

# **Model 2100 and 2200 Ultra SCSI Controller Enclosures**

User Guide

Second Edition (April 2000)  
Part Number: EK-SE2C8-UA. B01  
**Compaq Computer Corporation**

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# About This Guide

This guide includes the product description, configuration, function, status indications, and removal and installation instructions for elements in the Model 2100 and 2200 Ultra SCSI controller enclosures.

## Intended Audience

This publication is for use by *Compaq StorageWorks* Model 2100 and 2200 Ultra SCSI controller enclosure customers and employees who are responsible for configuring, installing, and maintaining SCSI controller enclosures.

## How This Guide is Arranged

This manual discusses the enclosure and its major elements. The manual is organized as follows:

### **Chapter 1, Introducing the Controller Enclosure**

Describes the enclosure specifics, including an overview of each enclosure and its major elements, options for upgrading a Model 2100 enclosure to a Model 2200 enclosure, and the cabling required to interface storage enclosures.

### **Chapter 2, Operating the Enclosure**

Describes configuration rules for the enclosure, startup and shutdown procedures, and fault detection.

### **Chapter 3, Environmental Monitoring Unit**

Provides the environmental monitoring unit (EMU) product description, functionality, and status indications.

### **Chapter 4, Input/Output Module**

Provides the input/output (I/O) module product description, configuration, and status indication.

### **Chapter 5, Power Supply**

Provides the enclosure power supply assembly product description, configuration, and status indications.

### **Chapter 6, External Cache Battery**

Provides the external cache battery (ECB) product description, status indications, and configuration.

### **Chapter 7, Fans**

Provides the fan assembly product description, configuration, functionality, and status indications.

### **Chapter 8, Removal and Installation Procedures**

Describes the physical removal and installation instructions for all enclosure elements, including the array controllers, cache modules, and ECB battery pack.

### **Appendix A, Regulatory Notices**

Provides enclosure regulatory notices.

### **Appendix B, Enclosure Specifications**

Provides enclosure physical, electrical, and environmental specifications.

### **Appendix C, Preparing an Enclosure for Use**

Describes how to assemble the enclosure. Identifies the recommended sequence to follow and provides information essential to assembling the enclosure.

### **Appendix D, Error Code Data**

Describes alarm levels and error codes presented on the EMU alphanumeric display.

### **Glossary**

### **Index**


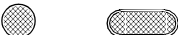

## **Getting Help**

After exhausting the information in this guide, obtain further information and help using the *Compaq* website at <http://www.compaq.com/products/>. This website also provides access to worldwide Compaq technical support phone numbers through the “Contact Us” link.

## Conventions

This guide uses the text conventions in Table 1 and special notices provided within this section.

### Text Conventions

<b>Table 1 Documentation Conventions</b>	
<b>Bold</b>	EMU alphanumeric display characters are presented in boldface. For example: <b>Ho</b> for horn mode and <b>En</b> for enabled.
SMALL CAPS	Used to indicate the status of an LED. For example: FLASHING means turning on and off, ON means on, and OFF means off
<i>italic type</i>	Italic type emphasizes important information and indicates complete titles of manuals.
<code>courier type</code>	Courier type indicates a keyboard command or screen display data.
A/R	As required
	The light emitting diode (LED) is OFF.
	The LED is FLASHING (blinking in half-second cycles).
	The LED is ON or blinking rapidly (blinking less than half-second cycles).

## Special Notices

This guide does not contain detailed descriptions of standard safety procedures. However, the guide does contain warnings for procedures that might cause personal injury and cautions for procedures that might damage the controller or its related components. Look for these symbols when performing the procedures in this guide:



**WARNING:** A warning indicates the presence of a hazard that can cause personal injury if precautions in the text are not observed.

---



**CAUTION:** A caution indicates the presence of a hazard that might damage hardware, corrupt software, or cause a loss of data.

---

**IMPORTANT:** An important note is a type of note that provides information essential to the completion of a task. Users can disregard information in a note and still complete a task, but they should not disregard an important note.

---

**NOTE:** A note provides additional information that is related to the completion of an instruction or procedure.

## Related Documents

Table 2 identifies publications that contain additional information relevant to Model 2100 and 2200 enclosure products.

Table 2 Relevant Publications	
Publication Title	Publication Number
<i>HSG60 Array Controller ACS Version 8.n<sup>1</sup> Installation and Configuration Guide</i>	Varied
<i>HSG80 Array Controller ACS Version 8.n<sup>1</sup> Configuration Guide</i>	Varied
<i>HSG60/HSG80 Array Controller ACS Version 8.n<sup>1</sup> CLI Reference Guide</i>	Varied
<i>HSG60/HSG80 Array Controller ACS Version 8.n<sup>1</sup> Maintenance and Service Guide</i>	Varied

1. Where “8.n” refers to a supported array controller software (ACS) version number

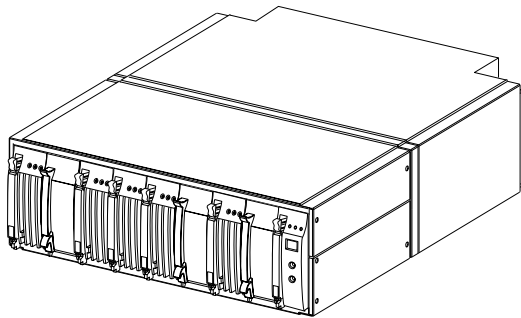
# Chapter 1

## Introducing the Controller Enclosure

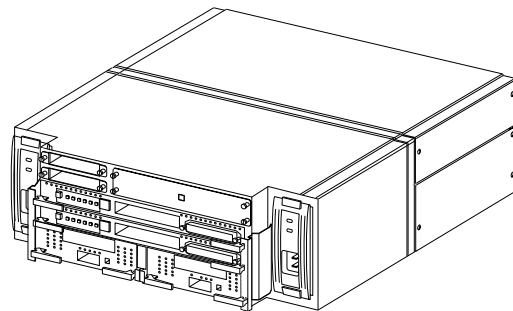
The Compaq StorageWorks Model 2100 and 2200 Ultra SCSI controller enclosures use Ultra SCSI buses to transmit and store data within up to six disk enclosures.

This chapter describes the enclosure and its major elements, called customer replaceable units (CRUs), and various enclosure options. Figure 1-1 illustrates a Model 2100 enclosure; Figure 1-2 illustrates a Model 2200 enclosure.

**NOTE:** This Compaq StorageWorks enclosure only supports single-ended Ultra SCSI buses.



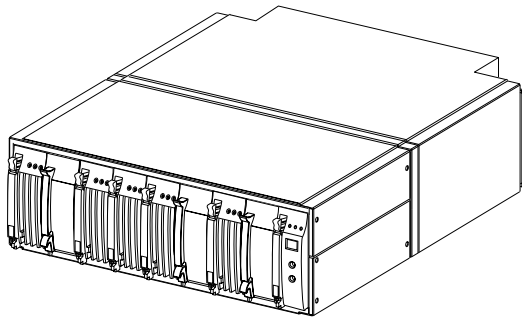
CXO6321D



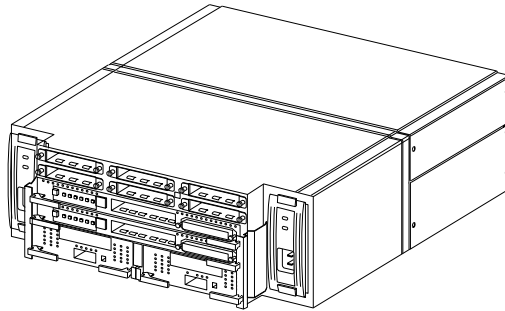
CXO7235A

Figure 1-1. Model 2100 controller enclosure





CXO6321D



CXO6322C

Figure 1-2. Model 2200 controller enclosure

## Product Description

The Compaq StorageWorks Ultra SCSI array controllers process host data at a transfer rate up to 100 megabytes per second (MB/s) in a wide Ultra SCSI configuration. Array controllers distribute this data, at the same rate, over six buses to disk enclosures. The controller enclosure is connected to the disk enclosure with single-ended, 16-bit (wide) Ultra SCSI bus cables. Table 1-1 lists the elements (devices) this enclosure accommodates and their function.

**Table 1-1 Major Enclosure Elements and Their Functions**

Element	Function
Array controller	A minimum of one or a maximum of two Ultra SCSI array controllers to operate the enclosure data buses. Model 2100 enclosures use HSG60 array controllers; Model 2200 enclosures use HSG80 array controllers.
Cache modules	A minimum of one or a maximum of two cache modules to support array controller operations. One cache is required per array controller. Each cache requires an external cache battery (ECB).
ECB	Four ECB bays are provided, but the enclosure <i>supports</i> only two ECBs at any given time. ECBs provide backup DC power to the cache modules in the event of a primary power failure. One ECB is required per installed array controller and cache set.
Environmental monitoring unit (EMU)	Monitors enclosure operations, detects and reports error conditions, and automatically initiates some corrective actions.
Input/output (I/O) module	Ultra SCSI single-ended I/O modules for connecting the enclosure to disk enclosures. Model 2100 enclosures use HSG60 array controllers that support only two I/O modules; Model 2200 enclosures use HSG80 array controllers that support six I/O modules.

**Table 1-1 Major Enclosure Elements and Their Functions**

Element	Function
Power supply	A minimum of one or a maximum of two 180 W power supplies provide DC power to enclosure elements.
Fan	Three dual-speed fan (blower) assemblies provide cooling air to enclosure elements.

For enclosures with fewer than the maximum number of elements installed, install blank panels or blank bezels to control airflow. Blank panels are required for empty array controller and cache module bays to reduce electromagnetic interference (EMI) and to maintain cooling airflow within operational requirements.



**WARNING:** When both array controller bays or a cache module bay is empty, a shock hazard exists on the backplane. *Do not* touch the backplane.

Always install a blank panel in any bay not currently in use.

**NOTE:** Compaq recommends using blank panels at all times for any empty enclosure element location to prevent a potential overtemperature condition. Since only two ECB bays are used at any one time—one per cache module—install a blank in any vacant ECB bay.

The enclosure mounts in a rack (cabinet) containing Radio Electronics Television Manufacturing Association (RETMA)—now known as Electronics Industries Association (EIA)—mounting rails. In a RETMA rack, the enclosure installs in a four unit (4U, which equals 177 mm/7 in) mounting space. To fill the full 4U height, a filler panel is positioned directly above the enclosure.

## Prerequisites

The *minimum set* of major elements recommended for enclosure operations includes:

- Array controller
- Cache module
- EMU
- ECB
- Two 180 W power supplies
- Three fans

■ I/O modules:

- ❑ Two in a Model 2100 enclosure with an HSG60 array controller
- ❑ Six in a Model 2200 enclosure with an HSG80 array controller

All of these elements (except the redundant power supply and the EMU) are essential elements for normal enclosure operation. Without the EMU, the enclosure loses some features and functionality, but data storage capabilities continue as normal. Any empty element bay requires the installation of a blank assembly. Figure 0-1 identifies major element locations within the enclosure.

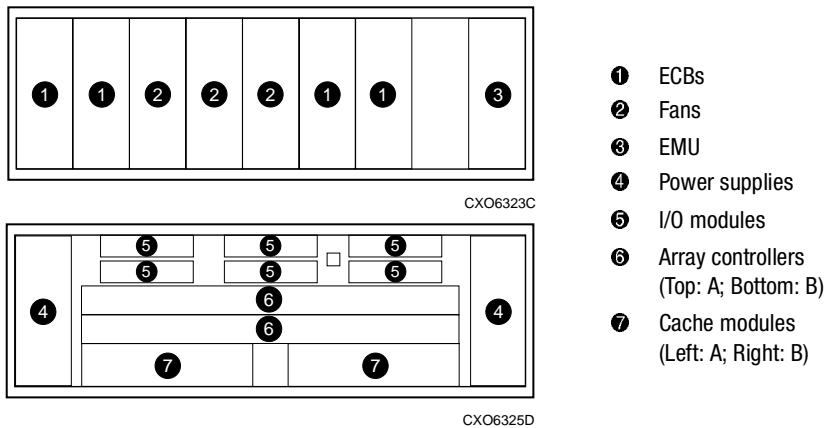


Figure 0-1. Major element mounting locations (front and rear)

**NOTE:** Model 2100 enclosures use HSG60 array controllers, which support only two I/O modules; whereas Model 2200 enclosures use HSG80 array controllers, which support all six I/O modules. For Model 2100 enclosures, a blank panel covers the four vacant I/O module bays (see Figure 1-1).

Appendix C describes the recommended sequence to follow for preparing an enclosure for use.

## Enclosure Power

One 180 W power supply adequately supports enclosure functions. A second power supply provides redundancy. Using two 180 W power supplies in the enclosure eliminates the power supply as a single point of failure.



**CAUTION:** Proper enclosure operation *requires* power supplies rated for at least 180 W.

---

## Controller Sets

The enclosure accommodates up to two controller sets. Each controller set is composed of an array controller, a cache module, and an ECB.



**CAUTION:** Proper cache module operation requires an ECB module for each cache. Refer to the array controller documentation for information about using controller sets and ECBs.

---

The following Compaq StorageWorks fibre channel array controllers function properly within the enclosure, using controller-compatible cache memory and a supported array controller software (ACS) version:

- HSG60 — supports two SCSI buses
- HSG80 — supports six SCSI buses

Various cabling configurations can be used to connect an array controller to a host. Refer to array controller documentation for cable configuration information.

## Storage CRUs

The enclosure *does not support* the installation of storage devices within the enclosure.

## Ultra SCSI Buses

Array controllers receive data from a host, process this data, and through ports, distribute the data over single-ended, 16-bit, Ultra SCSI buses to the disk enclosures. Each bus has 16 possible SCSI bus addresses (IDs): 0 through 15. Every node on each bus must have a unique SCSI bus ID. Both array controllers interface with all I/O modules, where very high density computer interconnect (VHDCI) cables connect the enclosure to the storage enclosures.

