

# Compaq StorageWorks

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## Enterprise Virtual Array Rack User Guide

Part Number: EK-E1RAK-UA. A01

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This publication is for use by individuals responsible for installing, operating, and maintaining the Compaq StorageWorks Enterprise Virtual Array Rack.

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# Contents

## About this Guide

Text Conventions . . . . .	vii
Symbols in Text . . . . .	ix
Symbols on Equipment . . . . .	ix
Rack Stability . . . . .	x
Getting Help . . . . .	x
Compaq Technical Support . . . . .	xi
Compaq Website . . . . .	xi
Compaq Authorized Reseller . . . . .	xi

## 1 Introducing the Enterprise Storage System Rack

An Overview of the Enterprise Storage System Racks . . . . .	1-1
Enterprise Storage System Configurations . . . . .	1-2
Basic Single-Rack Configuration . . . . .	1-3
Full Single-Rack Configuration . . . . .	1-4
Power Distribution . . . . .	1-5
PDUs . . . . .	1-7
PDMs . . . . .	1-8
HSV Controller Enclosures . . . . .	1-9
Fibre Channel Disk Drive Enclosures . . . . .	1-10
Doors . . . . .	1-11

## 2 Enterprise Storage System Configurations

6-Drive Enclosure Configuration . . . . .	2-2
12-Disk Drive Enclosure Configuration . . . . .	2-4

## 3 Enclosure Address Bus

Enclosure Address Bus Overview . . . . .	3-1
Drive Enclosures . . . . .	3-3
Controller Enclosures . . . . .	3-3

Enclosure Address Bus Connections . . . . .	3-4
<b>4 Power Distribution</b>	
An Overview of Rack AC Power Distribution . . . . .	4-1
PDU 1 . . . . .	4-3
PDU 2 . . . . .	4-3
PDUs . . . . .	4-4
PDMs . . . . .	4-6
<b>5 Troubleshooting Rack Operation</b>	
An Overview of Troubleshooting . . . . .	5-1
Troubleshooting a Rack . . . . .	5-2
Troubleshooting the Rack AC Power Distribution . . . . .	5-2
Troubleshooting PDU Failures . . . . .	5-3
Troubleshooting PDU AC Inputs . . . . .	5-3
Correcting an Overload Condition . . . . .	5-4
Troubleshooting PDM Failures . . . . .	5-5
Troubleshooting the Enclosure Address Bus . . . . .	5-6
Terminator Failures . . . . .	5-6
JB Failures . . . . .	5-7
Single Enclosure Address Bus Failures . . . . .	5-7
Drive Enclosure Failure . . . . .	5-8
Controller Enclosure Failure . . . . .	5-8
Removing and Installing a Rack Door . . . . .	5-12
<b>A Regulatory Notices</b>	
FCC Class A Certification . . . . .	A-1
Country-Specific Certifications . . . . .	A-2
<b>B Specifications</b>	
Physical Specifications . . . . .	B-1
Environmental Specifications . . . . .	B-2
Power Specifications . . . . .	B-3

**Glossary**

**Index**

**Figures**

1-1	6-drive enclosure storage system . . . . .	1-3
1-2	12-Drive enclosure storage system . . . . .	1-4
1-3	NEMA L6-30R receptacle, 3-wire, 30A, 60 Hz . . . . .	1-5
1-4	IEC 309 receptacle, 3-wire, 30A, 50 Hz . . . . .	1-5
1-5	Dual PDU assembly—top view . . . . .	1-7
1-6	Rack PDM . . . . .	1-8
1-7	HSV controller enclosure—front view . . . . .	1-9
1-8	HSV controller enclosure—rear view . . . . .	1-9
1-9	Fibre Channel disk drive enclosure—front view . . . . .	1-10
1-10	Drive enclosure—rear view . . . . .	1-10
1-11	Locking and unlocking a door . . . . .	1-11
2-1	6-drive enclosure storage system system layout . . . . .	2-3
2-2	12-Drive enclosure storage system layout . . . . .	2-5
3-1	Enclosure address bus . . . . .	3-2
3-2	Enclosure address bus components and connections . . . . .	3-4
3-3	Rack enclosure numbering . . . . .	3-5
4-1	Rack AC power distribution . . . . .	4-2
4-2	Dual PDU assembly major components . . . . .	4-4
4-3	Lowering a dual PDU assembly . . . . .	4-5
5-1	Removing and installing a door . . . . .	5-12
A-1	Typical enclosure certification label . . . . .	A-2

**Tables**

1	Text Conventions . . . . .	vii
2-1	6-drive Enclosure Storage System Configuration . . . . .	2-2
2-2	12-Disk Drive Enclosure Storage System Configuration . . . . .	2-4
5-1	Possible Enclosure Address Bus Failures . . . . .	5-9
B-1	Enterprise Storage System Rack Physical Specifications . . . . .	B-1
B-2	Environmental Operating Specifications . . . . .	B-2
B-3	Environmental Shipping or Short Term Storage Specifications . . . . .	B-2
B-4	Enterprise Storage System AC Power Specifications . . . . .	B-3



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# About this Guide

The following sections are covered:

- Text Conventions
- Symbols in Text
- Symbols on Equipment
- Rack Stability
- Getting Help
- Compaq Authorized Reseller

## Text Conventions

This document uses the conventions in Table 1 to distinguish elements of text.

