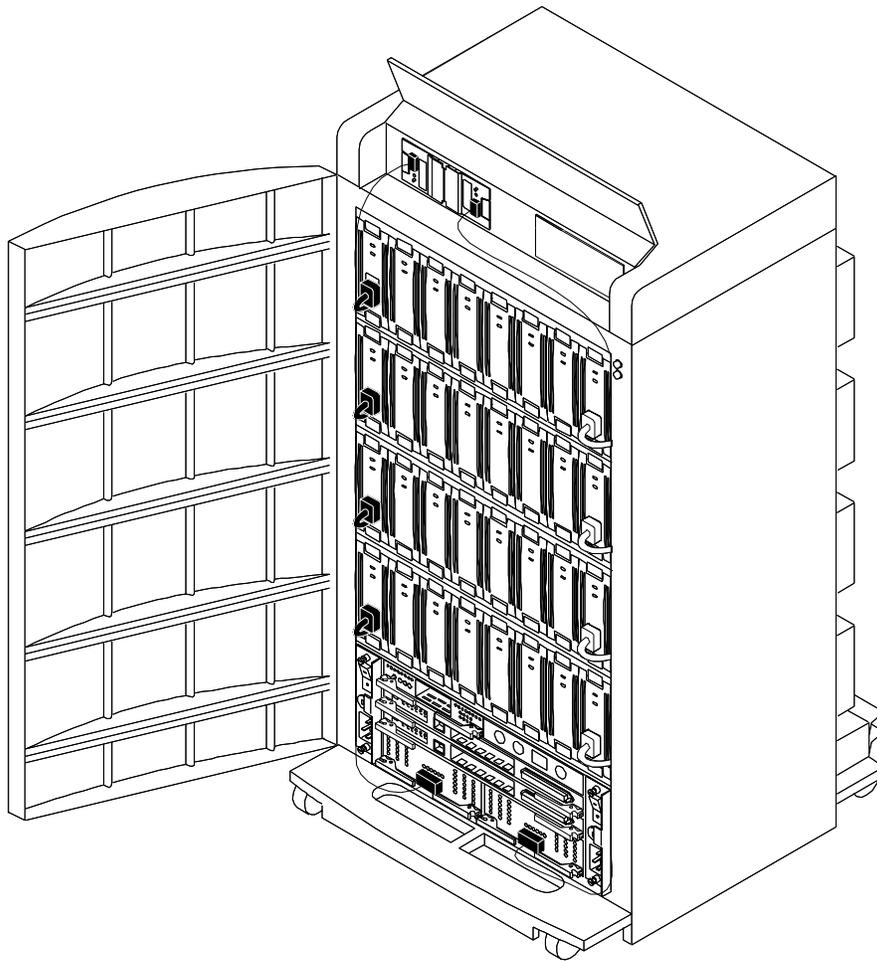
The RA8000 and ESA12000 Storage Subsystems are members of Compaq's StorageWorks family of modular enclosures. They share a common major component, the BA370 Rack Mountable Enclosure (Figure 1-1), that includes an Environmental Monitor Unit (EMU), a Power Verification and Addressing (PVA) module, power supplies, and an AC Power Entry Controller. StorageWorks storage devices, redundant power supplies, array controller(s), cache module(s), External Cache Battery (ECB), and redundant ac power entry controllers may also be included. Figures 1-2 , 1-3A, and 1-3B show three possible BA370 configurations.

Figure 1-1 BA370 Rack Mountable Enclosure



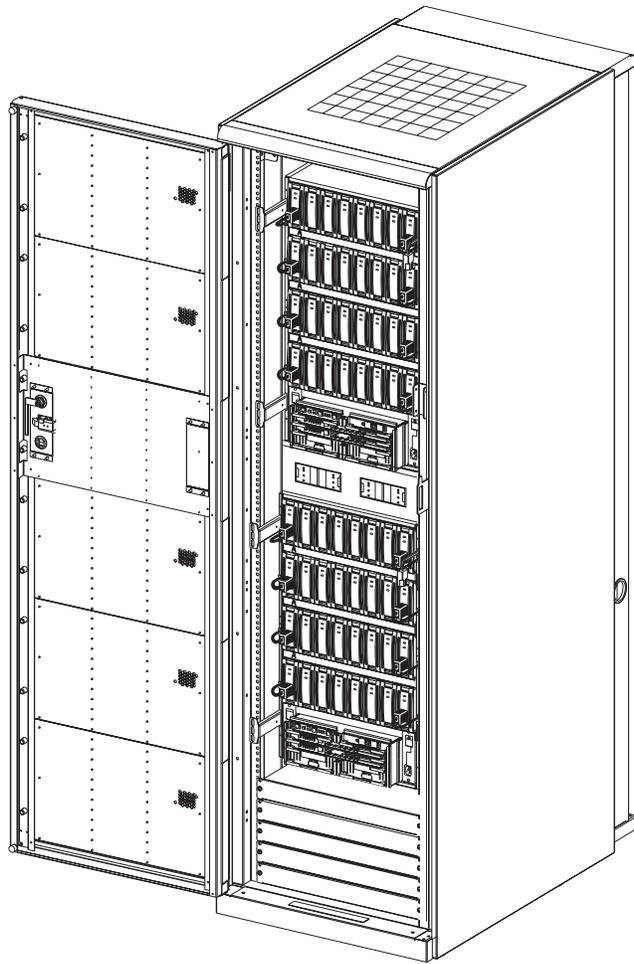
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Figure 1–2 RAID 8000 (RA8000) Pedestal



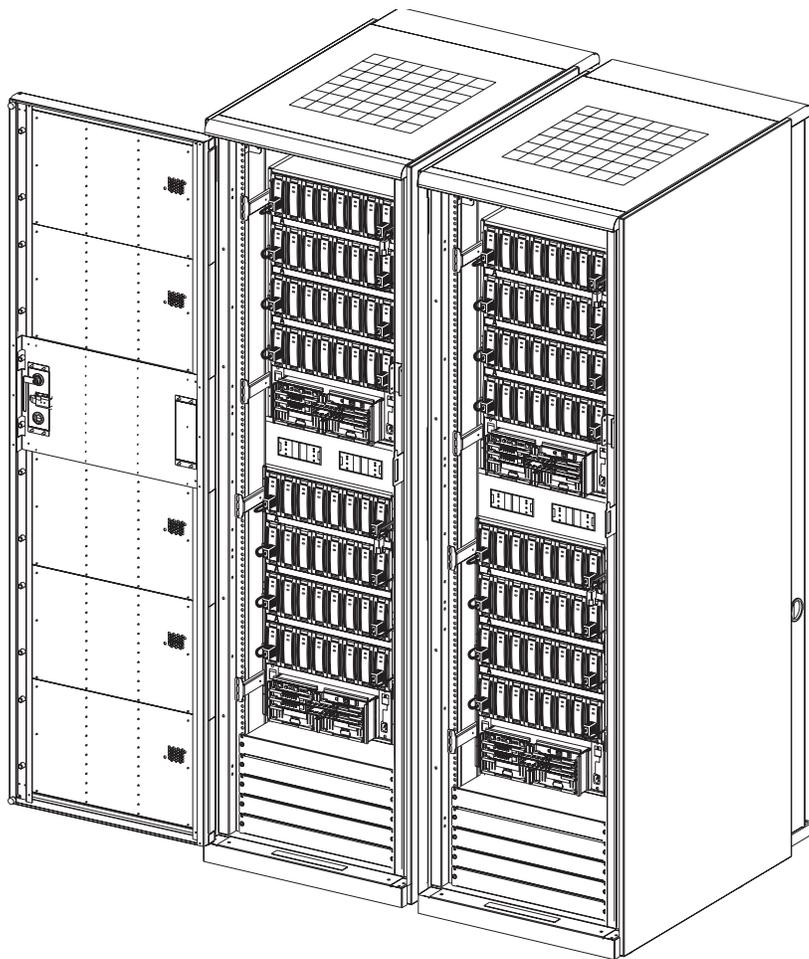
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Figure 1-3A ESA12000 Storage Cabinet (shown with two BA370 rack-mountable enclosures in a single cabinet)



CXO6618A

Figure 1-3B Joined ESA12000 Storage Cabinets (shown with four BA370 rack-mountable enclosures in two cabinets)



CXO6619A

The major features of the BA370 rack mountable enclosure are as follows:

- Holds up to twenty-four 3½-inch disk drive SBBs per BA370
- Redundant power distribution to eliminate single points of failure
- Redundant ac power entry controllers
- Contains six, single-ended, Ultra Wide SBB backplane SCSI buses
- Minimizes SCSI bus cables
- A StorageWorks HSG80 or HSZ80 RAID array controller (can hold single or dual redundant array controllers)
- All major components, except the single ended I/O modules and PVA module, can be replaced using the hot-swap method which reduces down time (described in Chapter 5)
- Fault monitoring and reporting capability for incorrect voltages, shelf blower failure, power supply failure, and excessive operating temperature
- The BA370 may be used as a master or an expansion unit
- One or two expansion enclosures can be connected to a master enclosure which provides SBB slots for up to 72 disk drives

NOTE

The master unit contains the array controller(s) and cache module(s). Expansion units contain additional storage devices on the same SCSI buses.

- The 24-SBB RAID Array 8000 storage subsystem and the ESA12000 storage subsystem are Class A FCC certified

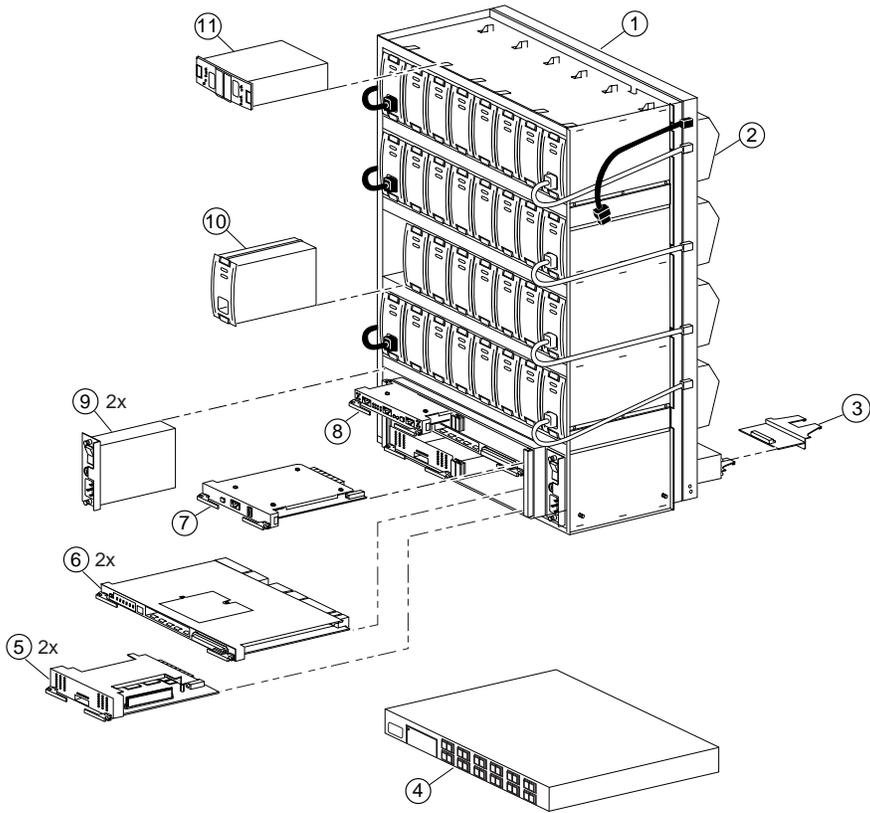
1.2 Major Components

A fully configured redundant subsystem (Figure 1-4) consists of the following major components:

- 1) A BA370 Rack mountable enclosure (1)
- 2) Cooling Fan (8)
- 3) Single-Ended I/O Modules (6)
- 4) Optional Fibre Channel or UltraSCSI Hub
(12-port Fibre Channel Hub shown)
- 5) Cache module (2)
- 6) HSG80 Fibre Channel RAID Array controllers (2) or
HSZ80 SCSI RAID Array Controllers (2)
- 7) Power Verification and Addressing (PVA) Module (1)
- 8) Environmental Monitor Unit (EMU) (1)
- 9) AC Input Power Controllers (1 standard, 2 shown in Figure 1-4)
- 10) 180-watt power supply (5 standard, 8 shown in Figure 1-4)
- 11) External Cache Battery (ECB), single
External Cache Battery (ECB), dual

Also, Power Distribution Unit (2) *Not shown, mounted in ESA12000 cabinet only*

Figure 1-4 Configured BA370 Rack Mountable Unit Major Components



CXO6568A

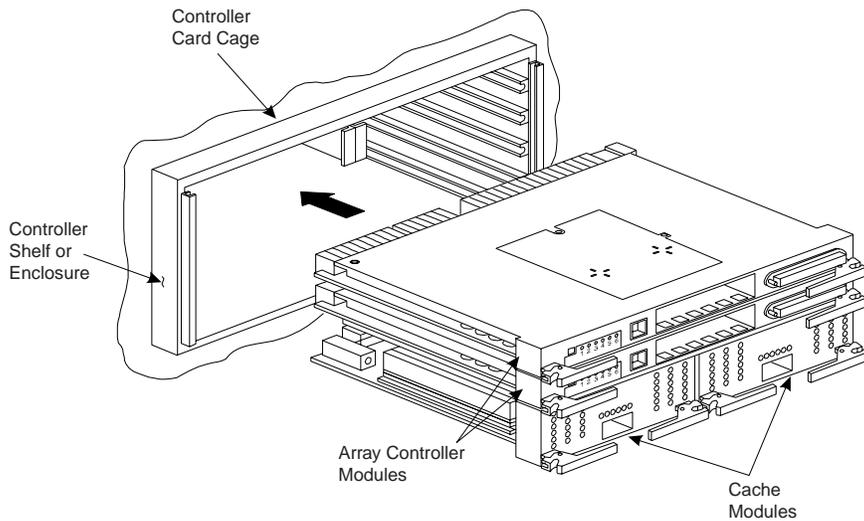
1.2.1 Array Controllers

Either an HSG80 Fibre Channel array controller or an HSZ80 UltraSCSI array controller can be used. The array controller presents the storage devices to the host system as another device connected to one of its I/O buses. The array controller then processes the I/O requests to the storage devices of the subsystem. The array controller(s) mount in the lower front of the cabinet (see Figure 1-5 for HSG80 and Figure 1-6 for the HSZ80). Installing two array controllers with cache modules provides complete array controller redundancy as described in either the *HSG80 Array Controller ACS Version 8.3 Maintenance and Service Guide* or *HSZ80 Array Controller ACS Version 8.3 Maintenance and Service Guide*.

NOTE

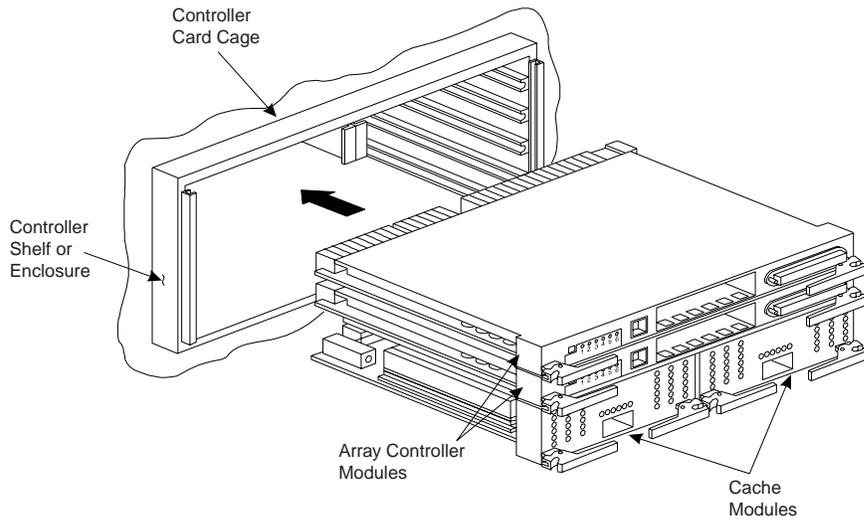
Array controllers and cache modules removed from array controller card cage for clarity in Figures 1-5 and 1-6. Modules are not a single unit.

Figure 1-5 HSG80 Array controller and Cache Modules



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Figure 1–6 HSZ80 Array controller and Cache Modules



SHR-1146

The array controller documentation describes procedures for:

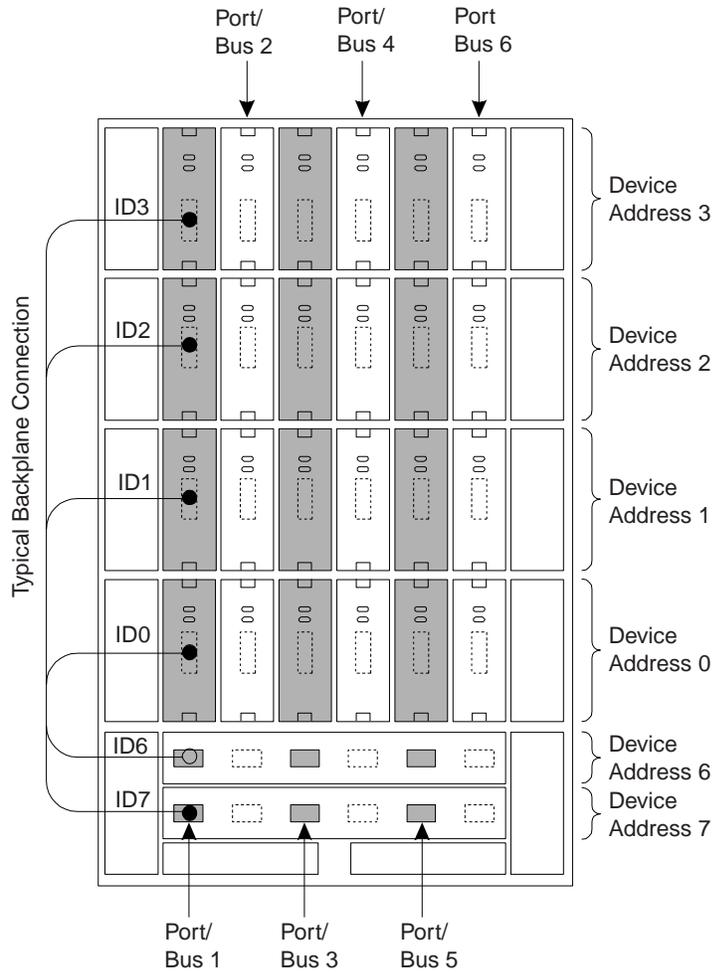
- Configuring the array controller
- Setting initial array controller parameters using a maintenance terminal
- Determining the proper method for replacing SBBs

The array controller software revision level determines the devices supported by the array controller.

1.2.2 SCSI Buses

There are six Ultra Wide SCSI buses associated with the array controller. The ports and device addresses for the master unit are shown in Figure 1-7.

Figure 1-7 SCSI Buses



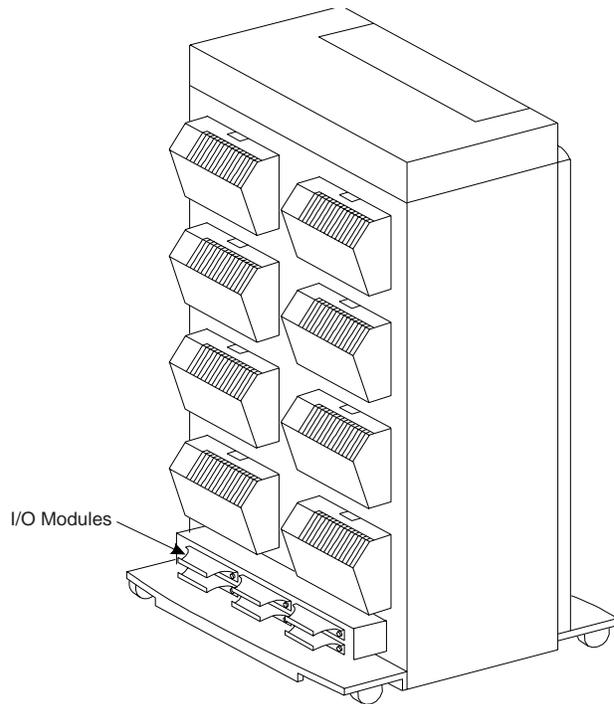
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The subsystem enclosure supports single-ended, Ultra Wide storage devices. The configuration rules for the SCSI buses are as follows:

- All devices and ports in the same column are on the same SCSI bus or port
- All devices in the same row (device shelf) have the same device address
- You may only install array controller-compatible Ultra Wide storage SBBs
- Device addresses 4 and 5 are only used when the SBB has a device address switch
- Device addresses are determined by the backplane connector into which the device is inserted unless the SBB has a device address switch

1.2.3 Single-Ended I/O Module (SE I/O)

Figure 1–8 Single-Ended I/O Module Location



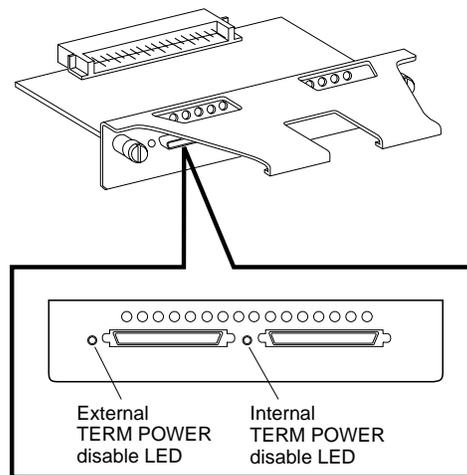
SHR-1148

Each SCSI enclosure, whether it is a master or an expansion enclosure, has six I/O modules mounted at the bottom rear of the enclosure as shown in Figure 1-8. In all enclosures these modules are the interconnection point between the array controller in the master enclosure and the devices in the expansion enclosures. In an UltraSCSI RAID subsystem, the I/O modules, the internal SCSI buses, and the array controller ports all have the same number. For example, array controller port 2, SCSI bus 2, and I/O module 2 are different elements of the same bus. Figure 2-34, Chapter 2, identifies the six I/O port numbers at the bottom of the enclosures. The major features of the single-ended I/O module are described in the following sections.

1.2.3.1 Expanding the UltraSCSI Bus

Each I/O module has an UltraSCSI single-ended bus expansion integrated circuit. This device isolates the internal and external SCSI bus and extends the length of the SCSI bus.

Figure 1-9 Single-Ended I/O Module



CX05947A

The two VHDCI female connectors are the connection points for expanding the SCSI buses between enclosures (see Figure 1-9). These connectors are wired in parallel and act as a tri-link connector. In an expansion configuration, Compaq recommends that maximum cable length not exceed 1.5 m (4.6 ft.) between enclosures. Compaq supplies a cable kit, DS-BNK37-IE, containing the necessary cables to connect an expansion unit.

1.2.3.2 Controlling the Internal SCSI Bus

The I/O module controls the internal SCSI bus in the following manner:

- Isolates the internal SCSI bus from the external SCSI bus.
- Provides single-ended SCSI bus termination.
- Disconnects the internal SCSI bus from the external SCSI bus when the EMU so directs.
- Distributes TERMPOWER (+5 V dc) to the internal SCSI bus.
- Turns ON the green internal TERMPOWER LED (see Figure 1-9) when the internal TERMPOWER is present.
- Turns OFF the green internal TERMPOWER LED (see Figure 1-9) when there is an internal TERMPOWER overcurrent condition.

1.2.3.3 Controlling the External SCSI Bus

The I/O module controls the external SCSI bus in the following manner:

- Provides single-ended SCSI bus termination.
- Distributes TERMPOWER (+5 V dc) to the external SCSI bus.
- Turns ON the green external TERMPOWER LED (see Figure 1-9) when the external TERMPOWER is present.
- Turns OFF the green external TERMPOWER LED(see Figure 1-9) when there is an external TERMPOWER overcurrent condition.
- Automatically disables the external bus termination when a cable is connected to the right hand VHDCI connector.

1.2.3.4 Controlling the Fault Bus

The I/O module controls the fault bus operation in the following manner:

- Provides a fault bus driver for improved signal transmission.
- Distributes the FAULT_CLK and FAULT_DATA signals from the master enclosure to the expansion enclosures.
- Distributes the SHELF_OK and SWAP_L signals from the expansion enclosures to the master enclosure.

1.2.3.5 “Warm Swapping” I/O Modules and Cables

You can replace either the I/O module or a cable when the associated SCSI bus is quiesced (no data transfers occurring) – a warm swap. This enables you to correct problems affecting only one bus without disrupting data transfers on the other five buses.

1.2.3.6 Maximum Bus Length

The maximum bus length, including external cables (distance from the I/O module terminator to the last terminator on the bus) is a function of the bus speed and the number of devices. If the external bus is configured point to point (from SE I/O module-to-SE I/O module with no devices installed in between), the cables may be extended to 20 meters due to the isolation and re-timing circuitry of the SE I/O module.

1.3 Error Detection and Reporting

The subsystem error detection and reporting function has two major elements – the fault bus and the EMU (environmental monitor unit). For a detailed discussion of error detection, fault reporting, and correction, refer to Chapter 4, Error Analysis and Fault Isolation.

1.3.1 Fault Bus

The subsystem fault bus monitors subsystem operation and reports fault conditions to either the HSG80 or the HSZ80 array controller and the EMU. The array controller and EMU then report the error condition to the user. The fault bus monitors the following conditions:

- Blower failure (SHELF_OK)
- Power supply failure (SHELF_OK)
- Storage device removal (SWAP_L)
- Storage device installation (SWAP_L)
- SBB failure (FAULT_CLK, FAULT_DATA)

The fault bus consists of three subsystem backplane signals routed to the array controller port connectors as follows:

- *Shelf Status Signal* – The SHELF_OK status signal indicates the state of subsystem power (ac and dc) and blower operation
- *SBB Swap Signal* – The SWAP_L signal is asserted whenever an SBB is removed or inserted in the subsystem
- *SBB Fault Signals* – The SBB amber LED displays either the storage address or indicates a device fault. This device fault LED is controlled by the fault clock (FAULT_CLK) and the fault data (FAULT_DATA) control signals.

1.3.2 Environmental Monitor Unit (EMU)

The primary function of the EMU (see Figure 1-10) is to monitor, process, report, and display enclosure and array controller environmental status information for the power supplies, temperature, blowers, configuration, SCSI addressing, I/O modules, communications, and the EMU microcode version. The EMU and array controller can exchange and process this information.

CAUTION

Proper operation of a storage subsystem requires an operational EMU and PVA in each BA370 rack mountable enclosure. You must also establish communications links between the EMUs to ensure proper subsystem operation and error reporting.

1.3.2.1 EMU Front Panel

The EMU front panel contains all of the user interface controls, connectors, and displays (see Figure 1-10 and Table 1-1).

Figure 1-10 Environmental Monitor Unit (EMU)

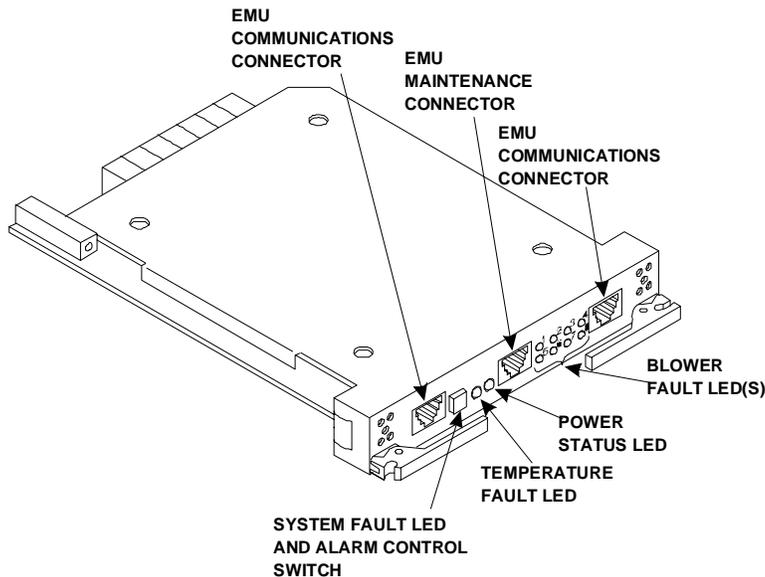


Table 1–1 EMU Front Panel Component Descriptions

Component	Function
EMU Com. Connector (LEFT)	Provides inter-EMU communications.
System Fault LED (amber) and Alarm Control Switch	The System Fault LED in the Alarm Control Switch is ON whenever there is an error condition. This LED is FLASHING whenever the EMU has one or more fault codes to display. When there is a fault code, momentarily pressing this switch turns OFF the audible alarm and starts the fault code LED display. Pressing the Alarm Control switch for at least 5 seconds clears all the active fault codes. After a controlled power shut down, momentarily pressing this switch will restore power to the enclosure.
Temperature Fault LED (amber)	Whenever either the ambient temperature or the enclosure backplane temperature exceeds the user-defined temperature set point, this LED is ON until the condition is corrected.
Power Status LED (green)	This LED is ON whenever there are: At least four operational +5 V dc power supplies At least four operational +12 V dc power supplies TERMPower is present on all six I/O modules This LED is OFF whenever there are: Fewer than four operational +5 V dc power supplies Fewer than four operational +12 V dc power supplies One or more I/O modules are missing TERMPower
EMU Maintenance Connector	You can connect a maintenance terminal or PC to this connector to display EMU: Error messages Information messages A PC can also load EMU microcode through this connector.
Blower Fault LEDs (amber)	One or more of these eight blower fault LEDs are ON whenever one or more blowers are: Not operating Not operating at the correct speed. Removed There is a fault code display
EMU Com. Connector (RIGHT)	Provides inter-EMU communications.

1.3.2.2 Array Controller Status

The master EMU also monitors the state of both array controllers. Should the EMU detect an array controller fault it can:

- Sound the audible alarm
- Cause the EMU system fault status LED to flash
- Display an array controller fault code on the blower LEDs when you momentarily press the Alarm Control switch

When an error is detected on the EMU array controller communications path, it causes an array controller fault.

1.3.2.3 I/O Module Status

The EMU also ensures that all six I/O modules are present, are properly installed, and that each has TERMPOWER. If any of these conditions are not met, the EMU reports an error condition to the array controller(s). The EMU also reports each I/O module type to the array controller. Should an array controller determine that the I/O module configuration is incorrect, it displays this information on the console.

An integrated circuit on each I/O module functions as an UltraSCSI bus extender. The EMU and the array controller can enable or disable individual I/O module circuits, thereby controlling individual external SCSI buses.