The following addresses are reserved for the array controllers:

- SCSI bus ID 7 — *always* used by Controller A, initially assuming primary controller responsibilities in all configurations. No other device on the bus can use this address.
- SCSI bus ID 6 — *always* used by Controller B, initially assuming redundant controller responsibilities. No other device on the bus can use this address.

## Communication Ports

One communication port adds functionality to the enclosure—the serial port (see Figure 1-4, ❶). This port is used for power monitoring activities and uses a 10-pin RJ45 cable connector. The serial port also allows the enclosure to communicate with other enclosures and devices.

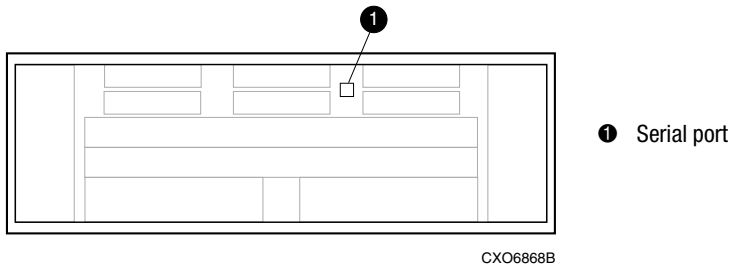


Figure 1-4. Communication port location

## Options

This section describes additional, user-orderable elements that can maximize enclosure capabilities.

### Upgrading a Model 2100 Enclosure to a Model 2200 Enclosure

Model 2100 enclosures can be upgraded to a Model 2200 enclosure by installing additional hardware. The required hardware includes:

- HSG80 array controller
- cache module (Model 2200 supported)
- ECB
- four I/O modules

### Redundant Controller Set

Base configurations consist of one controller set. This configuration sufficiently conducts all system operations. However, establishing a dual redundant system composed of two controllers, two cache modules, and two ECBs provides the most effective and efficient method of ensuring continuous system operation and eliminates any one element as a single point of failure.

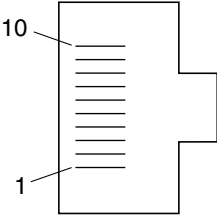
### Power Monitoring Devices

Important electrical aspects for connecting a power monitoring device, such as an uninterruptible power supply (UPS), are detailed in Appendix B. The serial port supports power monitoring connection capabilities. Use of a UPS ensures that the temporary loss of AC input power does not immediately shut down the system.

Table 1-2 identifies the power monitoring signals and their pinouts at the serial port. Under normal operations, both AC\_FAIL and TWO\_MINUTE\_WARNING are deasserted. When AC\_FAIL is asserted, this means that the UPS is running off its batteries. When two minutes of UPS battery life remain, the EMU initiates a controlled shutdown of the enclosure.

**NOTE:** All UPS planning is configuration-dependent. The user is responsible for planning and acquiring an appropriate size and type of UPS, based upon all enclosures supported by this device.

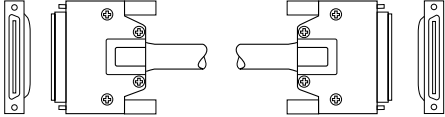
**Table 1-2 Serial Port Pinout for Power Monitoring**

Connector	Pin	Signal Name
Serial port connector:  Pins: 	10	
	9	
	8	
	7	
	6	
	5	Ground
	4	
	3	TWO_MINUTE_WARNING
	2	AC_FAIL
	1	

## Ultra SCSI Bus Cables

Compaq recommends using the shortest cable length possible to connect disk enclosures. The maximum supported cable length is 10 m (32.8 ft). Table 1-3 lists the available Ultra SCSI bus cables.

**Table 1-3 Ultra SCSI Bus Cables**

Cable Description	Length		Part Number
	Meters	Feet	
68-conductor cable with two 68-pin VHDCI straight plug connectors containing jack screws  	0.3	1.0	126308-001
	0.5	1.6	401939-001
	1.0	3.3	126308-003
	1.5	4.9	401941-001
	2.0	6.6	401940-001
	2.5	8.2	126308-006
	3.0	9.8	126308-007
	5.0	16.4	126308-008
	10.0	32.8	401942-001

# Chapter 2

## Operating the Enclosure

This chapter describes configuration rules for the enclosure, startup and shutdown procedures, and fault detection.

Other chapters in this manual contain detailed information about individual element functions, operations, and error conditions.

### Ultra SCSI Configuration Rules

Proper operation of the enclosure requires compliance with both the Ultra SCSI standard and hardware configuration rules. In some instances, operating system-specific configuration rules may also apply.

#### General

The following rules apply to an Ultra SCSI (FAST 20) bus for this enclosure:

- Ultra SCSI redundant array of independent disks (RAID) subsystems transfer data at a higher rate than FAST 10 subsystems (40 MB/s versus 20 MB/s).
- Installing a FAST 10 storage device reduces the bus average transfer rate as follows:
  - When the array controller communicates with the FAST 10 device, the communication rate is FAST 10 (the maximum rate this device can handle).
  - When the array controller communicates with a FAST 20 device, the communication rate is FAST 20 (the maximum rate this device can handle).
- 68-pin VHDCI cables and connectors are required.



- The following devices use a SCSI bus address (ID) and are classified as SCSI bus “nodes:”
  - ❑ Array controllers
  - ❑ Storage devices
  - ❑ EMUs
- Every node on a bus must have a unique SCSI bus ID.
- 16 SCSI bus IDs are available—*0 through 15*. Two are reserved for the array controller (6 and 7).
  - ❑ SCSI bus ID 7 is *always* assigned to Controller A.
  - ❑ SCSI bus ID 6 is *always* assigned to Controller B.
  - ❑ SCSI bus IDs *0 through 5* and *8 through 15* are available for disk enclosure use—as supported by the ACS version.

## Ultra SCSI RAID Controllers

The following *general* configuration rules apply to Ultra SCSI RAID array controllers:

- Controller A is the primary controller and *always* uses SCSI bus ID 7. No other device on the bus can use this address.
- Controller B is the redundant controller and *always* uses SCSI bus ID 6. No other device on the bus can use this address.
- Compaq Ultra SCSI array controllers support FAST 10 (20 MB/s) 16-bit (wide) storage devices.
- Compaq Ultra SCSI array controllers support Ultra SCSI (40 MB/s) 16-bit (wide) storage devices.



**CAUTION:** If a conflict exists between array controller configuration information and this document, use information in the array controller documentation.

---

**NOTE:** Storage device support is array controller-specific. Refer to array controller documentation to determine compatible storage devices.

## Power Application and Removal

To turn ON the enclosure, apply power to the AC power supply. Shutting down the enclosure involves quiescing the controllers and disconnecting the AC power cords from the enclosure power supplies.

Turning the enclosure ON causes the following actions to occur:

- Power supplies output +12 VDC and +5 VDC for enclosure operations.
- Fans draw cooling air flow through the enclosure.
- EMU and array controllers initialize system operations.
- ECBs begin charging.

Enclosure operations begin once enclosure power supplies receive AC source power.

**NOTE:** Before applying AC power to the enclosure, completely configure the entire subsystem (including the host and array controller cabling) as described in the appropriate publications.

## Fault Detection

Fault detection involves identifying errors and providing an indication to the user for analysis.

The EMU constantly monitors the operational status of the enclosure and its elements. In some instances, corrective action occurs automatically. Enclosure status changes are indicated by:

- A combination of light emitting diodes (LEDs) on the CRU and EMU
- An EMU audible alarm
- An *optional* maintenance terminal that connects to an array controller

Chapter 3 lists the status items that are monitored by the EMU.

For a detailed description of status LEDs and specific error conditions, see the chapter that discusses the specific element.

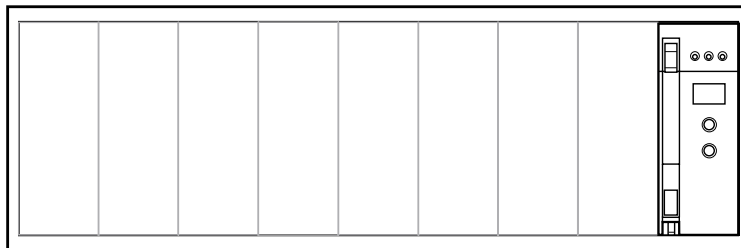
# Chapter 3

## Environmental Monitoring Unit

This chapter contains information concerning the multiformity EMU, including product description, configuration, functionality, and status indications.

### Product Description

The EMU monitors the enclosure status, reports error conditions, and controls some enclosure functions. The EMU mounts in the front of the enclosure (see Figure 3–1).



CXO6867A

Figure 3–1. EMU location

## Configuration

The EMU is *not* required for enclosure operation. However, some loss of features (monitoring) and functionality (disk isolation) occurs without an EMU installed.

## Functionality

Table 3-1 lists functions monitored by the EMU.

<b>Element</b>	<b>Function Monitored</b>
Rack	Power faults
Enclosure	■ Intake air temperature
EMU	■ System configuration and current status
Fan	■ Installation ■ Fan speed ■ Fan fail
Power supply	■ Installation ■ AC input power failure ■ +5 VDC backplane voltage ■ +12 VDC backplane voltage

# Status Indications

Status indications provided by the EMU are shown in Figure 3-2. The EMU contains three status LEDs (❶ through ❸), a two-digit, seven-segment alphanumeric display ❹, and two switches (❺ and ❻). The following sections describe each status indicator.

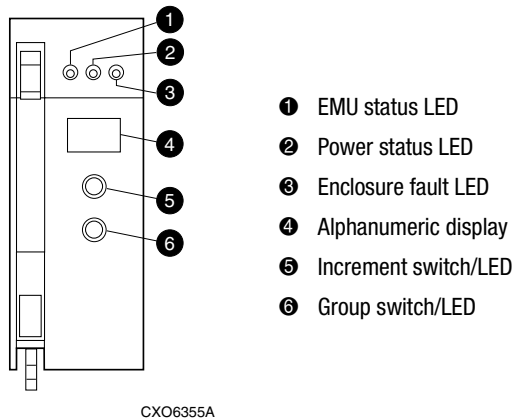


Figure 3-2. EMU bezel switches and status LEDs

The EMU uses audible and visual alarms to report faults and error conditions to the user (see Table 3-2).

**Table 3-2 EMU Alarm Types**

Alarm Type	Description
Audible	A high-pitched sound generated for each detected fault or error condition. If desired, the audible alarm horn can be disabled or muted.
Alphanumeric <b>id 0.2.</b> <b>04. 05</b>	Displays an alphanumeric code that identifies the enclosure address and error code information.
Status LEDs ○ ● ●	Displays enclosure and EMU operating status. Each LED displays three possible states (depicted at left): OFF (left LED), FLASHING (middle LED), and ON (right LED).

## Audible Alarm

By default, the EMU generates an audible alarm each time it detects an error condition. The audible alarm horn (or horn) can be muted or disabled using the EMU bezel switches.

Holding the group switch (refer to Figure 3-2, **ⓐ**) toggles the horn ON (mute) or OFF (unmute). Detection of any new error condition overrides the mute function, and sounds the audible alarm for the severest active error condition.

To mute and unmute the horn:

- **Mute** — Press and hold the group switch for approximately 2 seconds. The group switch LED turns ON and the audible alarm turns off when the horn is muted.
- **Unmute** — Press and hold the group switch for approximately 2 seconds. The group switch LED turns OFF and the audible alarm can sound when the horn is unmuted.

The horn (**Ho**) feature enables or disables the horn. Disabling the horn prevents an audible alarm from sounding at all times until the horn is enabled again. Disabling the horn also turns ON the group switch LED.

Navigate to the **Ho** display by using the group switch (see Figure 3-2, **ⓐ**). From the EMU default display (the **id** address setting, such as --), press the group switch twice. With **Ho** in the alphanumeric display, press the increment button (**ⓑ** in Figure 3-3) once to view the current setting. Change the current horn mode setting, from either enabled (**En**) to disabled (**di**), or vice versa, by using both the increment and group switches as indicated in the Figure 3-3. The **Ho** default setting is **En**.

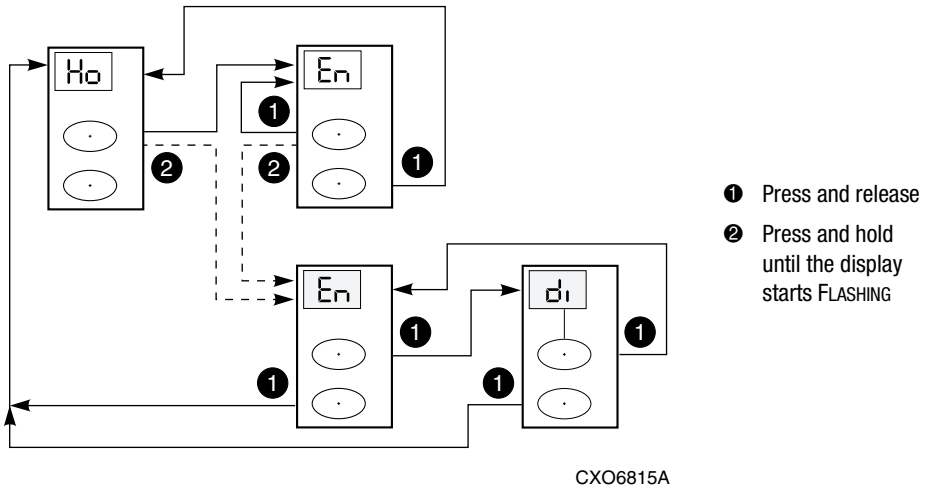


Figure 3-3. Changing the horn mode setting

## Alphanumeric Displays

The EMU uses two seven-segment alphanumeric characters to display the SCSI target ID address, horn mode setting, and error codes using alpha characters, decimal numbers, and periods. Valid display characters include:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, -  
 A, b, C, d, E, F, G, H, h, i, J, L, n, o, P, r, t, U, y, and .



**CAUTION:** Display of any character not listed above is an invalid display and indicates an EMU error condition.

The alphanumeric display presents the G character as □, the t character as ⊔, and the y character as 4.

## SCSI Target ID Address

The EMU does not use a SCSI bus address. The EMU SCSI target ID (**id**) setting will always indicate "--" by default and is not changeable.