**Table 1: Text Conventions**

Element	Convention	Examples
<ul style="list-style-type: none"><li>• <b>Named Keys</b></li><li>• <b>Key Sequences</b></li></ul>	<b>Bold</b>	<b>Home, Print Screen, Num Lock, Esc, PgUp</b> A plus sign (+) between two keys means that you should press them simultaneously: <b>Ctrl+A, Ctrl+Home, Alt+Ctrl+Del</b>
<ul style="list-style-type: none"><li>• Menu Items</li><li>• Directory Names</li><li>• Button Names</li><li>• Dialog Box Names</li></ul>	Initial Caps (for UNIX, AIX, and Solaris directory names, the exact case of every character is displayed).	On the File menu, choose Save. Save the file in the C:\StorageSets\Default directory. (UNIX, AIX, Solaris): Save the file in the /home/newuser/practice directory. To back up files, click the Backup Now button. In the Save As dialog box, choose the drive then the folder.

**Table 1: Text Conventions (Continued)**

Element	Convention	Examples
<ul style="list-style-type: none"> <li>• User Input and System Responses (Output and Error Messages)</li> <li>• COMMAND NAMES</li> <li>• Drive Names</li> </ul>	<p>Initial Caps and monospace font.</p> <p>COMMAND NAMES appear in upper case, unless they are case sensitive (UNIX, AIX, and Solaris command names are case sensitive and will not appear in uppercase).</p> <p>Entered &lt;variables&gt; are displayed in angle brackets (&lt; &gt;) and all lower case.</p>	<p>User Input and System Responses:</p> <ul style="list-style-type: none"> <li>• To exit from the program, type <code>Exit</code>.</li> <li>• At the prompt, type this command: <code>SHOW THIS_CONTROLLER</code> (no variable)</li> <li>• To see your settings, give the command: <code>SHOW &lt;storage sets&gt; FULL</code> (with variable)</li> <li>• You will see the <code>Continue?</code> message.</li> </ul> <p>Command Names</p> <ul style="list-style-type: none"> <li>• Use <code>SET THIS_CONTROLLER</code> to change parameters.</li> <li>• To manage storage, enter <code>RUN sysmgr.exe</code></li> <li>• (UNIX, AIX, Solaris): To list files, give the <code>ls</code> command.</li> <li>• Drive Names: Navigate to your CD-ROM drive (usually <code>D:</code> or <code>E:</code>).</li> </ul>
<i>filenames</i>	<p>Unless case sensitive, use <i>lowercase italics</i>. If filenames are case-sensitive (UNIX, AIX, Solaris) or are easier to understand with some upper case letters, the exact case of each character is displayed.</p>	<p>To configure storage, edit <i>storage set.ini</i>. Changes are stored in <i>NewSystemConfigurationFile.ini</i>. (UNIX, AIX, Solaris): Errors are logged to <i>MixedCaseFile.txt</i>.</p>
Menu Command Sequences	<p>Initial Caps, with a right angle bracket (&gt;) between items. Menu items are displayed as shown on screen.</p>	<p>To compare documents, choose: Tools &gt; Documents &gt; Compare.</p>
URLs	Sans serif font.	<a href="http://www.compaq.com/storage">http://www.compaq.com/storage</a>

## Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.



**WARNING:** Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life or damage to equipment.

---



**CAUTION:** Text set off in this manner indicates that failure to follow directions could result in damage to equipment or loss of information.

---

**IMPORTANT:** Text set off in this manner presents clarifying information or specific instructions.

**NOTE:** Text set off in this manner presents commentary, sidelights, or interesting points of information.

## Symbols on Equipment



Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

**WARNING:** To reduce the risk of injury from electrical shock hazards, do not open this enclosure.

---



Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

**WARNING:** To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

---



Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

**WARNING:** To reduce the risk of injury from a hot component, allow the surface to cool before touching.

---



Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

**WARNING:** To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the supplies and systems.

---



Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

**WARNING:** To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

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## Rack Stability



**WARNING:** To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
  - The full weight of the rack rests on the leveling jacks.
- 

## Getting Help

If you still have a question after reading this guide, contact a Compaq Authorized Service Provider or visit our website.

## Compaq Technical Support

In North America, call the Compaq technical support at 1-800-OK-COMPAQ. This service is available 24 hours a day, 7 days a week.

**NOTE:** For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call Compaq technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the Compaq website: <http://www.compaq.com>.

Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

## Compaq Website

The Compaq website has the latest information on this product as well as the latest drivers. Access the Compaq website at: <http://www.compaq.com/storage>.

## Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.



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# Introducing the Enterprise Storage System Rack

The Enterprise Virtual Array is a product that consists of one or more storage systems. A storage system consists of a pair of HSV controllers and the physical disk drives they manage. Each storage system is formally called an Enterprise Storage System. For the purposes of this manual, the name is frequently shorted to just “the storage system.”

This chapter discusses the Enterprise Storage System 42U racks, including major components, configurations, and uses.

## An Overview of the Enterprise Storage System Racks

The Compaq Model 9000 series rack provides the capability for mounting standard 483 mm (19 in) wide controller (Model 3220) and drive enclosures (Model 5214). The racks and rack-mountable enclosures are typically described using the vertical “U” measurements, where one “U” is 1.75 in (approximately 44 mm).

- The Enterprise Storage System drive enclosures are 3U, or 5.25 in (approximately 133 mm).
- The Enterprise Storage System controller enclosures are 1.5U, or 2.625 in (approximately 67 mm).

The rack has four feet and four casters. Raising the adjustable feet places the rack weight on the casters, so you can easily move the rack. Lowering the feet places the rack weight on the feet and prevents the rack from moving. The removable front and rear doors, and the removable side panels provide easy access to the rack interior.