1.3.2.4 Enclosure Configuration Information

The EMU maintains the following configuration information:

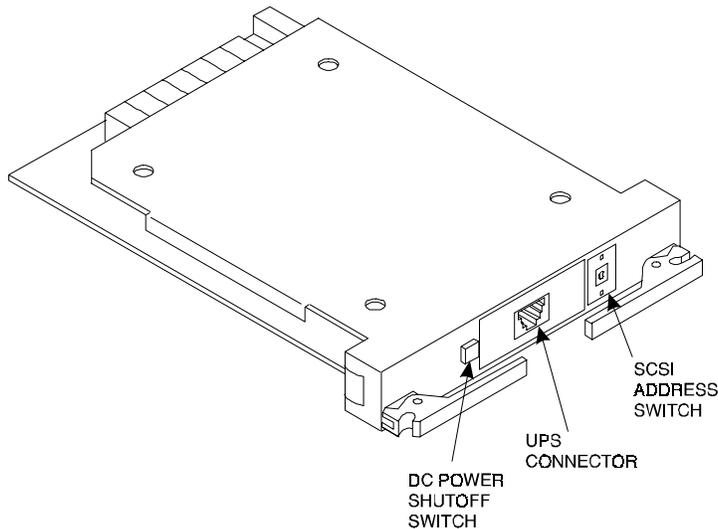
- Enclosure number
- EMU microcode version
- EMU message protocol version
- PVA SCSI ID setting
- Temperature sensor set points
- The number of installed power supplies by location
- The number of installed SBBs by location
- The number of installed blowers by location

1.3.3 Power Verification and Addressing (PVA) Module

Proper operation of the subsystem, whether it be a master or an expansion enclosure, requires both a PVA module and an EMU module. The PVA (Figure 1-11) and its associated EMU ensures that all major UltraSCSI components are functioning properly. When an error condition occurs, these modules notify the user that a problem exists. The array controller identifies the specific problem. The PVA and EMU LED displays identify possible causes of the problem.

The PVA mounts in the lower right section of the enclosure, directly above the array controller. The PVA and EMU have the same physical dimensions, use the same type connectors, and are mounted next to each other – the EMU on the left and the PVA on the right (see Figure 1-4). They are not interchangeable.

Figure 1–11 Power Verification and Addressing (PVA) Module



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As shown in Figure 1-11, the major user-accessible components of the PVA include the following:

- The dc power shutoff switch which includes a green power status LED
- The UPS connector (RJ-45) for future UPS monitoring capability
- The enclosure SCSI address switch that establishes the enclosure address and thereby the SCSI bus IDs for each storage device

The PVA has two status indicators:

- The green power status LED in the power shut down switch. This LED is ON whenever there at least four operational power supplies. When an error condition occurs, the LED is OFF and the PVA reports the error to the EMU. The EMU also monitors the power supplies for this condition
- An audible alarm that beeps at a slow rate when the PVA detects removal of or improper installation of the EMU. This ensures you are aware the EMU must be replaced within 8 minutes to prevent a system shut down

The primary functions of the PVA include the following:

- 1) Ensures that there is a minimum of four operational power supplies in the enclosure. If the PVA senses less than four power supplies, it notifies the EMU.
- 2) Allows the user to select the Compaq-supported device SCSI bus addresses for the master and each expansion enclosure.
- 3) Monitors the EMU status and:
 - Notifies the user of removal of the EMU
 - Notifies the user when there is no master EMU
 - Notifies the user when there are multiple master EMUs
 - Provides the user a switch to disconnect dc power from the enclosure power buses
 - Monitors the optional UPS for proper operation and reporting the UPS status (a planned future capability)

1.3.3.1 Monitoring Power Supply Operation

For accurate, reliable transfer of data without data corruption or loss, the enclosure requires a minimum of four operational power supplies to furnish both +5 and +12 Vdc for operation of the following:

- Storage Devices (SBBs)
- Array controllers and cache memories
- EMU
- PVA

Therefore, both the EMU and PVA monitor all of the power supplies (a maximum of eight) to ensure that at least four are operational. An error condition is indicated by one of the following conditions:

- The +5 Vdc voltage drops to +4.7 Vdc
- The +12 Vdc voltage drops to 11.4 Vdc

Another voltage essential for proper operation is the +5 Vdc termination power (TERMPower) required for the SCSI bus on each of the six I/O modules. If this voltage drops to +4.7 Vdc, an error condition exists.

As long as there are four operational supplies and TERMPower is correct, the EMU and PVA generate the POK (power OK) signal. As long as POK is present the array controller can continue to transfer data providing there are no other error conditions.

The loss of the POK signal for any reason causes the array controller to shut down and halt all data transfers. All six buses remain quiesced (no data transfers occurring) until the array controller determines that power is correct. The array controller does this by checking the status of the POK signal. Until the POK reports that there are at least four operational power supplies and that TERMPower is correct, the array controller, the cache memories, and all the devices remain passive. The EMU and the PVA continue to monitor the system and report the error condition.

1.3.3.2 Master Enclosure Controlled Power Shutdown

The EMU can shut down the dc power in the master enclosure or the subsystem when one of the following conditions occur:

- The EMU determines an extreme over-temperature condition that requires removing power from the subsystem
- The user presses and holds down the PVA dc power switch until the EMU initiates a controlled power shut down

NOTE

This procedure will only work when the array has been shut down.

When you initiate a controlled power shut down from the master enclosure PVA the sequence of events is as follows:

- 1) The EMU changes its status to indicate that the dc power switch was pressed
- 2) The master EMU notifies the array controller of the change in status.
- 3) When the array controller is ready, it sends a controlled power shutdown command to the master EMU.

- 4) A controlled power shut down is completed on all the subsystem cabinets.

NOTE

If the master EMU is not communicating with the array controller or the array controller does not support a controlled shut down, the master EMU commands all enclosures to perform an immediate power shut down.

1.3.3.3 Expansion Enclosure Initiated Power Shut Down

NOTE

This procedure will only work when the array controller(s) have been shut down.

When you press the PVA dc power switch on the expansion enclosure and the expansion EMU *can* communicate with the master EMU, one of the following power shut down operations occurs:

NOTE

When the expansion EMU *cannot* communicate with the master EMU, pressing the dc power switch causes an immediate controlled power shut down of only the expansion enclosure.

1. The slave EMU changes its status to indicate that the dc power switch was pressed.
2. The master EMU notes the change in status.
3. The master EMU notifies the array controller of the change in status.
4. When the array controller is ready, it sends a controlled power shut down command to the master EMU.
5. A controlled power shut down is completed on all the subsystem cabinets.

NOTE

If the master EMU is not communicating with the array controller or the array controller does not support a controlled shut down, the master EMU commands all enclosures to perform an immediate power shut down.

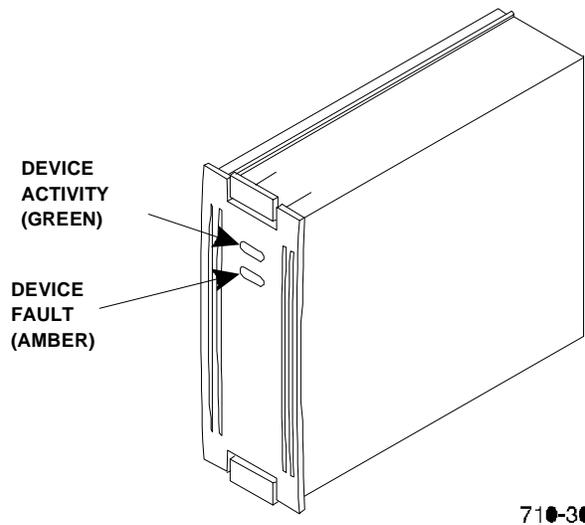
1.4 Storage Device SBBs

The BA370 can accommodate up to twenty-four 3½-inch storage device SBBs (Figure 1–12). Each occupies one slot (six SBBs per shelf). The SCSI device addresses of the SBBs can be assigned in the following ways:

- By the backplane connector
- With the SCSI device address switch mounted on the rear of the SBB

The HSG80 and the HSZ80 array controllers software product descriptions and release notes list the subsystem compatible SBBs.

Figure 1–12 Disk Drive SBB



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1.5 Power Configuration

There are two primary storage subsystem power configurations:

- *Standard* – 4 + 1 power configuration includes one ac power controller and five power supply SBBs on power bus **A**
- *Redundant* – 4 + 4 power configuration includes one ac power controller and four power supply SBBs on power bus **A**, one ac power controller, and four power supply SBBs on power bus **B**

When there are less than four operational power supplies, the subsystem will cease operating to preserve and protect the data. Table 1-2 lists the storage subsystem power components and configurations.

CAUTION

A minimum of four operational SBB power supplies are required for operation of the subsystem. The fifth SBB power supply provides redundancy.

Table 1–2 Storage Subsystem Major Power Components

Component	Order No.	Power Configurations	
		Standard	Redundant
ac Power Entry Controller	DS-BA35X-HE	1	2
Shelf Power Supply SBB	DS-BA35X-HH	5	8

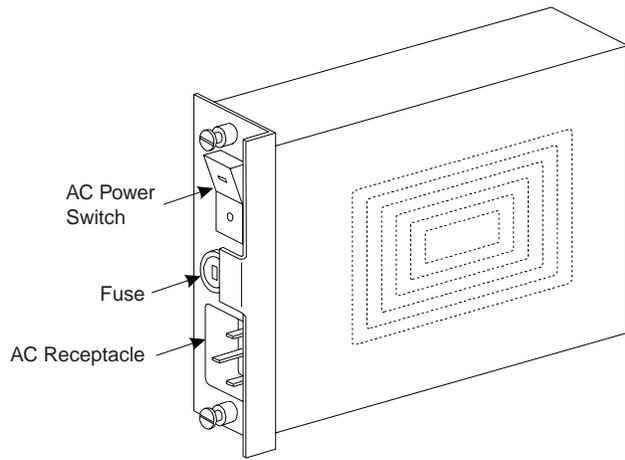
1.5.1 AC Power Entry Controllers

The ac input power is routed from the wall outlet to one of the power entry controllers (Figure 1-13) that may have either of the following input voltages:

- 100 – 120 V ac, 60 Hz, single-phase, 12A
- 220 – 240 V ac, 50 Hz, single-phase, 6A

Each power entry controller has a system ON/OFF switch and distributes ac power to all power supply SBBs on either power bus A or power bus B.

Figure 1–13 AC Power Entry Controller



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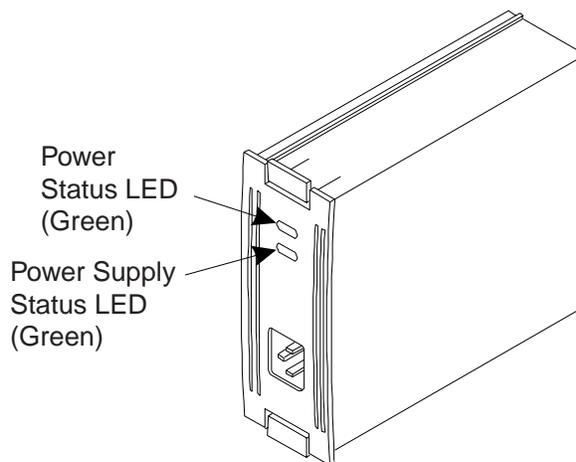
1.6 Power Supply SBBs

CAUTION

The subsystem requires power supply SBBs rated for at least 180 W such as the DS-BA35X-HH. You cannot use lower rated supplies, such as the 131 W (DS-BA35X-HA), the 145 W (DS-BA35X-HD), or the 150 W (DS-BA35X-HF).

The 180 W shelf power supply SBB (Figure 1-14) converts the ac voltage from the power controller to +5 V dc and +12 V dc for distribution throughout the storage subsystem. The maximum capacity of the storage subsystem is eight power supplies.

Figure 1–14 Typical Shelf Power Supply SBB



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The 4 + 1 standard configuration provides five power supplies connected to power bus A (the black power cords). As long as any four of these supplies are operational, the subsystem is operational. The failure of a second supply places the subsystem array controller in a reset state. This precludes further data processing and prevents the corruption or loss of the stored data.

With the 4 + 4 full redundant power option, the subsystem can survive multiple power supply faults. To fully realize the benefits of the 4 + 4 configuration, connect the ac power entry controllers to different ac distribution circuits on the same site distribution panel. The four subsystem power supply SBBs on the left end of the shelf are connected to ac power entry controller A. The four on the right end of the shelf are connected to ac power entry controller B.

1.7 Standard (4 + 1) Power Configuration

NOTE

The black power cord at the upper right corner of the subsystem is used only for the standard (4 + 1) configuration. It is not used for the redundant (4 + 4) configuration.

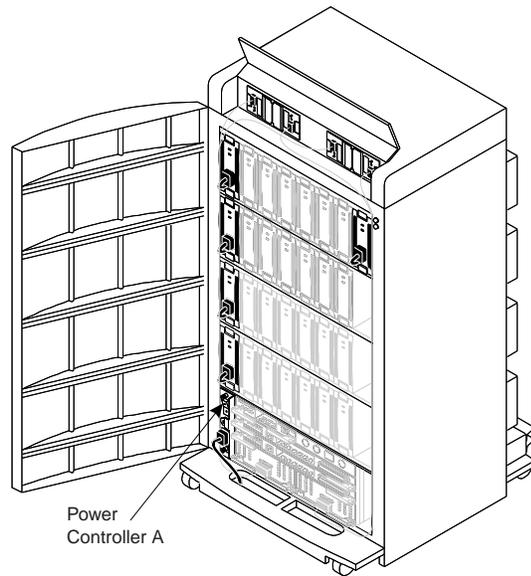
This standard power configuration (Figure 1-15) is the minimum configuration Compaq recommends. If a power supply SBB fails you might be able to replace it before a second fails. The standard power configuration has the following components:

- 5 – power supply SBBs
- 1 – ac power entry controller

Any one of the following errors will cause the subsystem to cease operation:

- Failure of two power supply SBBs
- Failure of the ac power entry controller
- Failure of the ac power source
- Failure of the PDU (ESA12000 only)

Figure 1–15 Standard Power Configuration (4 + 1)



1.8 Redundant (4 + 4) Power Configuration

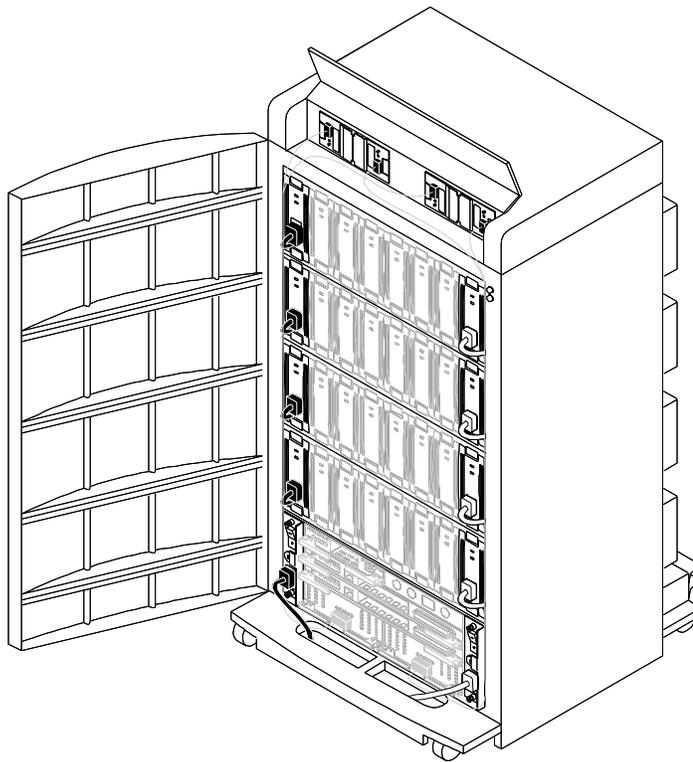
A full redundant power configuration requires two separate power sources, two ac entry power controllers, and eight shelf power supplies (Figure 1–16). Compaq recommends this configuration to provide complete power system redundancy. Any one of the following error conditions will cause the subsystem to cease operation:

- Failure of five power supply SBBs
- Failure of both ac power entry controllers
- Failure of both ac power sources
- Failure of both PDUs (ESA12000 only)

The primary ac source provides power to ac power entry controller A, which distributes the ac power through the four black power cords to the four power supply SBBs on the left end of each shelf.

The second, or redundant, ac source provides power to ac power entry controller B. The four power supply SBBs on the right end of each shelf are connected to power bus B with the four gray power cords.

Figure 1–16 Redundant Power Configuration (4 + 4)



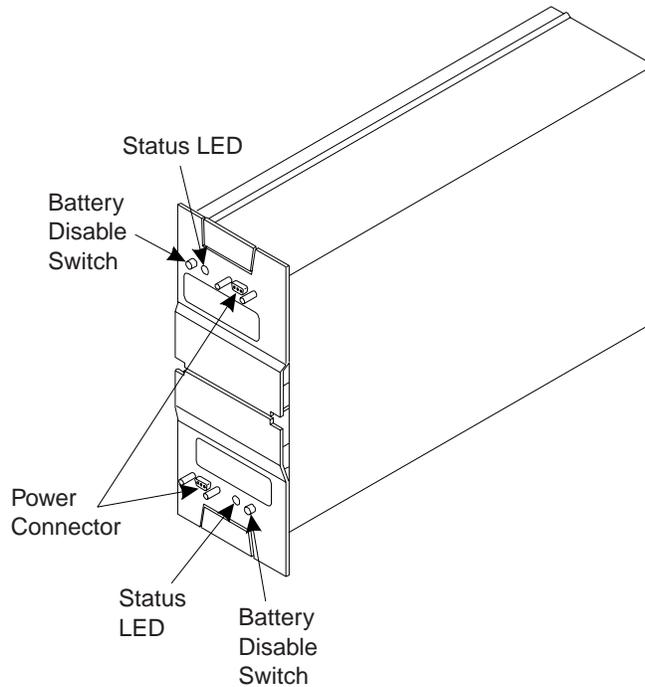
SHR-1152

1.9 ECB SBBs

The external cache battery (ECB) SBB provides power to the RAID array controller cache module if system power fails. The cache module in turn provides power to the ECB during normal operation. Compaq supplies two versions of ECBs: a single-battery ECB for single-array controller configurations and a dual-battery ECB for dual-redundant array controller configurations. Each battery has a power connector, status LED, and battery disable switch (see Figure 1-17).

To check the ECB status, look at the battery status LED (one for each cache module) for the appropriate indication (see Figure 1-17 and Table 1-3).

Figure 1-17 Dual-Battery ECB SBB



SHR-1154

Table 1-3 ECB Status Indications

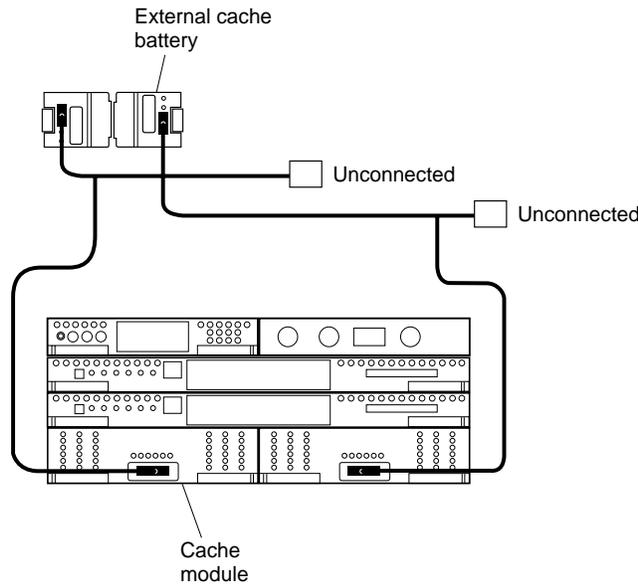
LED Status	Battery Status		
	System power is on and the ECB is fully charged.		
	System power is on and the ECB is charging.		
	System power is off and the ECB is supplying power to the cache.		
	System power is off and the ECB is not supplying power to the cache.		
LEGEND			
 = Off	 = On	 = Blink fast	 = Blink slow

In the RA8000, the ECB SBB is mounted at the top of the pedestal. In an ESA12000 cabinet, the ECB SBB is mounted in the middle front of the cabinet between the BA370 enclosures. A Y-cable connects the ECB to the array controller cache module. The cache is mounted under the array controller and is identified by the single plug in the middle of the module (Figure 1-18). Cache module to ECB cables are factory installed.

CAUTION

The ECB cable is configured in a “Y” to allow connection to a new battery without interrupting power to the cache module. The cable is only to be used to connect ONE battery to ONE cache module. Do not connect both ends of the ECB “Y” cable at the same time except when replacing ECBs. See chapter 5 of this manual for ECB replacement instructions.

Figure 1–18 Cache-to ECB-Connection



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1.10 Subsystem Cooling

As shown in Figure 1–19, the subsystem is equipped with eight dual-speed blowers. These blowers pull air in from the front of the cabinet, through the SBBs, array controllers, EMU and PVA, and exhaust it out the rear. Backplane connectors provide +12 V dc to operate the blowers and route the blower status signals to the shelf backplane and the EMU.

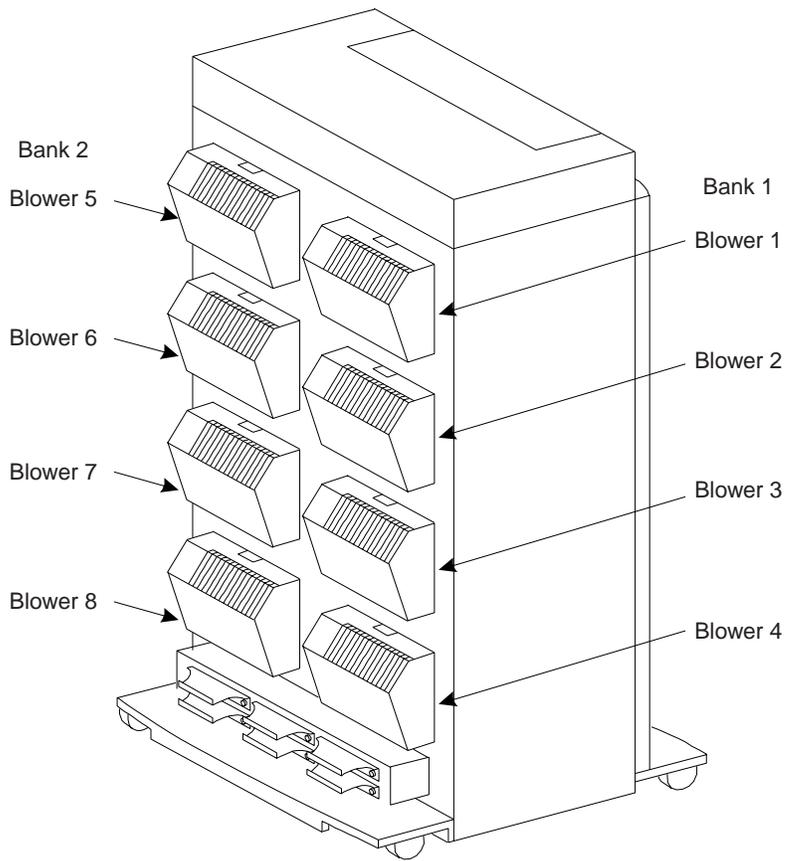
The EMU may be set to automatically increase fan speed or set to a constant fanspeed of high. Refer to the either the *HSG80 Array Controller ACS Version 8.3 Configuration and CLI Reference Guide* or *HSZ80 Array Controller ACS Version 8.3 Configuration and CLI Reference Guide* for the `set_emu` commands.

If set for automatic, the EMU switches all operational blowers from low-speed to high-speed when one or more of the following conditions occur:

- When a blower is removed
- When a blower malfunctions
- When a blower is not rotating at the right speed
- When the EMU detects an over-temperature condition

When the fault condition is corrected, the EMU returns the blowers to low speed.

Figure 1-19 Dual Speed Blower Locations



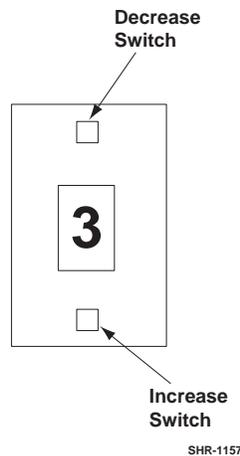
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1.11 Setting the PVA SCSI Address

The SCSI bus address switch on the front of the PVA module (see Figure 1-20) controls the SCSI address (device ID) of each storage device in the enclosure. The following configuration rules (restrictions) apply in establishing the PVA SCSI bus address:

- 1) The master PVA address is always 0.
There is only one master PVA in any subsystem installation.
- 2) The first expansion cabinet (if used) address is 2.
The second expansion cabinet (if used) address is 3.
In an expansion subsystem, no two enclosures can have the same address.
- 3) Compaq does not support any PVA address that assigns SCSI bus device addresses 6 or 7 to any storage device.
- 4) Compaq does not support any combination of PVA addresses that assign the same SCSI bus device address to more than one device on any SCSI bus.

Figure 1-20 PVA SCSI Address Switch



To decrease the configuration number:

Press the upper switch to step the address down one address at a time (decrement) until the preferred configuration number is displayed.

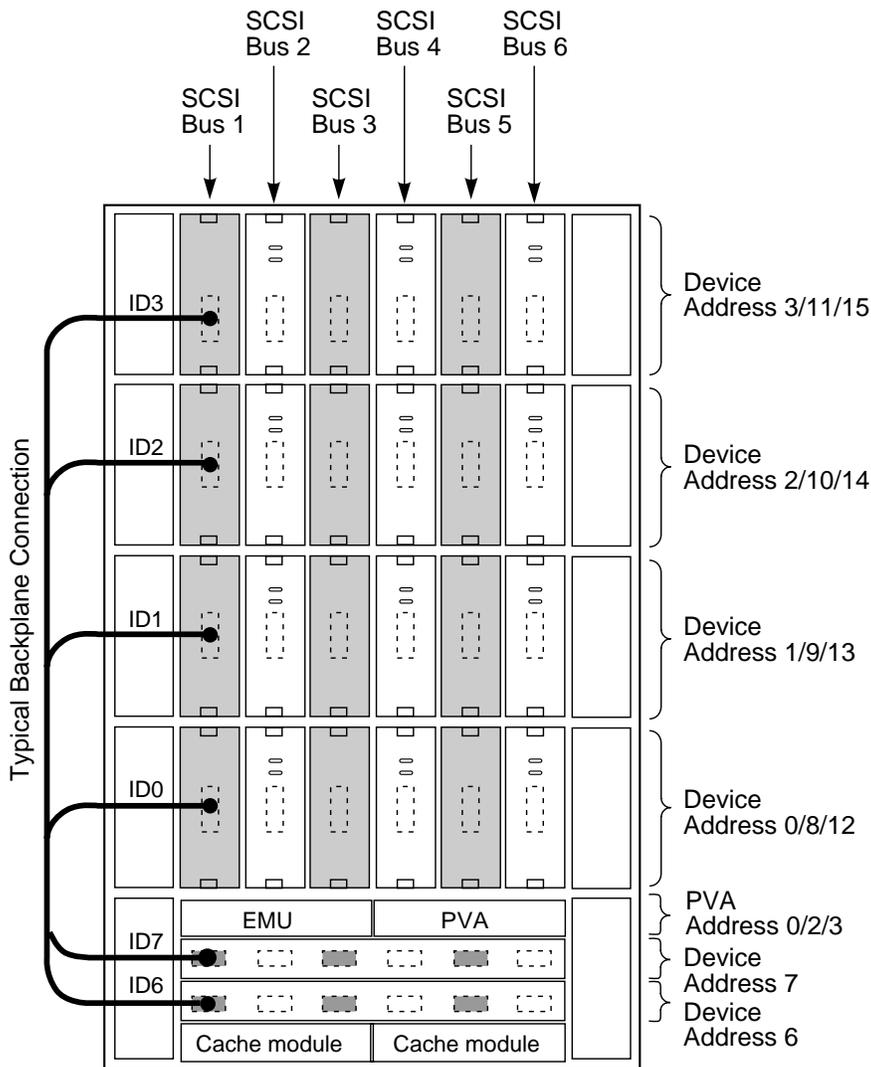
To increase the configuration number:

Press the lower switch to step the address up one address at a time (increment) until the preferred configuration number is displayed.

1.11.1 Compaq Supported Master PVA Address

Compaq supports PVA address “0” only for the master enclosure. Figure 1–21 defines the SBB device IDs for a master enclosure, first expansion, and second expansion units. The device addresses are denoted to the right of Figure 1–21.

Figure 1–21 Enclosure SCSI Bus Addresses for all SBB Device IDs



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1.11.2 Compaq Supported Expansion PVA Addresses

Compaq only supports PVA addresses 2 and 3 for expansion enclosures. Figure 1-20 defines the SBB device IDs for these two settings of the PVA SCSI bus address switch, respectively. The use of these addresses in combination depends on the number of enclosures and possible addressing conflicts.

CAUTION

Compaq does not support any PVA address combination not listed in Table 1-4.

Table 1-4 Expansion Enclosure Address Combinations

Enclosure	PVA Address Switch Setting for Two BA370 Rack Mountable units	PVA Address Switch Setting for Three BA370 Rack Mountable units
Master	0	0
First Expansion Unit	2	2
Second Expansion Unit	N/A	3

1.11.3 Non-Supported PVA SCSI Bus Addresses

Compaq *does not* support the following PVA SCSI bus addresses:

- Address 1
This PVA address assigns array controller SCSI bus device addresses 6 and 7 to storage devices.
- Address 4
This PVA address assigns addresses already assigned to the master enclosure.
- Address 5
This PVA address assigns array controller SCSI bus device addresses 6 and 7 to storage devices.
- Address 7
This PVA address assigns addresses already assigned to the master enclosure.

Installing the RA8000 and ESA12000 Storage Subsystems

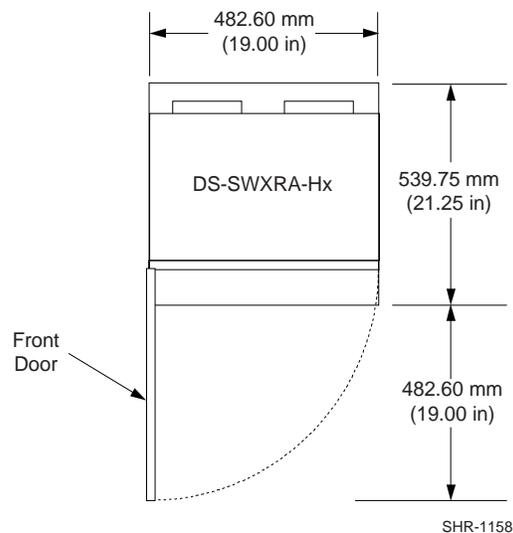
This chapter describes the site preparation and installation procedures for the RA8000 and ESA12000 Storage Subsystems. It also describes how to install options in the ESA12000. The chapter also contains ESA12000 expansion cabinet cabling instructions and an FRU list.

2.1 Installing the RA8000

2.1.1 RA8000 Site Preparation

The RA8000 storage cabinet is designed for installation in a Federal Communications Commission (FCC) Class A environment. Before installing the storage cabinet, make sure that adequate space is available in front of the cabinet for opening the front door (19 inches clearance) and around the cabinet for adequate airflow. See Figure 2–1 for specific space requirements.