## Horn Mode

Horn mode (**Ho**) disables or enables the EMU horn. A two-alpha character display indicates the horn as either enabled (**En**) or disabled (**di**). The default setting is **En**.

## Error Codes

If an error occurs, **Er** automatically displays in the EMU alphanumeric display and sounds an audible alarm. This display and alarm indicates that an error was detected.

**NOTE:** Each error code is displayed in the alphanumeric display for a minimum of 15 seconds, even if it clears immediately after detection.

If an active error code exists for 5 minutes or longer, the error code display changes immediately upon clearing of the error.

Three error code levels indicate the source and criticality of an error:

- Level 1 — CRU type (one hexadecimal character and one decimal character with two periods — **0.2.**). This code level identifies the CRU type that generated the error and its associated element number, such as power supply number 2 (**0.3.**).
- Level 2 — Element number (two decimal characters and one period, such as **02.**)
- Level 3 — Error code (two decimal characters only and *no* periods, such as **04**)

Error code criticality affects how long the audible alarm sounds. All error codes cause the increment switch LED to turn ON. For enclosure errors, there are four levels that are distinguished by an audible alarm:

- Unrecoverable — Alarm sounds constantly.
- Critical — Alarm toggles ON and OFF, sounding three beeps every 2 seconds.
- Noncritical — Alarm sounds two short beeps that repeat every 2 seconds.
- Informational — Alarm sounds one short beep that repeats every 2 seconds.

The EMU and **graphical user interface (GUI)** display error codes as follows:

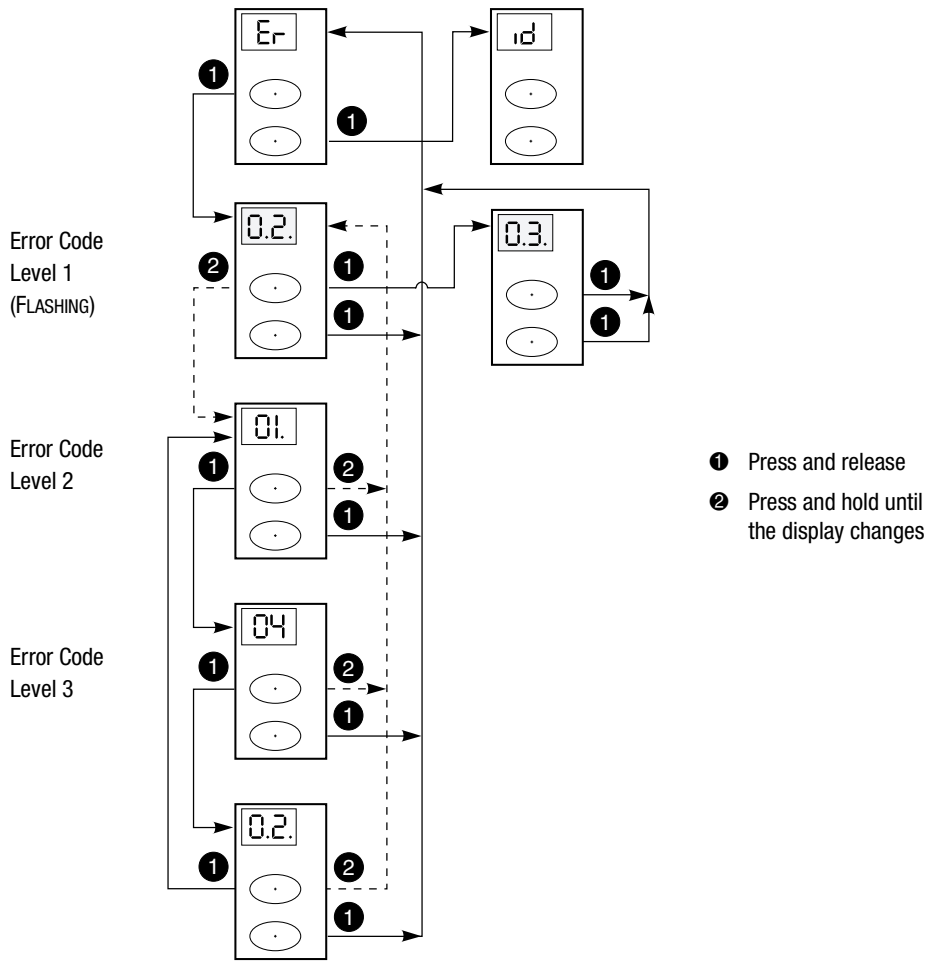
- All error codes are displayed on the EMU alphanumeric display.
- All error codes are displayed on the GUI, *except* EMU operating condition error codes.
- Valid CRU types range from **02** through **07** and incorporate two periods after each character.
- Valid error codes range from **01** through **05** and do not use periods.



- All **active** error codes are displayed in sequence, according to the highest level of severity and its timestamp.

**NOTE:** Within 15 seconds or less, after all errors are cleared, the EMU alphanumeric display automatically reverts to its SCSI target ID default display (--).

Figure 3-4 illustrates how to navigate through the multilevel error code displays. Appendix D contains detailed information pertaining to error code definitions.



CXO7237A

Figure 3-4. Navigating within the error code displays

## EMU Reset Conditions

Two general EMU *operating error* conditions reset the EMU. These error conditions display **FE** on the alphanumeric display, sound an audible alarm (a steady tone followed by three or five beeps), and then reset the EMU.

When the EMU returns to normal operating status, the alphanumeric display presents the default display (--). Active error codes will then be displayed once again. See Appendix D for details.

## Alarm Reminder Tones

The constant sounding of an audible alarm for an unresolved error can be annoying. A reminder feature can be activated using the GUI to hold the audible alarm to a minimum and still “remind” the user that an unresolved error exists. See Appendix D for details.

## Status LEDs

The EMU has five LEDs: three that indicate EMU operating status, one that indicates the presence of error conditions, and one that indicates when **Ho** mode is disabled or the audible alarm is muted.

Three operating status LEDs (see Figure 3-2, ❶, ❷, and ❸) display the operating status of the EMU and enclosure. Each LED functions independently from the other two LEDs. Their functions are as follows:

- The green EMU status LED ❶ continually FLASHES steadily during normal EMU operations. If this LED is constantly ON or OFF, the EMU has malfunctioned.
- The green power status LED ❷ turns ON when enclosure power is operating normally. If this LED remains OFF or FLASHES, an enclosure fault exists.
- The amber enclosure fault LED ❸ is normally OFF. It turns ON when an enclosure fault exists.

The remaining two LEDs (see Figure 3-2, ❹ and ❺) are switch-LED combinations that illuminate under specific conditions:

- While viewing a top-level display (**id** or **Ho**), the amber increment switch LED ❹ turns ON — and **Er** is displayed — upon detection of an error condition. The LED turns OFF only while viewing the last error in the active list, otherwise, it remains ON.
- The amber group switch LED ❺ turns ON when the horn is disabled or muted.

# Chapter 4

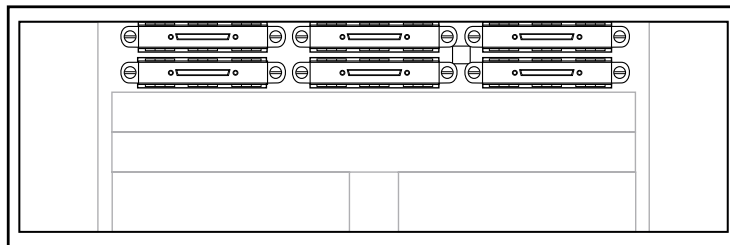
## Input/Output Module

This chapter contains information about the I/O module, including a product description, configuration data, and status information.

### Product Description

Enclosure I/O modules are Ultra SCSI single-ended I/O modules and are located in the rear of the enclosure (see Figure 4–1). Their functions include:

- Terminating each external Ultra SCSI bus connection
- Establishing Ultra SCSI bus communications between the enclosure and a storage enclosure



CXO7182A

Figure 4–1. I/O module locations

## Configuration

Each enclosure can support six I/O modules that interface with a disk enclosure using a VHDCI SCSI bus cable. Figure 4-2 illustrates the I/O module and Figure 4-3 correlates each I/O module bay to a specific SCSI bus number.

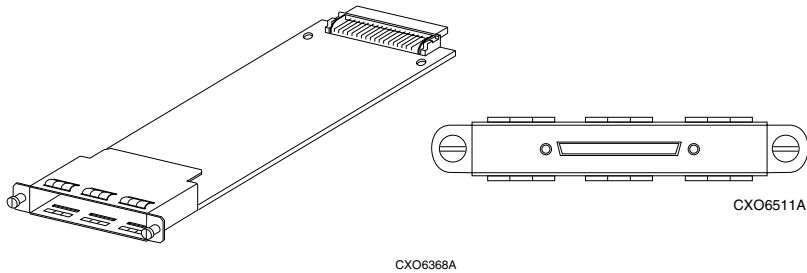


Figure 4-2. I/O module and external connector view

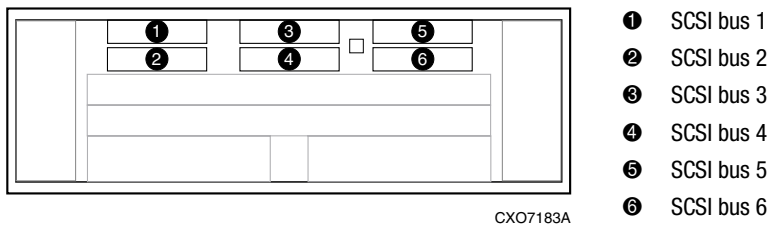


Figure 4-3. I/O module bay and bus number correlation

**NOTE:** Model 2100 enclosures use HSG60 array controllers, which support only two I/O modules—SCSI bus 1 ❶ and SCSI bus 2 ❷. Model 2200 enclosures use HSG80 array controllers, which support all six I/O modules. In Model 2100 enclosures, a blank panel covers the four vacant I/O module bays.

## Status Indicators

No status indicators exist on the I/O module. The EMU and array controllers monitor the status of each I/O module.

# Chapter 5

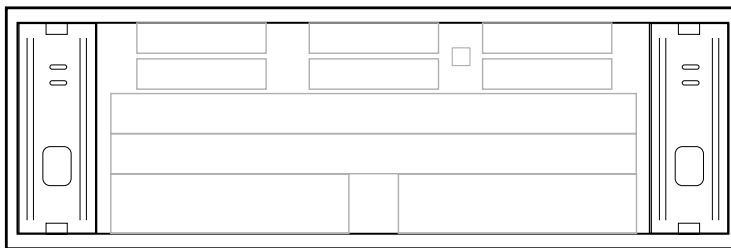
## Power Supply

This chapter contains information concerning the 180 W power supply, including product description, configuration, and status indications.

### Product Description

Each power supply converts an AC voltage into +5 VDC and +12 VDC power required for enclosure operations. These DC voltages are distributed to enclosure elements through the backplane.

Two power supplies mount in the rear of the enclosure (see Figure 5–1).

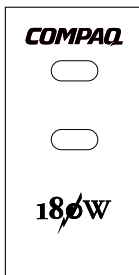


CXO6870B

Figure 5–1. Power supply locations

## Configuration

The enclosure accommodates two 180 W power supplies in a redundant power configuration. The bezel label is a distinguishing feature of a 180 W power supply (see Figure 5-2).



CXO5926B

Figure 5-2. 180 W power supply bezel label

One power supply supports all enclosure operations. A second power supply provides power redundancy to eliminate the power supply as a single point of failure.



**CAUTION:** Proper enclosure operation *requires* power supplies rated for at least 180 W.

---

Power supplies are numbered from left to right (PS1 and PS2 respectively), as viewed from the rear of the enclosure, for error code purposes.

## Status Indications

The two power supply LEDs (see Figure 5-3) display the power supply status. Normally, both of these LEDs are ON.

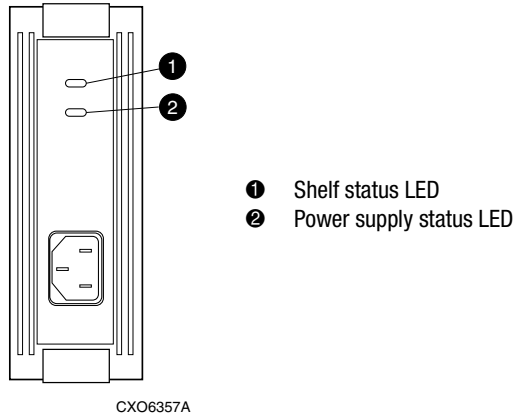


Figure 5-3. Power supply status LEDs

The green shelf status LED ❶ and green power supply status LED ❷ both turn ON if the power supply is operating normally. If the power supply fails, both LEDs turn OFF.

See Table 5-1 for a definition of selected power supply status LED displays and a description for each state.

Table 5-1 Power Supply Status LED Displays	
LED Display	Status Description
	This power supply is functioning properly.
	Two situations are plausible: <ol style="list-style-type: none"> <li>No AC input power. Check the AC power source.</li> <li>Power supply failed. Replace this power supply.</li> </ol>

# Chapter 6

## External Cache Battery

This chapter contains information concerning the ECB, including product description, configuration, and status indications.

### Product Description

To preserve write-back cache data in the event of a power failure, each cache module must be connected to an ECB. ECBs are installed in the front of the enclosure (see Figure 6–1).

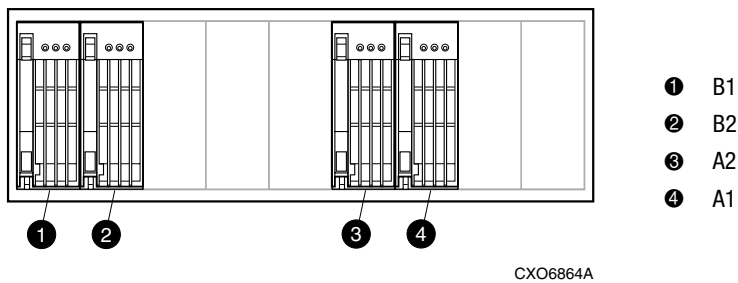
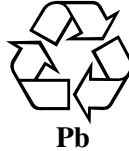


Figure 6–1. ECB bay locations



Every ECB contains a sealed, rechargeable, lead acid battery pack that can be replaced onsite. Chapter 8 contains the procedure for replacing the battery pack.