Each configuration has an upper and lower controller enclosure (the controller pair), drive enclosures, and an expansion bulkhead. Each controller pair and all the associated drive enclosures form a single storage system.

## Enterprise Storage System Configurations

This section provides an overview of the standard Enterprise Storage System configurations. For detailed configuration information, including expansion and interconnection, refer to the *Enterprise Virtual Array Initial Setup User Guide*.

The system configuration depends on the following factors:

- The controller pair (Model HSV110)
- The number of 3U enclosures per rack

**NOTE:** Although the 42U Enterprise Storage System rack can accommodate a total of 14 3U enclosures, the maximum configuration supported by Compaq is 13 enclosures (1 controller enclosure pair, and 12-drive enclosures).

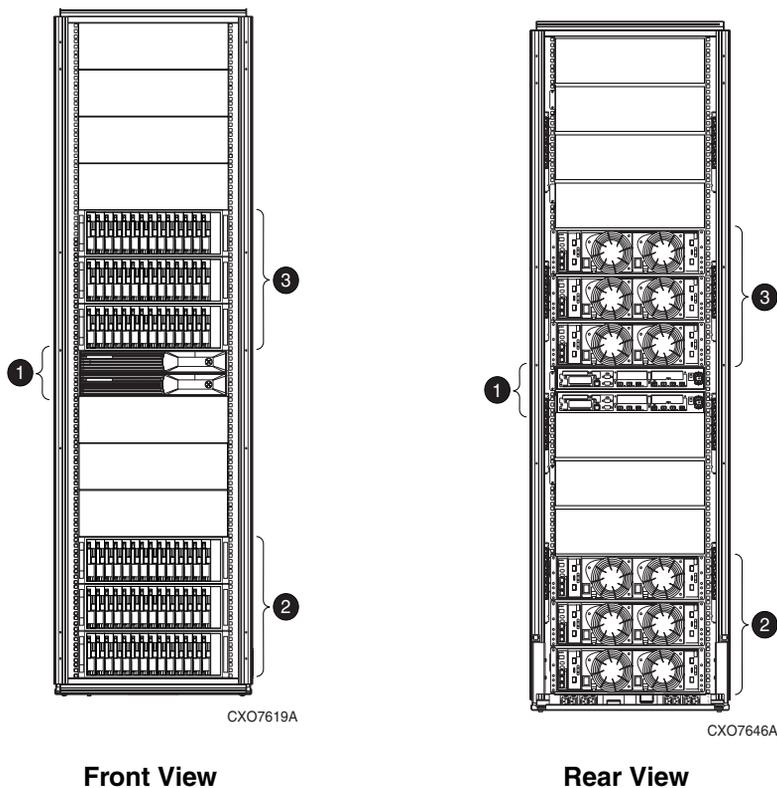
For a 6-drive enclosure configuration, there are 3U blank panels in locations 4, 5, 7, 11, 12, 13, and 14.

For a 12-drive enclosure configuration, there is a 3U blank panel in location 14.

- The minimum number of drive enclosures per single rack is 6.
- The maximum number of drive enclosures per single rack is 12.
- The minimum number of disk drives per single rack is 84.
- The maximum number of disk drives per single rack is 168.

## Basic Single-Rack Configuration

The basic Enterprise Storage System configuration is composed of 1 HSV110 controller pair and 6-disk drive enclosures (a maximum of 84 disk drives) mounted in a 42U rack (see Figure 1–1). This configuration includes the fiber optic cables, cable bobbins, loop expansion bulkhead, power cables, a dual PDU assembly, and eight power distribution modules (PDMs). There are blank panels in locations 4, 5, 6, 11, 12, 13, and 14.

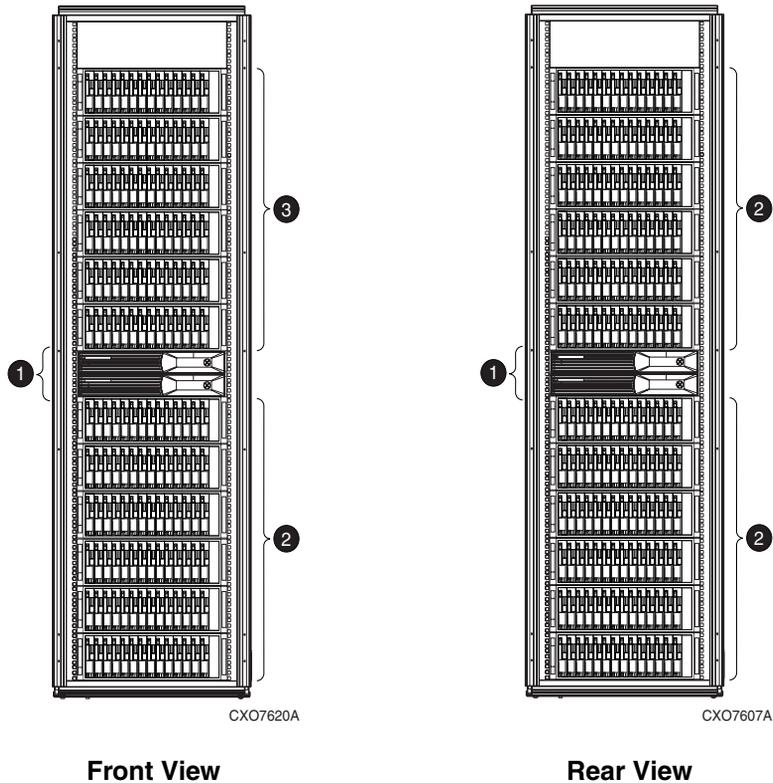


- ❶ Model 3220 controller pair (two HSV110 controllers) Bus Address 07
- ❷ Disk drive enclosures 1–3 Bus Addresses 01–03
- ❸ Disk drive enclosures 4–6 Bus Addresses 08–10

**Figure 1–1: 6-disk enclosure storage system**

## Full Single-Rack Configuration

The full Enterprise Storage System single-rack configuration is composed of 1 HSV110 controller pair and 12-drive enclosures (with a maximum of 168 disk drives) mounted in a 42U rack (see Figure 1–2). This configuration includes the fiber optic cables, cable bobbins, loop expansion bulkhead, power cables, a dual PDU assembly, and eight PDMs. The only differences between the basic and the full configuration are the number of drive enclosures and the maximum number of disk drives.