Figure 2–1 RA8000 Minimum Installation Clearance Measurements



2.1.2 Placing the RA8000 Storage Enclosure

Use the following procedure to move the storage cabinet to its designated site:

WARNING

Provide a clear path for the casters to prevent damage to the cabinet and injury to personnel.

1. Roll the subsystem cabinet to the desired location.
2. Engage the locks on the front casters to prevent the cabinet from moving.

2.1.3 Connecting the Subsystem to the Host

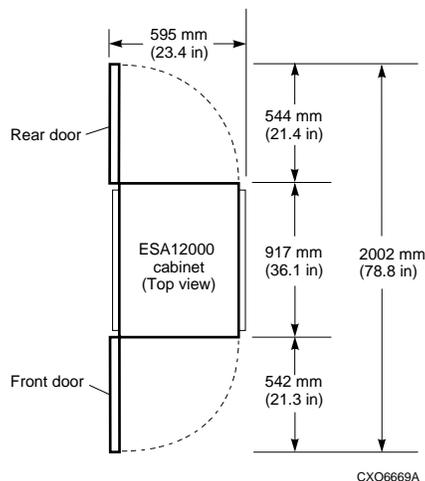
Refer to Sections 2.4.3 and 2.4.6 in this chapter and to the platform-specific host adapter and host system documents for information describing how to install the adapter and make subsystem cable connections.

2.2 Installing the ESA12000

2.2.1 Site Preparation

Before installing the ESA12000, ensure that adequate space is available in front and in back of the enclosure for opening the front and back doors. Also make sure there is adequate space around the enclosure for adequate airflow. See Figure 2–2 for specific space requirements.

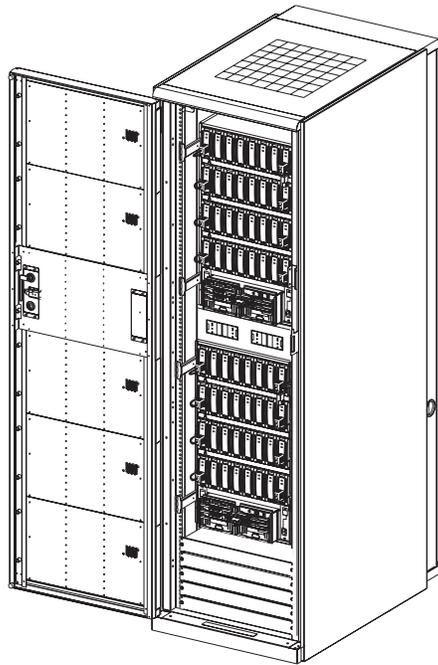
Figure 2–2 Minimum Installation Clearance Measurements



2.2.2 Moving the ESA12000 to It's Designated Site

Figure 2-3 shows an ESA12000 Storage Subsystem containing two BA370 Enclosures.

Figure 2-3 ESA12000 Storage Subsystem



WARNING

Use extreme caution when rolling the cabinet across the floor. Failure to raise all leveler feet and to provide a clear path for the cabinet's casters may result in the cabinet tipping over and injury to personnel.

Once the cabinet rack space is configured as desired, the cabinet may be rolled to its final installation position. Secure loose cabinet cables up and out of the way when rolling the cabinet. Use the following procedure to move the ESA12000 to its designated site:

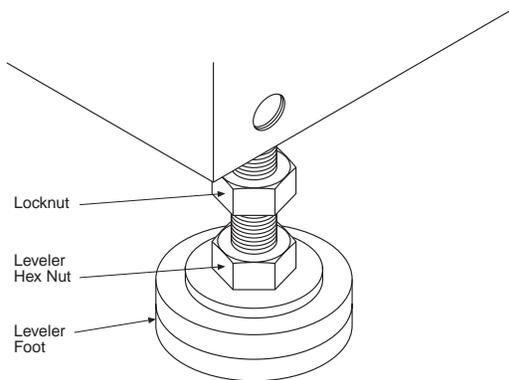
1. Roll the cabinet to the desired location.
2. To level the cabinet, perform the following steps:

NOTE

If you plan to join an expansion cabinet to the master cabinet, do not lower the levelers at this time.

- a) Loosen the locknuts on each leveler foot as shown in Figure 2–4.
- b) Turn each leveler hexnut clockwise until the leveler foot contacts the floor.
- c) Adjust each leveler foot until the cabinet is level and the load is removed from all casters. Verify that the casters spin freely.
- d) Tighten the locknuts on each leveler foot.

Figure 2–4 Leveler Foot Adjustment



SHR-1159

2.2.3 Joining Adjacent ESA12000s

A cabinet joiner and trim kit is included with the ESA12000 expansion cabinet (DS-SWXES-LA/B or DS-SWXES-TA/B). Use the joiner kit to join two ESA12000 cabinets together to expand the storage capacity of your subsystem. Refer to the joiner and trim kit instructions (*Joiner Kit Installation Information*, Document Part No.: *EK-JOINR-IN.D01*) supplied with the cabinet.

After two cabinets have been joined, refer to Section 2.4.7 of this guide for cabling instructions describing how to connect the components in the master cabinet to the components in the expansion cabinet.

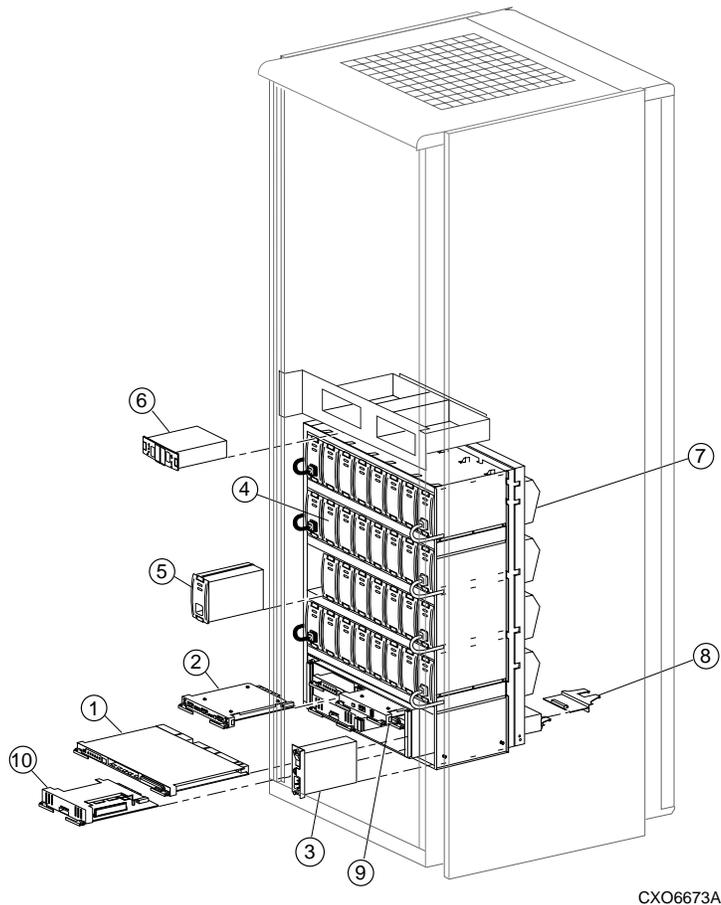
2.2.4 SW42U Cabinet Rack Mount Template

If your data center cabinet is a Compaq 42U cabinet rack, use the rack mount template supplied with the rack-mountable enclosure to select the correct mounting holes along the side rails of the cabinet.

2.3 BA370 Major Components

Figure 2–5 shows the major components in a ESA12000 subsystem. The configuration shown consists of one rack-mountable BA370 which contains 24 disk drive SBBs and a single ECB (external cache battery).

Figure 2–5 ESA12000 Subsystem Major Components



ESA12000 Major Components (Figure 2–5):

- 1) HSG80 Fibre Channel RAID Array controllers (2) or
HSZ80 SCSI RAID Array Controllers (2)
- 2) Environmental Monitor Unit (EMU) (1)
- 3) AC Input Power Controllers (1 standard, 2 shown in Figure 2–5)
- 4) Disk Drive SBB (24)
- 5) 180-watt power supply (5 standard, 8 shown in Figure 2–5)
- 6) External Cache Battery (ECB), single
External Cache Battery (ECB), dual
- 7) Cooling Fan (8)
- 8) Single-Ended I/O Modules (6)
- 9) Power Verification and Addressing (PVA) Module (1)
- 10) Cache module (2)

Also, Power Distribution Unit (2) *Not shown, mounted in ESA12000 cabinet only*

2.3.1 Installing Storage Building Blocks (SBBs)

This section describes the procedures for installing SBBs into a BA370 Enclosure. An SBB can contain disk drives, power supplies, and one or two external cache battery (ECB).

2.3.1.1 Installing Disk Drive SBBs

Additional disk drive SBBs may be installed into the BA370. You may install array controller-compatible 16-bit disk drive SBBs.

Recommended procedure for installing disk drive SBBs is to install them starting in the lower left corner in shelf 1 and advancing to the right. Then starting from the left, install all the drives in shelf 2. Continue using the same procedure for shelves 3 and 4. Installing the disk drive SBBs in this sequence distributes the SBBs evenly among the SCSI ports of the ESA12000. Install 18 giga-byte drives first, followed by 9 giga-byte drives. Install 4 giga-byte drives last.

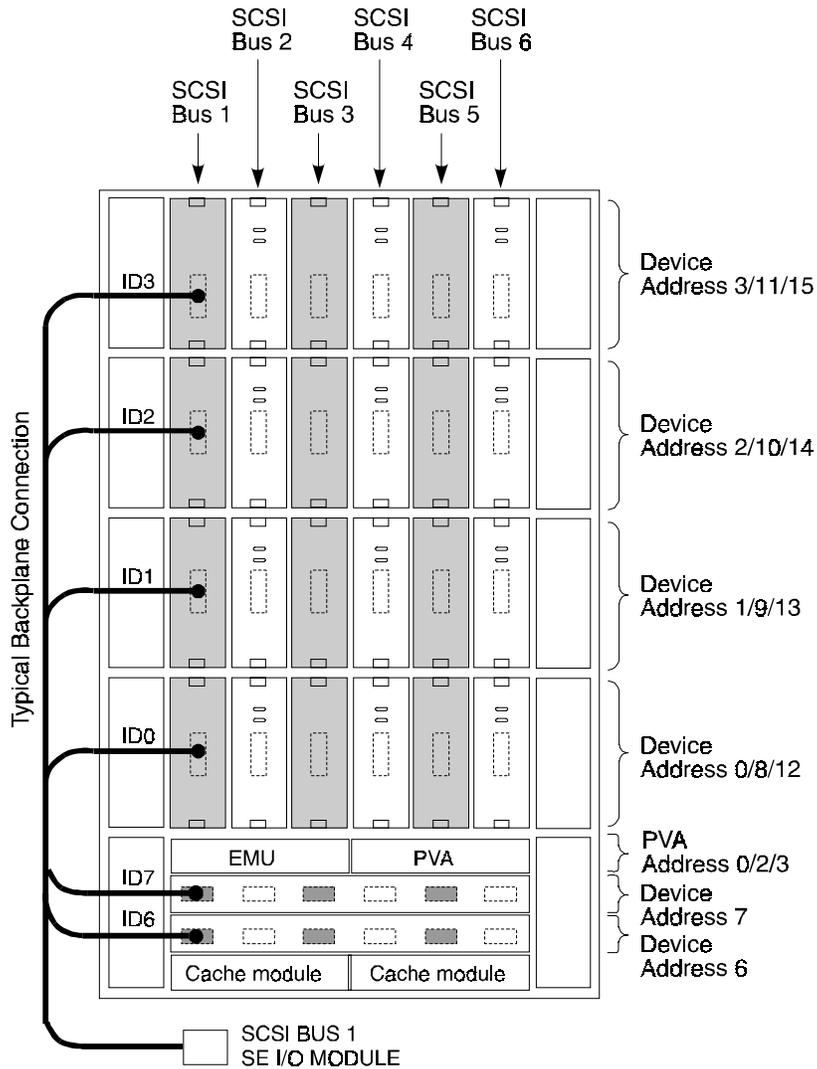
To install an disk drive SBB, hold it in both hands, insert the disk drive into the designated guide slots and firmly push the disk drive into the shelf until the mounting tabs snap into place.

Additional rules for configuring SCSI buses include:

1. All devices and ports in the same column are on the same SCSI bus or port.
2. All devices in the same row (device shelf) have the same device address.
3. Device address 4 and 5 are used only when the Disk Drive SBB has a device address switch.
4. Device addresses are determined by the backplane connector into which the device is inserted unless the SBB has a device address switch.
5. For the addressing of disk drive SBBs on the SCSI bus, device addresses for each SBB in each expansion cabinet are determined by the PVA address. The main cabinet's PVA address is set to PVA address 0. Device addresses in that cabinet have addresses 0 through 3. The PVA address in the first expansion cabinet is set to PVA address 2 and device addresses in that expansion cabinet have addresses 8 through 11. The PVA in the second expansion cabinet is set to PVA address 3 and device addresses for that expansion are from 12 through 15. Figure 2-6 helps to illustrate the addressing scheme.

Figure 2-6 shows the six 16-bit SCSI buses and their associated ports and device addresses. Refer to the *Chapter 3, Configuration Rules and Restrictions*, of the *SWXSC-AA Office Expansion RAID Enclosure User Guide, EK-SMCPD-UG*, for additional information on installing disk drive SBBs.

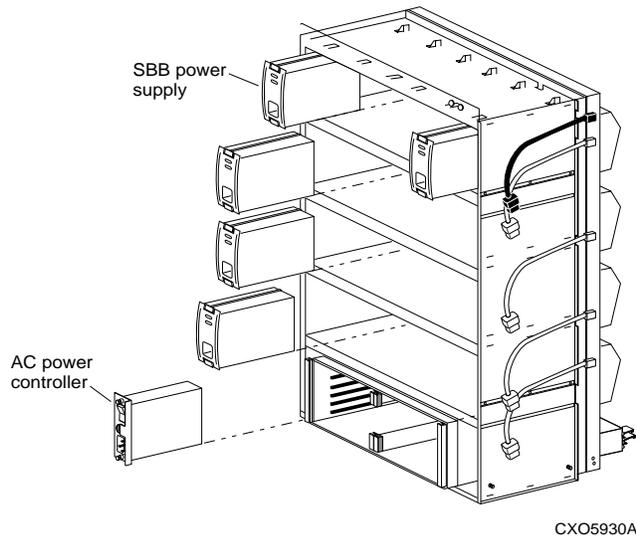
Figure 2-6 SCSI Buses, Associated Ports, and Device Addressing



2.3.1.2 Installing Power Supply SBBs

Each power supply SBB has two green status LEDs. The upper LED indicates ac power status and the lower LED indicates power supply status. The procedure for installing power supplies is basically the same for installing any SBB. Refer to Figure 2-7 during the installation.

Figure 2-7 Installing SBB Power Supply (n+1 Shown)



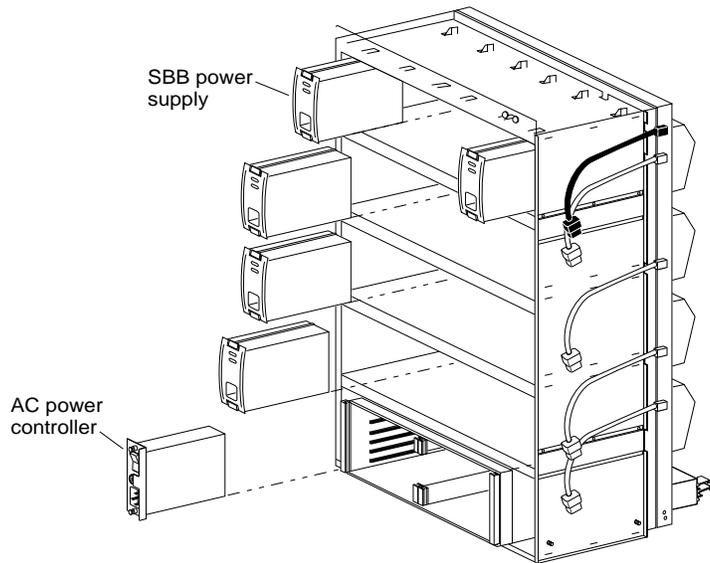
1. Insert the power supply SBB into the guide slots and push in until the power supply is fully seated and the mounting tabs are engaged into the shelf.
2. Connect the power cord to the power supply SBB.
3. If ac power is off, turn **ON** the ac power entry controller.
4. Observe the power supply SBB LEDs. Both LEDs should be lit, indicating proper power supply operation on the associated bus.

If the upper LED is not lit after installation this indicates that the power supply is not functioning properly and needs to be replaced. If both status LEDs are not lit after the installation, either there is a lack of ac power, the ac power entry controller has failed, or the power supply SBB just installed has failed.

2.3.1.3 Installing the AC Input Power Entry Controller

There are no external indications of a power controller failure on the ac power entry controller itself. Both status LEDs on the power supply being off indicates a possible power entry controller failure. Use the following procedure to install a new ac power entry controller. See Figure 2–8.

Figure 2–8 Installing an AC Input Power Entry Controller

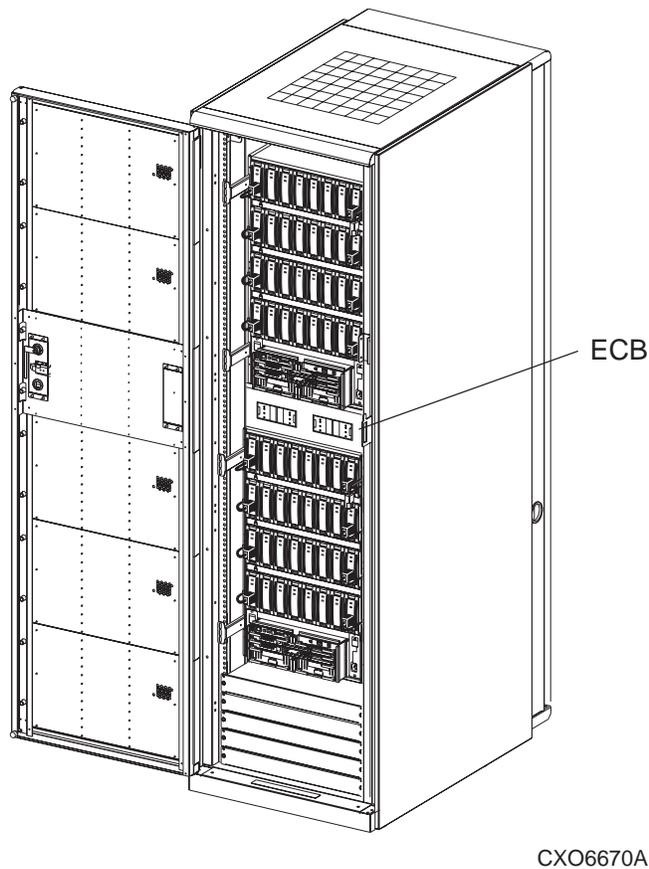


1. Press **0** on the ac power entry controller ON/OFF switch.
2. Insert the ac power entry controller into the BA370 enclosure.
3. Tighten the two retaining screws at the top and bottom of the ac power entry controller.
4. Connect the ac power cord to the ac power entry controller.
5. Press **1** on the ac power entry controller ON/OFF switch.
6. Observe the power supply status LEDs for proper operation.

2.3.2 Installing the External Cache Battery (ECB)

Install the ECBs into the into the ECB shelf of the ESA12000 or at the top of the RA8000 pedestal. Figure 2-9 shows the location of the ECB shelf in the ESA12000.

Figure 2-9 ECB Shelf Location in the ESA12000



2.4 Installing Additional Components (Options)

The following sections describe the procedures for installing additional components into the ESA12000 data center cabinet. The options available for the ESA12000 subsystem are as follows:

- **BA370 Universal Mounting Kit (DS-BA370-XB)** – Provides the components needed to add an expansion enclosure to increase the storage capacity of your subsystem installation. One or two BA370 enclosures can be installed in a cabinet
- **UltraSCSI Hub Shelf Mounting Kit (BA35X-RK)** – Provides components to mount a BA356 shelf into the cabinet. The hubs are installed in the BA356
- **External Cache Battery (ECB) Mounting Kit (DS-SW4XU-2U)** – Provides a mid-cabinet mounting shelf to support one or two ECB SBBs for the controller cache modules
- **Fibre Channel (FC) Hub Mounting Kit** – Installs mounting brackets to support the FC 12-port hub
- **Filler Panel Mounting Kit (DS-SW41U-XX)** – Contains blank panels to fill empty slots in the ESA12000 cabinet

2.4.1 Installing BA370 Universal Mounting Kit DS-BA370-XB

You may wish to install one or two BA370 rack-mountable enclosures into your SW41U or SW600 cabinet to expand the storage capacity of your subsystem. The BA370 expansion enclosure is shipped with a universal mounting kit (DS-BA370-XB) which contains the necessary components and hardware to install the BA370 into an 41U RETMA cabinet or an SW600 metric cabinet.

NOTES

Since the BA370 enclosure universal mounting kit is designed for use in more than one cabinet, there will be parts left over upon completing the installation process. For easy identification, a component part number is stamped on each bracket.

The cabinet opening required to install a BA370 expansion enclosure must be at least 30.5 in. (774.7 mm) high and 19 in. (482.6 mm) wide.

If you are installing a single BA370, it must be installed at the bottom of the cabinet for stability. After the plates are installed and secured, you must install two mounting brackets on each side of the BA370 along with a LED mounting bracket. Then, two persons are needed to lift, mount, and secure the BA370 to the two mounting plates in the cabinet. It is very important that you install the mounting plates and mounting brackets properly or the BA370 will not install.

If installing two BA370 enclosures in the same cabinet, install both the lower and upper enclosure mounting plates prior to installing the lower BA370 enclosure. This process makes it easier to identify the correct vertical rail holes and secure the mounting plates to the rails.

If an ECB shelf will be installed between the enclosures, Compaq recommends installing it prior to installing the second BA370 enclosure in the upper location. Otherwise, it might be difficult to secure the rear ECB shelf mounting brackets.

Perform the following procedures to install a single BA370 into the bottom location of the cabinet using the universal rack mounting kit.

Open and check the contents of the BA370 universal rack mounting kit. The kit should contain the following items:

Table 2-1 BA370 Universal Mounting Kit Parts List

Description	Qty.
Left Mounting Plate	1
Right Mounting Plate	1
BA370 Mounting Bracket	4
LED Bracket Assy.	1
Cover Plate	1
8-32 x 1/4 in. Pan-Head SEMS Screws	8
10-32 x 5/8 Pan-Head SEMS Screws	31
10-32 x 1/2 in. Flat-Head Machine Screw	4
6-32 x 3/8 in. TRUSS-Head Screw	1
10-32 Clip U-Nuts	12
Cable Ties	18

2.4.1.1 Installing the Lower Enclosure

The following procedures describe the mounting kit installation process for both the 41U RETMA and SW600 metric cabinets. Complete only the procedure that applies to your specific cabinet design. Although the illustrations depict the installation into a 41U RETMA cabinet, they are also used to support a kit installation into a metric cabinet.

NOTE

Count only the cabinet rail holes that are 0.281 inch in diameter, beginning at the bottom of the cabinet. DO NOT count the first smaller hole at the very bottom or top of the rail.

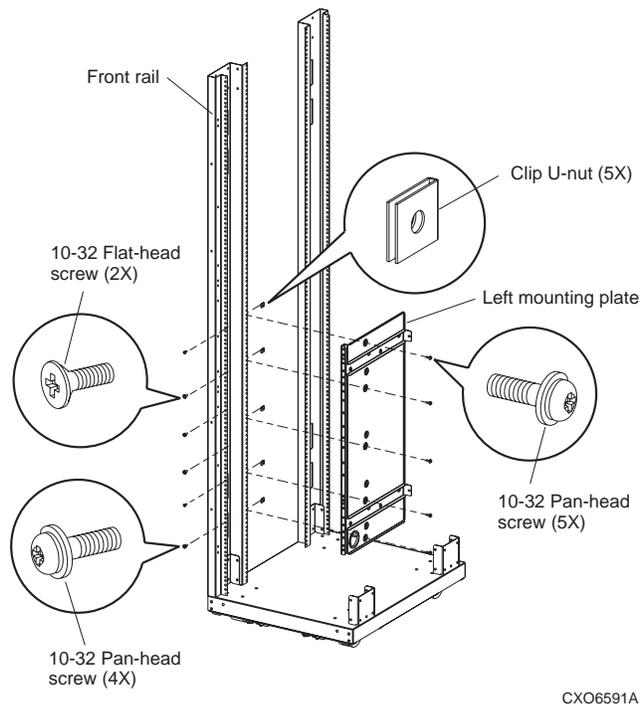
Installing the Left-Lower Mounting Plate into a 41U RETMA Cabinet:

1. Install five clip U-nuts on the rear leg of the left-front rail using vertical rail hole numbers 18, 27, 40, 54, and 65 as shown in Figure 2–10.
2. Hold up the left mounting plate, align the dimpled holes on the mounting plate (see Figure 2–10) with the clip U-nuts installed in step 1 and install five 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front cabinet rail, install two 10-32 x 1/2 in. flat-head screw in holes 27 and 53 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install four 10-32 x 5/8 pan-head screws in the front cabinet rail using holes 17, 35, 44, and 64. Tighten the four screws.

Installing the Left-Lower Mounting Plate into a Metric (SW600) Cabinet:

1. Install four clip U-nuts on the rear leg of the left-front rail using vertical rail hole numbers 3, 9, 16, and 25 as shown in Figure 2–10.
2. Hold up the left mounting plate, align the dimpled holes on the mounting plate (see Figure 2–10) with the clip U-nuts installed in step 1 and install four 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the left-front cabinet rail, install two 10-32 x 1/2 in. flat-head screw in holes 9 and 24 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install three 10-32 x 5/8 pan-head screws in the front leg of the left-front cabinet rail using holes 2, 16, and 30. Tighten the screws.

Figure 2–10 Installing Left-Lower Mounting Plate (41U RETMA Shown)



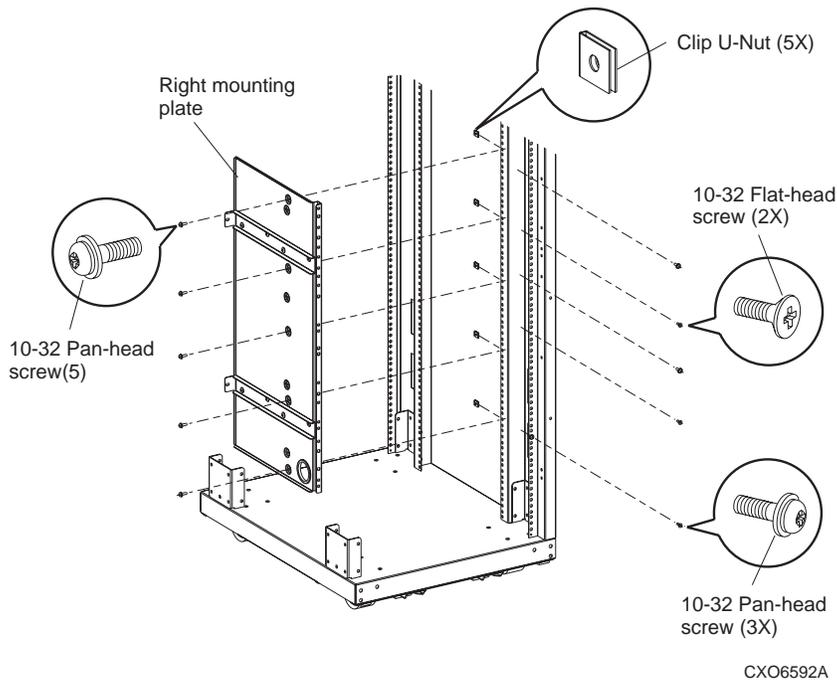
Installing the Right-Lower Mounting Plate into a 41U RETMA Cabinet:

1. Install five clip U-nuts on the rear leg of the left-front rail using vertical rail hole numbers 18, 30, 42, 53, and 65 as shown in Figure 2–11.
2. Hold up the left mounting plate, align the front column of dimpled holes on the mounting plate (see Figure 2–11) with the clip U-nuts installed in step 1 and install five 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the right-front cabinet rail, install two 10-32 x 1/2 in. flat-head screws in holes 35 and 52 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install three 10-32 x 5/8 pan-head screws in the front-leg of the right-front cabinet rail using holes 17, 44, and 62. Tighten the three screws.

Installing the Right-Lower Mounting Plate into a Metric (SW600) Cabinet:

1. Install four clip U-nuts on the rear leg of the right-front rail using vertical rail hole numbers 3, 10, 19, and 28 as shown in Figure 2-11.
2. Hold up the left mounting plate, align the rear column of dimpled holes on the mounting plate (see Figure 2-11) with the clip U-nuts installed in step 1 and install four 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the right-front cabinet rail, install two 10-32 x 1/2 in. flat-head screws in holes 10 and 26 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install three 10-32 x 5/8 pan-head screws in the front-leg of the right-front cabinet rail using holes 2, 18, and 30. Tighten the three screws.

Figure 2-11 Installing the Right Mounting Plate (RETMA Cabinet Shown)



2.4.1.2 Installing the LED Bracket and the BA370 Mounting Brackets

NOTE

If your enclosure arrived with an LED bracket assembly previously installed, some procedural steps can be omitted.

Complete the following procedure to install the LED bracket assembly and enclosure mounting brackets on a BA370 enclosure. Refer to Figures 2–12 and 2–13 as necessary for clarity.

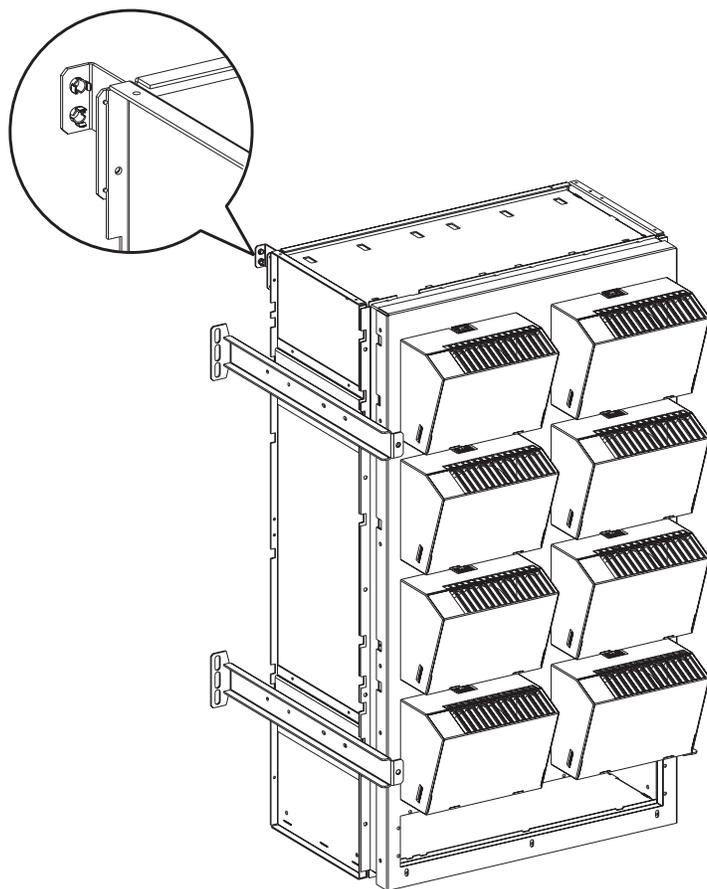
1. Align the two dimples on the back of the LED bracket assembly with the front-right edge of the BA370 enclosure (see Figure 2–12) and secure the bracket to the cabinet using the 6-32 x 3/8 in TRUSS head screw (see Figure 2–13).
2. Install the LEDs at one end of the LED cable assembly (attached at top of enclosure) by snapping the green LED into the top hole of the bracket and the amber LED into the bottom hole.