**NOTE:** The ECB battery pack is a sealed, rechargeable, lead acid battery that displays the following label and must be recycled or disposed of properly after replacement.



## Configuration

As shown in Figure 6-1, the enclosure has four ECB bays. Each array controller and cache set within the enclosure requires an ECB. ECB bays A1 and A2 (see Figure 6-1, ③ and ④) support Cache A. ECB bays B1 and B2 (see Figure 6-1, ① and ②) support Cache B. Installing an ECB in either bay (A1 or A2, B1 or B2) protects the supported cache module. *Do not* install more than one ECB per array controller and cache set (A or B), except during ECB replacement.

**NOTE:** No more than two ECBs are supported within the enclosure at any time—one for each array controller and cache set. Install blanks in the unused ECB bays.

# Status Indications

The ECB bezel contains three status LEDs (see Figure 6-2).

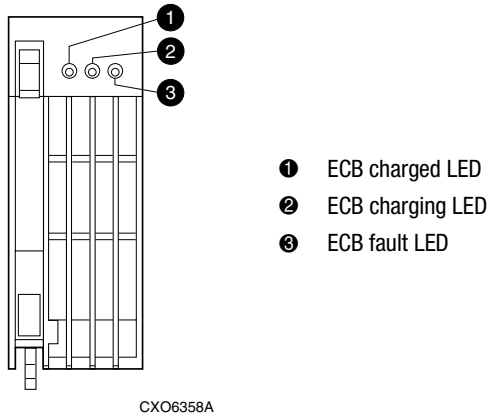


Figure 6-2. ECB status LEDs

The green ECB charged LED ❶ turns ON to indicate a fully charged ECB battery.

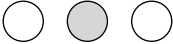






The green ECB charging LED ❷ turns ON to indicate a charging ECB battery. This LED FLASHES during the ECB startup self-test.

The amber ECB fault LED ❸ turns ON to indicate a bad battery. The ECB fault LED begins FLASHING if:

- The ECB battery is not plugged in properly.
- The battery temperature is out of limits.
- Load testing is in progress.

See Table 6-1 for a definition of valid ECB status LED displays.

**Table 6-1 ECB Status LED Displays**

LED Display	Status Description
	Initial startup self-test is running.
	ECB battery is charging.
	ECB battery is fully charged and operating normally.
	ECB battery load testing is in progress. The FLASH rate is once every 1.5 seconds.
	Two FLASH rates are possible: <ul style="list-style-type: none"> <li>■ FLASH rate of once every ½ second: indicates that the either ECB battery is not properly plugged into the ECB circuit board or the battery temperature is out of limits.</li> <li>■ FLASH rate of once every 4 seconds: indicates that the ECB battery is protecting the cache module memory—no enclosure power applied.</li> </ul> <p><b>NOTE:</b> During shipping or a long-term power-off condition, the ECB battery will FLASH to indicate that the battery is protecting cache memory. If this protection is not required, reseal the ECB to stop the LED from FLASHING and prevent the ECB battery from discharging.</p>
	Indicates that the battery temperature is out-of-limits and the battery suspended changing. After the ECB battery warms up to above +10 °C or cools below 50 °C, the FLASHING ECB fault LED turns OFF and the battery resumes charging.
	ECB battery is defective.



**CAUTION:** ECB battery pack leave the manufacturer fully charged. However, ECB battery packs might not arrive fully charged due to storage and shipping. Compaq recommends placing this ECB into a powered-up enclosure until the ECB charged LED turns ON, before placing the ECB into a production environment.

# Chapter 7

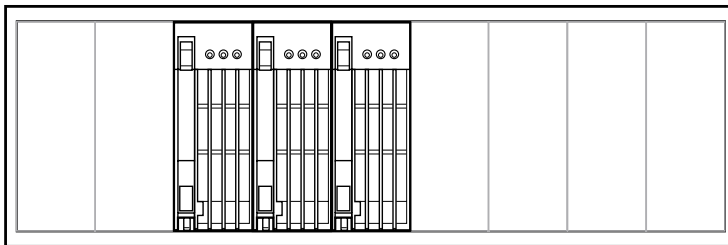
## Fans

This chapter contains information about the fans, including product description, configuration, functionality, and status indications.

Proper enclosure operation requires establishing and maintaining the right operating environment as specified in Appendix A. This operating environment involves establishing and maintaining the correct *ambient* temperature. Failure to maintain a proper operating environment might cause the elements to malfunction and compromise data integrity.

### Product Description

The three enclosure fans are an integral part of the enclosure. The fans are arranged side-by-side in the enclosure front and draw air into the enclosure through the fan front bezel (see Figure 7–1).



CXO6865A

Figure 7–1. Fan locations

Temperature is monitored by the EMU (see Chapter 3) using an intake air temperature sensor and stored high-limit temperature settings. If an overtemperature condition is detected by the EMU, the EMU directs all operational fans to function at high speed, increasing air flow and cooling throughout the enclosure. When the overtemperature condition no longer exists, the EMU directs the fans to operate at normal speed.

**NOTE:** The enclosure cools properly with only two operational fans, provided the third fan or a blank bezel is installed. However, two defective fans creates an error condition that will develop an overtemperature condition if not resolved.

## Configuration

The enclosure accommodates three fans. A minimum of two operational fans are required. If the enclosure does not contain an EMU, all fans automatically operate at high-speed by default. Otherwise, the EMU directs the operating speed of the fans.

Fans are numbered from left to right (Fan 1, Fan 2, and Fan 3 respectively), as viewed from the front of the enclosure, for error code purposes.

## Functionality

Cool air is drawn into the fan module through the bezel and directed into a plenum (composed of the backplane). The plenum distributes this cooling air to each element. Each fan operates on +12 VDC supplied from a backplane connector. Fan status and speed control signals are routed through the backplane to the EMU.

When an error condition exists that involves either the fans, intake air temperature, or exhaust air temperature, the EMU switches all operational fans into high speed, increasing air flow throughout the enclosure. This air flow increase permits continued enclosure operations without data loss or corruption. However, if a second fan malfunctions, air flow from the remaining fan is insufficient for normal enclosure operations. Unless at least one of the two defective fans is replaced within 10 minutes, the EMU initiates an enclosure shutdown.

The following conditions cause the EMU to increase fan speed:

- Removing a fan module
- A fan operating too slowly
- A stalled fan
- An increase in enclosure temperature

**NOTE:** Replace any defective fan immediately.

## Status Indications

Each fan module contains status LEDs that indicate its current operating status (see Figure 7-2).

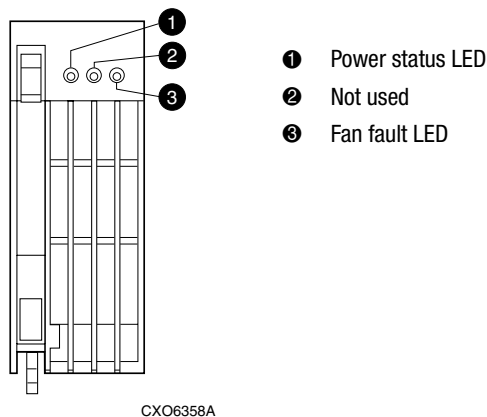




Figure 7-2. Fan status LEDs

The green power status LED ❶ turns ON when power is applied to the fan. This LED is normally ON and only turns OFF when enclosure DC power is removed.

The amber fan fault LED ❸ turns ON if the fan stops or rotates too slowly, or upon fan failure detection.

See Table 7-1 for a definition of fan status LED displays.

<b>Table 7-1 Fan Status LED Displays</b>	
<b>LED Display</b>	<b>Status Description</b>
	The fan is operating normally.
	A fan fault exists. Replace the fan module.

# *Chapter 8*

## **Removal and Installation Procedures**

This chapter describes removal and installation procedures for enclosure elements.

### **Handling Enclosure Elements**

This section describes two replacement methods used during removal and installation procedures and the electrostatic discharge (ESD) procedures that coincide with handling enclosure elements.

### **Element Replacement Methods**

Elements follow either a hot-pluggable or a pluggable power-on replacement method. The definitions for each are as follows:

- **Hot-pluggable** — Allows replacing an element without removing enclosure power or hindering enclosure operations.
- **Pluggable** — Allows replacing an element without removing enclosure power, but requires quiescing the affected data buses.



## ESD Protective Measures

A discharge of static electricity from a finger or other conductor might damage printed circuit boards or other static sensitive devices, reducing the life expectancy of the device. To prevent ESD damage, observe the following precautions:

- Avoid hand contact by transporting and storing devices in a static-safe container.
- Keep electrostatic-sensitive devices in their containers until they arrive at a static-free work station and ready for installation.
- Place devices on a grounded surface before removing them from their container.
- Avoid touching the backplane, connectors, pins, leads, and exposed circuitry.
- Follow proper grounding methods for handling static-sensitive devices.

Recommended grounding methods include using one or more of the following:

- Wear an ESD wrist strap connected to a grounded workstation or computer chassis.
- Use heel straps, toe straps, or bootstraps at standing workstation. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.



**CAUTION:** If recommended grounding equipment is not available, have an Authorized Compaq Service Provider install the part.

---

## Removal and Installation Procedures

Table 8-1 identifies the replacement methods and replacement procedures for each enclosure element. In all cases, a power-off replacement method is possible.

**Table 8-1 Element Replacement Methods and Procedures**

Element	Recommended Replacement Method	Replacement Procedures
EMU	Hot-pluggable	Table 8-2 and Table 8-3
I/O Module	Pluggable <sup>1</sup>	Table 8-4 and Table 8-5
Power Supply	Hot-pluggable (redundant power supply configuration)	Table 8-6 and Table 8-7
ECB Battery Pack	Power-off only	Table 8-8
ECB	Array controller dependent: Pluggable <sup>1</sup> or hot-pluggable	Table 8-9 and Table 8-10
Fan	Hot-pluggable	Table 8-11 and Table 8-12
Array Controller	Pluggable <sup>2</sup> or power-off <sup>3</sup>	Table 8-13 and Table 8-14
Cache Module	Pluggable <sup>2</sup> or power-off <sup>3</sup>	Table 8-13 and Table 8-14

1. Requires using the field replacement utility (FRUTIL). Refer to array controller documentation for replacement procedures.
2. Applies *only* to dual-redundant controller configurations. Requires using FRUTIL. Refer to array controller documentation for replacement procedures.
3. Applies to all single-controller configurations, and dual-redundant controller configurations without FRUTIL support.



**CAUTION:** If a conflict exists between the replacement procedures within this document and those within array controller-specific documentation, use procedures in the array controller documentation.

## Preliminary Information

Figure 7-3 illustrates element locations within the enclosure.

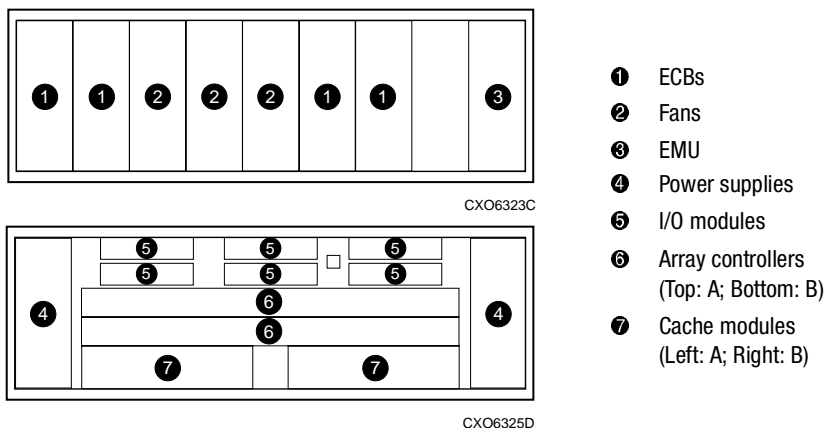
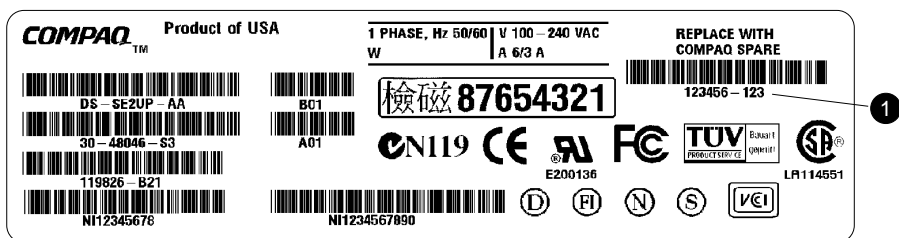


Figure 7-3. Element mounting locations

**NOTE:** Model 2100 enclosures use HSG60 array controllers, which support only two I/O modules; whereas Model 2200 enclosures use HSG80 array controllers, which support six I/O modules. For Model 2100 enclosures, a blank panel covers the four vacant I/O module bays.

A label affixed to each element identifies its replacement part number (see Figure 7-4, ❶). Use this number to order a replacement element. Also, *use this number to verify the proper element was received, before beginning any replacement procedure.*

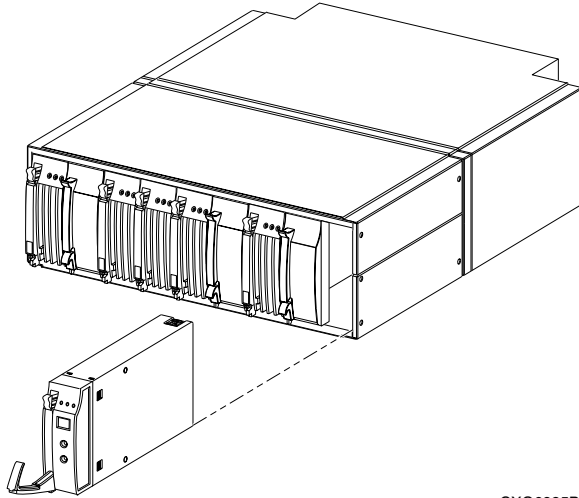


CXO6879A

Figure 7-4. Typical element label

**EMU**

The EMU is hot-pluggable. See Figure 8-3 as needed during the removal and installation. Complete the procedure in Table 8-2 to remove an EMU. Complete the procedure in Table 8-3 to install an EMU.