- ❶ Model 3220 controller pair (two HSV110 controllers) Bus Address 07
- ❷ Disk drive enclosures 1–6 Bus Addresses 01–06
- ❸ Disk drive enclosures 7–12 Bus Addresses 08–13

**Figure 1–2: 12-Drive enclosure storage system**

## Power Distribution

AC power is distributed to the rack through a dual PDU assembly mounted at the bottom rear of the rack. The characteristics of the full redundant rack power configuration are as follows:

- Each PDU is connected to a separate circuit-breaker-protected, 30A AC site power source (220–240 VAC  $\pm 10\%$ , 50 or 60 Hz,  $\pm 5\%$ ). Figure 1–3 and Figure 1–4 illustrate the compatible 60 Hz and 50 Hz wall receptacles.



CXO7549A

**Figure 1–3: NEMA L6-30R receptacle, 3-wire, 30A, 60 Hz**



CXO5409B

**Figure 1–4: IEC 309 receptacle, 3-wire, 30A, 50 Hz**



**CAUTION:** If local regulations forbid use of these receptacles, you must change the connectors on the PDU power cords.

---

- The standard power configuration for any Enterprise Storage System rack is the fully redundant configuration. Implementing this configuration requires:
  - Two separate circuit-breaker-protected, 30 Amp site power sources with a compatible wall receptacle (see Figure 1–3 and Figure 1–4).
  - One dual PDU assembly.  
Each PDU connects to a different wall receptacle.
  - Eight PDMs (“AC power strips”) per rack.  
Four PDMs mount vertically on each side of the rack.  
Each set of four PDMs connects to a different PDU.
  - The drive enclosure power supplies on the left (PS 1) connect to the PDMs on the left with a gray, 26 in (66 cm) power cord.
  - The drive enclosure power supplies on the right (PS 2) connect to the PDMs on the right with a black, 26 in (66 cm) power cord.
  - The upper controller connects to a PDM on the left with a gray, 60 in (152 mm) power cord.
  - The lower controller connects to a PDM on the right with a black, 26 in (66 cm) power cord.

The configuration provides complete power redundancy and eliminates all single points of failure for both the AC and DC power distribution.

## PDU's

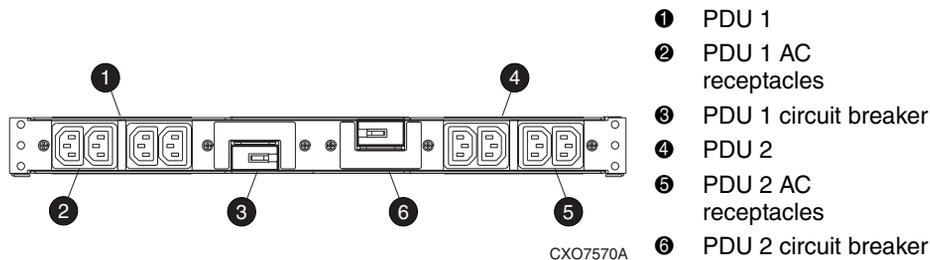
Each Enterprise Storage System rack has either a 50 or 60 Hz, dual PDU mounted at the bottom rear of the rack.

**IMPORTANT:** The major difference between the two PDU types is the cable power connector.

- The standard 50 Hz PDU cable has an IEC 309, 3-wire, 30A, 50 Hz connector.
- The standard 60 Hz PDU cable has a NEMA L6-30R, 3-wire, 30A, 60 Hz connector.

If these connectors are not compatible with the site power distribution, you must replace the PDU power cord cable connector.

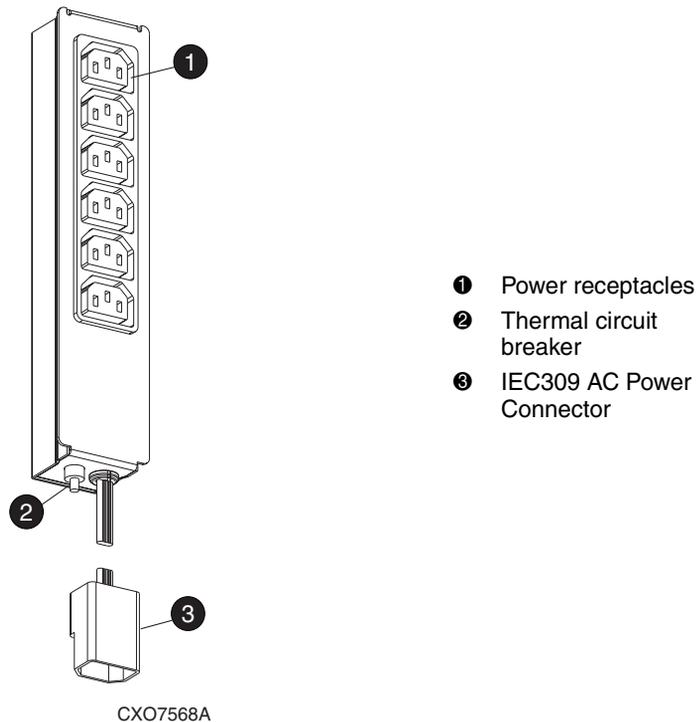
Each of the two PDU power cables has an AC power source specific connector. The circuit-breaker-controlled PDU outputs are routed to a group of four AC receptacles (see Figure 1–5). The voltages are then routed to PDMs, sometimes referred to as AC power strips, mounted on the two vertical rails in the rear of the rack.