NOTE

For 41U RETMA cabinets, use the second and fourth holes from the front of the flange on the bracket in the following step. For metric cabinets, use the first and third holes on the bracket.

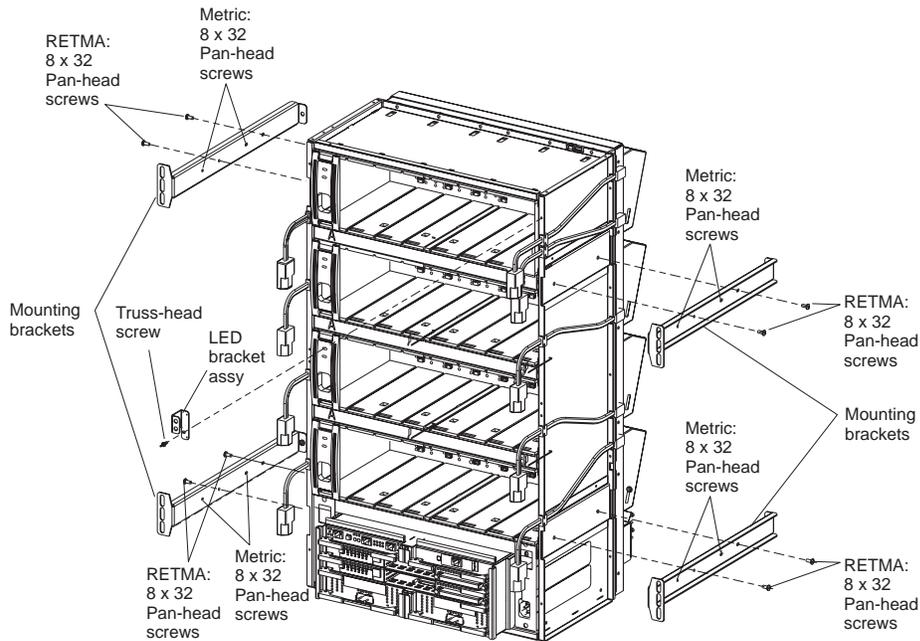
3. Attach four mounting brackets (two on the left side and two on the right side of the BA370 enclosure) using eight 8-32 x 1/4 in pan head screws as shown in Figure 2–13 and fully tighten the screws.

Figure 2-12 Positioning the LED Bracket on the BA370



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Figure 2-13 Installing the LED Bracket and BA370 Mounting Brackets



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2.4.1.3 Installing the Lower BA370 Enclosure into the Cabinet

WARNING

The full BA370 enclosure weighs more than 102 kg (225 lbs.). To prevent personal injury:

- Always mount an empty enclosure into a cabinet prior to installing devices.
- Use at least two people to lift, align, insert, and secure the enclosure into a cabinet.
- Extend the cabinet stabilizer legs, if available, to prevent the cabinet from tipping over while the enclosure is being inserted into the upper location.

CAUTION

If installing a second BA370 into an operational cabinet, ensure all power is removed from the cabinet prior to installing the enclosure.

If installing two BA370 enclosures, always install the lower unit first for stability and safety.

Proceed as follows to install a BA370 enclosure into the cabinet:

1. Remove all components from the BA370 enclosure being mounted.
2. For cabinets with stabilizer legs:
 - a) Pull out and fully extend the stabilizer legs from under the cabinet.
 - b) Adjust the leveling foot on each stabilizer leg so that it is firmly pressed against the floor.

NOTE

If the enclosure does not align or slide smoothly into the cabinet in the following procedure, then the mounting plates inside the cabinet may not be installed properly.

3. Using two or more people, carefully lift the BA370 enclosure and insert its mounting brackets into the corresponding mounting plate channels in the appropriate cabinet location, and then slowly slide the enclosure into the cabinet.

WARNING

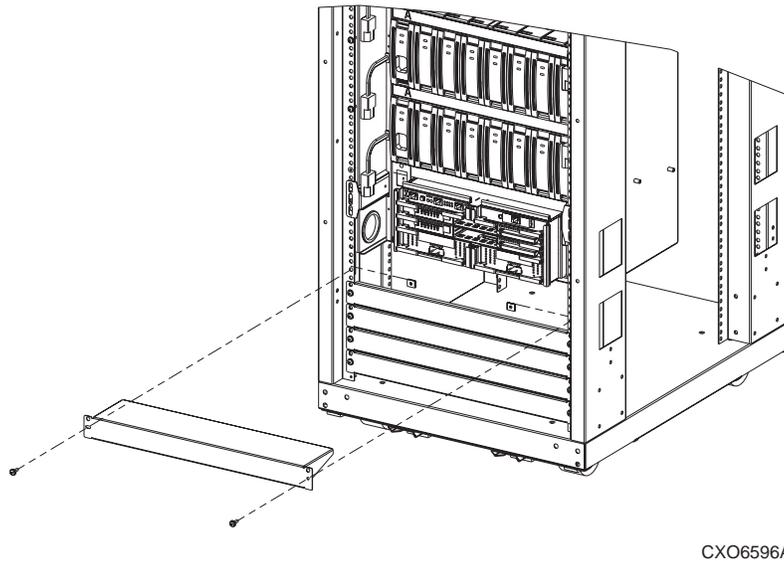
Once the enclosure is inserted into the mounting plate channels, **DO NOT** release the enclosure until it is fully inserted into the cabinet. The mounting brackets and the mounting plate channels cannot support an enclosure that is only partially inserted. Damage to equipment and personal injury might result.

NOTE

For 41U RETMA cabinets, one screw is required in the *middle slot* of each mounting bracket flange in the following step. For metric cabinets, one screw is required in the *top and bottom slots* of each mounting bracket flange.

4. Secure the BA370 to the cabinet by installing four 10-32 x 5/8 in pan-head screws through the front flange of the mounting brackets and fully tighten the screws.
5. From the rear of the cabinet, secure the mounting brackets to mounting plate channels by installing four 10-32 x 5/8 in pan head screws through the four mounting plate tabs and fully tighten the screws.
6. For 41U RETMA cabinet installations, proceed to step 7. For metric cabinet installations, proceed to step 10 and continue.
7. Install two clip u-nuts in the first available 1U space below the lower enclosure.
8. Orient the cover plate so that the extended surface faces upward as shown in Figure 2-14.
9. Align the holes in the cover plate over the clip u-nuts installed in previous step 7 and secure the plate to the cabinet using two clip U-nuts and two 10-32 x 5/8 in pan head screws and fully tighten the screws (see Figure 2-14).
10. On top of the enclosure, connect the other end of the LED cable to the connector from the door-mounted LED cable assembly.
11. Ensure all LED cable connections are firmly seated.

Figure 2–14 Installing the Cover Plate



2.4.1.4 Installing the Upper Enclosure in the Cabinet

This procedure describes how to install a second BA370 enclosure into the top location of the expansion cabinet. As in the previous section, separate procedures are included to install the mounting plates in both 41U RETMA and SW600 metric cabinets. Complete only the procedure that applies to your specific cabinet design. The illustrations in the previous section (Figures 2–10 through 2–14) support both 41U RETMA and metric cabinet installations.

WARNING

Never install a BA370 enclosure in the top location of the cabinet without first installing an enclosure in the lower location, or ensuring the lower section of the cabinet is sufficiently weighed to provide cabinet stability.

Installing the Left-Upper Mounting Plate into a 41U RETMA Cabinet:

1. Install five clip U-nuts on the rear leg of the left-front cabinet rail using vertical rail hole numbers 75, 84, 97, 111, and 112.
2. Hold up the left mounting plate, align the front column of dimpled holes on the mounting plate with the clip U-nuts installed in step 1 and install five 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the left-front cabinet rail, install two 10-32 x 1/2 in. flat-head screw in holes 84 and 110 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install four 10-32 x 5/8 pan-head screws in the front leg of the left-front cabinet rail using holes 74, 92, 101, and 121. Tighten the four screws.

Installing the Left-Upper Mounting Plate into a Metric (SW600) Cabinet:

1. Install four clip U-nuts on the rear leg of the left-front cabinet rail using vertical rail hole numbers 34, 40, 47, and 56.
2. Hold up the left mounting plate, align the rear column of dimpled holes on the mounting plate with the clip U-nuts installed in step 1 and install four 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the left-front cabinet rail, install two 10-32 x 1/2 in. flat-head screw in holes 40 and 55 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install three 10-32 x 5/8 pan-head screws in the front leg of the left-front cabinet rail using holes 33, 47, and 61. Tighten the screws.

Installing the Right-Upper Mounting Plate into a 4IU RETMA Cabinet:

1. Install five clip U-nuts on the rear leg of the left-front rail using vertical rail hole numbers 75, 87, 99, 110, and 122.
2. Hold up the left mounting plate, align the front column of dimpled holes on the mounting plate with the clip U-nuts installed in step 1 and install five 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the right-front cabinet rail, install two 10-32 x 1/2 in. flat-head screws in vertical rail holes 92 and 109 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install three 10-32 x 5/8 pan-head screws in the front-leg of the right-front cabinet rail using vertical rail holes 74, 101, and 119. Tighten the three screws.

Installing the Right-Upper Mounting Plate into a Metric (SW600) Cabinet:

1. Install four clip U-nuts on the rear leg of the right-front rail using vertical rail hole numbers 34, 41, 50, and 59.
2. Hold up the left mounting plate, align the rear column of dimpled holes on the mounting plate with the clip U-nuts installed in step 1 and install four 10-32 x 5/8 in. pan-head screws finger tight in these locations. Do not tighten the screws at this time.
3. On the front leg of the right-front cabinet rail, install two 10-32 x 1/2 in. flat-head screws in vertical rail holes 41 and 57 and tighten the screws.
4. Fully tighten all remaining screws installed in step 2.
5. Install three 10-32 x 5/8 pan-head screws in the front-leg of the right-front cabinet rail using holes 33, 49, and 61. Tighten the three screws.

Installing the Upper BA370 Enclosure into the Cabinet

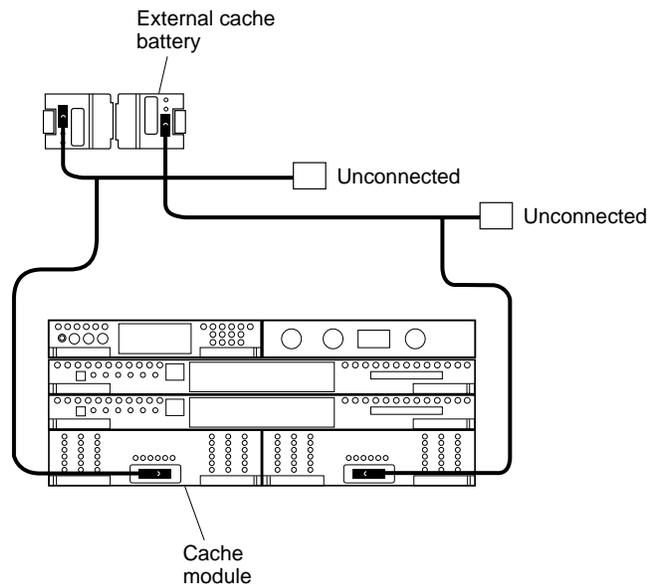
Perform the procedures described in paragraph 2.4.1.3 to install the BA370 enclosure into the upper location of the cabinet. **Take all of the precautionary measures listed in paragraph 2.4.1.3 to safeguard personnel and prevent damage to the equipment.**

2.4.2 Connecting AC Power and ECB Cables

If power is applied to the master cabinet, power down the controllers by following the procedure contained in the *DIGITAL StorageWorks HSZ80 Array Controller HSOE Version 7.0 Service Manual*. Remove ac power to the BA370 by moving the switch on the ac power entry controllers to 0. Remove ac power to the Power Distribution Unit (PDU) by moving the breaker switch to 0. Disconnect the power distribution unit from the ac power source.

1. For BA370's with 4+4 power configurations, go to the rear of the cabinet and plug the black ac power cord from the BA370's ac power entry controller into the bottom PDU that already has a black power cord plugged into it. For dual-redundancy units, plug the gray ac power cord from the BA370's ac power entry controller into the top PDU in the rear of the SW600 cabinet. Attach ECB cables to the ECB and to the cache modules. The top BA370 ECB is located on the left-hand side of the ECB shelf. The bottom BA370 ECB is located on the right-hand side of the ECB shelf. Repeat the same procedure for the 41U RETMA cabinet (note: the PDUs are located in the front and rear of the cabinet in the 41U).
2. Plug the PDU ac power cable(s) into the ac power source.
3. Connect the ECB Y-cables between the ECB batteries and the cache modules as shown in Figure 2–15.

Figure 2–15 Installing ECB Y-Cables



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2.4.3 Installing the DS-BA356-SG UltraSCSI Hub 41U RETMA Shelf Mounting Kit

The UltraSCSI Hub Shelf option is installed in a 41U RETMA cabinet using the BA356 shelf mounting kit. The kit allows you to install up to two 3-port or 5-port SCSI Hubs in either the front and/or the rear of a cabinet containing 41 U RETMA mounting rails. The height of the shelf is approximately 150 mm (5.9 in.).

WARNING

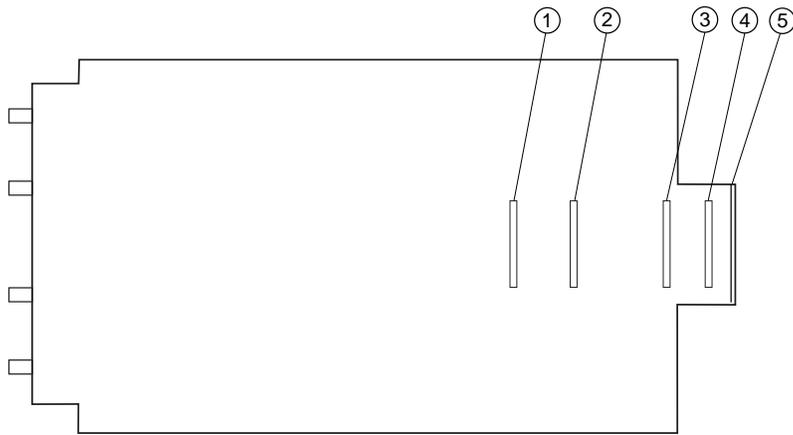
High voltages are present within the cabinet when power is applied. Always turn off ac power to the cabinet and disconnect the power cords from the wall outlet before proceeding with this procedure.

Also, the rail edges in the cabinet are very sharp. Never slide hands along cabinet rail edges.

Proceed as follows to install the shelf mounting kit into the cabinet:

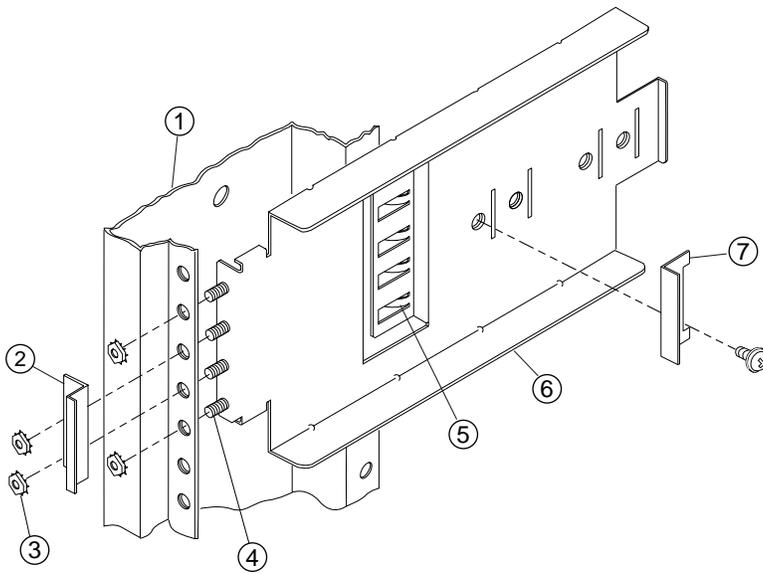
1. Turn off all ac power to the cabinet and disconnect the power cords.
2. Open the shelf mounting kit and layout the contents of the kit on a convenient working surface.
3. Refer to Figures 2-16 and 2-17 install the appropriate stop bracket on each mounting bracket throughout the installation procedure.
4. Place the first mounting bracket ⑥ behind the outer flange and against the inner flange of the left-hand cabinet vertical wall ①. Ensure the mounting studs ④ and tabs ⑤ are aligned with the vertical rail holes.
5. Slide the mounting bracket ⑥ forward to seat the studs ④ and tabs ⑤.
6. Install an M5 KEP nut ③ on both the top and bottom stud ④ and tighten fully.

Figure 2-16 Mounting Bracket Stop Positions



CXO6242A

Figure 2-17 Mounting Example Using Stop Position 1



CXO6254B

Callout Legend (Figure 2–17)

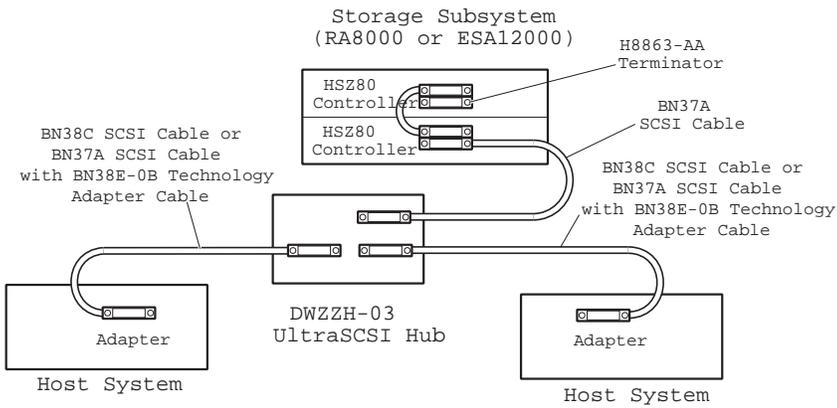
Callout	Description
1	Vertical Cabinet Rail
2	Locking Bracket
3	M5 KEP Nut
4	Mounting Stud
5	Mounting Tab
6	Mounting Bracket
7	Stop Position Bracket

7. Repeat steps 3 through 6 for the other mounting bracket using the right-hand vertical wall of the cabinet.
8. Slide the BA356 shelf into the mounting brackets until fully seated against the stop brackets ⑦. If the correct position was used, the front of the shelf will be flush with the rest of the shelves in the cabinet.
9. Position the appropriate locking bracket ② over the two middle studs ④ of the left-hand mounting bracket ⑥, install two M5 KEP nuts ③, and finger tighten.
10. Adjust the locking bracket ② so that the flange is firmly seated against the shelf.
11. Fully tighten the M5 KEP nuts ② installed in step 9.
12. Repeat steps 9 through 11 for the other locking bracket on the right-hand mounting bracket.

The BA356 shelf is now ready for you to mount the three or five-port UltraSCSI Hub into the cabinet. For a single hub installation, we recommend that you mount the hub in the right-hand slot locations of the shelf. This will minimize cable-run interference between the hub and the controller. Detailed information describing the rack-mountable UltraSCSI hub can be found in document EK-SMDZS-UG.

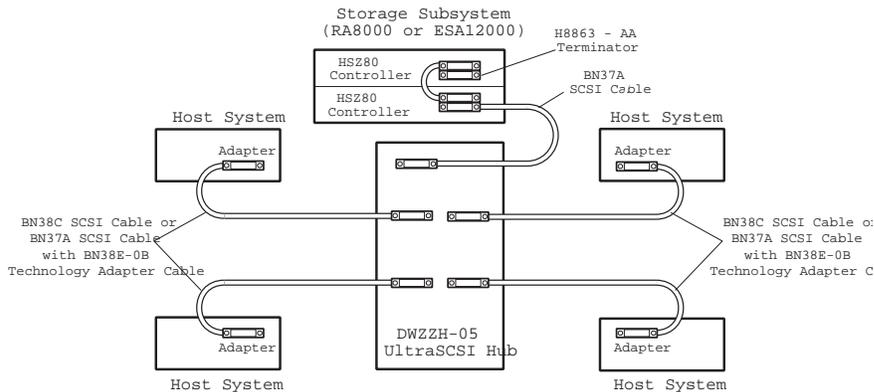
You are now ready to make the cable connections between the hub(s) and the array controller(s). Figures 2–18 and 2–19 show examples of configuration layouts for three and five-port hubs, respectively.

Figure 2-18 Three-Port UltraSCSI Hub Configuration Layout



SHR-1101

Figure 2-19 Five-Port UltraSCSI Hub Configuration Layout



SHR-1132

2.4.4 Installing a Filler Panel Mounting Kit in a 41U RETMA Cabinet

This procedure describes how to install the filler panel mounting kit (DS-SWX41-XK) into the 41U RETMA cabinet.

NOTE

If a cabinet has a particular filler panel configuration that was factory installed, do not remove the panels unless you are reconfiguring the cabinet. If adding enclosures or reconfiguring the cabinet, use filler panels in all open cabinet slots.

2.4.4.1 Installation Procedure

NOTE

The panels in the mounting kit are stamped with identifying part numbers. Also, not all of the parts are used in each cabinet configuration.

1. Unpack and inspect the contents of the panel mounting kit. It should contain the following components:

Description	Qty.
1 Unit (1U) Filler Panel	4
5 U Filler Panel	1
1U Cover Plate	1
10-32 x 5/8 Pan-Head SEMS Screws	14
U-Nut	14

The filler panels and cover plate in this kit mount in either a 1U space or 5U space. A single U-space (1U) is composed of three rail holes and measures 1.75 inches in height. Spacing between the first and second hole, and between the second and third hole in a U-space is 0.625 in. Spacing between the third hole in a U-space and the first hole of a second U-space is 0.5 in. Thus, a 1U space measures 1.75 in (0.625 + 0.625 + 0.5). This three hole pattern repeats the entire length of the rails in a 41U RETMA cabinet.

A 5U space takes up five 1U hole patterns or 8.75 in (5 x 1.75 in).

NOTE

Correct placement of each filler panel is dependent upon using the appropriate rail holes which make up the 1U or 5U height.

A cover plate can be mounted in two ways:

- *Extended Face Up*, if installed below the lowest enclosure within the cabinet as shown in Figure 2–20.
- *Extended Face Down*, if installed above the highest enclosure within the cabinet.

Mount the appropriate size and number of filler panels above or below the cover plate, installing enough panels to close the opening extending to the top or bottom of the cabinet.

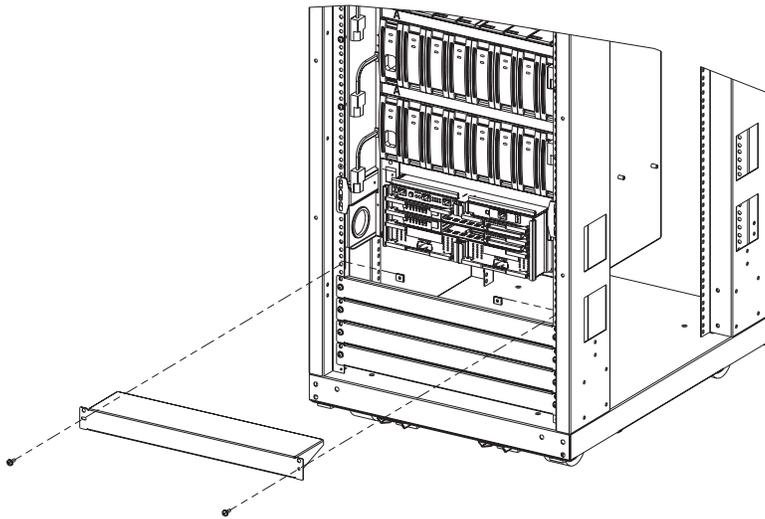
1. Identify the cover plate mounting location (below the lowest enclosure or above the highest enclosure), using the first available 1U space.
2. Insert a U-nut in each cabinet rail hole opening where a panel hole corresponds with a cabinet rail hole.
3. Align the panel with the U-nuts installed in the previous step and secure it only finger-tight using SEMS screws.

NOTE

Two U-nuts and two SEMS screws are required for a cover plate and each 1U filler panel. Four U-nuts and four SEMS screws are required for a 5U filler panel.

Do not tighten the SEMS screws until all screws have been started.

Figure 2–20 Installing the Cover Plate



CXO6596A

4. Fully tighten the SEMS screws.
5. Identify the number and placement of 1U and 5U filler panels sufficient to fill the remaining opening above or below the cover plate.

NOTE

Install filler panels from the cover plate up or down, beginning with the first available 1U (for a 1U filler panel) or 5U space (for a 5U filler panel).

If necessary, install additional filler panels using the first available 1U space or 5U space.

6. Repeat steps 2 through 5 as appropriate using a 1U or 5U filler panel until the opening above or below the cover plate is closed.

2.4.5 Installing the DS-SWX4U-2U External Cache Battery (ECB) Shelf Mounting Kit

This procedure describes how to install the ECB mounting kit (DS-SWX4U-2U) into an 41U RETMA cabinet. Once the kit is installed, either one or two ECB SBBs can be mounted into the shelf.

Compaq recommends mounting the ECB shelf in the front of the cabinet directly above the lower BA370 enclosure. The shelf is capable of holding two ECB SBBs (a single or dual ECB module). If only one ECB (either a single or dual module) is installed, a blank bezel must be installed in the other opening of the shelf.

NOTE

If only one BA370 enclosure is installed within the cabinet, the space above the ECB shelf must be covered with 5U and 1U filler panels to provide adequate air flow within the cabinet. If two BA370 enclosures are installed, no filler panels are required above the upper enclosure.

If two BA370 enclosures will be installed within the cabinet, Compaq recommends installing the ECB shelf prior to installing the second BA370 enclosure in the upper location. Otherwise, it might be difficult to secure the rear ECB shelf mounting brackets.

2.4.5.1 Installation Procedure (See Figure 2-21)

Perform the following procedure to install the ECB shelf into the cabinet:

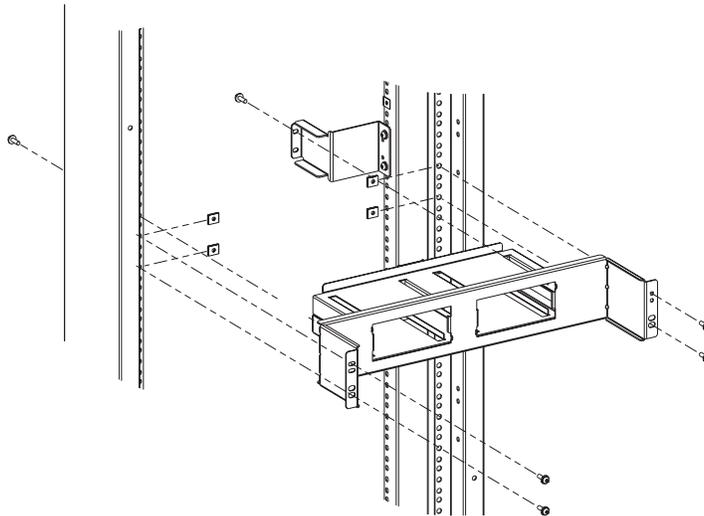
NOTE

Count only the cabinet rail holes that are 0.281 inch in diameter, beginning at the bottom of the cabinet. DO NOT count the first smaller hole at the very bottom or top of the rail.

1. Unpack and inspect the contents of the ECB shelf mounting kit. It should contain the following components:

Description	Qty.
ECB Shelf	1
Angle Bracket	2
SBB Filler Bezel	1
10-32 x 5/8 Pan-Head SEMS Screw	10
10-32 U-Nut	8

Figure 2–21 Installing the ECB Shelf Mounting Kit



CXO6599A

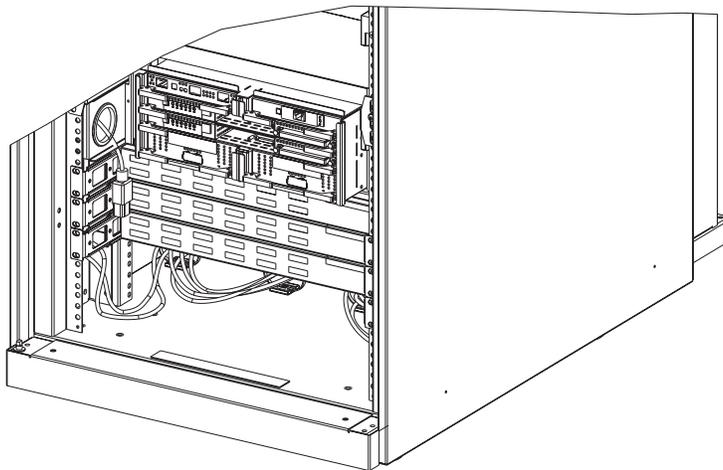
2. Install two clip U-nuts in the rear leg of the left-front cabinet rail, using holes 69 and 72 as shown in Figure 2–21.
3. Holding the angle bracket, align it with the holes containing the U-nuts installed in the previous step and secure the bracket using two 10-32 x 5/8 in Pan Head screws.
4. Repeat steps 2 and 3 for the rear leg of the right-front cabinet rail.

5. Insert four clip U-nuts in rail holes 68 and 71 on both cabinet vertical rails.
6. Insert the ECB shelf into the angle brackets, align the shelf with the four clip U-nuts installed in the previous step and secure it using four 10-32 x 5/8 in Pan Head screws (two on the left and right sides) finger-tight.
7. From the rear of the cabinet, secure the back of the ECB shelf to the angle brackets by installing two 10-32 x 5/8 in Pan Head screws (one in the upper hole of the left angle bracket and lower hole of the right angle bracket—as seen from the rear).
8. From the front of the cabinet, fully tighten the four screws (installed in step 6) that hold the ECB shelf to the cabinet rails.
9. If only one ECB is being installed in the shelf, insert the filler bezel into the open slot.
10. Connect the ECB Y-cable(s) between the ECB module(s) and the cache module at the bottom of the BA370 cabinet (see Figure 2–15).

2.4.6 Installing the Fibre Channel Hub Mounting Kit

This procedure describes how to install a fibre channel (FC) hub using a FC hub mount kit into an ESA12000 cabinet. A FC hub can be mounted in any 1U space within a 41U RETMA cabinet. However, Compaq recommends installing the hub below the lowest enclosure in the cabinet. If installing more than one hub, mount subsequent hubs (up to four) directly below the first hub (see Figure 2-22). Each hub installation requires a 1U space. HSG80 array controller configuration examples are included following the procedure.