CXO6925B

Figure 8-3. EMU removal and installation

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**Table 8-2 Removing an EMU**


---

1. Press the release tab and pivot the lever.
  2. Remove the EMU from the enclosure.
- 

---

**Table 8-3 Installing an EMU**


---

1. Press the release tab and pivot the lever.
2. Insert the EMU until its lever engages the enclosure.
3. Lift the lever upward until the lever locks.
4. If enclosure power is applied, verify that the following EMU status LED indication is display.



## I/O Module

Each I/O module functions independently of the others, but all I/O modules within the enclosure must be the identical model. Figure 8-4 correlates each I/O module bay to a specific SCSI bus number.

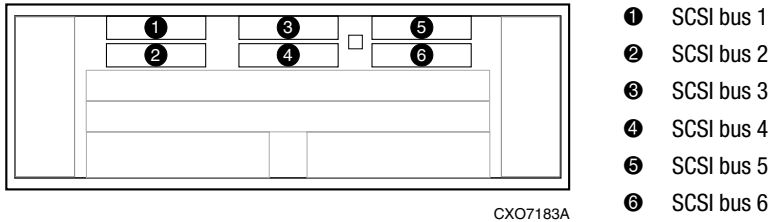


Figure 8-4. I/O module bay to SCSI bus number correlation

**NOTE:** Model 2100 enclosures use HSG60 array controllers, which support only two I/O modules—SCSI bus 1 ❶ and SCSI bus 2 ❷; whereas Model 2200 enclosures use HSG80 array controllers, which support all six I/O modules. For Model 2100 enclosures, a blank panel covers the four vacant I/O module bays.

The I/O module is pluggable. See Figure 8-5 as needed during the removal and installation. Complete the procedure in Table 8-4 to remove an I/O module. Complete the procedure in Table 8-5 to install an I/O module.

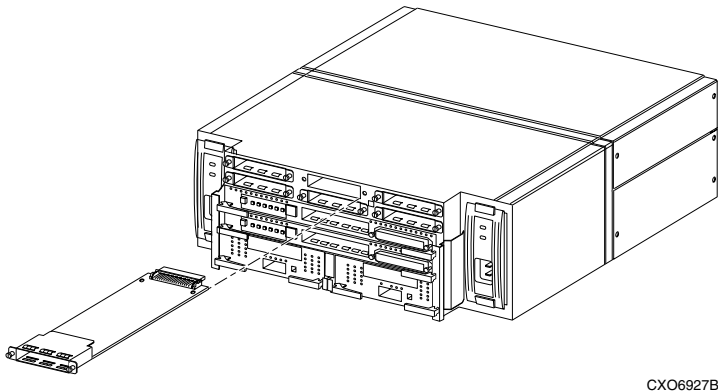

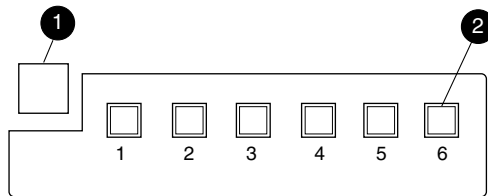


Figure 8-5. I/O module removal and installation

**Table 8-4 Removing an I/O Module**

1. Refer to array controller documentation for pluggable replacement procedures and use these procedures to replace the I/O module.  
Otherwise, proceed to step 2.
2. Press the appropriate port button (numbered 1 through 6 as shown below ) on the operator controller panel on each array controller to quiesce the applicable bus for the I/O module.  
Proceed to the next step when all port button LEDs FLASH simultaneously, indicating a quiesced bus.



CXO6216C

3. Disconnect the bus cable from the I/O module being removed (see Figure 8-4).
4. Unscrew two mounting screws and remove the I/O module from the enclosure.

**Table 8-5 Installing an I/O Module**

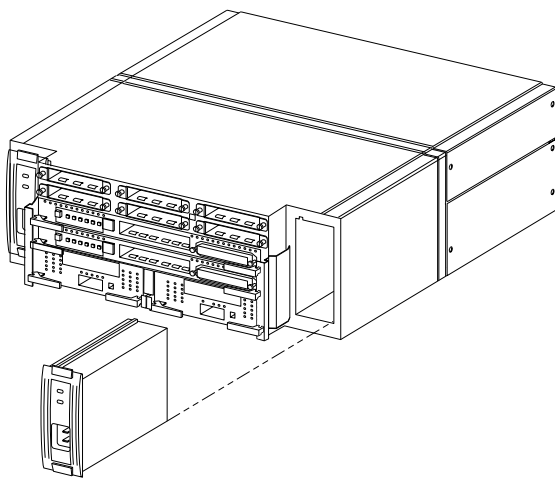
1. Insert and fully seat the I/O module in the appropriate location (see Figure 8-1).
2. Secure the I/O module to the enclosure using two mounting screws.
3. Connect and secure the bus cable to the I/O module.
4. Press the appropriate port button on the operator controller panel on each array controller to activate the applicable bus for the I/O module.  
The port button LED turns ON if activity is present on the bus.

## Power Supply

In redundant power supply configurations, follow hot-pluggable procedures; otherwise, follow power-off procedures. See Figure 8-6 as needed during the removal and installation. Complete the procedure in Table 8-2 to remove a power supply. Complete the procedure in Table 8-3 to install a power supply.



**CAUTION:** The enclosure *requires* power supplies rated for at least 180 W.



CXO6926B

Figure 8-6. Power supply removal and installation

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### Table 8-6 Removing a Power Supply

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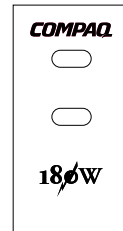
1. For hot-pluggable, go to step 4. For power-off, proceed to step 2.
  2. Shut down the array controllers using array controller documentation.
  3. Disconnect the power cord from the power supply (see Figure 8-6).
  4. Disengage and remove the power supply from the enclosure.
  5. Disconnect the fan from the power supply.
-

---

**Table 8-7 Installing a Power Supply**

---

1. Verify that the bezel displays this label.



CX05926B

- 
2. Insert the power supply until mounting tabs engage the enclosure and lock.
  3. Connect the power cord to the power supply.
  4. For hot-pluggable, verify that both power supply status LEDs turn ON.
-



## ECB Battery Pack and ECB

This section describes ECB battery pack and ECB replacement procedures. Perform ECB battery pack replacement procedures in an ESD-controlled environment. ECB replacement procedures within an operating enclosure is array controller-specific.

Each ECB battery pack has a label (displaying a “born-on” date) that indicates when the battery was tested and initially charged. Determine battery freshness by this “born-on” date label (for example, DC:03MAR99 means that the battery received its initial charge on March 3, 1999).

**NOTE:** A fully discharged ECB battery pack takes up to 3.5 hours to charge completely.

### Replacing an ECB Battery Pack

To replace an ECB battery pack, complete the procedure in Table 8-8.

**NOTE:** The ECB battery pack is a sealed rechargeable lead acid battery that displays the following label and must be recycled or disposed of properly after replacement.

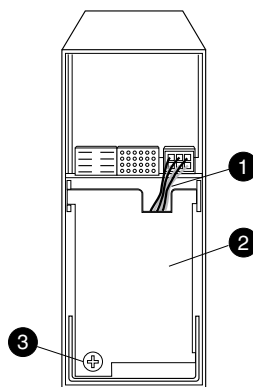


---

**Table 8-8 Replacing an ECB Battery Pack**

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1. Remove the battery retaining bracket ❷ by unscrewing the retaining fastener ❸.

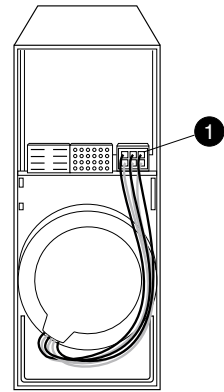


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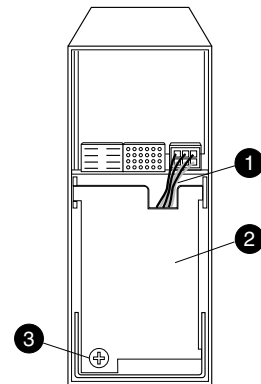
**Table 8-8 Replacing an ECB Battery Pack (Continued)**

2. Unplug the battery wire connector ❶ and remove the battery pack by pulling on the battery wire bundle.
3. Orient the replacement battery pack and wires as shown and fully insert the battery.
4. Plug in the battery wire connector ❶.



CXO6332A

5. Reposition the battery retaining bracket ❷ and guide the battery wires ❶ out the opening.
6. Secure the retaining bracket fastener ❸.



CXO6333A

## Replacing an ECB

For array controller configurations with FRUTIL support, follow pluggable procedures; otherwise, follow hot-pluggable procedures. See Figure 8-7 for ECB bay locations.

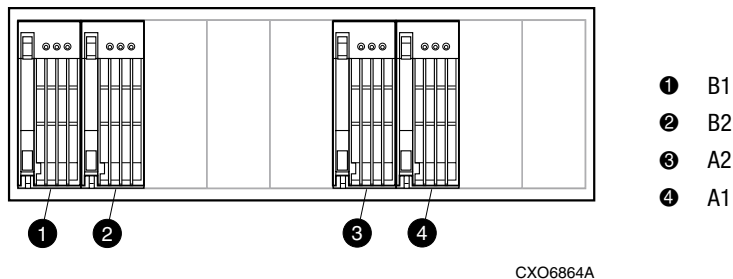


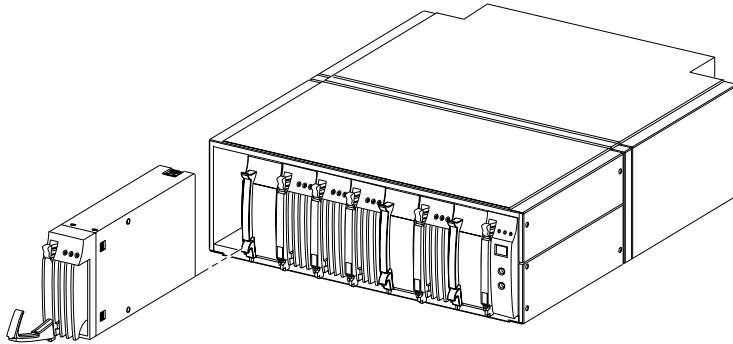
Figure 8-7. ECB bay locations

Pluggable procedures use FRUTIL to update the ECB battery's expiration date and deep discharge history.

Hot-pluggable procedures only replace the ECB using a vacant bay opening (A or B) that correlates with the defective ECB. This method *does not* update ECB battery history data. This procedure installs the replacement ECB and then removes the defective ECB.

Refer to Figure 8-8 as needed during the removal and installation. Complete the procedure in Table 8-9 to install an ECB. Complete the procedure in Table 8-10 to remove an ECB.

**NOTE:** No more than two ECBs are supported within the enclosure at any time—one for each array controller and cache set. Install blanks in remaining vacant ECB bays to control air flow.



CXO6922B

Figure 8-8. ECB removal and installation

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**Table 8-9 Installing an ECB**


---

- Using Figure 8-7, determine the specific bay to install the ECB.

**NOTE:** Make sure this bay supports the same cache module as the ECB being removed.

- Refer to array controller documentation for pluggable procedures and use these procedures to replace the ECB.  
Otherwise, proceed to step 3 for hot-pluggable procedures.

- Press the release tab and pivot the lever downward on the replacement ECB.

- Remove the blank panel from the vacant bay (A or B).

- Insert the ECB into the vacant bay until its lever engages the enclosure.

- Lift the lever upward until the lever locks.

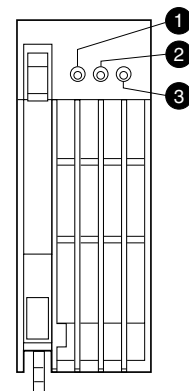
- If enclosure power is applied, verify that the ECB charging LED ② begins FLASHING.

- Following ECB initialization, verify that either the ECB charged LED ① or ECB charging LED ② turned On.

---

**IMPORTANT:** Do not remove the old ECB until the ECB charged LED on the replacement ECB turns On.

---



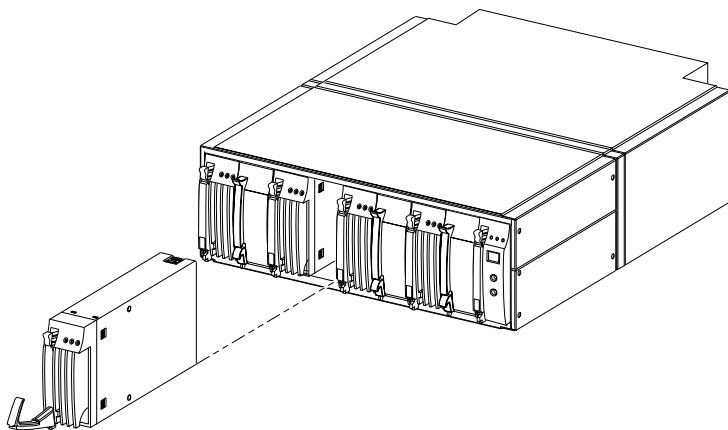
CXO6358A

**Table 8-10 Removing an ECB**

1. Determine the specific ECB to remove.
2. Press the release tab and pivot the lever.
3. Remove the ECB from the enclosure.
4. Install a blank panel in the vacant ECB bay.

## Fan

Fans are hot-pluggable. See Figure 8-9 as needed during the removal and installation. Complete the procedure in Table 8-11 to remove a fan. Complete the procedure in Table 8-12 to install a fan.



CXO6923B

Figure 8-9. Fan removal and installation



**CAUTION:** Operating the enclosure with one fan removed significantly alters the normal air flow pattern and reduces air flow through remaining elements. Install a blank bezel to control air flow.