**Figure 1–5: Dual PDU assembly—top view**

## PDMs

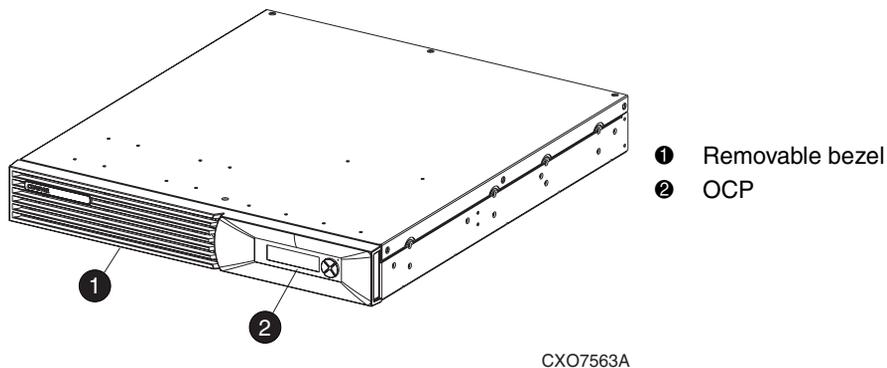
Each of the thermally-protected PDMs connects to one of the four AC receptacles on a PDU (see Figure 1–6). The power modules on the right of the rack connect to the right PDU. The power modules on the left of the rack connect to the left PDU. Individual power cords connect the controller and drive enclosure power supplies to these modules.



**Figure 1–6: Rack PDM**

## HSV Controller Enclosures

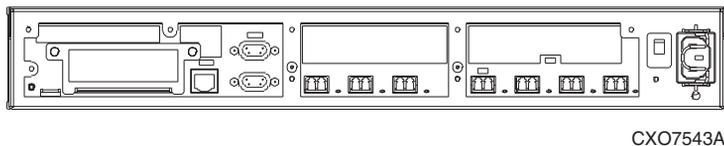
Each Enterprise Storage System has two HSV-series controllers, an upper and a lower (see Figure 1–7). On the front of each controller is a removable bezel ❶ and an operator control panel (OCP) ❷. With the OCP controls, you can display system information and enter system parameters.



**Figure 1–7: HSV controller enclosure—front view**

To service the controller blowers or cache batteries, you must remove the bezel.

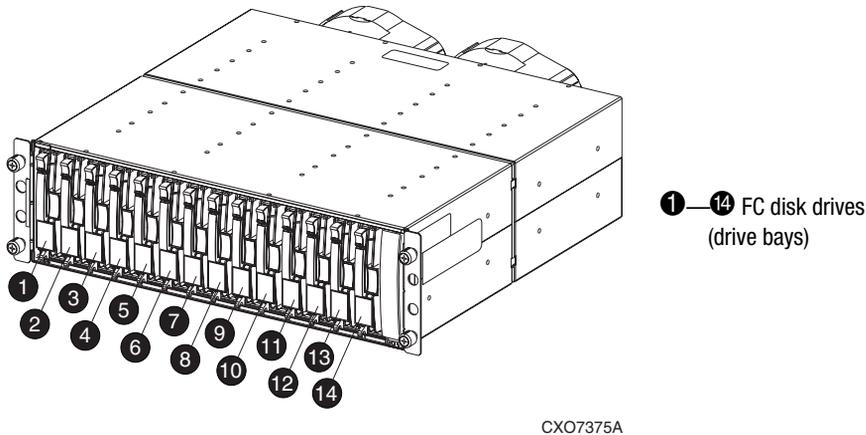
The data and power connectors located on the rear of each controller enclosure are the interfaces to the enclosure address bus, the drive enclosures, the other controller enclosure, and a PDM (see Figure 1–8). Refer to the *Enterprise Virtual Array HSV Controller User Guide* for detailed information about the controller connectors.



**Figure 1–8: HSV controller enclosure—rear view**

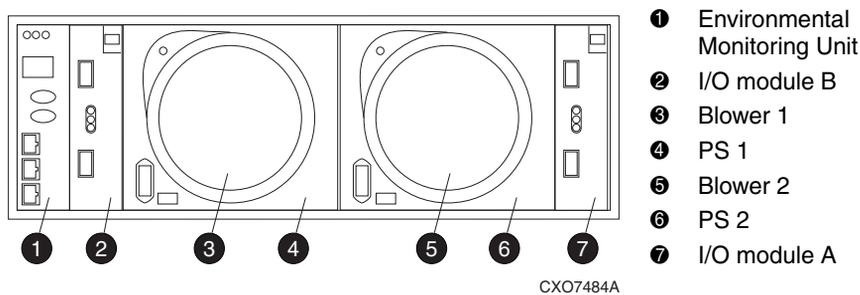
## Fibre Channel Disk Drive Enclosures

The Fibre Channel disk drives mount in the front of the disk drive enclosure (see Figure 1–9). For ease of reference, the disk drives are usually referred to by their physical location, the drive bay number.