Figure 2-22 Three FC-Hub Configuration Example



CXO6626A

2.4.6.1 Power Cord Installation Procedure

Before installing a FC hub, a power cord for each hub being installed must be installed. For multiple FC hub configurations, Compaq recommends connecting primary hubs to the primary PDU and secondary hubs to the redundant PDU.

Complete the following procedure to install a power cord for each FC hub being installed.

1. Unpack and inspect the contents of the FC hub mounting kit. It should contain the following components:

Description	Qty.
Mounting Plate Bracket	2
Slide Bracket	2
Rear Mounting Bracket	2
10-32 x 5/8 Pan-Head SEMS Screws	8
Flat Head Screw	4
U-Nut	8

2. Identify the FC hub mounting location.
3. Remove any filler panels from the installation location.
4. Remove all power from the cabinet.

WARNING

HIGH VOLTAGES are present in the cabinet when power is applied. Failure to disconnect power from the cabinet may result in personal injury or death.

5. Remove four screws securing the redundant PDU located directly below the installation area.
6. Pull the redundant PDU outward and route the male plug end of each power cord under the PDU. Ensure the appropriate number of power cords is routed under the PDU (one cord per hub),
7. Plug each power cord into the appropriate primary or redundant PDU. For multiple FC hub configurations, consider labeling each power cord as primary or redundant.
8. Gently push the redundant PDU back into the cabinet and secure the PDU using the four screws removed in step 5.

CAUTION

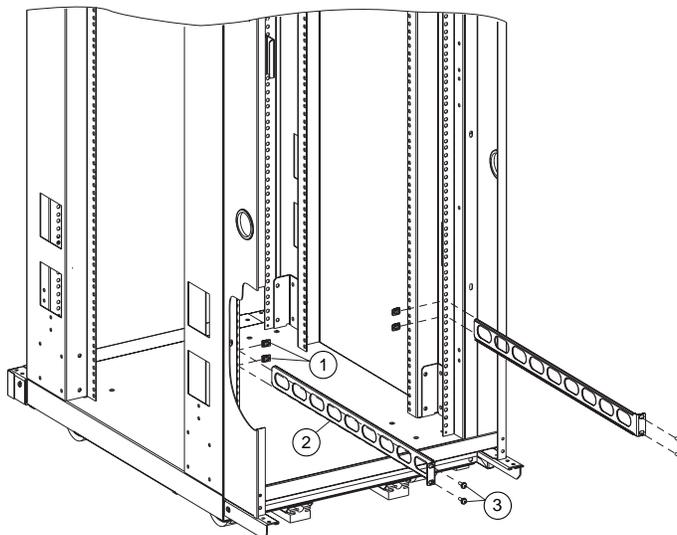
Ensure the hub power cords exposed below the PDU are not pinched and are of sufficient length for connection to the appropriate FC hub.

2.4.6.2 Hub Installation Procedure (See Figures 2-23, 2-24 and 2-25)

Complete the following procedure to install an FC hub into the cabinet using the FC hub mount kit.

1. Install two U-nuts in the first and third hole of the first U-space available under the lowest enclosure at the rear of the cabinet (see ①, Figure 2-23).
2. Reposition or remove any cabling that might interfere with installing a hub in the designated location.

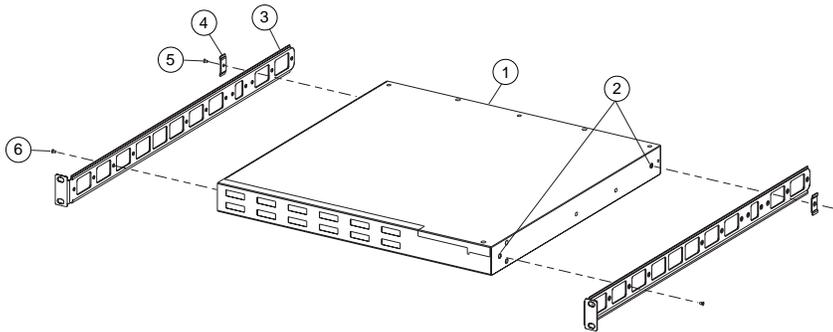
Figure 2-23 Installing U-Nuts and Brackets



CXO6623A

3. Align the first rear mounting bracket ② flange with the two u-nuts installed in the previous step and secure the bracket using two pan head SEMS screws ③.
4. Repeat steps 1 and 3 for the second rear mounting bracket using the right-hand cabinet vertical rail. Ensure this bracket uses the same U-space holes as the left-hand bracket.
5. Remove four flat head screws ② that originally came installed with the FC hub and discard them (two screws on the left side and two on the right side).

Figure 2–24 Attaching Slide Brackets



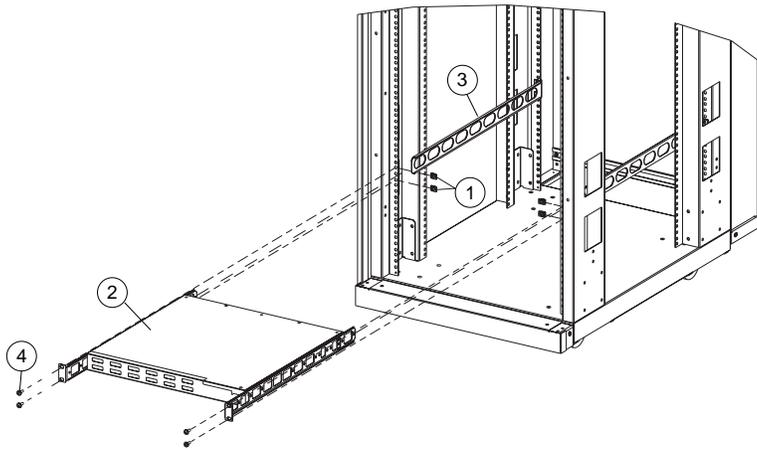
CXO6624A

6. Insert a flat head screw (6, Figure 2–24) in the third hole from the front of the bracket and into the same hole from which a screw was removed from the left-front hub area, and secure it finger tight.
7. Insert a flat head screw (5, Figure 2–24) through the mounting plate bracket and the second slide bracket opening from the rear.
8. Insert the screw into the hole from which a screw was removed from the left-rear hub area, securing it finger tight. Ensure the mounting plate bracket position clamps onto the slide bracket when secured to the hub.
9. Fully tighten both flat head screws securing the slide bracket to the hub.
10. Repeat steps 5 through 9 to connect the second slide bracket to the right side of the hub.
11. Install two U-nuts (1, Figure 2–25) in the first and third hole of the first U-space available under the lowest enclosure at the front of the cabinet on both the left and right cabinet vertical rails.

NOTE

Ensure this U-space matches that used for installing the rear mounting brackets in the back of the cabinet.

Figure 2–25 Installing Slide Brackets



CXO6625A

12. Align the hub slide brackets (2, Figure 2–25) with both rear mounting brackets (3, Figure 2–25) and insert the slide brackets into the mounting brackets, pushing inward until the slide bracket flange contacts the cabinet vertical rails.

CAUTION

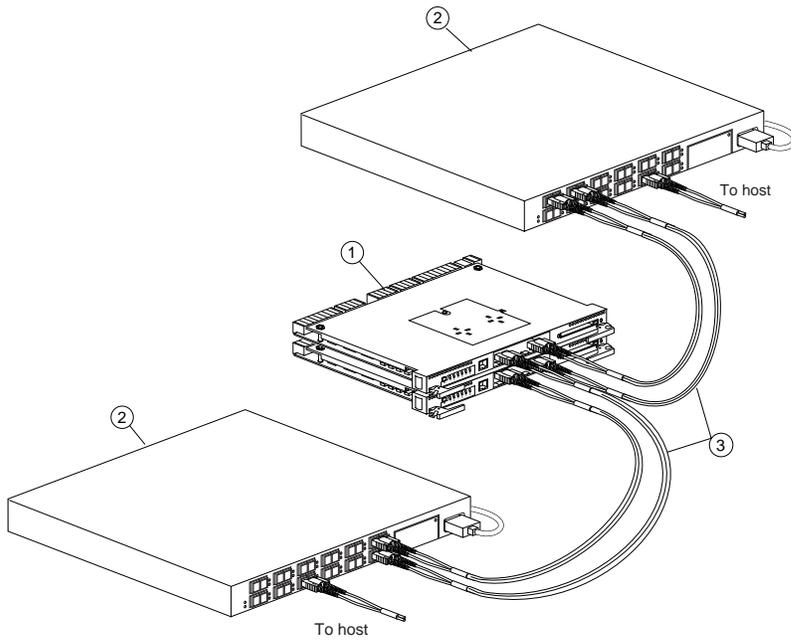
Failure to support the hub in a relatively level position during installation can damage the rear mounting brackets. Maintain this position until the slide bracket is fully secured to the cabinet vertical rails.

13. Align the two left slide bracket holes with the two u-nuts installed in step 7 and install two pan head SEMS screws (4, Figure 2–25), securing the bracket to the cabinet rail.
14. Repeat step 13 for the right slide bracket.
15. Repeat steps 1 through 14 for each additional FC hub you plan to install.
16. Connect a power cord to each FC hub installed.
17. Reposition or reconnect any cabling affected during the procedures.
18. Refer to Figures 2–26 through 2–33 for specific examples of various HSG80 array controller configurations.

2.4.6.3 HSG80 Array Controller Configuration Examples (Figures 2-26 through 2-33)

Figure 2–26 shows the cable connections between dual FC hubs and dual array controllers. The cables to the hubs can connect into any open connector. Unused connections need no termination.

Figure 2–26 Dual Controller, Dual Hub Configuration



CXO6496A

¹ HSG80 controllers

² Fibre Channel Arbitrated Loop Hub

³ Multi-mode Fiber Optic Cable

Figure 2–27 shows a block diagram of a Single Controller/Single Server configuration using a single active port. This configuration offers no redundancy.

Figure 2–27 Single Controller/Single Server/Single Port

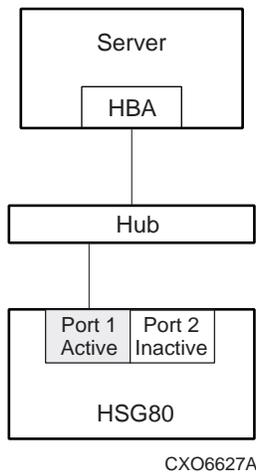


Figure 2–28 shows a Single Controller/Single Server configuration using two active ports for increased performance.

Figure 2–28 Single Controller/Single Server/Dual Port Configuration

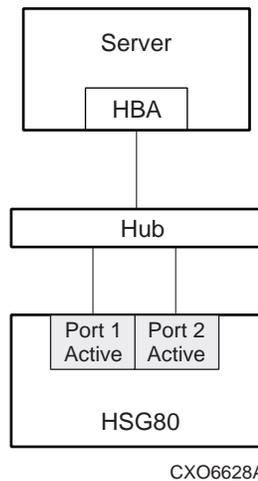
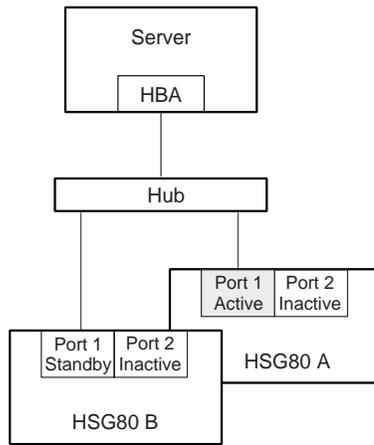


Figure 2–29 shows a Dual Controller/Single Server configuration utilizing one port on each controller which offers controller redundancy.

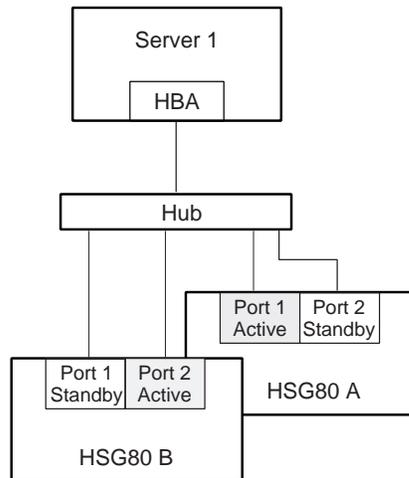
Figure 2–29 Dual Controller/Single Server/Single Port Configuration



CXO6629A

Figure 2–30 shows a Dual Controller/Single Server configuration utilizing both ports on the controllers. One port is the active port on each controller, the other is in standby. This offers controller redundancy and faster performance.

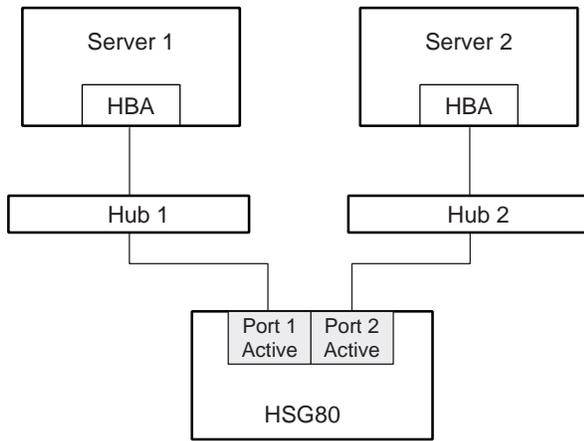
Figure 2–30 Dual Controller/Single Server/Dual Port Configuration



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Figure 2–31 shows a Single Controller/Dual Server configuration. This configuration allows multiple servers to share the storage subsystem. Servers in this configuration do not have access to the other server’s storage unless they are clustered.

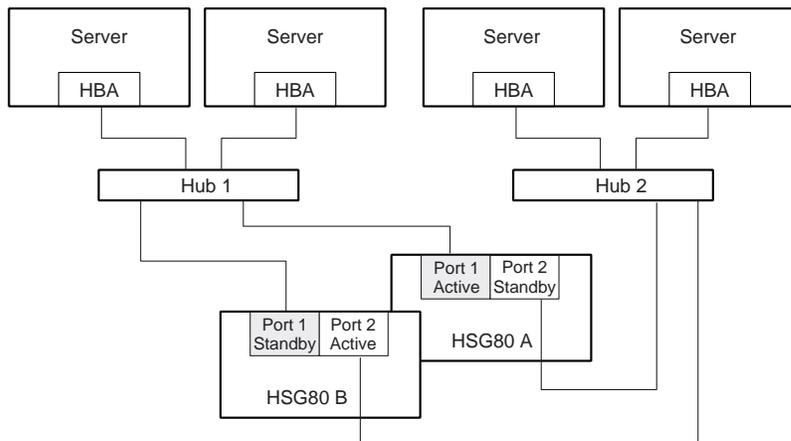
Figure 2–31 Single Controller/Dual Server/Dual Port Configuration



CXO6631A

Figure 2–32 shows a Multiple Server/Dual Controller configuration which offers controller redundancy and allows the servers to share the storage subsystem.

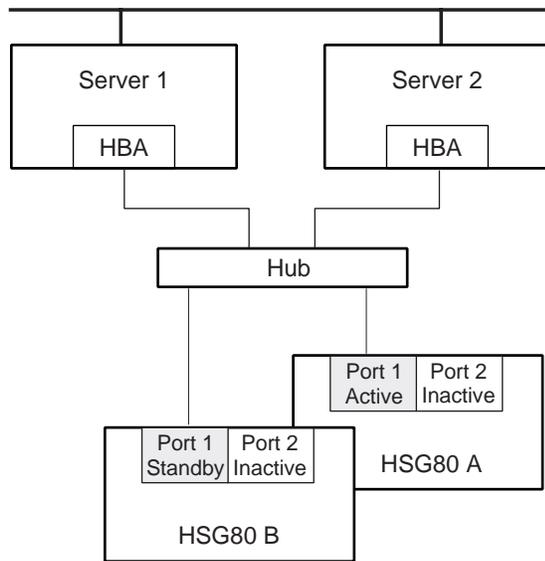
Figure 2–32 Multiple Server/Dual Controller Configuration



CXO6633A

Figure 2–33 shows a Dual Server/Single Hub configuration which offers controller and server redundancy.

Figure 2–33 Clustered Dual Server/Single Hub Configuration



CXO6634A

2.4.7 Cabling a Master Enclosure to an Expansion Enclosure(s)

This section describes how to connect the cables between a master enclosure and an expansion enclosure. Perform the procedures in this section following the installation of the joiner kit installation instructions (see paragraph 2.2.3).

NOTE

One DS-BNK37-1E cable kit is required for each expansion unit.

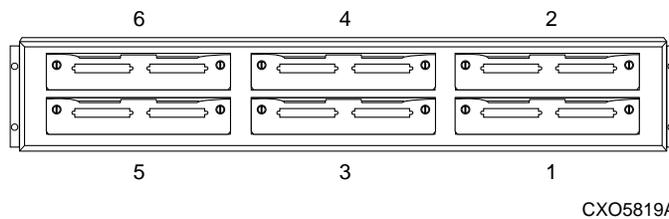
2.4.7.1 Cabling Sequence

When adding an expansion BA370 unit, the following sequence is suggested.

1. Connect all six SE I/O cables between units.
2. After the SE I/O cables are attached, connect the EMU communication cable.
3. Set the PVA address.

2.4.7.2 Attaching the SE I/O Cables

Figure 2-34 SE I/O Port Identification



There is a separate cable for each port of the controller and all cables are identical. Refer to Figure 2-34 and attach the cables to one port at a time. SE I/O cables are connected port-to-port maintaining the same port number at each end. Port 1 of the master unit connects to port 1 of the expansion unit(s), port 2 of the master unit connects to port 2 of the expansion unit(s), and so forth. Start with the bottom row (ports 1, 3, 5) first then the top row (ports 2, 4, and 6).

Place the cable clip on each cable prior to attaching the cable to the I/O module. Orient the connector on the cable to match the I/O module connector and plug the cable connector into the I/O module connector.

CAUTION

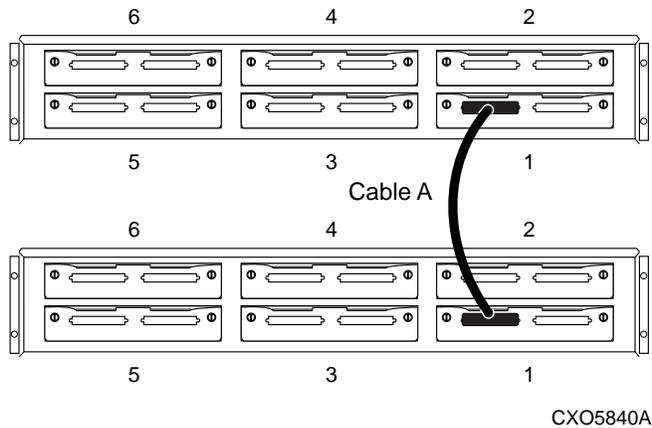
Do not overtighten the jackscrews in the following step.
Over-tightening could damage the connectors.

Secure the cable by finger-tightening the cable connector jackscrews.
Slide the cable clip along the cable and press it into the hole of the I/O module bracket.

2.4.7.3 Cabling for One Expansion Unit

For a single expansion unit, cable from the **terminated** side of the I/O module on the master unit to the **terminated** side of the expansion unit. The terminated side is identified by the resistor symbol, it is also the LEFT-hand connector of the SE I/O module. See Figure 2–35.

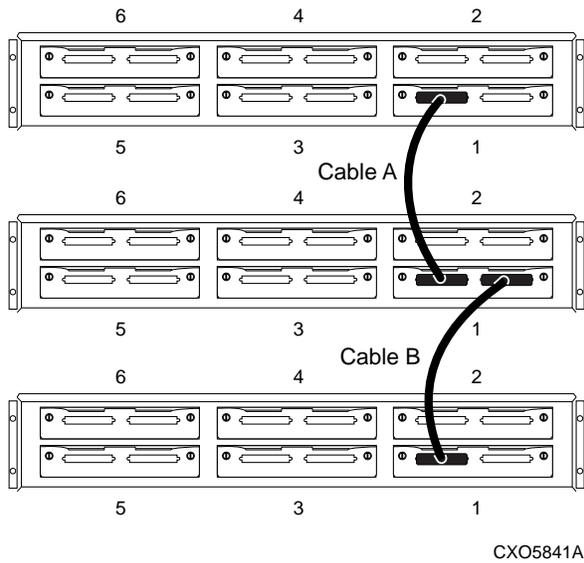
Figure 2–35 SE I/O Port Wiring (One Expansion Unit)



2.4.7.4 Cabling for Two Expansion Units

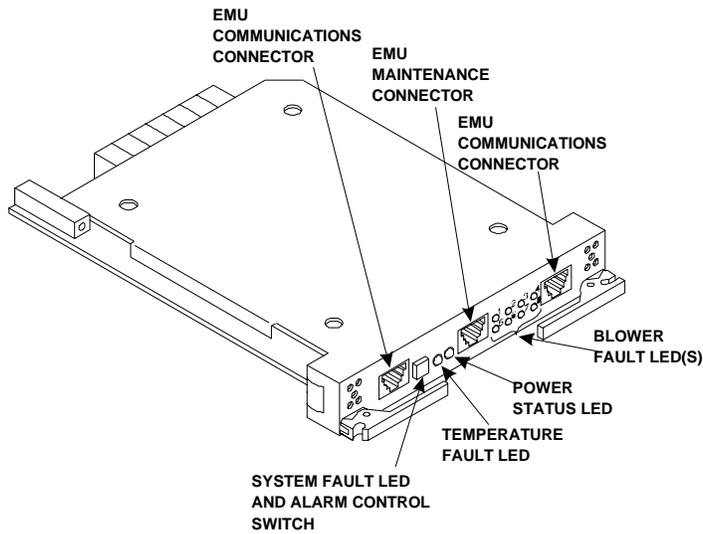
For two expansion units, cable from the **terminated** side of the I/O module on the master unit to the **terminated** side of the I/O module on the first expansion unit. Then connect from the **unterminated** side of that I/O module on first expansion unit to the **terminated** side of the I/O module on the second expansion unit. The unterminated side is identified by the resistor symbol enclosed in a circle with a diagonal bar across the symbol. It is also the RIGHT-hand connector of the SE I/O module. See Figure 2–36.

Figure 2-36 SE I/O Connections for Two Expansion Units



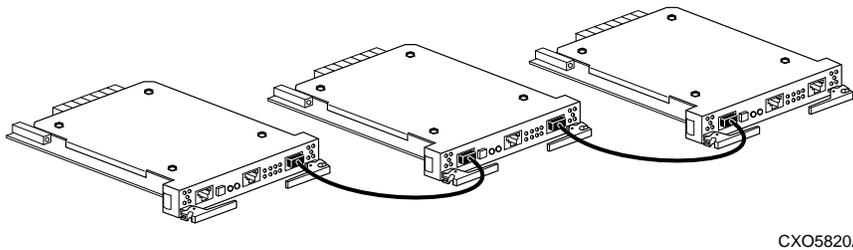
2.4.7.5 Attaching the EMU Communications Cable

Figure 2-37 EMU Front Panel



Connect the EMU communications cable from one EMU communications port (see Figure 2–37) of the master BA370 Enclosure to the communications port of the first expansion unit. If there is a second expansion unit, connect an EMU communications cable from one EMU communications port of the first expansion unit to a communications port of the second expansion unit. See Figure 2–38.

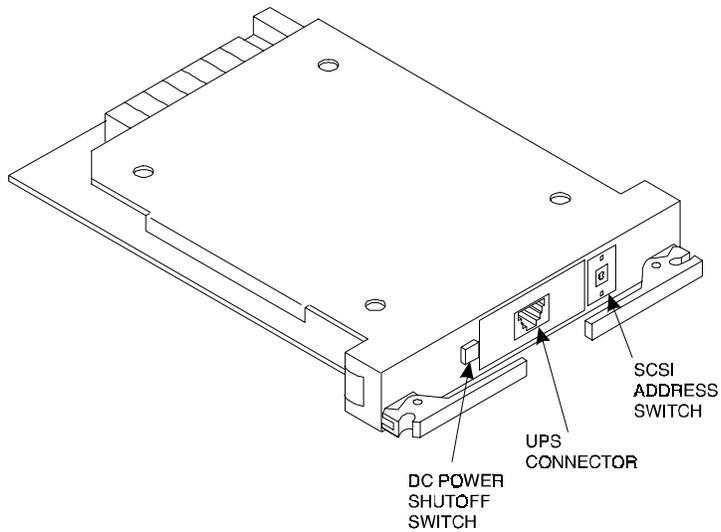
Figure 2–38 Multiple EMUs Connected Together



CXO5820A

2.4.8 Setting the PVA Addresses

Figure 2–39 PVA Module Front Panel



710-47

Compaq supports enclosure addresses 2 and 3, only for expansion enclosures. Figure 2–40 defines the SBB device IDs for these two settings of the PVA SCSI bus address switch. The use of these addresses in combination depends on the number of enclosures and possible addressing conflicts.

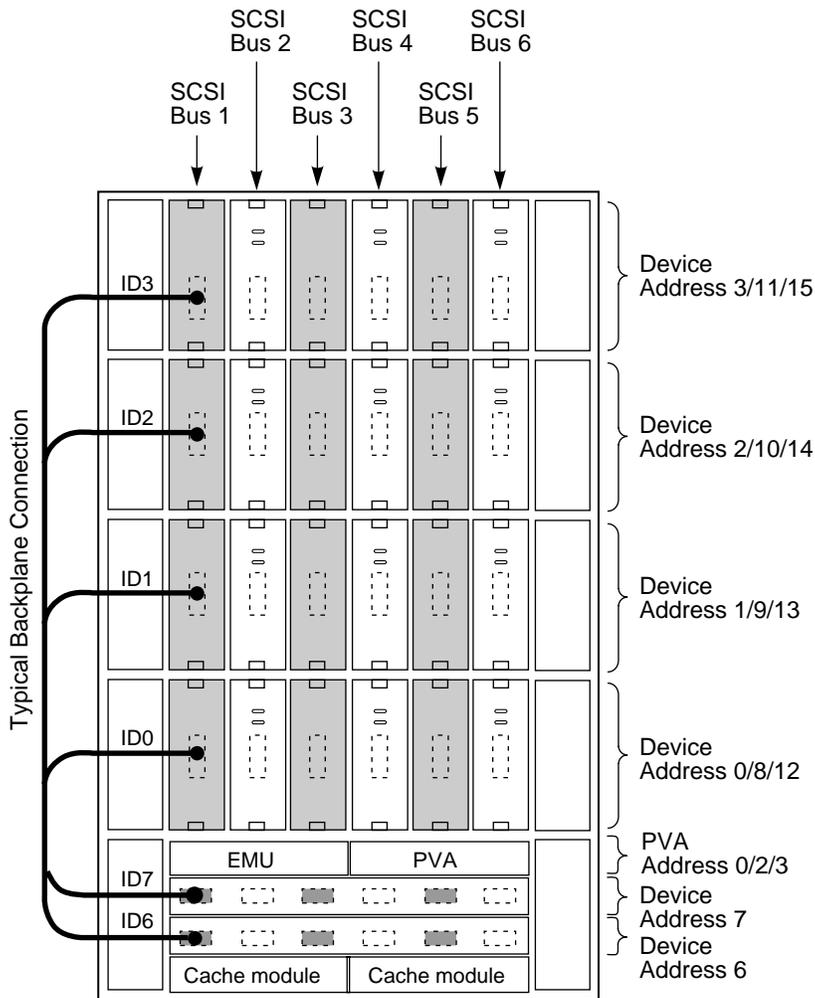
CAUTION

Compaq does not support any enclosure address combination not listed in Table 2–3.

Table 2–3 Expansion Enclosure Address Combinations

Enclosure	PVA Address Switch Setting for Two BA370 Rack Mountable Units	PVA Address Switch Setting for Three BA370 Rack Mountable Units
Master	0	0
First Expansion Enclosure	2	2
Second Expansion Enclosure	N/A	3

Figure 2-40 Expansion Enclosure SCSI Bus Addresses



CX05889A

2.5 Installing SBBs

This section describes the procedures for installing Storage Building Blocks (SBBs) into a BA370 rack mountable enclosure. The SBB can contain disk drives, power supplies, and the external cache battery.

2.5.1 Installing Disk Drive SBBs

Initial and additional disk drive SBBs may be installed into the BA370 rack-mountable enclosure. The recommended procedure for installing disk drive SBBs is to install them into the enclosure bottom to top and from left to right as viewed from the front of the enclosure. Refer to Section 5.7.4 in Chapter 5 of this guide for specific disk drive SBB installation instructions.

Before beginning the disk drive SBB installation process, group the SBBs according to capacity. If there is more than one BA370 enclosure involved, divide each of the groups by total number of BA370 rack mountable enclosures. Now distribute the disks (by capacity) amongst the BA370s. The goal is to spread the disks across the BA370s to ensure that a raidset is not all on one BA370. It is not necessary to favor the master BA370 [the one with the array controller(s)] over the expansion enclosure(s).

Example:

DISK TYPE	TOTAL NUMBER OF DISKS BY TYPE	NUMBER OF DISKS IN MASTER	NUMBER OF DISKS IN EXPANSION
RZ1DB, 18GB, WIDE Ultra	18	4	5
RZ1CB, 9GB, WIDE Ultra	9	3	2
RZ1BB, 4GB, WIDE Ultra	4	1	2

To install an disk drive SBB, hold it in both hands, insert the disk drive into the designated guide slots and firmly push the disk drive into the shelf until the mounting tabs snap into place.

Additional rules for configuring SCSI buses include:

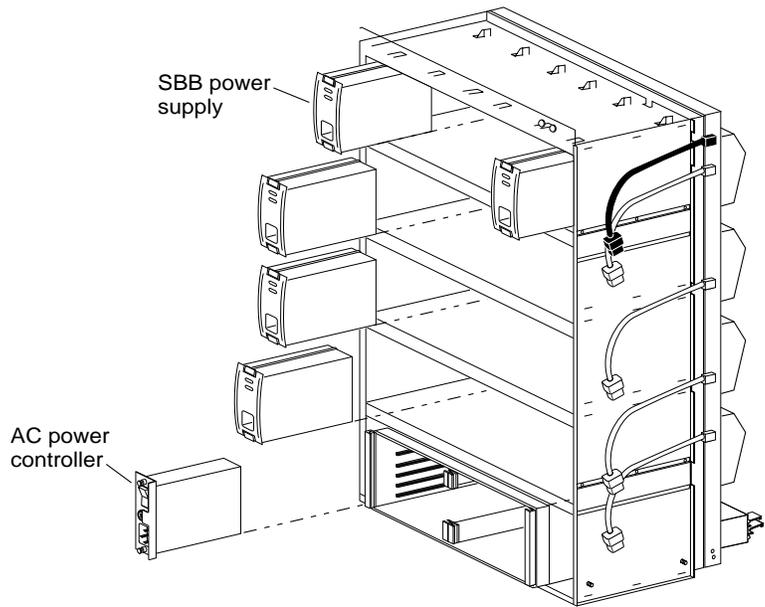
1. All devices and ports in the same column are on the same SCSI bus or port.
2. All devices in the same row (device shelf) have the same device address.
3. Devices installed must be listed in the HSZ80 and HSG80 Solutions Software SPD or Release Notes.
4. Device address 4 and 5 are used only when the disk drive SBB has a device address switch.
5. Device addresses are determined by the backplane connector into which the device is inserted unless the SBB has a device address switch.
6. For the addressing of disk drive SBBs on the SCSI bus, device addresses for each SBB in each expansion cabinet are determined by the PVA address as follows:
 - The main cabinet's PVA address is set to PVA address 0 and device addresses in that cabinet have addresses 0 through 3.
 - The PVA address in the first expansion cabinet is set to PVA address 2 and device addresses in that expansion cabinet have addresses 8 through 11.
 - The PVA in the second expansion cabinet is set to PVA address 3 and device addresses for that expansion are from 12 through 15.