With two fans removed, an overtemperature condition will develop unless a second operational fan is installed.

---

**Table 8-11 Removing a Fan**

---

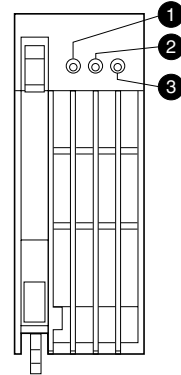
1. Determine the specific fan to remove (see Figure 8-1).
  2. Push up on the release tab and lower the lever.
  3. Remove the fan from the enclosure.
- 

---

**Table 8-12 Installing a Fan**

---

1. Press the release tab and pivot the lever.
2. Insert the fan until its lever engages the enclosure.
3. Lift the lever upward until the lever locks.
4. If enclosure power is applied, verify that the fan power status LED **1** turned ON.



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---

## Array Controllers and Cache Modules

The enclosure accommodates either a single or a dual array controller configuration. For each array controller installed, a corresponding cache module must also be installed. For dual redundant array controller configurations with FRUTIL support, follow pluggable procedures; otherwise, follow power-off procedures. See Figure 8-10 for array controller and cache module locations within the enclosure.

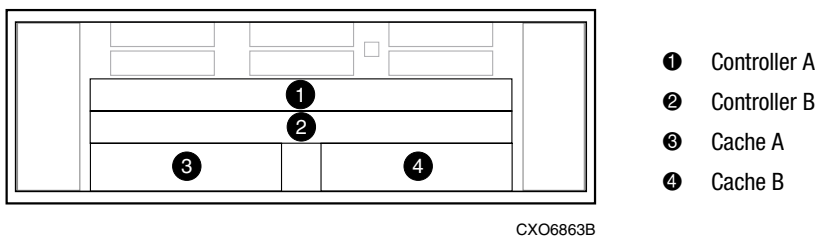


Figure 8-10. Array controller and cache module locations

See Figure 8-11 and Figure 8-12 during the removal process.

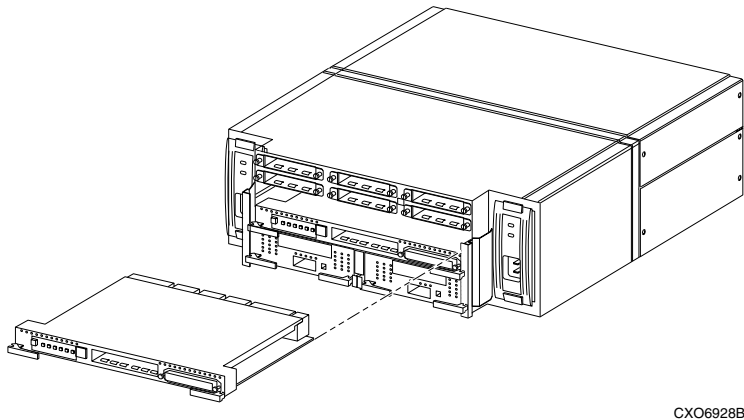
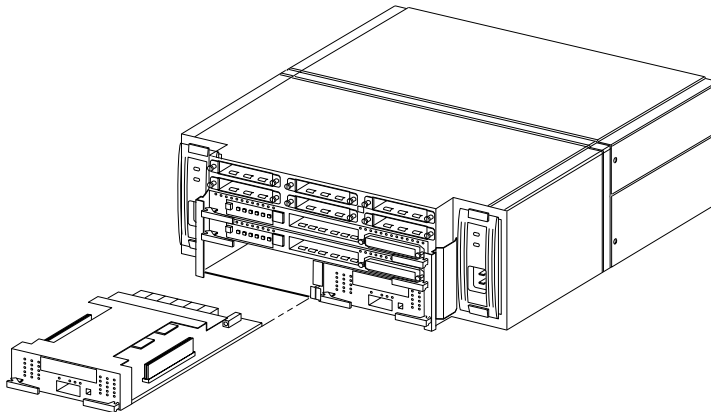


Figure 8-11. Array controller removal and installation



CXO6929B

Figure 8-12. Cache module removal and installation



**WARNING:** When both array controller bays or a cache module bay is empty, a shock hazard exists on the backplane. *Do not* touch the backplane. Always install a blank panel in any bay not currently in use.



**CAUTION:** If a conflict exists between the replacement procedures within this document and those within array controller-specific documentation, use procedures in the array controller documentation.

## Removing an Array Controller or Cache Module

Table 8-13 provides the procedure for removing an array controller or cache module.

**Table 8-13 Removing an Array Controller or Cache Module**

1. Refer to array controller documentation for pluggable procedures and replace the element. Otherwise, proceed to step 2 for power-off procedures.
2. Disconnect any cabling attached to the element.
3. Simultaneously pull outward on the two extractor latches to remove the element.
4. To remove a second element, repeat step 2 and step 3.



## Installing an Array Controller or Cache Module

Enclosure bays for array controller and cache sets are matched. Compaq recommends installing a single-set configuration into Controller A and Cache A bays (see Figure 8-10). For dual redundant configurations, both controller and cache bays are occupied.

**NOTE:** An ECB is *required* for each array controller and cache set installed.

Table 8-14 provides procedures for installing an array controller or cache module. For additional, detailed instructions on installing the array controller, cache module, and cabling, refer to array controller documentation.

**NOTE:** After all enclosure elements are installed and power is applied to the enclosure, refer to the array controller documentation to configure the array controllers for Ultra SCSI operation.

---

**Table 8-14 Installing an Array Controller or Cache Module**

---

1. Refer to array controller documentation for pluggable procedures and install the element. Otherwise, proceed to step 2 for power-off procedures.
  2. Insert the element into the bay and push the element in until the extractor latches engage the enclosure.
  3. Push inward on the extractor latches to firmly seat the element.
  4. Configure element cabling using the array controller documentation.
  5. To install a second element, repeat step 2 through step 4.
-

# *Appendix A*

## **Regulatory Notices**

This appendix lists country-specific regulatory standards with which this product complies.

### **Federal Communications Commission Rules and Regulations: Part 15**

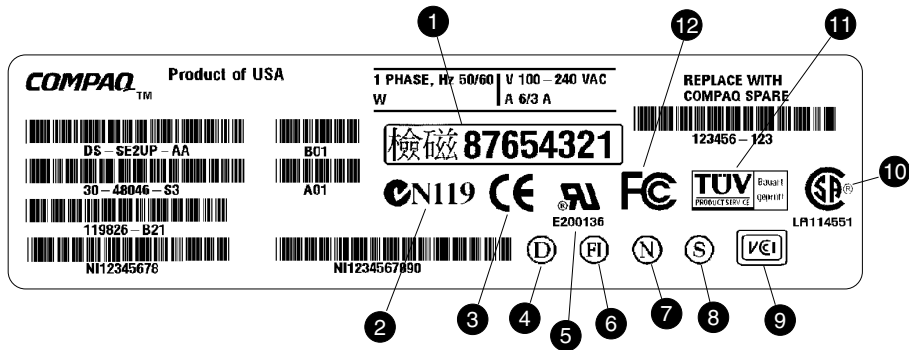
Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. The FCC requires devices to bear a label indicating its interference potential.

### **Electromagnetic Compatibility (EMC) Certification**

The equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against interference when the equipment is operated in a commercial environment. The equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

## Country-Specific Certifications

Compaq tests all the electronic devices in its product for compliance with various country-specific regulatory requirements. A product label specifies the regulation with which the product complies. Each element, enclosure, and rack that requires certification displays a product label similar to the one in Figure A-1.



CXO6892A

- |  |  |
|--|--|
| ① Taiwan EMC and Safety BCIQ                         | ⑦ Norway Safety (NEMKO)                    |
| ② Australia C-Tick EMC                               | ⑧ Sweden Safety (SEMK)                     |
| ③ Europe: CE-Mark EMC and Safety Declaration         | ⑨ Japan VCCI Class B                       |
| ④ Denmark Safety (DEMCO)                             | ⑩ Canada CSA                               |
| ⑤ USA Underwriter's Laboratory component recognition | ⑪ Germany TÜV Product services recognition |
| ⑥ Finland Safety (FIMKO)                             | ⑫ USA FCC Class B                          |

Figure A-1. Product label showing country-specific certifications

**NOTE:** The certification symbols on the label depend upon the certification level.

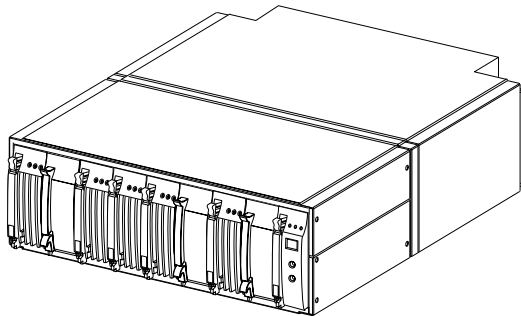
For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol—shown in Figure A-1, ⑫.

Other symbols that change based upon the product or certification level include: ① and ⑨.

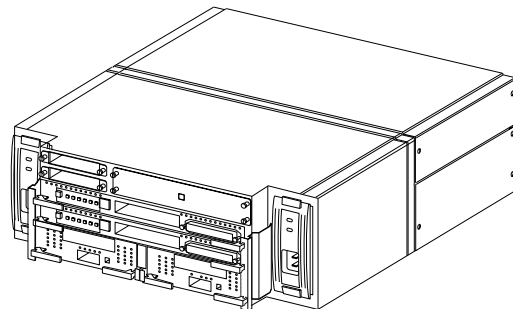
# Appendix *B*

## Enclosure Specifications

This appendix defines the physical, electrical, and environmental specifications for the Compaq StorageWorks Model 2100 and 2200 Ultra SCSI controller enclosures (shown in Figure B-1 and Figure B-2, respectively).

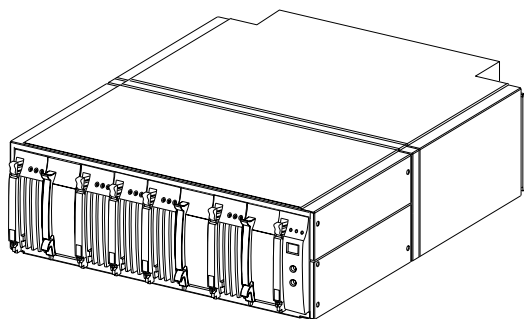


CXO6321D

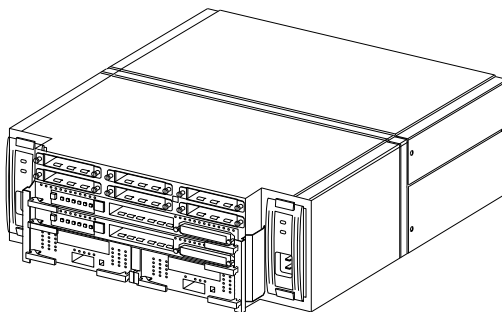


CXO7235A

Figure B-1. Model 2100 controller enclosure



CXO6321D



CXO6322C

Figure B-2. Model 2200 controller enclosure

**NOTE:** The operating and servicing physical specifications, as well as the electrical specifications, for the Ultra SCSI controller enclosure are rack- and configuration-specific.

## Physical and Electrical Specifications

Table B-1 provides enclosure physical specifications.

Table B-1 Physical Specifications				
Item	Height	Width	Depth	Weight
Enclosure	150 mm (5.9 in)	445 mm (17.5 in)	558 mm (22.0 in)	Empty:
				12.2 kg (27.1 lb)
				Full <sup>1</sup> :
				26.6 kg (59.0 lb)
EMU	122 mm (4.8 in)	46 mm (1.8 in)	254 mm (10 in)	0.9 kg (1.9 lb)
ECB	114 mm (4.5 in)	46 mm (1.8 in)	244 mm (9.6 in)	1.6 kg (3.6 lb) <sup>2</sup>
Fan	114 mm (4.5 in)	46 mm (1.8 in)	244 mm (9.6 in)	1 kg (2.2 lb)
I/O module	15 mm (0.6 in)	91 mm (3.5 in)	254 mm (10 in)	0.1 kg (0.3 lb)

**Table B-1 Physical Specifications (Continued)**

Item	Height	Width	Depth	Weight
180 W power supply	122 mm (4.8 in)	46 mm (1.8 in)	216 mm (8.5 in)	1 kg (2.1 lb)
Controller module	25 mm (1.0 in)	312 mm (12.3 in)	269 mm (10.6 in)	1.3 kg (3.0 lb)
Cache module	43 mm (1.7 in)	142 mm (5.6 in)	269 mm (10.6 in)	0.5 kg (1.2 lb)

1. Full compliment of elements (includes two array controllers and two cache modules)
2. ECB weight with battery pack installed

Table B-2 provides the electrical specifications for the enclosure.

**Table B-2 Electrical Specifications**

Item	Specification
Input voltage	100 to 240 V rms (110 to 240 VAC) 1.2 A @ 220 to 240 VAC, 50 Hz 2.5 A @ 110 to 120 VAC, 60 Hz
DC output voltages	12 VDC nominal 10.0 A <i>maximum</i> continuous 5.0 VDC nominal 12.0 A <i>maximum</i> continuous Maximum Load: 180 W

Table B-3 identifies enclosure electrical specifications to assist in planning the size and type of UPS for power monitoring.

**Table B-3 Enclosure UPS Specifications**

Item	Specification
Enclosure power drain	125 Voltamps
Minimum UPS battery life required to clear the cache	12 Minutes

## Environmental Specifications

The operating environmental specifications are listed in Table B-4 and the nonoperating environmental specifications are listed in Table B-5. These specifications are the same as for all *Compaq* storage devices.