**Figure 1–9: Fibre Channel disk drive enclosure—front view**

The rest of the drive enclosure elements, the power connections, and the data connections are in the rear of the drive enclosure (see Figure 1–10). The *Enterprise Virtual Array Drive Enclosure User Guide* describes each of these elements in detail.



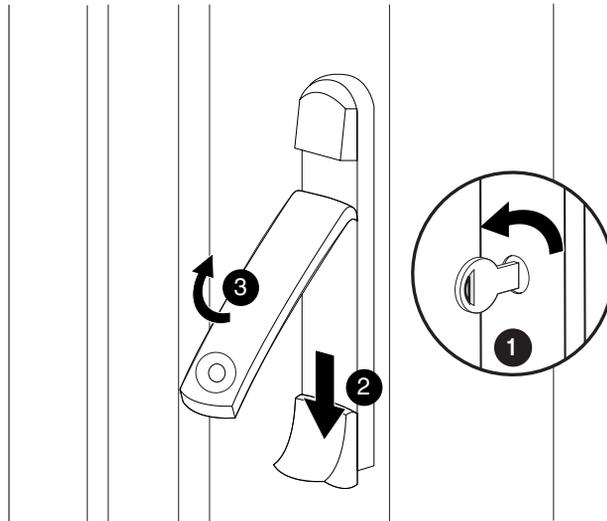
**Figure 1–10: Drive enclosure—rear view**

## Doors

The front and rear doors provide protection for the equipment. Both doors have handles with locks.

To open a door (see Figure 1–11):

1. Turn the key **1** to the left to unlock the door.
2. Press the handle release button **2**. The handle pops open.
3. Lift the handle up and out **3** to open the door.



CXO7594A

**Figure 1–11: Locking and unlocking a door**

To close a door:

1. Press the handle down and in until the release button engages the handle.
2. Turn the key to the right to lock the door.



---

# Enterprise Storage System Configurations

This chapter discusses the Compaq supported Enterprise Storage System rack configurations in general. For detailed descriptions and discussion about the supported configurations, see the *Enterprise Virtual Array Initial Setup User Guide*.

**NOTE:** Configuration information in this publication does not address configure-to-order (CTO), authorized reseller-created, or customer-created configurations.

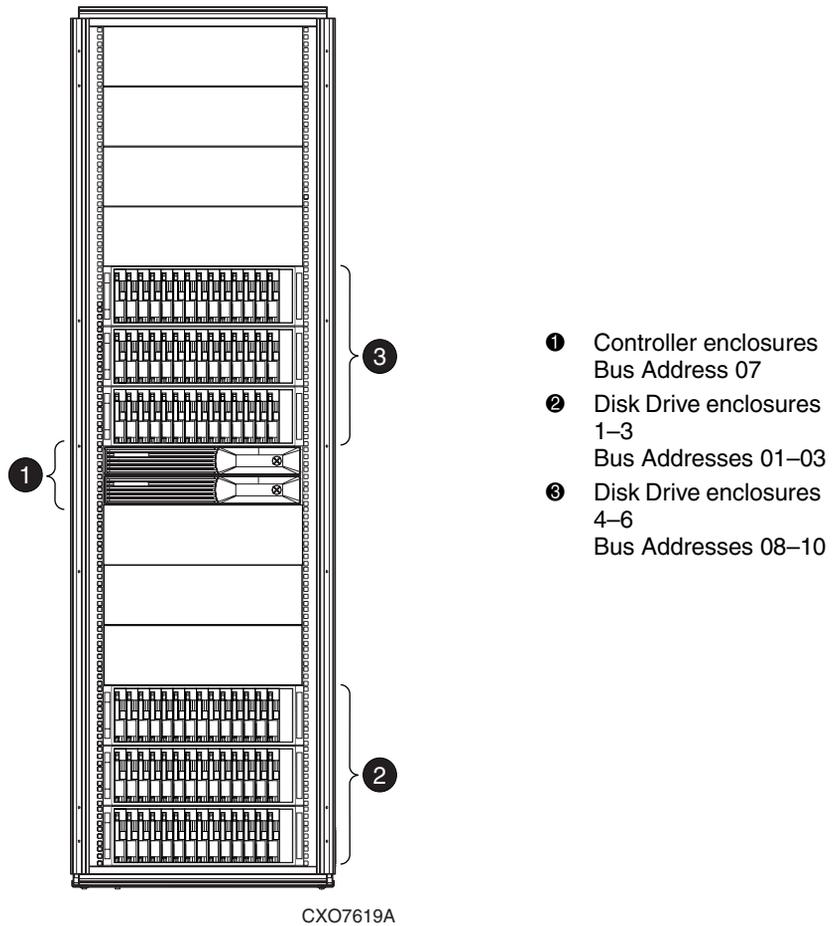
This publication does not address upgrading any configuration by adding controller or drive enclosures.

## 6-Drive Enclosure Configuration

The basic, or minimum, Compaq supported configuration (consists of one controller pair and six drive enclosures see Table 2–1 and Figure 2–1). You can select the number of disk drives per enclosure and the drive capacity.