Figure 2-40 helps to illustrate the addressing scheme. Figure 2-40 shows the six Ultra Wide SCSI buses and their associated ports and device addresses.

2.5.2 Installing Power Supplies SBBs

Each power supply SBB has two green status LEDs. The upper LED indicates AC power status and the lower LED indicates power supply status. The procedure for installing power supplies is basically the same for installing any SBB. Refer to Figure 2-41 during the installation.

Figure 2-41 Installing Power Supply SBB (4+1 Shown)



1. Insert the power supply SBB into the guide slots and push in until the power supply is fully seated and the mounting tabs are engaged into the shelf.
2. Connect the power cord to the power supply SBB.
3. Turn on the ac input power entry controller.
4. Observe the power supply SBB LEDs. Both LEDs should be lit, indicating proper power supply operation on the associated bus.
5. If the upper LED is not lit after installation this indicates that the power supply is not functioning properly and needs to be replaced. If both status LEDs are not lit after the installation, either there is a lack of ac power, the ac input power entry controller has failed, or the power supply SBB just installed has failed.

2.5.3 Installing the AC Input Power Entry Controller

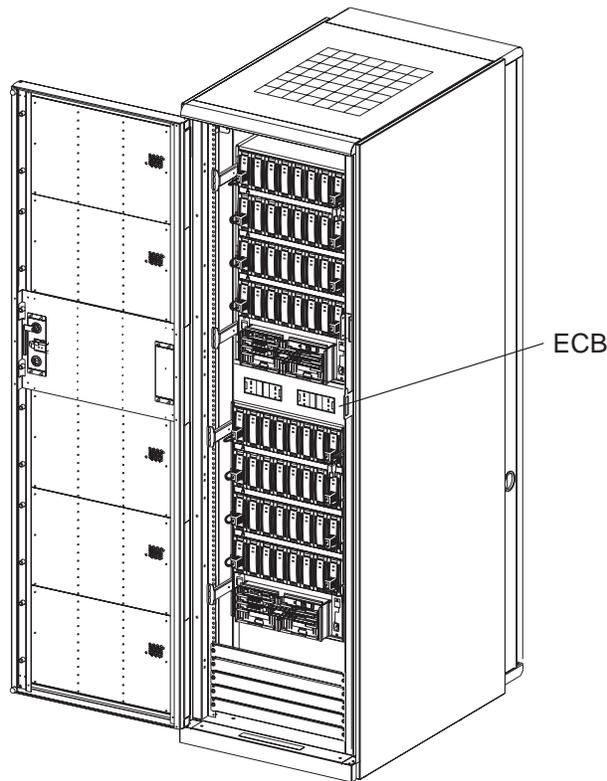
There are no external indications of a power controller failure on the ac power entry controller itself. Both status LEDs on the power supply being off indicate a possible power controller failure. Use the following procedure to install a new ac power entry controller. Refer to Figure 2-42.

1. Press **O** on the ac input power entry controller ON/OFF switch.
2. Insert the ac input power entry controller into the BA370 enclosure.
3. Tighten the two retaining screws at the top and bottom of the ac input power entry controller.
4. Connect the ac power cord to the ac input power entry controller.
5. Press **I** on the ac input power entry controller ON/OFF switch.
6. Observe the power supply status LEDs for proper operation.

2.5.4 Installing the External Cache Battery (ECB)

Install the external cache batteries (ECBs) into the ESA12000 ECB shelf mounted in the front of the cabinet or at the top of the RA8000 pedestal. Figure 2-42 illustrates the location of the ECB shelf in the ESA12000 cabinet.

Figure 2-42 ECB Shelf Location (ESA12000 Shown)



CXO6670A

The following procedure details external cache battery installation

1. Insert the external cache battery into the guide slots of the ECB shelf.
2. Push in the external cache battery until it seats firmly into the shelf and the mounting tabs engage the shelf.
3. Connect the ECB Y-cable between the cache modules and the ECB as shown in Figure 2-15.

3

Configuring the Storage Cabinet

This chapter describes the configuration rules and restrictions for configuring the Environmental Monitor Unit (EMU) and Power and Verification Assembly (PVA). When specific rules and restrictions are not provided, references are given to the proper StorageWorks documentation.

3.1 Configuring the EMU

Configuring the EMU requires connecting to the EMU communications bus and then using the CLI SET_EMU command to establish the following:

- Enclosure backplane temperature sensor set points on all enclosures
 - SENSOR_1 or SENSOR_1_SETPOINT = DEFAULT
 - SENSOR_2 or SENSOR_2_SETPOINT = DEFAULT
- EMU module internal temperature sensor set point SENSOR_3 or SENSOR_3_SETPOINT = DEFAULT
- The blower speed controls of either FANSPEED = HIGH or FANSPEED = AUTOMATIC

Compaq recommends setting the FANSPEED to AUTOMATIC, unless (1) the ambient temperature is in excess of 38°C (100°F), (2) there is no air conditioning, or both conditions exist. Should these conditions exist, Compaq recommends setting the FANSPEED to HIGH.

NOTE

For instructions on using these commands, refer to the *CLI Reference Manual*.

3.1.1 Connecting the EMU Communications Bus

In an expansion configuration you must establish communications between the master EMU and each of the expansion EMUs. This is accomplished by connecting a communications port on each EMU to a communications port on another EMU. By establishing an EMU communications bus chain you ensure that the master EMU can monitor and control all the enclosures in the UltraSCSI subsystem.

Compaq recommends that you use a BN25G cable no longer than 4 m (13.1 ft.) to connect the EMUs.

3.1.2 Setting the Temperature Sensors

There are three temperature sensors in each UltraSCSI enclosure – two on the rear of the backplane in the top middle and one mounted on the EMU module.

The EMU sensor monitors the input, or ambient, air temperature while the two enclosure sensors monitor the exhaust air temperature. The exhaust air temperature is higher than the ambient air temperature during normal operation.

In an expansion configuration (two or more enclosures operating with the same controller) you only set the master EMU temperatures. The temperature set points for the other UltraSCSI enclosures, the “slaves”, automatically change to match the setting for the master EMU.

Users have the option of setting the temperature at which an individual sensor reports an overtemperature condition. The desired temperature is entered in degrees Celsius within the range of 0°C (32°F) through 49°C (120°F). See Table 3–1 for the relationship between °C (Celsius) and °F (Fahrenheit).

Tables 3–2 and 3–3 describe the rules to adhere to when setting temperature set points. For detailed instructions about using the `set emu` commands, refer to the array controller CLI documentation.

Should the ambient temperature regularly be higher than 35°C (95°F), Compaq recommends you select a temperature setting that ensures the continued operation without endangering the components. Setting the temperature sensors to the highest expected ambient temperature should ensure optimum operation.

CAUTION

To ensure proper operation, enter all temperatures in °C. You cannot enter temperatures as fractions, decimals, or in °F.

Table 3–1 EMU Set Point Temperature Conversions

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
0	32	10	50	20	68	30	86	40	104
1	34	11	52	21	70	31	88	41	106
2	36	12	54	22	72	32	90	42	108
3	37	13	55	23	73	33	91	43	109
4	39	14	57	24	75	34	93	44	111
5	41	15	59	25	77	35	95	45	113
6	43	16	61	26	79	36	97	46	115
7	45	17	63	27	81	37	99	47	117
8	46	18	64	28	82	38	100	48	118
9	48	19	66	29	84	39	102	49	120

Table 3–2 Temperature Set Point Rules – EMU Firmware Vers. 1.0 and 1.1

1. Enter all temperatures in degrees Celsius (°C). Do not use fractions, decimals, or degrees Fahrenheit (°F).
2. The EMU set point (sensor_3) temperature must be a minimum of 6°C (11°F) <i>greater than</i> the highest expected ambient (intake) temperature.
3. The backplane set points (sensor_1 and sensor_2) must be the same temperature and a minimum of 13°C (23°F) <i>greater than</i> the highest expected ambient temperature. This requires a minimum setting of 7°C (13°F) <i>greater than</i> the EMU set point.
4. EMU firmware versions 1.0 or 1.1 <i>cannot use</i> the <code>set emu sensor_n_setpoint=default</code> command. Instead, the following command is required: <pre>set emu sensor_n_setpoint=nn</pre> ((where nn is the desired temperature in °C).

Table 3–3 Temperature Set Point Rules – EMU Firmware Vers. 1.2 and 1.3

1.	Enter all temperatures in degrees Celsius (°C). Do not use fractions, decimals, or degrees Fahrenheit (°F).
2.	The EMU set point (sensor_3) temperature must be a minimum of 2°C (4°F) <i>greater than</i> the highest expected ambient (intake) temperature.
3.	The backplane set points (sensor_1 and sensor_2) must be the same temperature and a minimum of 12°C (22°F) <i>greater than</i> the highest expected ambient temperature. This requires a minimum setting of 10°C (18°F) <i>greater than</i> the EMU set point.
4.	<p>EMU firmware versions 1.0 or 1.1 <i>cannot use</i> the <code>set emu sensor_n_setpoint=default</code> command. Instead, the following command is required:</p> <pre style="text-align: center;">set emu sensor_n_setpoint=nn</pre> <p>((where nn is the desired temperature in °C).</p>

3.1.3 Setting the Blower Speed Control

The UltraSCSI enclosure blowers normally operate at low speed and provide sufficient air flow to cool the enclosure components and ensure proper operation. You can use the CLI FANSPEED command to change the operating speed of the blowers.

- When you set FANSPEED = HIGH all blowers in all enclosures operate at high speed
- When you enter FANSPEED = AUTOMATIC the local EMU controls the blower speed in each enclosure

Compaq recommends using the FANSPEED = AUTOMATIC command to enable the EMU in each enclosure to implement corrective action whenever any one of the following error conditions occurs:

- A blower fails
- You remove a blower
- A blower is rotating too slowly to provide sufficient air flow
- The ambient air temperature (EMU intake) exceeds the user defined temperature
- Either backplane (exhaust) temperature exceeds the user-defined temperature

When the EMU detects any of these error conditions, it will automatically switch all the operational blowers to high speed, thereby increasing the air flow through the enclosure to reduce the possibility of component failure. Simultaneously, the EMU can initiate the following actions:

- Enable the audible alarm on the EMU
- Turn on the amber System Fault LED whenever the temperature exceeds one or more set points
- Turn on the amber Temperature Fault LED
- Notify the controller of the error condition
- Start the EMU 8-minute timer when (1) all blowers in a bank are defective, or (2) a blower is removed

NOTE

Removing a blower significantly changes the air flow pattern within the enclosure. This can cause an over-temperature condition in a very short time. Therefore, this condition starts the 8-minute timer.

When you momentarily and hold press the alarm control switch, the EMU audible alarm will turn off and the fault status LEDs remain on. At this time, the blower LEDs will display the system fault codes (see EMU System Fault Code Displays in Chapter 4).

3.1.4 Alarm Control Switch

Whenever a power, environment, or blower error or fault condition occurs, the EMU turns on the local audible alarm. At the same time, the alarm sounds and an amber LED in the switch turns on. The alarm remains on until one of the following conditions occurs:

- Correction of the error condition
- The user momentarily presses the alarm control switch

When you momentarily press the alarm control switch you turn off the audible alarm for all current error conditions in the local subsystem. The alarm remains off until one of the following conditions occurs:

- One hour elapses
- A different fault occurs
- An existing fault clears and re-occurs

When you press and hold the alarm control switch for at least 5 seconds you clear all the fault codes.

NOTE

The alarm control switch does not affect either the error condition or the error code. Only correcting the error condition will clear the error code.

During a controlled power shut down, the alarm control switch functions as an enclosure power switch. When a controlled power shut down is in affect, you must press the alarm control switch to restore dc power to the enclosure.

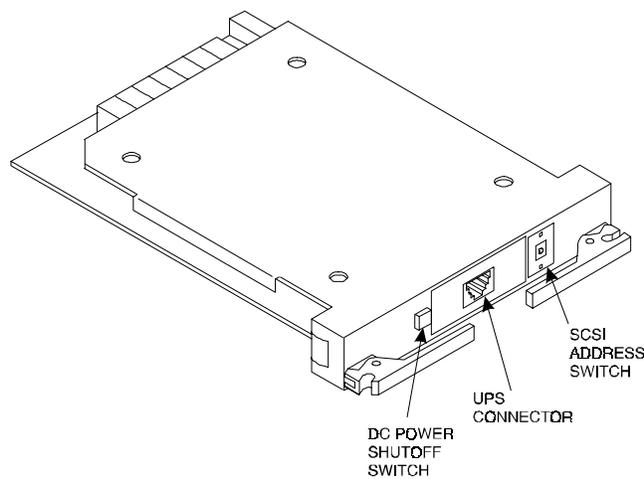
3.2 Setting the PVA Addresses

The front panel of the PVA module is shown in Figure 3-1. Compaq supports enclosure addresses 2 and 3, only for expansion enclosures. Figure 3-2 defines the SBB device IDs for these two settings of the PVA SCSI bus address switch. The use of these addresses in combination depends on the number of enclosures and possible addressing conflicts.

CAUTION

Compaq does not support any enclosure address combination not listed in Table 3-4.

Figure 3-1 PVA Module Front Panel

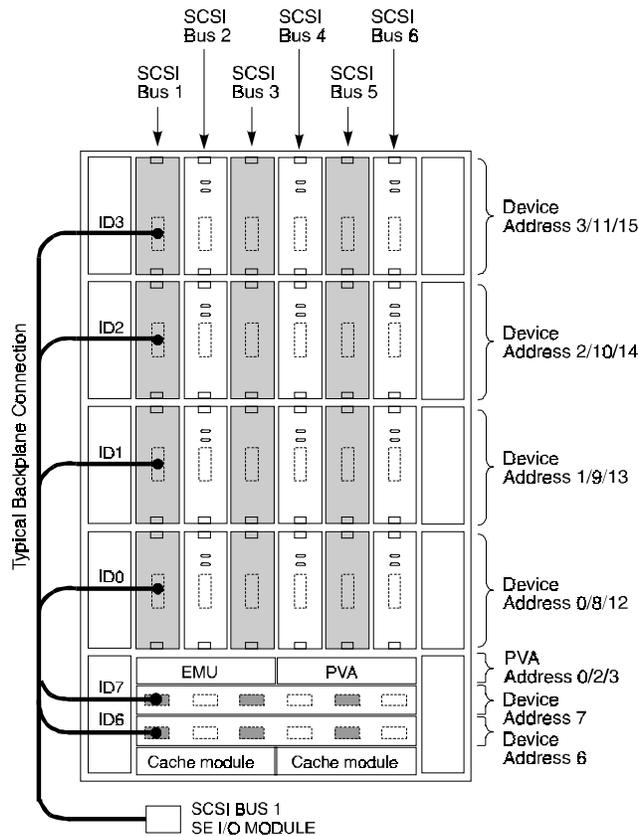


710-47

Table 3-4 Expansion Enclosure Address Combinations

Enclosure	PVA Address Switch Setting for Two BA370 Rack Mountable Units	PVA Address Switch Setting for Three BA370 Rack Mountable Units
Master	0	0
First Expansion Enclosure	2	2
Second Expansion Enclosure	N/A	3

Figure 3-2 Expansion Enclosure SCSI Bus Addresses



4

Error Analysis and Fault Isolation

This chapter describes the errors, faults, and significant events that can occur during the storage subsystem initialization and normal operation. The chapter provides a description of the events and how to respond. The error and event descriptions isolate failures to the field replaceable unit (FRU). Refer to Chapter 5 for a list of FRUs.

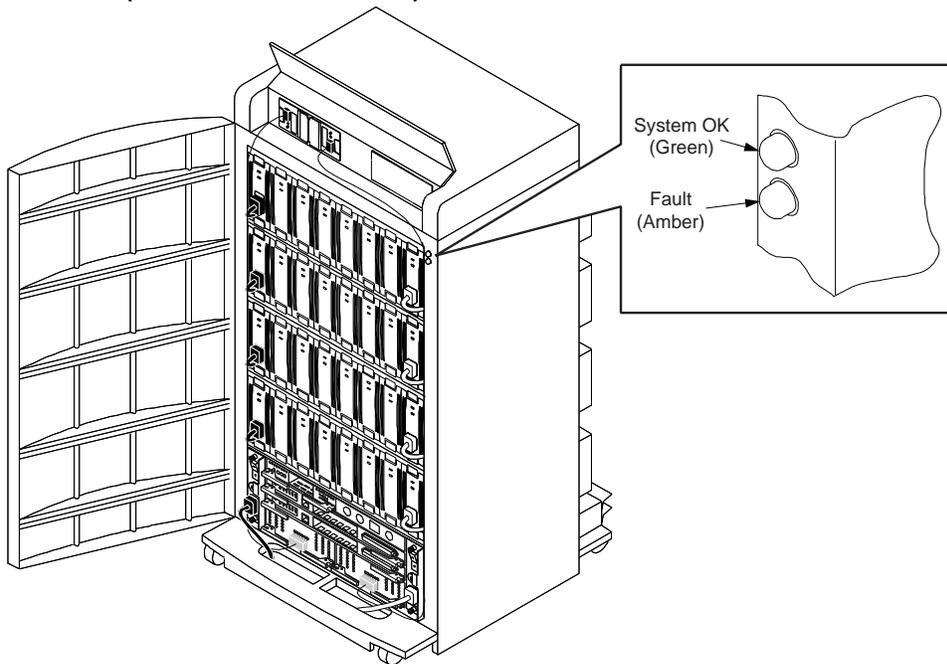
4.1 Storage Subsystem Error Reporting

On the subsystem, multiple light emitting diodes (LEDs) display error conditions. The two most easily observed are located on the subsystem front panel (Figure 4–1). These two LEDs are simple *go-no go* indicators. The green LED is the System OK LED; the amber LED is the Fault LED.

When the Fault LED is ON, you must check all the other status LEDs to determine the cause of the error:

- the EMU front panel (see Tables 4–3 and 4–4)
- the disk drive SBB LEDs (see Table 4–5)
- the power supply LEDs (see Table 4–6)
- the array controller LEDs to isolate the error condition to a component (see the *HSG80 or HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide*)

**Figure 4-1 Storage Subsystem Status LEDs
(RA8000 Pedestal Shown)**



SHR-1160

NOTE

The ESA12000 cabinet has subsystem status LEDs mounted in the cabinet door and in a small panel above or to the top right side of each BA370 Rack Mountable Enclosure. The cabinet door LEDs permit the operator to determine the subsystem status without opening the cabinet door.

Table 4–1 Subsystem Status LEDs

Symbol	Condition
 <p>710-34A</p>	<p>Operating normally; no error conditions.</p>
 <p>710-34B</p>	<p>A failed subsystem component exists.</p> <p>Recommended Corrective Actions</p> <ol style="list-style-type: none"> 1. Check the EMU control panel LEDs to determine an overtemperature condition, a blower problem, or a power problem. <p>Replace the defective blower or power components.</p> <ol style="list-style-type: none"> 2. Check the individual disk drive SBBs for an error condition. 3. Check the system terminal for error messages.
 <p>710-34C</p>	<p>The subsystem does not have power applied or is in a RESET state.</p> <p>Recommended Corrective Action</p> <ol style="list-style-type: none"> 1. Check the EMU control panel LEDs to determine which component has failed. 2. Check that at least four operational SBB power supplies exist. 3. Check the system terminal for error messages.
 <p>ON =  OFF = </p> <p>710-34D</p>	

4.2 EMU Error and Fault Status Reporting

The EMU processes subsystem status reports, and when an error condition occurs, notifies you of the problem using the EMU audible alarm and the status LEDs (system, temperature, power, blower) located on the EMU front panel (see Figure 4–2).

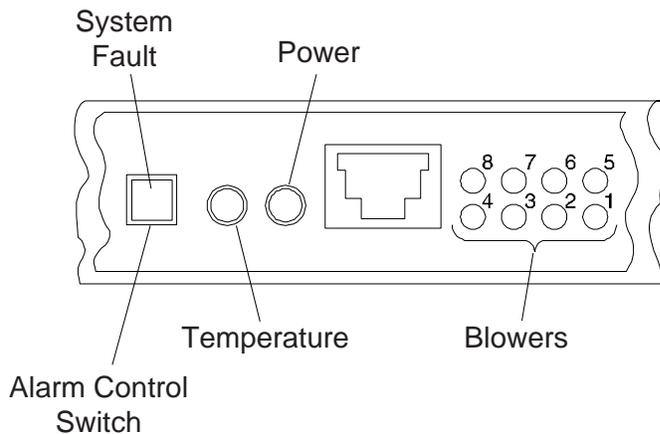
Whenever the audible alarm sounds, check the EMU status LEDs to determine the problem.

NOTE

Should the audible alarm sound, but the status LEDs not indicate an error condition, the error condition may no longer exist. However, you should always check the array controller error log to verify the error condition no longer exists.

The EMU reports the subsystem status, including error conditions, to the array controller, which records this information in the error log and displays the status on the array controller console.

Figure 4–2 EMU Front Panel Layout



SHR-1161

4.3 EMU Subsystem Status LEDs

Table 4–2 shows the possible EMU status LED displays. LEDs that blink or flash at a one-second or greater interval are considered ON.

Table 4–2 EMU Subsystem Status LEDs

Symbol	Condition
 710-58A	ON (or blinking slowly at an interval of 1 second or more)
 710-58B	OFF
 710-58C	Flashing (blinking at an interval of less than 1 second)

4.3.1 EMU Status LEDs

The EMU status LEDs (see Table 4–3) display the status of the following: the enclosure (system fault), the temperature (overtemperature), the error conditions (enclosure fault), and the individual blowers and banks of blowers. When the enclosure is functioning properly, only the Power LED is ON. Table 4–3 describes:

- The EMU status LED displays
- The enclosure status associated with each display
- The probable cause of the error condition
- The actions recommended to correct the problem

NOTE

Not all possible combinations of LED displays can be shown. Therefore, only a representative sampling of the possible displays appears in Table 4–3.

Table 4–3 EMU Status Displays

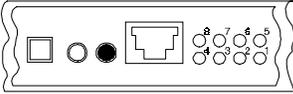
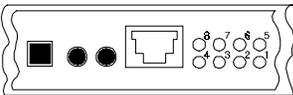
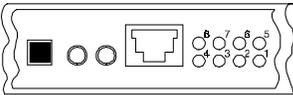
EMU LED Display	EMU Status
 <p style="text-align: right;">710-58A</p>	<p>Operational Enclosure</p> <p>The subsystem is fully operational. The power supplies and blowers are functioning properly. The EMU intake and backplane exhaust air temperatures are within user-specified limits.</p>
 <p style="text-align: right;">710-58B</p>	<p>Overtemperature Condition</p> <p>Probable Cause 1—A temperature in one or more enclosures is above the user-specified limit.</p> <p>Determine and correct the cause of this condition quickly to prevent an overtemperature condition from inducing a subsystem RESET or failure.</p> <p>Probable Cause 2—A temperature set point is too low for this environment.</p> <p>Change the temperature set point.</p>
 <p style="text-align: right;">710-58C</p>	<p>Nonoperational Enclosure</p> <p>Probable Cause 1—Either + 5 V dc or 12 V dc out of range.</p> <p>Observe the individual power supply status LEDs to determine the defective power supply and replace it.</p> <p>Probable Cause 2—TERMPower less than + 4.5 V dc on one or more I/O modules.</p> <p>Replace the I/O modules displaying a TERMPower LED OFF indication.</p>

Table 4–3 EMU Status Displays (continued)

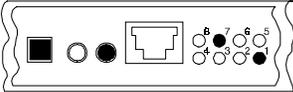
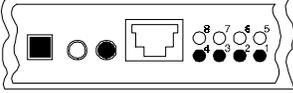
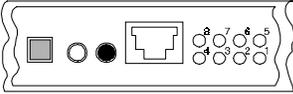
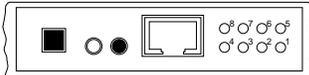
EMU LED Display	EMU Status
 <p style="text-align: right;">710-56D</p>	<p>Single Blower Fault</p> <p>Operational blowers are running at high speed.</p>
 <p style="text-align: right;">710-56E</p>	<p>Missing Blower Fault or Multiple Blower Faults</p> <p>Operational blowers are running at high speed.</p> <p>Probable Cause 1—A blower is removed. Replace the missing blowers.</p> <p>Probable Cause 2—All blowers in one bank are not operating. Remove and install blowers correctly within 8 minutes.</p> <p>Probable Cause 3—Multiple blowers are installed incorrectly. Remove and install blowers correctly within 8 minutes.</p> <p>Comment—In this example, one of the following conditions exist in shelf bank 1:</p> <ul style="list-style-type: none"> • A blower is removed. • Two or more blowers are not operating. <p>Failure to replace the missing or defective blowers within 8 minutes might result in the enclosure entering standby power mode.</p>

Table 4–3 EMU Status Displays (continued)

EMU LED Display	EMU Status
 <p style="text-align: right;">710-58F</p>	<p>Configuration Error (Example 1) Probable Cause 1—Configuration error. See the Configuration Fault Code Reporting section for the specific error condition. Probable Cause 2—Slave EMU cannot communicate with the master EMU. See the Configuration Fault Code Reporting section for the specific error condition. Probable Cause 3—External SHELF_OK signal indicates error. See the Configuration Fault Code Reporting section for the specific error condition.</p>
 <p style="text-align: right;">CXO6546A</p>	<p>Configuration Error (Example 2) Configuration errors listed in probable causes 1 through 4 also sound the audible alarm.</p> <p>Probable Cause 1—Invalid cache module installed. Verify that the cache module is the proper model.</p> <p>Probable Cause 2—Defective cache module. Replace the defective cache module.</p> <p>Probable Cause 3—Defective ECB. Replace the defective ECB.</p> <p>Probable Cause 4—Misconfigured array controller setup. Setup as dual redundant, but only one array controller is running. Setup as non-dual-redundant, but two array controllers are running. Reconfigure the array controller setup.</p> <p>Probable Cause 5—Defective or misconfigured disk drive. Replace or reconfigure the applicable disk drive.</p>

4.3.2 Configuration Fault Code Reporting

The system fault, temperature, power, and blower LEDs cannot display all the possible system faults. Therefore, a flashing system fault LED indicates that the blower LEDs are displaying a two-digit, hexadecimal fault code. The upper LEDs (8–5) display the first digit (the most significant digit); the lower LEDs (4–1) display the second digit (the least significant digit).

The EMU can display configuration fault codes on the blower LEDs (see Table 4–4) only when the system fault LED is flashing. To view fault codes on the blower LEDs, you must press and hold the alarm control switch.

Once you press the alarm control switch, the EMU initiates the following actions:

1. Displays the first reported hexadecimal fault code on the blower LEDs three times in succession.
 - The LEDs display the first reported fault code the first time for one second, then go off
 - The LEDs display the first reported fault code the second time for one second, then go off
 - The LEDs display the first reported fault code the third time for one second, then go off
2. Displays the next reported fault code three times.
3. Displays all fault codes in sequence. Then, the cycle starts over.

Release the alarm control switch to stop the fault code display.

NOTE

When multiple corrective actions are listed, complete the first procedure and see if the problem is corrected. If the problem still exists, complete the second procedure.

Table 4-4 EMU Fault Code LED Displays

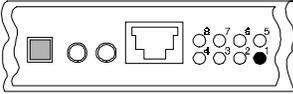
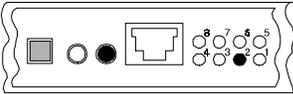
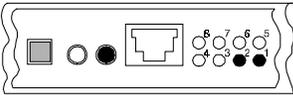
Display	Fault Code, Cause, Corrective Action
 <p>710-57A</p>	<p>Fault Code 01 One of the following Boot ROM error conditions exists:</p> <ol style="list-style-type: none"> 1. A Boot ROM Signature failure. Replace the EMU. 2. A Boot ROM Checksum failure. Replace the EMU.
 <p>710-57B</p>	<p>Fault Code 02 Both microcode images are bad.</p> <ol style="list-style-type: none"> 1. Load microcode image into the EMU from a PC or maintenance terminal. 2. Replace the EMU.
 <p>710-57C</p>	<p>Fault Code 03 Either a PVA SCSI ID switch setting is invalid (set to 1, 4, 5, 6, or 7) or there is no master enclosure identified (SCSI bus ID = 0).</p> <ol style="list-style-type: none"> 1. Ensure PVA SCSI ID switch settings are as follows: <ul style="list-style-type: none"> • Master enclosure—0 • First expansion enclosure—2 • Second expansion enclosure—3 2. If any PVA SCSI ID switch setting is changed, the array controllers must be RESET to recognize the new setting. 3. Replace each of the PVAs in sequence (first, the master, then the expansions) until the fault condition clears.

Table 4-4 EMU Fault Code LED Displays (continued)

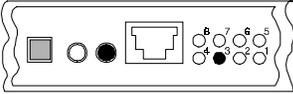
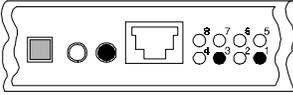
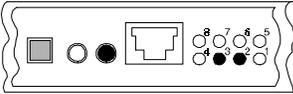
Display	Fault Code, Cause, Corrective Action
 <p>710-57D</p>	<p>Fault Code 04 Master EMU cannot communicate with expansion EMU.</p> <ol style="list-style-type: none"> 1. Ensure PVA SCSI ID switch settings are as follows: <ul style="list-style-type: none"> • Master enclosure—0 • First expansion enclosure—2 • Second expansion enclosure—3 2. If any PVA SCSI ID switch setting is changed, the array controllers must be RESET to recognize the new setting. 3. Ensure EMU cables are properly connected. 4. Disconnect and reconnect each EMU cable one at a time. Replace the defective cable. 5. Replace the EMU.
 <p>710-57E</p>	<p>Fault Code 05 Master EMU cannot communicate with the array controller.</p> <ol style="list-style-type: none"> 1. Replace the EMU. 2. Replace the array controller.
 <p>710-57F</p>	<p>Fault Code 06 One or more temperature sensors indicate an “invalid” temperature—one that is greater than 49°C (120°F).</p> <ol style="list-style-type: none"> 1. Replace the EMU. 2. Instruct Field Service that temperature sensors need replacing.