**Table B-4 Operating Environmental Specifications**

Condition	Specification
Ambient temperature	+10 °C to +35 °C (+50 °F to +95 °F) Derate for altitude 0.5 °C per 300 m to 3000 m (1 °F per 1000 ft to 10,000 ft)
Relative humidity	10% to 90% at a maximum wet bulb temperature of 28 °C (82 °F)
Air quality	No to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air

**Table B-5 Nonoperating Environmental Specifications**

Condition	Specification
<b>Storage (Up to 1 Year)</b>	
Ambient temperature	-20 °C to +60 °C (-4 °F to +140 °F) up to 3000 m (10,000 ft)
Relative humidity	10% to 95% at a maximum wet bulb temperature of 29 °C (84 °F)
<b>Shipping (Up to 72 Hours)</b>	
Ambient temperature	-40 °C to +60 °C (-40 °F to +140 °F) up to 9100 m (30,000 ft)
Relative humidity	10% to 90% at a maximum wet bulb temperature of 30 °C (86 °F)

# Appendix *C*

## Preparing an Enclosure for Use

The enclosure might arrive without some elements installed. Compaq recommends using the assembly sequence in this appendix to ensure a safe and orderly installation process.



**WARNING:** With a full complement of devices installed, the enclosure weighs approximately 27.4 kg (60.6 lb). To prevent personal injury:

- Always mount an empty enclosure into a rack prior to installing enclosure devices.
  - Use two people to lift, align, and insert the enclosure into a rack.
- 

This appendix identifies the recommended enclosure element installation and connection sequence.

### Initial Assembly Procedures

The actual procedures for removing and installing enclosure elements are described within Chapter 8. Therefore, rather than repeating the installation procedures, the following sections primarily address special assembly steps and considerations.



## Removing Elements

Refer to the procedures listed in Table C-1 to remove each element. *Do not* remove the I/O modules.

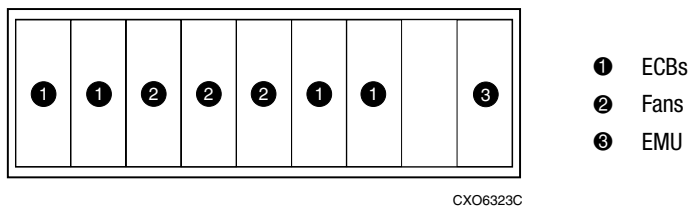
Table C-1 Procedural References for Removing Elements	
Element to Remove...	Go to Procedural Reference...
EMU	Table 8-2 on page 5
Power supply	Table 8-6 on page 8
ECB	Table 8-10 on page 14
Fan	Table 8-11 on page 15

## Installing the Enclosure

After removing the elements listed in Table C-1, install the *empty* enclosure using rack documentation. Then return to this document and continue with the assembly instructions contained in the following sections.

## Installing Enclosure-Front Elements

Four types of elements are installed in the enclosure front—the EMU, ECB, and fans (see Figure C-1).



CXO6323C

Figure C-1. Enclosure-front element locations

Follow the specific installation procedure for each element as required:

- Install the EMU using Table 8-3.
- Install all ECBs and blanks using Table 8-9. Cache A requires an ECB in bay A1 or A2. Cache B requires an ECB in bay B1 or B2.
- Install all three fans using Table 8-12.

## Installing Array Controllers and Cache Modules

The enclosure accommodates either a single or dual array controller configuration. For each array controller installed, a corresponding cache module and ECB must also be installed.

Install all array controllers, cache modules, and blanks (if applicable) using Table 8-14.

## Connecting Ultra SCSI Bus Cables and Host Cabling

Ultra SCSI bus cables connect the enclosure to as many as six disk enclosures. Host cabling connects the enclosure to a host computer or host adapter.

### Ultra SCSI Bus Cables

Bus cables connect to enclosure I/O modules (see Figure C-2). See Chapter 1, Table 1-3 for available cable lengths.

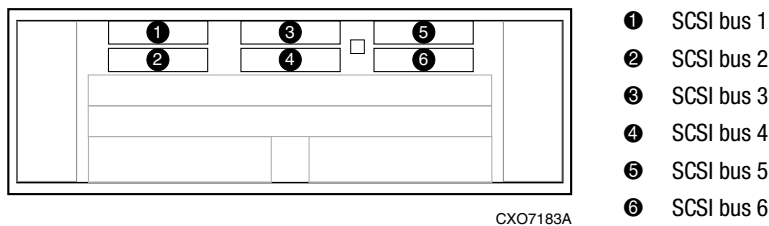


Figure C-2. I/O module mounting locations

**NOTE:** Model 2100 enclosures use HSG60 array controllers, which support only two I/O modules—SCSI bus 1 ❶ and SCSI bus 2 ❷; whereas Model 2200 enclosures use HSG80 array controllers, which support all six I/O modules. For Model 2100 enclosures, a blank panel covers the four vacant I/O module bays.

Complete the procedure in Table C-2 to connect the Ultra SCSI bus cables.

---

**Table C-2 Installing Ultra SCSI Bus Cables**

---

1. Connect the bus cable to the I/O module connector.
  2. Tighten two bus cable jackscrews.
  3. Connect the opposite end of the bus cable to a disk enclosure.
  4. Repeat steps 1 through 3 to connect other bus cables.
- 

### Host Cables

Refer to the array controller documentation for procedures on connecting the enclosure to a host. Cable connection procedures might include:

- Controller-to-controller
- Controller-to-host

## Installing the Power Supplies

Before installing the power supplies, read the following Caution and Note.



**CAUTION:** The enclosure immediately turns ON when AC source power is applied to the enclosure.

---

**NOTE:** Before applying AC power to the enclosure, completely configure the entire subsystem (including the host and array controller cabling) as described in the appropriate publications.

Install all power supplies using Table 8-7.

## Configuring the Enclosure

See Chapter 2 for general configuration rules. Then configure the array controllers using array controller documentation.

# Appendix *D*

## Error Code Data

The enclosure SCSI target ID address, horn mode, and error code displays are presented in an alphanumeric format on the EMU seven-segment alphanumeric display. All error codes are defined as fatal or nonfatal. Fatal indicates an EMU failure. Nonfatal indicates a fault condition that requires user intervention to resolve the problem. This appendix briefly defines both types of error codes. Chapter 3 describes the EMU in more detail.

The following general rules apply to displaying the ID address and error codes:

- The default SCSI target ID (**id**) address is disabled (--).
- CRU types range from **00** through **07**. Two decimal points are used, one after each character.
- Error codes range from **01** through **05**. One decimal point is used after the second character.
- The EMU alphanumeric display presents all types of error conditions.
- The GUI displays *nonfatal* (unrecoverable, critical, noncritical, and informational) error codes.
- The alphanumeric display sequence is as follows:
  - Data for **id** is the default display—unless an error occurs, then the display is **Er**
  - **id, Ho, Er** (if an active error exists), and repeats
  - All active error codes are displayed in priority sequence and ordered using a timestamp (oldest first)

- For clarity, the valid alphabetical characters displayed are as follows:
  - **A, C, E, F, G** (displayed as □), **H, J, L, P, and U**
  - **b, d, h, i, n, o, r, t** (displayed as □), and **y** (displayed as □)

## Alarms

Error alarms can be categorized as either *fatal* (EMU reset required) or *nonfatal* (user interaction required).

### Fatal Error Alarms

Detection of a fatal alarm means that the EMU is not operating properly. The EMU attempts to clear the error by resetting itself.

**NOTE:** Resetting of the EMU does not impact data storage functionality.

Whenever an EMU failure is detected, the following occurs:

- **FE** is displayed on the alphanumeric display
- The audible alarm sounds a 2-second steady tone and then three to five beeps
- The EMU resets
- **00** is displayed on the alphanumeric display after the EMU resumes normal operations

### Nonfatal Error Alarms

The EMU monitors enclosure and element operations and alerts the user to various error conditions that might impact enclosure functionality. Each nonfatal error condition is assigned an alarm severity level of either unrecoverable, critical, noncritical, or informational.

Two things determine the error condition display sequence: the alarm severity and order of occurrence by time. For example, all unrecoverable alarms are displayed before any other alarm. When there are no unrecoverable alarms, critical error alarms have priority. Each succeeding alarm level has priority over the lower levels, but only if no active, higher-level alarms exist.

Any *nonfatal* alarm establishes the following conditions:

- EMU alphanumeric display indicates Er
- Sounding of the audible alarm—unless disabled or muted
- The increment switch LED is ON, unless viewing the last error in the active list, then the increment switch turns OFF.
- If the audible alarm is muted, the group switch LED remains ON until all alarms are cleared. If the audible alarm is disabled, the group switch LED will always be ON.

## Unrecoverable Alarm

This alarm occurs if one or more enclosure elements have *failed*, disabling some enclosure functionality. The enclosure might be incapable of recovering or bypassing the failure and requires repair to correct the condition. *Immediate corrective action is required.*

**NOTE:** The EMU alphanumeric display presents all errors. *The GUI does not display fatal errors.*

This alarm establishes the following conditions:

- Maintains highest precedence over all other alarms.
- Sounds the unrecoverable alarm tone (constant tone).
- If **Ho** alarm mode is **En** and the audible alarm is muted, then the audible alarm becomes *unmuted* and sounds the unrecoverable alarm tone.
- If **Ho** alarm mode is **En**, either the unrecoverable alarm tone sounds or, if disabled (**di**) or muted, the group switch LED turns ON.

## Critical Alarm

This alarm occurs if one or more enclosure elements have failed or operate outside of their specifications. These failures make normal enclosure operations of *at least some elements* impossible.

This *caution report* indicates that implementing corrective action can prevent the condition from escalating to an unrecoverable condition.

This alarm establishes the following conditions:

- Only unrecoverable alarms take precedence over this alarm.
- Maintains precedence over noncritical and informational alarms.

- Sounds the critical alarm tone (alarm toggles ON and OFF, sounding three beeps every 2 seconds).
- If **Ho** alarm mode is **En** and the audible alarm is muted at a lower error level, then the audible alarm becomes *unmuted* and sounds the critical alarm tone.
- If **Ho** alarm mode is **En**, either the critical alarm tone sounds or, if disabled (**di**) or muted at this level, the group switch LED turns ON.

## Noncritical Alarm

This alarm occurs if one or more enclosure elements have failed or operate outside of their specifications. These failures *do not* affect normal enclosure operations. If additional noncritical failures occur, the ability of enclosure devices to operate correctly might be reduced.

This *error report* indicates that implementing corrective action can prevent this condition from escalating to a critical condition.

This alarm establishes the following conditions:

- Unrecoverable and critical alarms take precedence over this alarm.
- Maintains precedence over informational alarms.
- Sounds the noncritical alarm tone (two short beeps that repeat every 2 seconds).
- If **Ho** alarm mode is **En** and the audible alarm is muted at a lower error level, then the audible alarm becomes *unmuted* and sounds the noncritical alarm tone.
- If **Ho** alarm mode is **En**, either the critical alarm tone sounds or, if disabled (**di**) or muted at this level, the group switch LED turns ON.

## Informational Alarm

Certain error conditions do not significantly affect enclosure operations. However, knowing that a error condition exists allows the user an opportunity to implement corrective action before an element failure occurs.

This alarm establishes the following conditions:

- All other alarms take precedence over this alarm
- Sounds the informational alarm tone (one short beep that repeats every 2 seconds)
- If **Ho** alarm mode is **En** and the audible alarm is muted at this level, only a higher level alarm will unmute the audible alarm.

- If **Ho** alarm mode is **En**, either the informational alarm tone sounds or, if disabled (**di**) or muted at this level, the group switch LED turns ON.

## Alarm Reminder Tones

The constant sounding of the various alarm tones become annoying after a couple of minutes. To insert a pause between the repeating 2-second alarm tone sequence, activate the “remind” option from the GUI. Table D-1 distinguishes the normal alarm tones and the remind tones.

<b>Alarm Type Name</b>	<b>Normal Alarm Tone</b>	<b>Remind Tone</b>
Unrecoverable	Steady tone	2-second steady tone followed by a 30-second pause
Critical	1-second steady tone at 2-second intervals	Three beeps followed by a 30.5-second pause
Noncritical	Two beeps at 2-second intervals	Two beeps followed by a 31.5-second pause
Informational	One beep at 2-second intervals	One beep followed by a 31.5-second pause



## Error Codes

Three enclosure elements are assigned a unique, two digit element ID number (see Table D-2) for error code purposes. IDs that are part of the error code format as explained in this section.

<b>Active IDs</b>	<b>Enclosure Element</b>
<b>02.01.–02.02.</b>	Power supplies
<b>03.01.–03.03.</b>	Fans
<b>0.7.01.</b>	EMU
All other IDs reserved for future use.	

### Error Display Timing

Error codes are displayed for a minimum of 15 seconds from the time the error is reported or until the error is corrected, allowing the user time to identify the problem. Each alarm report initiates the 15 second time out, ensuring that when there are multiple errors or a recurring error, the code is displayed. The complete alarm report is stored and can be recalled using a combination of the increment and the group switches.

### Error Code Format

The alphanumeric display error condition displays are in the format **CRU Tupe Element Number Error Code**. For example, **0.3. 02. 04** indicates an insufficient cooling air for Fan 2.

**NOTE:** The periods in the display identify the error display level.

The CRU type display has a period *after each digit*.

The element number display has a period *after the second digit*.

The error code display has *no periods*.

## Correcting Problems

Correcting an error condition might require the user to perform a specific set of actions. In some cases, the only corrective action is to replace the element. However, for any error condition the user should:

1. Record the error code.
2. Implement the recommended corrective action.
3. If there is no corrective action, or if the corrective action does not correct the problem, contact customer support.

## Error Code List

The error codes listed in Table D-3 identify each potential error code, its criticality and cause, and corrective action for resolving the error. The “\*\*” indicates that more than one element can cause this error code to occur. In an actual error code, a numeric value for the responsible element replaces the “\*\*.” The element indicated by this value is identified within the problem definition/corrective action for each error code.