**Table 2–1: 6-drive Enclosure Storage System Configuration**

Major Component	Quantity
42U Rack with: 1 each, dual PDU assembly 8 each, PDM 1 each, Expansion bulkhead	1
❶ Controller enclosure with: 2 each, HSV110 controller 2 each, Cache battery 2 each, Blower 7 each, 2-GB transceiver 7 each, Fiber optic cable, 2 m (6.6 ft) 1 each, Power cable	2
❷ and ❸ 14-Disk Drive enclosure (Model 5214) with: 2 each, Blower 1 each, EMU 1 each, I/O module A 1 each, I/O module B 2 each, Power supply, 499 W 4 each, 2-GB transceiver 2 each, Fiber optic cable, 2 m (6.6 ft) 2 each, Power cable	6
Maximum number of Fibre Channel disk drives (Drive capacity is user-specified)	84



**Figure 2–1: 6-drive enclosure storage system layout**

## 12-Disk Drive Enclosure Configuration

This full single-rack Compaq supported configuration consists of one controller pair and 12-disk drive enclosures (see Table 2–2 and Figure 2–2). You can select the number of drives per drive enclosure and the drive capacity.

**Table 2–2: 12-Disk Drive Enclosure Storage System Configuration**

Major Components	Quantity
42U Rack with: 1 each, dual PDU assembly 8 each, PDM 1 each, Expansion bulkhead	1
❶ Controller enclosure with: 2 each, HSV110 controller 2 each, Cache battery 2 each, Blower 7 each, 2-GB transceiver 7 each, Fiber optic cable, 2 m (6.6 ft) 1 each, Power cable	2
❷ and ❸ 14-Disk Drive enclosure (Model 5214) with: 2 each, Blower 1 each, EMU 1 each, I/O module A 1 each, I/O module B 2 each, Power supply, 499 W 4 each, 2-GB transceivers 2 each, Fiber optic cable, 2 m (6.6 ft) 2 each, Power cable	12
Maximum number of Fibre Channel disk drives (drive capacity is user-specified)	168