Table 4-4 EMU Fault Code LED Displays (continued)

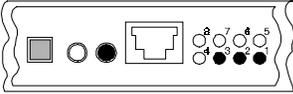
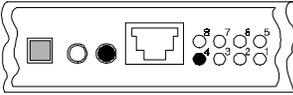
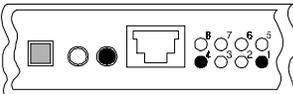
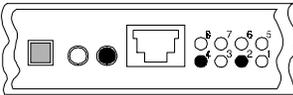
Display	Fault Code, Cause, Corrective Action
 <p style="text-align: right;">710-57G</p>	<p>Fault Code 07 Invalid configuration. Requires an array controller-specific action (see the <i>HSG80</i> or <i>HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide</i>).</p>
 <p style="text-align: right;">710-57H</p>	<p>Fault Code 08 Two PVA SCSI ID switch settings are the same.</p> <ol style="list-style-type: none"> 1. Ensure the PVA SCSI ID switch settings are as follows: <ul style="list-style-type: none"> • Master Enclosure—0 • First Expansion Enclosure—2 • Second Expansion Enclosure—3 2. If any PVA SCSI ID switch setting is changed, the array controllers must be RESET to recognize the new setting. 3. Replace each of the PVAs in sequence (first, the master, then the expansions) until the fault condition clears.
 <p style="text-align: right;">710-57I</p>	<p>Fault Code 09 An EMU is installed in a PVA slot. Remove the EMU from the PVA slot and install it into the slot immediately to the left.</p>
 <p style="text-align: right;">710-57J</p>	<p>Error Code 0A No PVA is installed. Install a PVA.</p>

Table 4-4 EMU Fault Code LED Displays (continued)

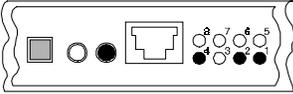
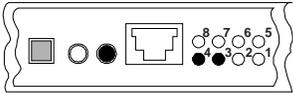
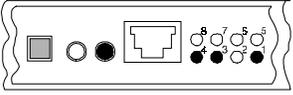
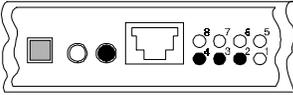
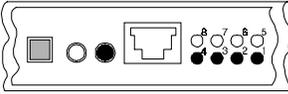
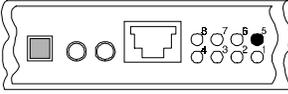
Display	Fault Code, Cause, Corrective Action
 <p>710-57K</p>	<p>Fault Code 0B Array controller fault. Requires an array controller-specific action (see the <i>HSG80</i> or <i>HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide</i>).</p>
 <p>710-57L</p>	<p>Fault Code 0C One or more defective power supplies. Observe all power supply status LEDs. Replace any power supply with the lower (power supply status) LED turned OFF.</p>
 <p>710-57M</p>	<p>Fault Code 0D The master enclosure SCSI bus ID address is incorrect or an array controller is installed in an expansion enclosure.</p> <ol style="list-style-type: none"> 1. Change the master enclosure SCSI bus ID to 0. The array controller must be RESET to recognize the new setting. 2. If necessary, remove the array controller from the expansion enclosure and install it in the master enclosure.
 <p>710-57N</p>	<p>Fault Code 0E EMU memory test failed. Replace the EMU.</p>

Table 4-4 EMU Fault Code LED Displays (continued)

Display	Fault Code, Cause, Corrective Action
 <p>710-57Q</p>	<p>Fault Code 0F</p> <p>Initial Display</p> <p>Less than four operational power supplies remain.</p> <p>Replace the defective power supplies.</p> <p>Standby Power Mode Display</p> <p>Power has been removed from the enclosure.</p> <p>Comment—The EMU places the system in the standby power mode for this fault indication. After replacing the defective power supplies, momentarily press the alarm control switch to restore dc power to the enclosure. The initial display appears when a fault is detected.</p> <p>The standby power mode display appears after the EMU removes dc power from the enclosure.</p>
 <p>710-57Q</p>	<p>Fault Code 10</p> <p>EMU diagnostic program is loaded.</p> <p>The audible alarm is ON continuously and it cannot be cleared by pressing the alarm control switch.</p> <ol style="list-style-type: none"> 1. Load new microcode. The array controllers must be RESET to recognize the new microcode. 2. Replace the EMU with one containing the proper microcode. The array controllers must be RESET to recognize the new microcode.

4.3.3 Shutting Down the Subsystem

Implementation of the controlled power shutdown ensures that subsystem components are properly protected when significant error conditions exist. The shutdown can be initiated either automatically by the EMU or by you.

A controlled shutdown accomplishes the following:

- Disconnects all the power supply output voltages from the enclosure power buses. This includes the internal TERMPOWER on the I/O modules. The power supplies remain operational as long as the ac input voltage is present.
- Supplies a “trickle” voltage to the EMU to maintain the controlled power shutdown state.
- Enables the alarm control switch power on function

Two types of shutdowns exist:

- Automatic shutdown using standby power mode
- Full power shutdown

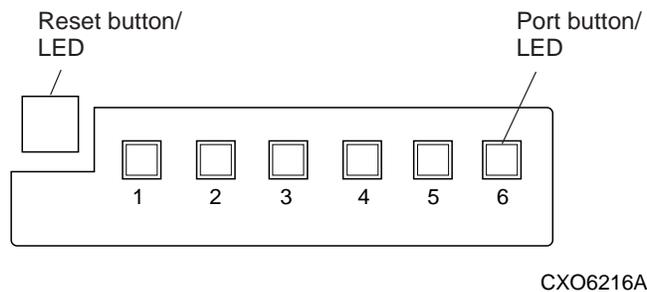
See Chapter 5, “Replacing Components,” for a full description and for both procedures.

4.4 Array Controller Error Conditions

The HSG80 and HSZ80 array controller operator control panels (OCPs) contain the following switches and indicators (see Figure 4–3):

- Array controller reset switch with an embedded status LED
- Six SCSI bus status LEDs (port LEDs)

Figure 4–3 HSG80 and HSZ80 OCP Display



The array controller LED indicates the status of the controller. This LED flashes constantly once the array controller initialization process is complete and the software is functioning. Pressing this switch resets the array controller.

The port LEDs are OFF when the bus is functioning properly. A port LED that is ON or FLASHING indicates that a device on the bus is not functioning properly.

4.5 Storage Device Fault Notification

The disk drive SBBs two front panel LEDs display the status of the drives using one of three possible states (ON, OFF, or FLASHING). The green Device Activity LED is ON or FLASHING when the SBB is active (processing data). The amber Device Fault LED is either ON or FLASHING to indicate an error condition or configuration problem. Table 4-5 defines the various operational conditions of the storage SBB status LEDs. Table 4-6 lists the SBB LED display combinations and the corresponding drive status.

CAUTION

Removing a disk drive SBB when the Device Activity LED is ON or FLASHING can cause the loss or corruption of data.

Figure 4-4 Disk Drive SBB LEDs

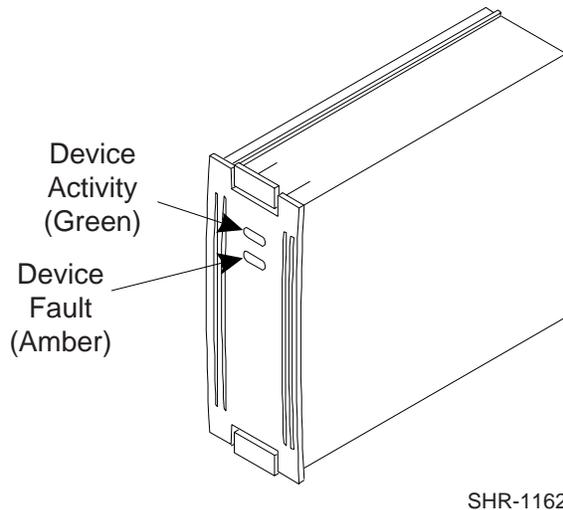


Table 4–5 Storage SBB Status LEDs Conditions

Symbol	Condition
 710-60C	ON (or blinking slowly at an interval of 1 second or more)
 710-60E	OFF
 710-60D	Flashing (blinking at an interval of less than 1 second)

Table 4–6 Storage SBB Status LED Displays

LED Display	Storage SBB Status
 710-35A	The storage SBB is operating normally (no fault condition).
 710-35B	The storage SBB is operating normally. The unit is inactive and no fault is present.
 710-35C	The storage SBB is probably not responding to control signals. Replace the SBB.
 710-35C	The storage SBB is active and in spin-down status because of a fault. Replace the SBB after the device has spun down.
 710-60A	Two conditions are possible: <ol style="list-style-type: none"> 1. In response to a fault bus message, the array controller is spinning down the device. Replace the SBB after the device has spun down. 2. A signaling response to a user initiated array controller "locate" command.
 710-60B	The storage SBB is inactive and spun down. Replace the SBB.

4.6 Power Supply Fault Notification

Each power supply SBB has two green LEDs that display the status of the power supply. Table 4-6 describes the state of these LEDs, the status being reported, and the recommended corrective action.

Figure 4-5 Power Supply SBB Status LEDs

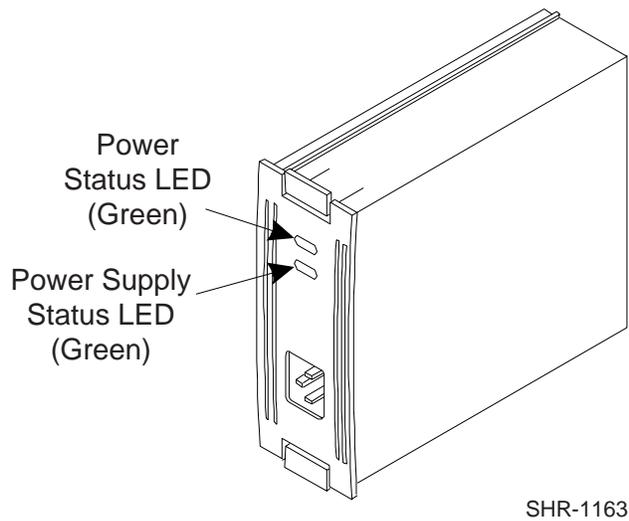


Table 4-7 Power Supply SBB Status LEDs

Symbol	Condition
 710-60C	ON (or blinking slowly at an interval of 1 second or more)
 710-60E	OFF

Table 4–8 Power Supply SBB Status LED Displays

LED Display	Power Supply SBB Status
 <p>710-35C</p>	<p>The power supply is functioning properly.</p>
 <p>710-35D</p>	<p>A blower or power supply fault occurred:</p> <ul style="list-style-type: none"> • Check the operating condition of each blower. <p>Replace the defective blower.</p> <ul style="list-style-type: none"> • Check all power supplies for one with both LEDs in the OFF state. <p>Replace this power supply.</p>
 <p>710-35B</p>	<p>A power fault has occurred:</p> <ol style="list-style-type: none"> 1. There is no ac power. <p>Check the ac power source.</p> <ol style="list-style-type: none"> 2. This power supply has failed. <p>Replace the power supply.</p>

4.7 I/O Module and Expansion Cable Error Conditions

The EMU monitors the status of all the I/O modules for the following error conditions:

- The installation of incompatible I/O modules
- A TERMPower problem

Either of these error conditions might cause the array controller to cease operation without implementing procedures to protect the data.

4.7.1 I/O Module or Expansion Cable

Follow these procedures to remove an I/O module or expansion cable:

CAUTION

Before removing an I/O module or an expansion cable, completion of the following procedures is mandatory to prevent inducing an array controller error condition.

1. Clear the cache and shut down the array controller.
2. Turn OFF the subsystem power.

NOTE

For dual-redundant array controller configurations, you can remove the I/O module while the subsystem is running using the field replacement utility (FRUTIL). Refer to "Replacement Procedures" in the *HSG80 or HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide*.

4.7.2 Incompatible I/O Modules

Only when all I/O modules are the same type can an UltraSCSI RAID subsystem function properly. The Compaq UltraSCSI array controller only supports single-ended, UltraSCSI buses. Therefore, you can only use single-ended I/O modules. Installing any other module type creates an error condition that the EMU reports to the array controller.

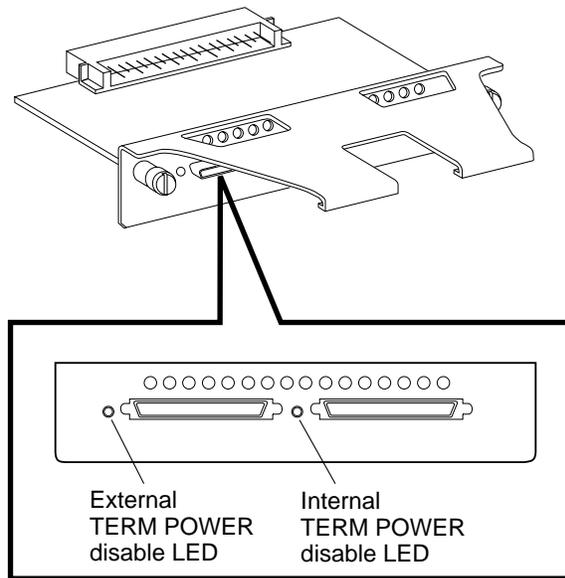
4.7.3 No I/O Module Installed

Failure to install an I/O module, or installing an I/O module incorrectly, automatically disables the SCSI bus within the enclosure. Without an I/O module, the TERMPower becomes unavailable to the internal SCSI bus and the bus cannot function.

4.7.4 TERMPOWER Errors

The I/O module displays the TERMPOWER status for both the internal and the external bus (see Figure 4–6). The nominal TERMPOWER voltage for both buses is +5 V dc.

Figure 4–6 I/O Module LEDs



CXO5947A

- The green internal and external TERMPOWER LEDs are ON during normal operation
- Whenever a TERMPOWER overcurrent condition exists, the associated LED is OFF

When an internal TERMPOWER overcurrent condition occurs, you must replace the I/O module. When an external TERMPOWER overcurrent condition occurs, you must first replace the associated cable. If this does not correct the problem, then replace the I/O module.

5

Replacing Components

This chapter describes the procedures to remove and install the field replaceable units (FRUs) in the RA8000/ESA12000. The FRUs are listed and shown in the last section of the chapter.

5.1 Replacing an Array Controller, Cache Module, or External Cache Battery

NOTE

For dual-redundant-array controller configurations, you can use FRUTIL to replace the “other controller,” to replace the other cache module, and to replace the external cache battery with the cabinet powered on. See the appropriate *HSG80 Array Controller ACS Version 8.x Maintenance and Service Guide* or the *HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide* for the procedures.

5.1.1 Tools Required

You need the following tools to remove or replace the array controller module:

- ESD (electrostatic discharge) strap
- Small blade screwdriver for Trilink and external cache battery cable fasteners

5.1.2 Precautions

In general, you should follow routine ESD protection procedures when handling array controller modules and cache modules and when working around the cabinet and shelf that houses the modules.

Follow these guidelines to further minimize ESD problems:

- Use ESD wrist straps, antistatic bags, and grounded ESD mats when handling array controllers and cache modules
- Attach the lead on the ESD strap to a convenient cabinet grounding point
- After removing a module from the shelf, place the module into an approved antistatic bag or onto a grounded antistatic mat
- Remain grounded while installing a replacement module

CAUTION

Follow program card guidelines or damage to the program card and array controller software can result.

5.2 Preparing Your Host System

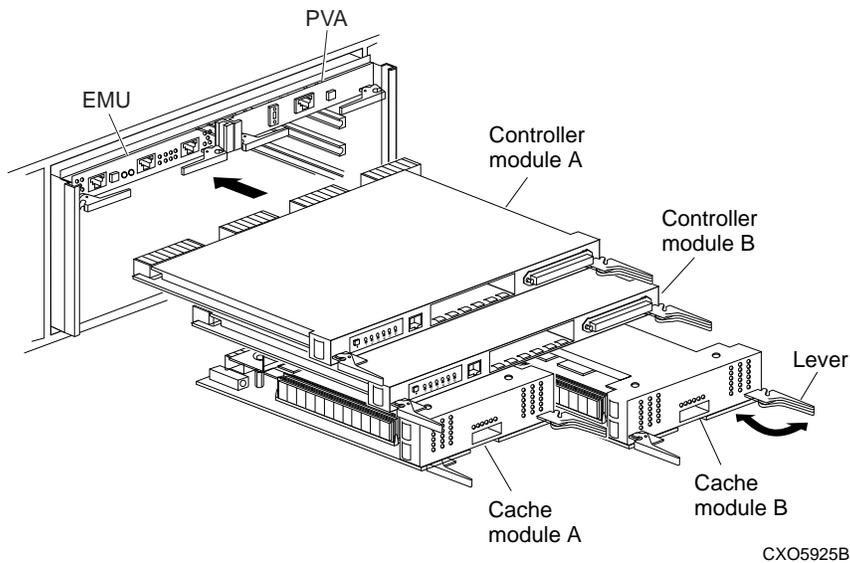
Before starting the upgrade process you will need to prepare your system. This includes performing a complete system backup and shutting down the system.

5.2.1 Back Up the System

As a precaution before starting this procedure you should backup the entire system, especially data stored on the RAID Array.

5.3 Array Controller Replacement

Figure 5-1 Array Controllers and Cache Modules



5.3.1 Array Controller Removal

Use the following steps to remove an array controller:

1. From the host console, dismount the logical units in the subsystem. If you are using a Windows NT® platform, shut down the server.
2. If the array controller is operating, connect a PC or terminal to the array controller's maintenance port. If the array controller is not operating, go to step 5.
3. Run FMU to obtain the last failure codes, if desired.

CAUTION

The cache module may contain data if the array controller crashed and you weren't able to shut it down with the SHUTDOWN *controller* command.

4. Shut down the array controllers. In single array controller configurations, shut down "this controller." In dual-redundant controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

```
SHUTDOWN OTHER_CONTROLLER
SHUTDOWN THIS_CONTROLLER
```

When the array controller shuts down, its reset button and the first three LEDs are lit continuously. This process may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

CAUTION

Electrostatic discharge (ESD) can easily damage a array controller. Wear a snug-fitting, grounded ESD wrist strap.

5. Remove the program card's ESD cover and program card. Save them for the new array controller.

NOTE

One or two host bus cables [HSG80] or one or two trilink connectors with host bus cables (or terminators) [HSZ80] may be attached, depending on the configuration.

6. Remove the host bus cables from the array controller [HSG80], or remove the trilink connectors from the array controller, but don't disconnect the host bus cables (or terminators) from the trilink connectors [HSZ80].
7. If connected, disconnect the PC or terminal from the array controller's maintenance port.
8. Disengage both retaining levers and remove the array controller, then place the array controller into an approved antistatic bag or onto a grounded antistatic mat.

5.3.2 Array controller Installation

Use the following steps to install an array controller:

CAUTION

ESD can easily damage an array controller. Wear a snug-fitting, grounded ESD wrist strap.

Make sure you align the array controller in the appropriate guide rails. If you do not align the array controller correctly, damage to the backplane can occur.

1. Insert the new array controller into its slot, and engage its retaining levers.

NOTE

One or two host bus cables [HSG80] or one or two trilink connectors with host bus cables (or terminators) [HSZ80] may be attached, depending on the configuration.

2. If your array controller is an HSZ80, remove the trilink connectors from the new array controller and transfer the host bus cables (with trilinks attached) to the new array controller. If the subsystem is equipped with an HSG80, connect the fibre channel containing the FC cables to the new HSG80 array controller.
3. Connect a PC or terminal to the array controller's maintenance port.
4. Remove the program card's ESD cover.
5. Press and hold the reset button while inserting the program card into the new array controller. Release and replace the ESD cover.
6. When the CLI prompt reappears, display details about the array controller you configured. Use the following command:

```
SHOW THIS_CONTROLLER FULL
```

7. Configure the array controller as described in the appropriate *HSG80 Array Controller ACS Version 8.x Configuration and CLI Reference Guide* or the *HSZ80 Array Controller ACS Version 8.x Configuration and CLI Reference Guide*.

NOTE

If the array controller you're installing was previously used in another subsystem, purge its old configuration. See "CONFIGURATION RESET" in the appropriate *HSG80 Array Controller ACS Version 8.x Configuration and CLI Reference Guide* or the *HSZ80 Array Controller ACS Version 8.x Configuration and CLI Reference Guide*.

8. To restore a configuration saved with the SAVE_CONFIGURATION switch, press the reset button and device port button 6.
9. Using CLCP (Code Load Code Patch), install any patches that you had installed on the previous array controller as described in the appropriate *HSG80 Array Controller ACS Version 8.x Maintenance and Service Guide* or the *HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide*.

10. Restart the server if you are using a Windows NT platform. Mount the logical units on the host.
11. Set the subsystem date and time with the following command:

```
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
```
12. Disconnect the PC or terminal from the array controller's maintenance port.
13. In a dual-redundant array controller configuration, repeat the procedure for the "other controller."

5.4 Cache Module Replacement

5.4.1 Cache Module Removal

Use the following steps to remove a cache module:

1. From the host console, dismount the logical units in the subsystem. If you are using a Windows NT® platform, shut down the server.
2. If the array controller is operating, connect a PC or terminal to the array controller's maintenance port.

If the array controller is not operating, go to step 5.

3. Run FMU to obtain the last failure codes, if desired.
4. Shut down the array controllers. In single array controller configurations, shut down "this controller." In dual-redundant array controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

```
SHUTDOWN OTHER_CONTROLLER  
SHUTDOWN THIS_CONTROLLER
```

When the array controller shuts down, its reset button and the first three LEDs are lit continuously. This process may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

CAUTION

Electrostatic discharge (ESD) can easily damage a cache module. Wear a snug-fitting, grounded ESD wrist strap.

5. Disable the ECB by pressing the battery disable switch until the status light stops blinking—about five seconds.

CAUTION

The ECB must be disabled—the status light is not lit and is not blinking—before disconnecting the ECB cable from the cache module. Failure to disable the ECB could damage the cache module.

6. Disconnect the ECB cable from the cache module.
7. Disengage both retaining levers and remove the cache module. Place the cache module into an antistatic bag or onto a grounded antistatic mat.

5.4.2 Cache Module Installation

Use the following steps to install a cache module:

CAUTION

ESD can easily damage a cache module. Wear a snug-fitting, grounded ESD wrist strap.

Make sure you align the cache module in the appropriate guide rails. If you do not align the cache module correctly, damage to the backplane can occur.

1. Insert the new cache module into its slot and engage its retaining levers.

CAUTION

The ECB must be disabled—the status light is not lit and is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB could result in ECB damage.

2. Connect the ECB cable to the new cache module.
3. If not already connected, connect a PC or terminal to the array controller's maintenance port.
4. Restart the array controller by pressing its reset button.
5. When the CLI prompt appears, display details about the array controller you configured. Use the following command:

```
SHOW THIS_CONTROLLER FULL
```

6. Restart the server if you are using a Windows NT platform. Mount the logical units on the host.

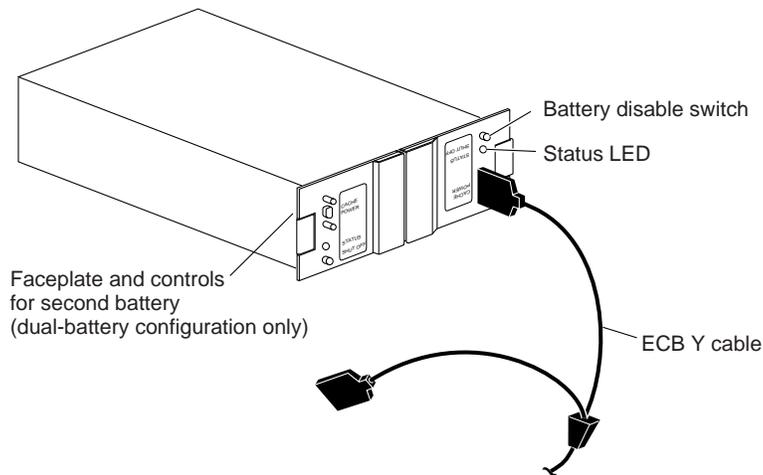
7. Set the subsystem date and time. In single array controller configurations, set “this controller.” In dual-redundant array controller configurations, set “this controller” and the “other controller” with the following commands:

```
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss  
SET OTHER_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
```

8. Disconnect the PC or terminal from the array controller’s maintenance port.

5.5 External Cache Battery Replacement

Figure 5-2 External Cache Battery Storage Building Block



CXO6305B

Use the following steps to replace the external cache battery with the cabinet powered off:

1. If the array controller and cache module are not operating, go to step 4. Otherwise, go to the next step.
2. Connect a PC or terminal to the array controller’s maintenance port. The array controller to which you’re connected is “this controller.”
3. Shut down the array controllers. In single array controller configurations, shut down “this controller.” In dual-redundant array controller configurations, shut down the “other controller” first, then shut down “this controller” with the following commands:

```
SHUTDOWN OTHER_CONTROLLER  
SHUTDOWN THIS_CONTROLLER
```

When the array controllers shut down, their reset buttons and their first three LEDs are lit continuously. This may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

4. Turn off the power to the subsystem.
5. Insert the new ECB SBB into its slot.

CAUTION

The ECB cable has a 12-volt and a 5-volt pin. Improper handling or misalignment when connecting or disconnecting could cause these pins to contact ground, resulting in cache module damage.

6. Connect the open end of the ECB Y cable to the new ECB.
7. Restore power to the subsystem. The array controller automatically restarts.
8. Disconnect the ECB cable from the old ECB.
9. Start FRUTIL with the following command:

```
RUN FRUTIL
```

FRUTIL displays the following:

```
Do you intend to replace this controller's cache battery? Y/N
```

10. Enter Y(es). FRUTIL displays the following:

```
If the batteries were replaced while the cabinet was powered down, press return.
```

```
Otherwise follow this procedure:
```

```
WARNING: Ensure that at least one battery is connected to the Y cable at all times during this procedure.
```

1. Connect the new battery to the unused end of the 'Y' cable attached to cache A [or B].
 2. Disconnect the old battery. Do not wait for the new battery's status light to turn solid green.
 3. Press return.
11. Press return.

FRUTIL displays the following:

```
Updating this battery's expiration date and deep discharge history.  
Field Replacement Utility terminated.
```

12. Disconnect the PC or terminal from the array controller's maintenance port.

13. In a dual-redundant array controller configuration and if the ECB was replaced for both cache modules, connect the PC or terminal to the other array controller's maintenance port. The array controller to which you're now connected is "this controller."
14. Repeat steps 9 through 12.
15. Remove the old ECB SBB.

5.6 Shutting Down the Subsystem

Various ways exist for the subsystem to shut down. It can shut down automatically as a result of a power failure or component problem, in response to the EMU communicating with the array controller, or when you manually shut down the subsystem.

The EMU in any enclosure can initiate a shutdown to protect the components from an overtemperature condition. The conditions that cause the EMU to initiate this action include one or more of the following:

- Any two temperature sensors register a temperature of 50°C (122°F)
- Removing one or more blowers for approximately 8 minutes
- No blowers have been operational for approximately 8 minutes
- Fewer than four operational power supplies

5.6.1 Automatic Shutdown Using Standby Power Mode

When the subsystem operates in the standby power mode, the dc power becomes disconnected from the backplane. However, ac input power is still applied to the shelf power supplies. In this mode, the EMU alarm control switch functions as the standby power switch. To restore dc power to the backplane, press the alarm control switch on each enclosure EMU.

5.6.2 Full Power Shutdown

A full power shutdown means removing the dc power from the backplane (standby power mode), then removing ac power from the ac input power entry controllers in each enclosure.

When you are ready to turn on the subsystem, turn on the expansion enclosures first, then turn on the master enclosure.

5.6.2.1 Shutting Down the Subsystem for a Cold Swap

Use the following steps to shut down the subsystem:

1. Connect a PC or terminal to the maintenance port of one of the array controllers in your subsystem, if it is not already connected.
2. From a host console, stop all host activity and dismount the logical units in the subsystem.
3. Shut down the array controllers. In single-controller configurations, you only need to shut down “this controller.” In dual-redundant array controller configurations, shut down the “other controller” first, then shut down “this controller” with the following commands:

```
SHUTDOWN OTHER_CONTROLLER
SHUTDOWN THIS_CONTROLLER
```

When the array controllers shut down, their reset buttons and their first three LEDs are lit continuously. This may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

4. Turn OFF the ac input power entry controllers on the master enclosure.
5. Turn OFF the ac input power entry controllers on the expansion enclosures.

CAUTION

If you are shutting down the array controller for longer than one day, perform the steps in “Disabling the External Cache Battery,” in section 5.6.2.3. This process prevents the write-back cache batteries from discharging.

5.6.2.2 Turning on the Subsystem

Use the following steps to turn on the subsystem:

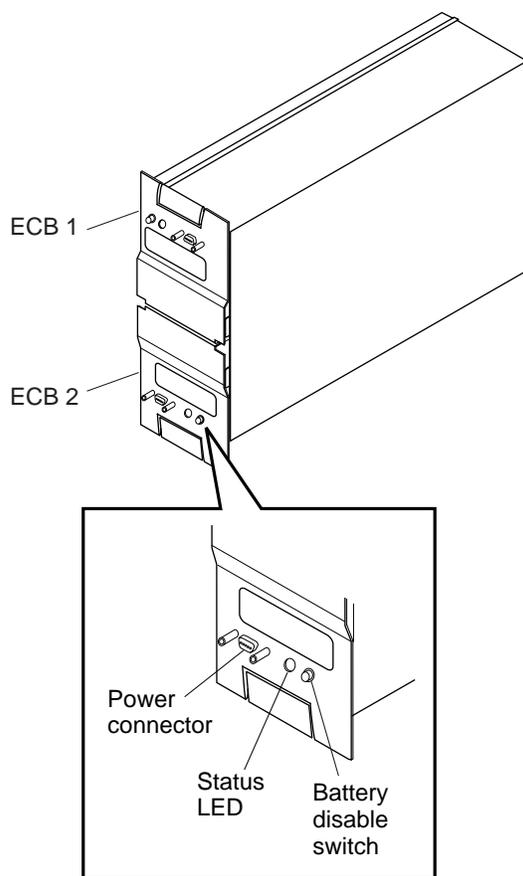
CAUTION

To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master enclosure.

1. On the expansion enclosures, turn on all ac input power entry controllers.
2. On the master enclosure, turn on all ac input power entry controllers.