**Table D-3 Error Code List**

Error Code	Problem Definition/Corrective Action
0.2. **. 01	<p><b>Noncritical</b>—Two error possibilities:</p> <ul style="list-style-type: none"> <li>■ Power supply error. No AC power supplied to the power supply. Make sure the AC power cord is connected to the power supply. Make sure AC power is applied to the AC input power cord that connects to the power supply.</li> <li>■ High voltage alert. Verify that AC input power levels are within tolerances. Replace power supply soon.</li> </ul> <p>** = “01.” for PS1 or “02.” for PS2</p>
0.2. **. 02	<p><b>Critical</b>—High voltage error. Verify that AC input power levels are within tolerances. Replace power supply now.</p> <p>** = “01.” for PS1 or “02.” for PS2</p>
0.2. **. 03	<p><b>Noncritical</b>—Low voltage alert. Verify that AC input power levels are within tolerances. Replace power supply soon.</p> <p>** = “01.” for PS1 or “02.” for PS2</p>
0.2. **. 04	<p><b>Critical</b>—Low voltage error. Verify that AC input power levels are within tolerances. Replace power supply now.</p> <p>** = “01.” for PS1 or “02.” for PS2</p>

**Table D-3 Error Code List (Continued)**

<b>Error Code</b>	<b>Problem Definition/Corrective Action</b>
<b>0.3. **. 03</b>	<b>Noncritical</b> —Fan failure error. Replace the fan now. **. = “01.” for Fan1, “02.” for Fan2, or “03.” for Fan3.
<b>0.3. **. 04</b>	<b>Noncritical</b> —Fan missing error. Insufficient enclosure cooling. Install a fan soon. **. = “01.” for Fan1, “02.” for Fan2, or “03.” for Fan3.
<b>0.3. **. 05</b>	<b>Unrecoverable</b> —Fan missing failure. Insufficient enclosure cooling. Install a fan now. **. = “01.” for Fan1, “02.” for Fan2, or “03.” for Fan3.
<b>0.4. **. 01</b>	<b>Noncritical</b> —High Temperature alert. Check for an empty bay or for a high operating environment ambient air temperature. Fill any open bay with the required element or blank bezel. Reduce the operating environment ambient air temperature to within environmental specifications (see Appendix B). **. = “01.” for PS1, “02.” for PS2, or “03” for EMU
<b>0.4. **. 02</b>	<b>Critical</b> —High Temperature error. Check for an empty bay or for a high operating environment ambient air temperature. Fill any open bay with the required element or blank bezel. Reduce the operating environment ambient air temperature to within environmental specifications (see Appendix B). **. = “01.” for PS1, “02.” for PS2, or “03” for EMU
<b>0.4. **. 03</b>	<b>Noncritical</b> —Low Temperature alert. Check for low operating environment ambient air temperature. Fill any open bay with the required element or blank bezel. Increase the operating environment ambient air temperature to within environmental specifications (see Appendix B). **. = “01.” for PS1, “02.” for PS2, or “03” for EMU
<b>0.4. **. 04</b>	<b>Critical</b> —Low Temperature error. Check for low operating environment ambient air temperature. Fill any open bay with the required element or blank bezel. Increase the operating environment ambient air temperature to within environmental specifications (see Appendix B). **. = “01.” for PS1, “02.” for PS2, or “03” for EMU

# Glossary

This glossary defines terms pertaining to the Compaq StorageWorks Model 2200-Series Ultra SCSI controller enclosure and associated equipment.

<b>ACS</b>	Array controller software. Software designed to operate an array controller.
<b>active</b>	The disk drive CRU is spinning up, or down, or transferring data to or from the array controller.
<b>ambient temperature</b>	The temperature of the air surrounding the rack, enclosure, or CRU that dissipates the heat generated by the device. Also referred to as the intake air temperature.
<b>array controller</b>	A stand-alone device that connects a host adapter to the storage SCSI bus. This device provides RAID functionality, typically has multiple SCSI bus ports, performs the lower layers of the SCSI protocol, and normally operates in the initiator role.  Also referred to as controller or SCSI bus controller.
<b>array controller software</b>	<i>See ACS.</i>
<b>backplane</b>	The electronic printed circuit board mounted in the center of the enclosure. This board contains the ECB, fan, EMU, power supply, I/O module, array controller, and cache module connectors.

<b>blank panel</b>	<p>A panel used to cover open, unused areas in a enclosure for either EMI suppression, air flow control, or cosmetic purposes.</p> <p>Blank panels normally cover empty array controller, cache module, and I/O module bays.</p>
<b>cable connector</b>	<p>Any connector that is physically part of a cable assembly attached to backplanes or other nondevice connectors.</p>
<b>cache module</b>	<p>A fast storage buffer.</p>
<b>CE-Mark</b>	<p>A European Economic Community (EEC) certification label that identifies electronic devices authorized for sale within member nations.</p>
<b>CE-Mark Class A</b>	<p>Similar to, but more stringent than the FCC Class A certification, this certification label is displayed on electronic devices that are for use in a commercial environment. A CE-Mark certified device can also be used in the United States.</p>
<b>channel</b>	<p>Another term for a SCSI bus.</p> <p><i>See also</i> <b>SCSI bus</b>.</p>
<b>CRU</b>	<p>Customer replaceable unit.</p>
<b>device</b>	<p>The targets, initiators, hubs, converters, bus expanders, and similar devices interconnected to form a SCSI bus. Connectors, expanders, and hubs do not use a SCSI bus ID.</p> <p><i>See also</i> <b>node</b>.</p>
<b>di</b>	<p>An EMU alphanumeric display code representing “disabled.” An option that disables the audible alarm horn or establishes the default SCSI target ID address (id).</p> <p><i>See also</i> <b>Ho</b> and <b>id</b>.</p>
<b>disk</b>	<p>A storage device supporting random access to fixed size blocks of data.</p>
<b>ECB</b>	<p>External cache battery. A device that protects the contents stored in cache memory modules for a limited amount of time using backup battery power.</p>
<b>EIA</b>	<p>Electronics Industries Association. Formerly known as RETMA.</p>
<b>electromagnetic interference</b>	<p><i>See</i> <b>EMI</b>.</p>

<b>Electronics Industries Association</b>	<i>See</i> EIA.
<b>electrostatic discharge</b>	<i>See</i> ESD.
<b>EMI</b>	Electromagnetic interference. The impairment of a signal by an electromagnetic disturbance.
<b>EMU</b>	Environmental Monitoring Unit. The device that monitors the status of the Ultra SCSI RAID enclosure to include power, intake air temperature, fan status, and so forth, detects error and fault conditions, displays these conditions, reports the conditions to the user and the array controller, and, in some cases, implements corrective actions.
<b>En</b>	An EMU alphanumeric display code representing “enabled.” An option that enables the audible alarm horn. <i>See also</i> <b>Ho</b> .
<b>environmental monitoring unit</b>	<i>See</i> EMU.
<b>ESD</b>	Electrostatic discharge. The discharge of a potentially harmful static electric voltage as a result of improper grounding.
<b>external cache battery</b>	<i>See</i> ECB.
<b>fan</b>	An airflow device mounted in a StorageWorks enclosure.
<b>FAST 10</b>	Wide SCSI. Establishes a maximum wide transfer rate of 20 MB/s.
<b>FAST 20</b>	<i>See</i> Ultra SCSI.
<b>FCC</b>	Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.
<b>FCC Class A</b>	This certification label is displayed on electronic devices for use only in a commercial environment within the United States. A CE-Mark certified device can be used in the United States in the same environment as the equivalent FCC certification.

<b>Federal Communications Commission</b>	<i>See</i> <b>FCC</b> .
<b>field replacement utility</b>	<i>See</i> <b>FRUTIL</b> .
<b>FRUTIL</b>	Field replacement utility. Used to replace some elements within a controller enclosure without shutting down the subsystem (in a dual redundant configuration).
<b>graphical user interface</b>	<i>See</i> <b>GUI</b> .
<b>GUI</b>	Graphical user interface. A graphical display presented on a monitor screen.
<b>Ho</b>	An EMU alphanumeric display SCSI target ID address representing “horn” (Ho). From this address the audible alarm horn can be disabled (di) or enabled (En). <i>See</i> <b>di</b> and <b>En</b> .
<b>host</b>	The primary or controlling computer (in a multiple computer network) to which storage is attached.
<b>host adapter</b>	A device that connects the host system I/O bus (for example, a PCI bus) to the storage SCSI bus. A host adapter performs the lower layers of the SCSI protocol and normally operates in the initiator role.
<b>host computer</b>	<i>See</i> <b>host</b> .
<b>host controller</b>	A device that connects the host system I/O bus (for example, a PCI bus) to the storage SCSI bus. A host controller provides RAID functionality, typically has multiple SCSI bus ports, performs the lower layers of the SCSI protocol, and normally operates in the initiator role.
<b>hot-pluggable</b>	A method of device replacement whereby the complete system remains online and active during device removal or insertion. The device being removed or inserted is the only device that cannot perform operations during this process. <i>See also</i> <b>pluggable</b> .
<b>I/O module</b>	Input/output module. A SCSI enclosure or storage enclosure device that integrates a single-ended SCSI bus with either an 8-bit single-ended, 16-bit single-ended, or 16-bit differential SCSI bus.

<b>id</b>	SCSI target ID default address for the Multivendor EMU. <i>See also SCSI target ID.</i>
<b>ID</b>	Identifier. As used in SCSI bus ID, SCSI ID or device ID.
<b>identifier</b>	<i>See ID.</i>
<b>input/output module</b>	<i>See I/O module.</i>
<b>LED</b>	Light-emitting diode. A semiconductor diode that emits light when voltage is applied. Typically used on indicator panels to display an operating status.
<b>light-emitting diode</b>	<i>See LED.</i>
<b>maintenance terminal</b>	The operator terminal used to identify an HS-family controller, to enable its host paths, to define its subsystem configuration, and to check its status. The HS-family maintenance terminal accepts any terminal conforming to EIA-423. Use the maintenance terminal to configure a storage subsystem.
<b>MB/s</b>	Megabytes per second. The per second byte transfer rate with a binary multiplier of 1,024,000.  The bus width (8- or 16-bit), the number of bytes per word (1 or 2, respectively), and the bus clock frequency determines the transfer rate in MB/s.
<b>megabytes per second</b>	<i>See MB/s.</i>
<b>node</b>	A SCSI bus target or initiator that uses a SCSI bus ID. For example, disk drives, tape drives, array controllers, and adapters all have a SCSI bus ID and are nodes. Hubs, expanders, and converters are devices and do not have a SCSI bus ID.  An Ultra SCSI bus can have a maximum of 16 nodes (SCSI bus addresses 0 through 15).  A narrow bus can have a maximum of eight nodes (SCSI bus addresses 0 through 7).
<b>overtemperature</b>	A condition where the temperature is above a specified limit and can cause equipment failure if not corrected.



- pluggable** A method of device replacement whereby the complete system remains online during device removal or insertion. There are no data transfers over the enclosure bus during removal or installation of an element (the bus is “quiesced”). System booting or code loading cannot occur until insertion of the replacement device. There is no noticeable impact on user applications that are not dependent upon the devices on the affected SCSI bus.  
*See also hot-pluggable.*
- port** A logical route for data in and out of an array controller. A port can contain one or more channels, all of which contain the same type of data.
- power supply** A power supply that provides +5 VDC and +12 VDC to StorageWorks enclosures. These supplies can be either AC input (120 VAC) or DC input (48 VDC).
- quiescing** To make a bus inactive, still, quiet, or dormant.
- rack** Another term for cabinet. A means for storing enclosures, power system elements, and cabling.
- Radio Electronics Television Manufacturing Association.** *See RETMA.*
- RAID** Redundant array of independent disks. A set of storage techniques devised to increase the performance and availability of a storage subsystem.
- redundant array of independent disks** *See RAID.*
- RETMA** Radio Electronics Television Manufacturing Association. Currently known as the EIA.  
*See also EIA.*
- SCSI** Small computer system interface. This ANSI interface defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of seven devices.
- SCSI target ID** An address given to the EMU in a shelf or enclosure that might be connected to an SCSI-3 Enclosure Services (SES) network.  
*See also id.*

<b>single-ended bus</b>	A bus in which the voltage of a single wire in relation to ground determines each signal's logic level.
<b>small computer system interface</b>	<i>See</i> SCSI.
<b>StorageWorks</b>	The set of enclosure products that allows customers to design and configure their storage subsystem. Components include power, packaging, and interconnections in a StorageWorks enclosure. SBBs and array controllers are integrated therein to form storage subsystems. System-level enclosures to house the enclosures and standard mounting devices for SBBs are also included.
<b>target</b>	A SCSI device that performs an operation requested by an initiator.
<b>terminator</b>	<p>The interconnect component that form the ends of the transmission lines in bus segments. A SCSI domain must have at least one segment and therefore at least two terminators. The terminators ensure that inactive SCSI bus signals are in a known state.</p> <p>There are two basic types of terminators—active and passive:</p> <ul style="list-style-type: none"><li>• Single-ended bus segments use active, linear terminators.</li><li>• Differential bus segments use a passive (linear totem pole) terminators except for special cases where the electrical transmission lines are very short and only one termination or pull-up is required.</li></ul>
<b>UL</b>	Underwriters Laboratories. An organization that tests and certifies electrical devices.
<b>Ultra SCSI</b>	<p>An improvement in SCSI technology invented in 1993 by the Digital Equipment Corporation StorageWorks Engineering Group. Subsequently the ANSI SCSI standards committee issued standard X3T10 for Ultra SCSI.</p> <p>The Ultra SCSI improvements over Fast SCSI include the following:</p> <ul style="list-style-type: none"><li>• Maximum transfer rate increases from 10 Mb/s to 20 Mb/s</li><li>• Maximum wide bus bandwidth increases from 20 MB/s to 40 MB/s</li><li>• VHDCI cables and connectors are significantly thinner and smaller</li></ul> <p>Also known as FAST 20.</p>
<b>Underwriters Laboratories</b>	<i>See</i> UL.

**uninterruptable  
power supply**      *See UPS.*

**UPS**      Uninterruptable power supply. A battery-powered power supply that provides backup AC power whenever the primary AC power is lost. How long backup power is provided depends upon the UPS size and the equipment supported.

**very high density  
computer  
interconnect**      *See VHDCI.*

**VHDCI**      Very high density computer interconnect. A 68-pin interface with connectors on 0.8 mm centers. Required for Ultra SCSI.

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