5.6.2.3 Disabling the External Cache Batteries

Figure 5-3 External Cache Batteries



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NOTE

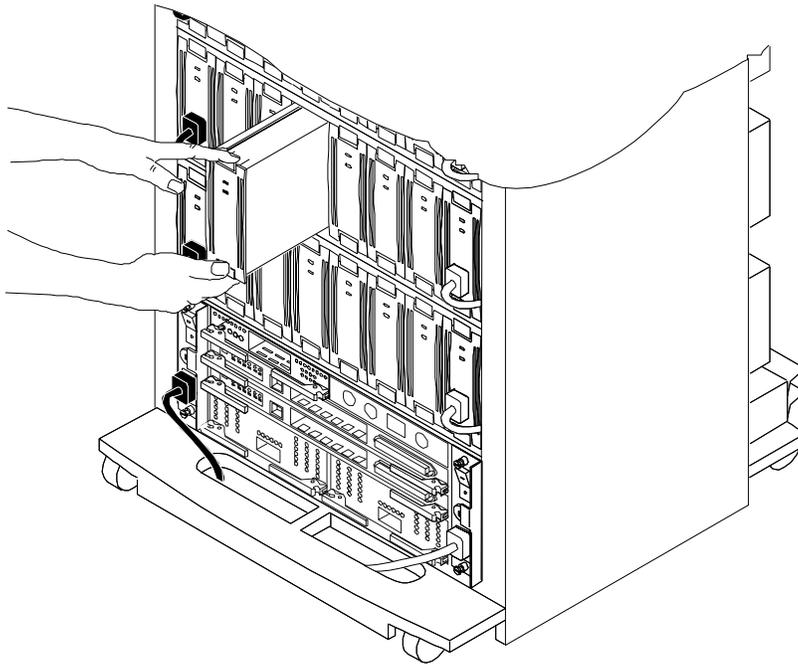
The ECB SBB may contain one or two batteries, depending on the configuration.

Disable the ECB by pressing and holding each switch for approximately 5 seconds. The switch is the small button labeled SHUT OFF next to the status LEDs. The ECB's status LED will flash once and then shut off.

5.7 Disk Drive SBB Replacement

Three methods are available for replacing disk drive SBBs: hot swap, warm swap, or cold swap. However, before replacing a device, read all cautions, handling rules, and replacement procedures, as well as determining the replacement method based on the capabilities of the array controller.

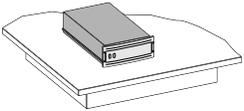
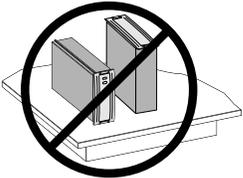
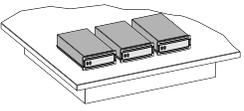
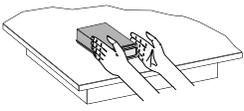
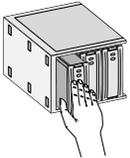
Figure 5-4 Location of the Disk Drive SBB



SHR-1165

5.7.1 SBB Handling Procedures

Table 5-1 SBB Handling Rules

Do	Do NOT
<p>Set an SBB on its side.</p>  <p>CXO6549A</p>	<p>Set an SBB on its edge.</p>  <p>CXO6550A</p>
<p>Set SBBs side by side.</p>  <p>CXO6551A</p>	<p>Stack SBBs.</p>  <p>CXO6552A</p>
<p>Set an SBB down gently.</p>  <p>CXO6553A</p>	<p>Drop an SBB.</p>  <p>CXO6554A</p>
<p>Push an SBB into the shelf gently, but firmly.</p>  <p>CXO6555A</p>	<p>Force the SBB into the shelf.</p>  <p>CXO6556A</p>

5.7.1.1 Hot Swap

When performing a hot swap, power and data are present on the disk drive SBB backplane connector.

CAUTION

Although the HSG80 and HSZ80 array controllers support hot swap, other controllers do not. Refer to the array controller documentation to verify which array-controller-supported swap method to use.

If you are not positive that your controller supports hot swap, Compaq recommends using warm swap to protect data integrity.

Use hot swap to remove and replace disk drive SBBs from a system that is online and active.

5.7.1.2 Warm Swap

When performing a warm swap, power is present on the disk drive SBB backplane connector and no data exists on the bus. Before performing a warm swap, quiesce the bus at the array controller and observe the green activity status LED on the disk drive SBB to ensure it is not flashing.

CAUTION

Perform a warm swap only when the green device activity LED is OFF.

5.7.1.3 Cold Swap

When performing a cold swap, neither power nor data is present on the disk drive SBB plug connector. This method requires you turn OFF the enclosure power in all the UltraSCSI RAID subsystem enclosures.

5.7.2 Disk Drive SBB Removal

Use the following steps to remove a disk drive SBB:

1. To perform a hot swap, go to step 4.
2. To perform a warm swap, quiesce the SCSI bus at the array controller, then go to step 4.
3. To perform a cold swap, shut down the subsystem as described in section 5.6.2.1, “Shutting Down the Subsystem for a Cold Swap.”

NOTE

For steps 4 and 5, you can use the extractor tool for removing disk drives. Simply attach it to the drive and pull it out.

4. Press the disk drive SBB mounting tabs together to release the SBB.
5. Use both hands and pull the disk drive SBB out of the shelf.
6. Place the disk drive SBB into an electrostatic bag.

5.7.3 Single Disk Drive SBB Installation

Use the following steps to install a disk drive SBB:

1. Verify that the disk drive SBB is the correct model, and fill in the bezel label information for this disk drive.
2. Insert the disk drive SBB into the guide slot and push it in until the mounting tabs engage the shelf, fully seating the disk drive SBB.
3. After installing the disk drive SBB during a hot swap, go to step 6.
4. If performing a warm swap, press the EMU alarm control switch on the master enclosure to restart the subsystem then go to step 6.

CAUTION

To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master.

5. If performing a cold swap:
 - a) Plug in the subsystem's power cord, if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn on all ac input power entry controllers.
6. Verify that the amber device fault LED is OFF.

NOTE

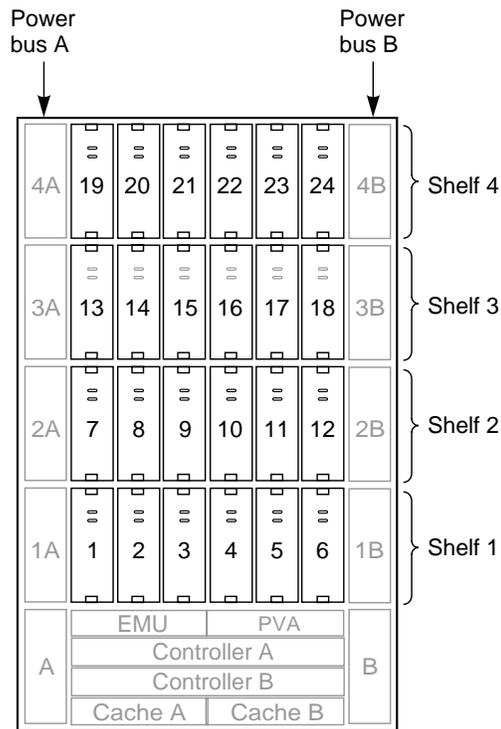
When the SCSI bus is active and the disk drive SBB has power, the green device activity LED is ON, FLASHING, or OFF. The amber device fault LED is OFF.

5.7.4 Multiple Disk Drive SBB Installation in an UltraSCSI Enclosure

Use the following steps to install multiple disk drive SBBs:

1. Verify that the disk drive SBB is the correct model, and fill in the bezel label information for each disk drive SBB.
2. Install all the disk drive SBBs, starting in the lower left corner in shelf 1 (devices 1–6) and advancing to the right.

Figure 5-5 Placement of Multiple Disk Drive SBBs



CX05811A

3. Starting from the left, install all the disk drive SBBs in shelf 2 (devices 7–12).
4. Starting from the left, install all the disk drive SBBs in shelf 3 (devices 13–18).
5. Starting from the left, install all the disk drive SBBs in shelf 4 (devices 19–24).

CAUTION

To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master enclosure.

6. Start the subsystem:
 - a) Plug in the subsystem's power cord, if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn all ac input power entry controllers.
7. Verify that the amber device fault LED is OFF.

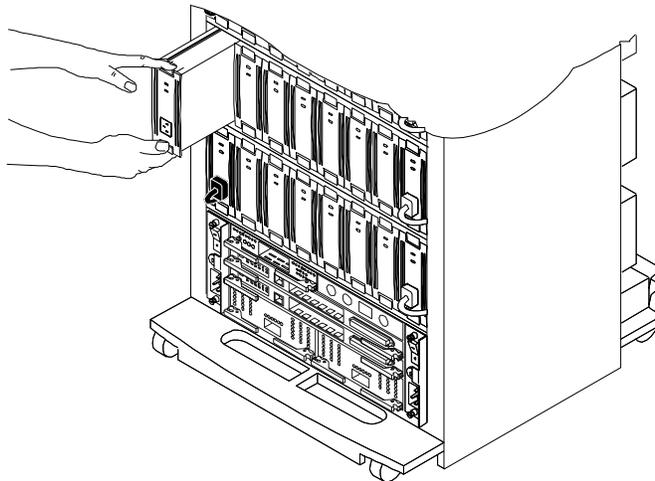
NOTE

When the SCSI bus is active and the disk drive SBB has power, the green device activity LED is ON, FLASHING, or OFF. The amber device fault LED is OFF.

5.8 Power Supply SBB Replacement

Two methods are available for replacing power supply SBBs: hot swap and cold swap. However, before replacing a power supply, read all cautions, handling rules, and replacement procedures, as well as determining the replacement method based on the capabilities of the array controller.

Figure 5-6 Location of the Power Supply SBB



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5.8.1 Handling Instructions

Read all handling rules in Table 5–1, section 5.7 “SBB Handling Procedures.”

5.8.2 Power Supply SBB Removal

Use the following steps to remove a power supply SBB:

1. To perform a hot swap, go to step 3.
2. To perform a cold swap, shut down the subsystem as described in section 5.6.2.1, “Shutting Down the Subsystem for a Cold Swap.”

NOTE

For steps 4 and 5, you can use the extractor tool for removing a power supply SBB. Simply attach it to the drive and pull it out.

3. Disconnect the power cord from the front of the power supply SBB.
4. Press the power supply SBB mounting tabs together to release the SBB.
5. Use both hands and pull the SBB out of the shelf.
6. Place the SBB into an electrostatic bag.
7. On a flat surface, lay the power supply on its side.

5.8.3 Power Supply SBB Installation

Use the following steps to install a power supply SBB:

1. Check the bezel label to verify that the power supply being installed is a 180-W power supply.
2. Insert the power supply into the guide slots and push it in until the bezel mounting tabs engage the shelf, fully seating the power supply.
3. Connect the power cord to the front of the power supply.
4. If performing a hot swap, go to step 6.

CAUTION

To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master enclosure.

5. If performing a cold swap, restart the subsystem:
 - a) Plug in the subsystem's power cord, if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn on all ac input power entry controllers.
6. Verify the array controller places the subsystem into an operational state.
7. Verify that both power supply status LEDs are ON.

5.9 Enclosure Blowers

When a blower malfunctions, the remaining blowers operate at high-speed to increase air flow through the components. Enough air circulates in order to permit continued operation without disrupting or losing data. However, Compaq recommends replacing a defective blower immediately.

The EMU reports an error condition when a blower malfunctions, and the error condition may be seen on the EMU LEDs.

5.9.1 Enclosure Blower Removal

CAUTION

Operating an enclosure with a blower removed significantly changes the air flow pattern and reduces air flow through the components. If a blower is removed and not replaced within approximately 8 minutes, the array controllers will shut down and the EMU will turn OFF the dc power distribution.

Use the following steps to remove an enclosure blower:

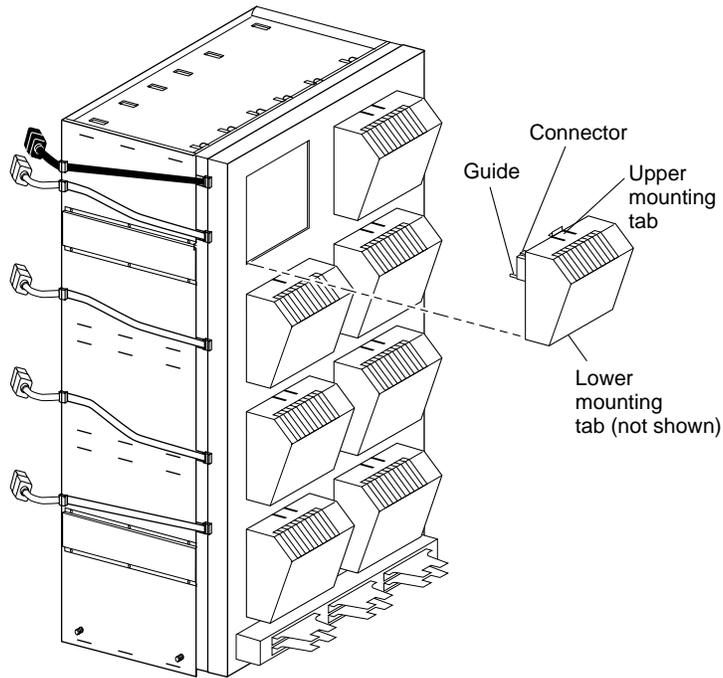
1. Use both hands to firmly press the upper and lower blower mounting tabs together to release the blower.
2. Pull the defective blower straight out.
3. Place the blower into an electrostatic bag.

5.9.2 Enclosure Blower Installation

Use the following steps to install an enclosure blower:

1. Orient the replacement blower to align its connector and guide pin with the backplane blower connector, as shown in Figure 5-7.

Figure 5-7 Location of the Blowers



CXO5753A

2. Push the blower straight in, until the upper and lower mounting tabs snap into place.
3. If dc power is applied to the enclosure, verify the blower starts operating.

5.10 AC Input Power Entry Controller

The ac input power entry controller provides all ac power distribution to the shelf power supplies.

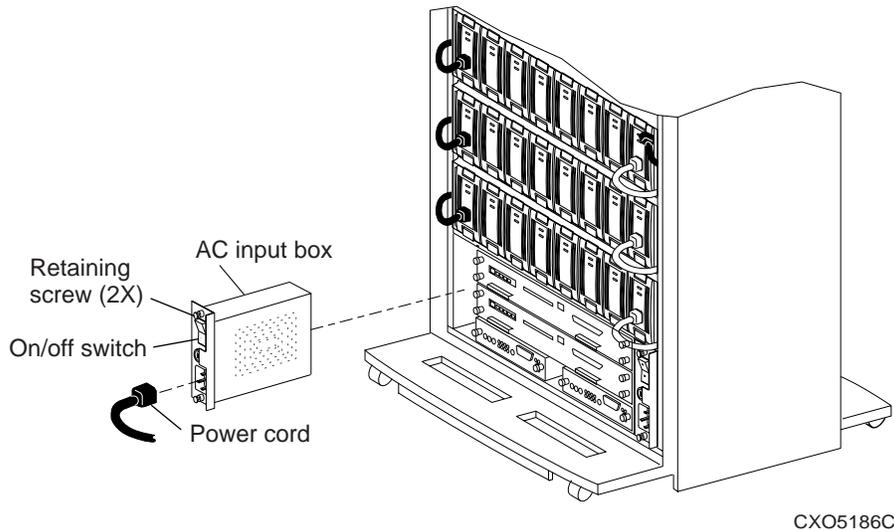
WARNING

Only qualified service personnel can replace an ac input power entry controller.

To prevent the possibility of injury or death as a result of electrical shock:

- Always disconnect the ac power cord before removing an ac input power entry controller.
- Never touch the backplane connector or circuit board.
- Always install the ac input power entry controller before connecting the ac power cord.

Figure 5–8 Location of the AC Input Power Entry Controller



5.10.1 AC Input Power Entry Controller Removal

Use the following steps to remove an ac input power entry controller:

1. For redundant and optimum (n+ 4) power configurations, verify that all eight power supplies are operational and then go to step 3.
 - a) Verify that four of the power supplies are good.
 - b) Verify that the LEDs on the other 4 power supplies are not lit.
2. For a standard (n+ 1) power configuration, shut down the subsystem as described in section 5.6.2.1, “Shutting Down the Subsystem for a Cold Swap.”
3. Make sure the ac input power entry controller being replaced is turned OFF.
4. Disconnect the ac power cord from the ac input box.
5. Loosen the two retaining screws and remove the ac input power entry controller.
6. Place the ac input power entry controller into an electrostatic bag.

5.10.2 AC Input Power Entry Controller Installation

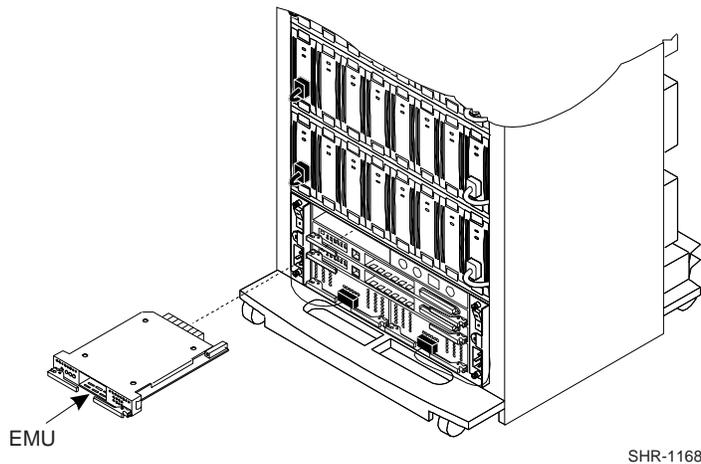
Use the following steps to install an ac input power entry controller:

1. On the ac input power entry controller being installed, turn OFF the switch.
2. Align the ac input power entry controller with either slot A or slot B in the lower left or lower right corner of the RAID enclosure, respectively.
3. Push in on the ac input power entry controller to fully seat it.
4. Tighten the two retaining screws.
5. Connect the ac power cord from the ac power source to the ac input power entry controller.
6. If necessary, repeat steps 1 through 6 to install a second ac input power entry controller.
7. Start the subsystem as follows:
 - a) Plug in the subsystem’s power cord if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn on all ac input power entry controllers.

5.11 EMU

The EMU can be removed using either the removal and installation procedures in this section or the procedures in the *HSG80 Array Controller ACS Version 8.x Maintenance and Service Guide* or the *HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide*. Figure 5–9 shows the location of the EMU.

Figure 5–9 Location of the EMU



5.11.1 EMU Removal

Use the following steps to remove an EMU:

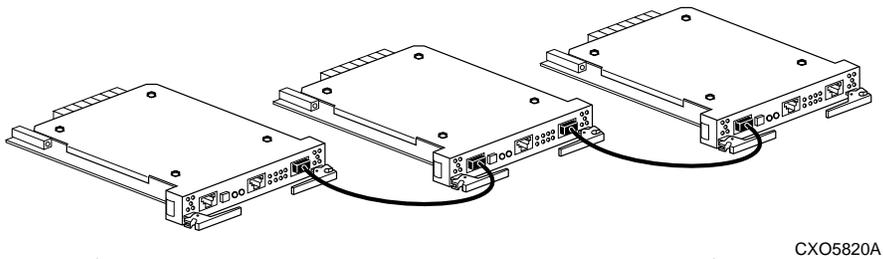
1. Shut down the subsystem as described in section 5.6.2.1, “Shutting Down the Subsystem for a Cold Swap.”
2. Remove the EMU-to-EMU communication bus connections.
3. Pull the EMU extractor latches outward and remove the EMU.

5.11.2 EMU Installation

Use the following steps to install an EMU:

1. Align the EMU in the left-hand slot and insert it.
2. Pull the EMU extractor latches outward. Push the EMU into the slot until the extractor latches engage the enclosure, then push the extractor latches inward to seat and secure the EMU.
3. If expansion enclosures exist, use a BN26M series cable to create the EMU-EMU communication bus connections as shown in Figure 5–10.

Figure 5–10 EMU Communication



CAUTION

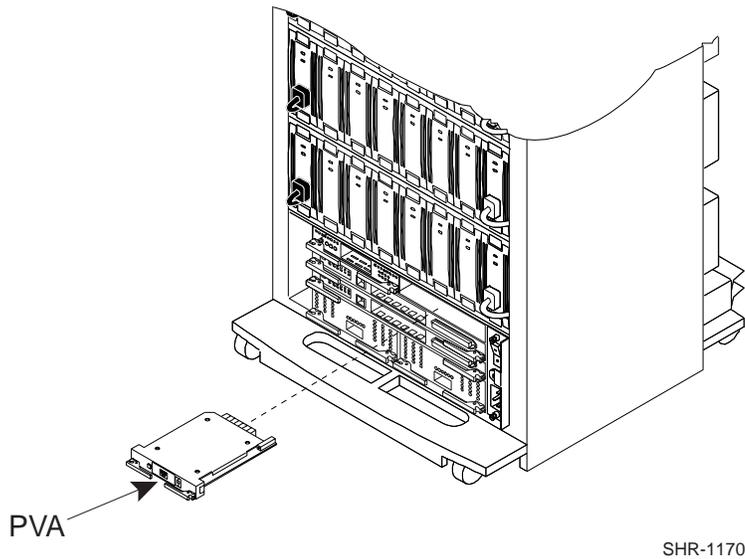
To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master enclosure.

4. If performing a cold or warm swap, restart the subsystem:
 - a) Plug in the subsystem's power cord, if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn on all ac input power entry controllers.
5. After the array controller is operational, verify the subsystem is functioning properly.

5.12 PVA Module

The PVA can be removed using either the removal and installation procedures in this section or the FRUTIL commands in the *HSG80 Array Controller ACS Version 8.x Maintenance and Service Guide* or the *HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide*. Figure 5–11 shows the location of the PVA module.

Figure 5–11 Location of the PVA



5.12.1 PVA Removal

NOTE

To perform a hot swap using FRUTIL commands, you can replace the PVA according to the directions in the *HSG80 Array Controller ACS Version 8.x Maintenance and Service Guide* or the *HSZ80 Array Controller ACS Version 8.x Maintenance and Service Guide*.

Use the following steps to remove a PVA (cold swap):

1. To perform a cold swap, shut down the subsystem as described in section 5.6.2.1, “Shutting Down the Subsystem for a Cold Swap.”
2. Note the enclosure address setting (0, 2, or 3) on the PVA SCSI ID switch.
3. Pull both extractor latches outward and remove the PVA.

Use the following steps to remove a PVA (warm swap):

1. Quiesce the SCSI bus at the controller.
2. Note the enclosure address setting (0, 2, or 3) on the PVA SCSI ID switch.
3. Pull both extractor latches outward and remove the PVA.

5.12.2 PVA Installation

Use the following steps to install a PVA:

1. Align the PVA with the right-hand slot and insert it.
2. Pull the PVA extractor latches outward. Push the PVA into the slot until the extractor latches engage the enclosure, then push the extractor latches inward to seat and secure the PVA.
3. Ensure the PVA SCSI ID switch is set to the valid number for the enclosure.
 - Master enclosure—0
 - First expansion enclosure—2
 - Second expansion enclosure—3
4. If performing a hot swap, go to step 7.
5. If performing a warm swap, press the EMU alarm control switch on the master enclosure to restart the subsystem and go to step 7.

CAUTION

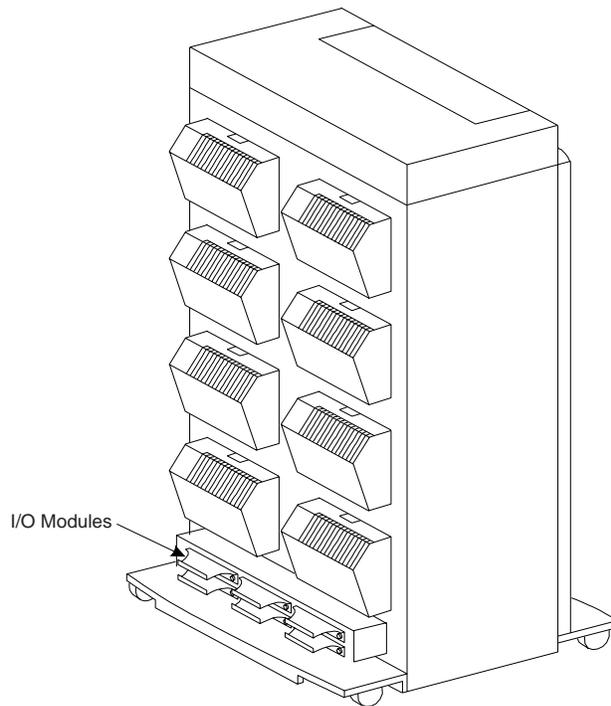
To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master enclosure.

6. If performing a cold swap, restart the subsystem as follows:
 - a) Plug in the subsystem's power cord, if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn on all ac input power entry controllers.
7. After the array controller is operational, verify that the subsystem is functioning properly.

5.13 I/O Module

I/O modules are also referred to as device ports. Figure 5–12 shows the location of the I/O modules.

Figure 5–12 Location of the I/O Modules



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5.13.1 I/O Module Removal

CAUTION

To prevent interrupting a data transfer or losing data, shut down the subsystem before removing an I/O module.

Use the following steps to remove an I/O module:

1. Shut down the subsystem as described in section 5.6.2.1, “Shutting Down the Subsystem for a Cold Swap.”
2. Use a screwdriver to loosen two spring-loaded mounting screws on the I/O module.
3. Grasp the I/O module by the cable support bracket and pull it straight out until it is removed from the enclosure shroud.
4. Cut the wire tie securing the left cable.
5. Loosen the thumb screws and remove the left cable.
6. Label the left cable connector.
7. If a right cable is attached, repeat steps 4 through 6.
8. Place the I/O module into an electrostatic bag.

5.13.2 I/O Module Installation

Use the following steps to install an I/O module:

CAUTION

Jumpers are factory-installed—do not modify jumper settings.

To prevent from damaging the screws, do not overtighten the VHDCI connectors when reconnecting the cable to the I/O module.

1. Align the cable with the I/O module connector.
2. Gently insert the cable connector into the module connector.
3. Tighten both cable connector thumb screws to fully seat the connector.
4. Install a wire tie through the holes on the cable support bracket and around the cable.
5. Tighten the wire tie.

6. If attaching a cable to the right I/O module connector, repeat steps 1 through 5.
7. Align the I/O module with the backplane connector in the enclosure shroud.
8. Gently insert the module and fully seat it.
9. Use a screwdriver to tighten the spring-loaded mounting screws. **Do not** overtighten – it may damage the screws.

CAUTION

To allow the array controller to properly recognize addresses, ensure that you turn on the expansion enclosures before turning on the master enclosure.

10. Turn on the subsystem:
 - a) Plug in the subsystem's power cord, if it is not already plugged in.
 - b) On all expansion enclosures, turn on all ac input power entry controllers.
 - c) On the master enclosure, turn on all ac input power entry controllers.

5.14 FRU Parts List

The Field Replaceable Units in the storage cabinet is shown in the exploded view of Figure 5-13. Refer to Figure 5-13 to identify the FRU, and then to Table 5-2 to obtain the description of the FRU and its corresponding part number.

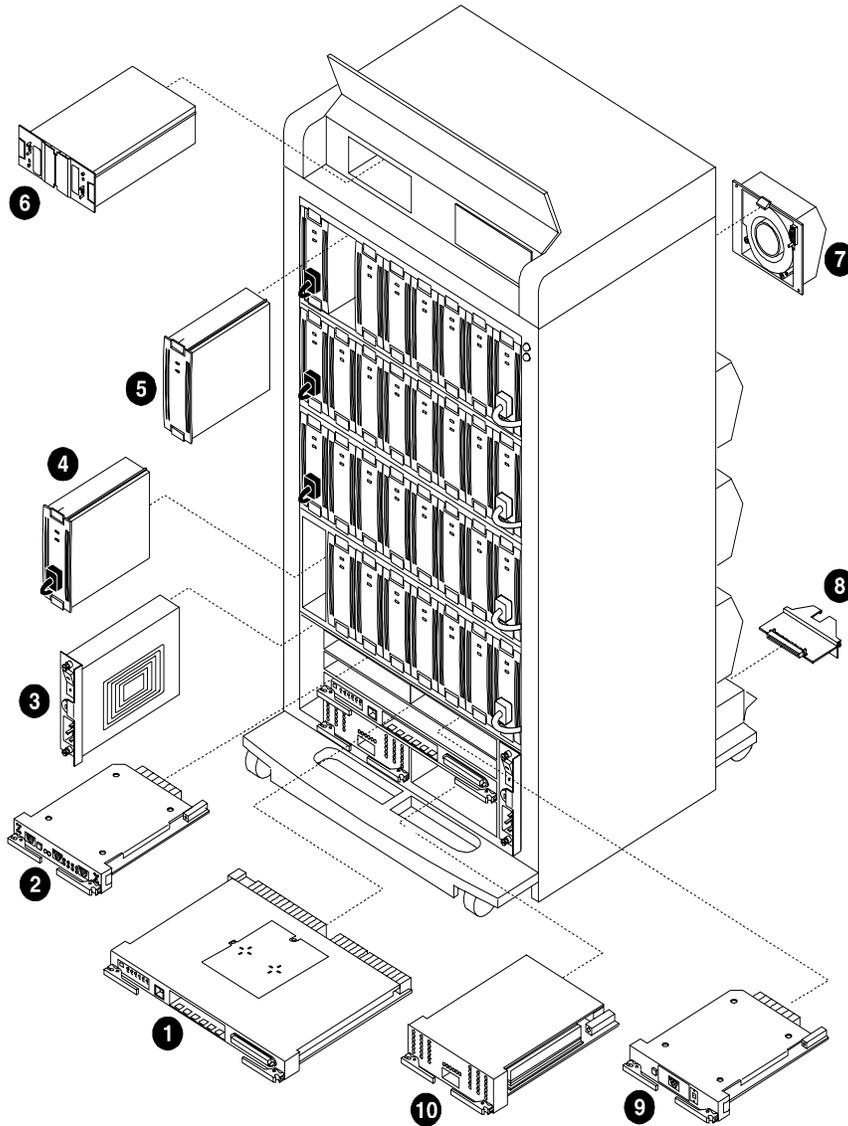
Table 5–2 Subsystem Field Replaceable Units

Item	Description	COMPAQ Part Number	DIGITAL Part Number
1	HSG80 Array Controller HSZ80 Array Controller	400285-001 Not yet available	70-33259-S1 70-33252-S1
2	Environmental Monitor Unit (EMU)	400286-001	FC-BA35X-EB
3	AC Power Entry Controller	400287-001	FC-BA35X-HE
4	Power Supply SBB	400288-001	FC-BA35X-HH
5	External Cache Backup (ECB) Dual Single	400291-001 400292-001	FC-HS35X-BD FC-HS35X-BC
6	Dual-Speed Blower, Blue Dual-Speed Blower, Gray	400293-001 Not yet available	FC-BA35X-MK FC-BA35X-ML
7	Single-Ended I/O Module, Blue Single-Ended I/O Module, Gray	400294-001 401911-001	FC-BA35X-MN 70-32856-S2
8	Power Verification and Addressing (PVA)	400299-001	FC-BA35X-EC
9	Cache Module	400295-001	70-33256-S1
10	DIMM, 32 MB*	400296-001 400297-001	70-DIMS1-01 70DIMS1-02
11	Power Distribution Unit (PDU)** 60 Hz 50 Hz	401950-001 401951-001	FC-SW41U-XA FC-SW41U-XB

* 64 MB, 128 MB, 256 MB, or 512 MB may be mounted in the cache module.

** The Power Distribution Unit (PDU) is used in the ESA12000 only.

Figure 5–13 Subsystem Field Replaceable Parts (RA8000 Pedestal Shown)



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Item number 11, the PDU, is not shown.