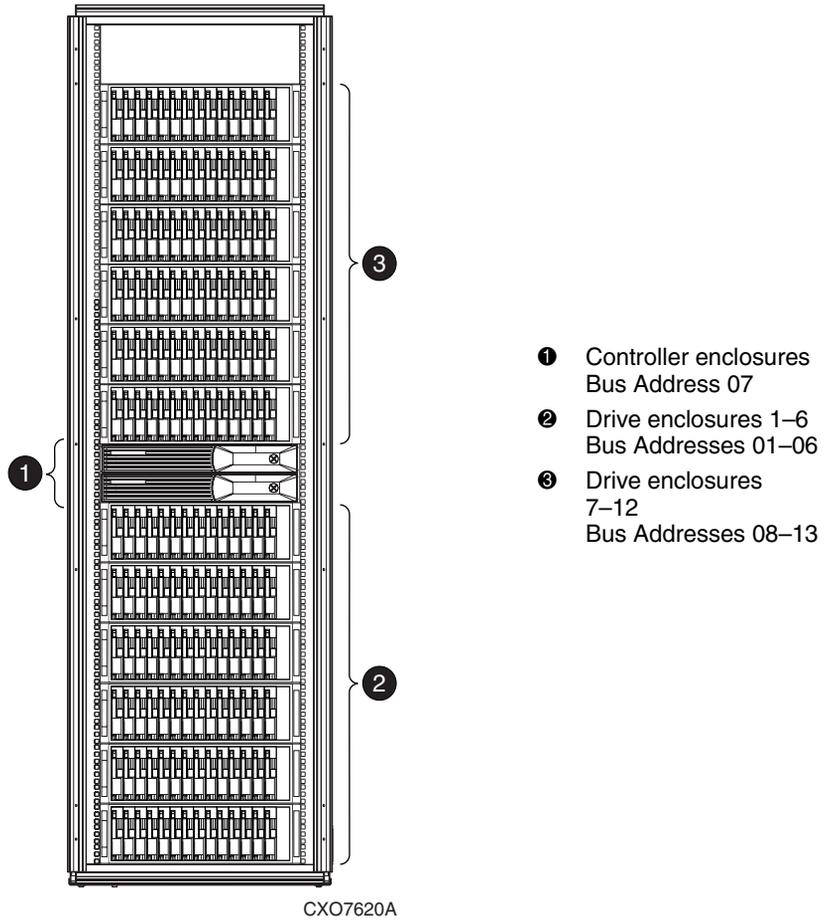


Figure 2–2: 12-Drive enclosure storage system layout



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## Enclosure Address Bus

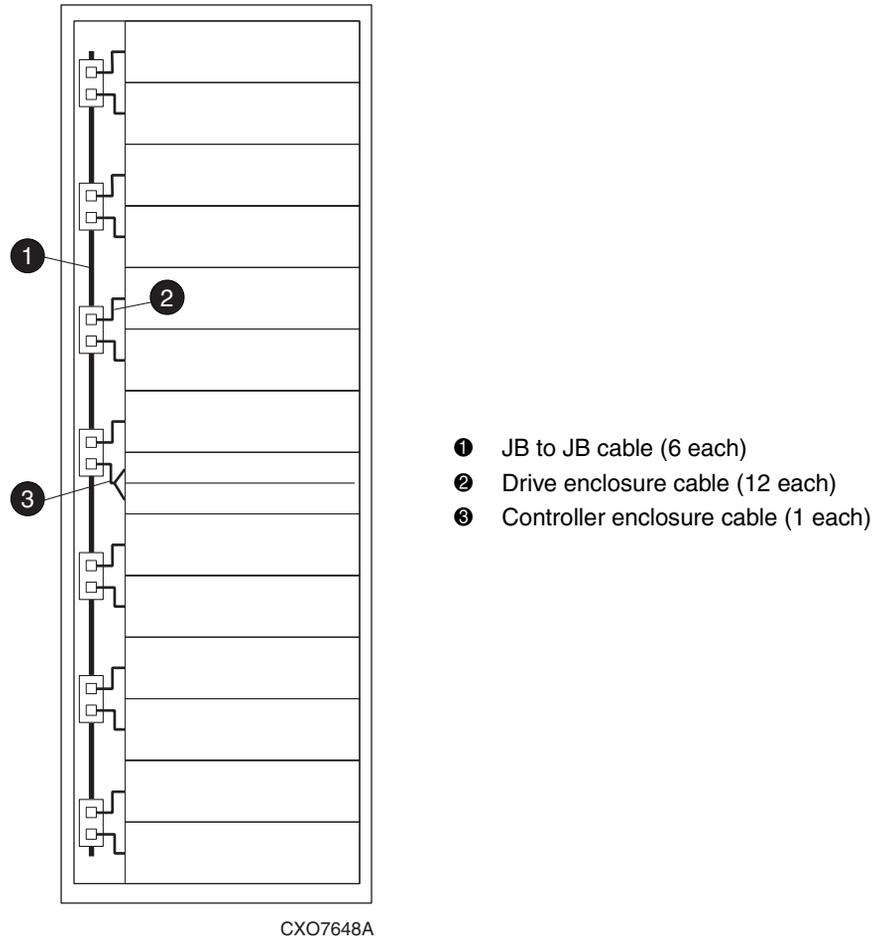
This chapter discusses in detail, the function, operation, troubleshooting, and repair of the enclosure address bus.

### Enclosure Address Bus Overview

The enclosure address bus is composed of cables and junction boxes (JBs) that interconnect the drive enclosures with the controller enclosures. This bus allows for managing and reporting environmental conditions within the rack. Each EMU collects data about the associated drive enclosure.

The Enterprise Storage System 5200 series family drive enclosure numbers are always assigned by the enclosure address bus. Connecting a controller enclosure or a drive enclosure to a enclosure address bus JB automatically establishes an enclosure number, based on the distance the enclosure is from the bottom terminator in 3U (5.25 in) *increments*.

Single-rack enclosure numbers are in the range of *01* through *14* (see Figure 3–1).



**Figure 3-1: Enclosure address bus**

## Drive Enclosures



**CAUTION:** The default EMU alphanumeric display is the enclosure number, which *must be in the range 01 through 14.*

When an Enterprise Storage System drive enclosure displays an enclosure address of 00, there is a problem with the address bus. To isolate and eliminate this problem, refer to Chapter 5, “Troubleshooting Rack Operation.”

---

**IMPORTANT:** The enclosure number is automatically assigned. You cannot assign the enclosure number.

Another function of the enclosure address bus is to provide *out-of-band* communications within a reporting group. A reporting group is an Enterprise Storage System controller pair and the associated Enterprise Storage System 5200 series family disk enclosures. The Enterprise Storage System controller pair assigns a unique decimal reporting group number to all EMUs on each FC-AL loop. For detailed information about the reporting group number, see *Enterprise Virtual Array Drive Enclosure EMU User Guide*.

## Controller Enclosures

The controller enclosures are half the height (1.5U, 2.625 in) of the basic enclosure address bus increment (3U, 5.25 in). The controller pair has a single enclosure number. The controllers attach to the same JB connector using a special Y cable.



**CAUTION:** Failure of the enclosure address bus could prevent the HSV element controller from detecting the controller or the associated drive enclosures. To isolate and eliminate this problem, refer to Chapter 5, “Troubleshooting Rack Operation.”

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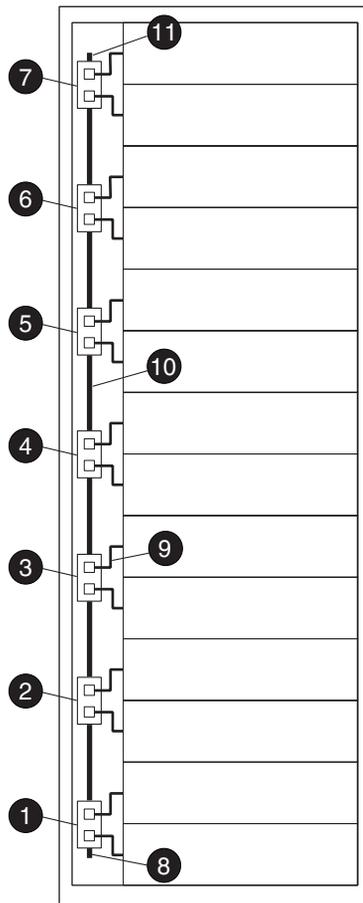
## Enclosure Address Bus Connections

Figure 3–2 shows the typical configuration of a single 42U rack with 14 enclosures.

**NOTE:** Although the 42U Enterprise Storage System rack can accommodate a total of 14 3U enclosures, the maximum configuration supported by Compaq is 13 enclosures (1 controller enclosure pair, and 12-drive enclosures).

For a 6-drive enclosure configuration, there are 3U blank panels in locations 4, 5, 7, 11, 12, 13, and 14.

For a 12-drive enclosure configuration, there is a 3U blank panel in location 14.



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### Enclosure Address Bus JBs

- ❶ JB for enclosures 1 and 2
- ❷ JB for enclosures 3 and 4
- ❸ JB for enclosures 5 and 6
- ❹ JB for enclosures 7 and 8
- ❺ JB for enclosures 9 and 10
- ❻ JB for enclosures 11 and 12
- ❼ JB for enclosures 13 and 14

### Enclosure Address Bus Components

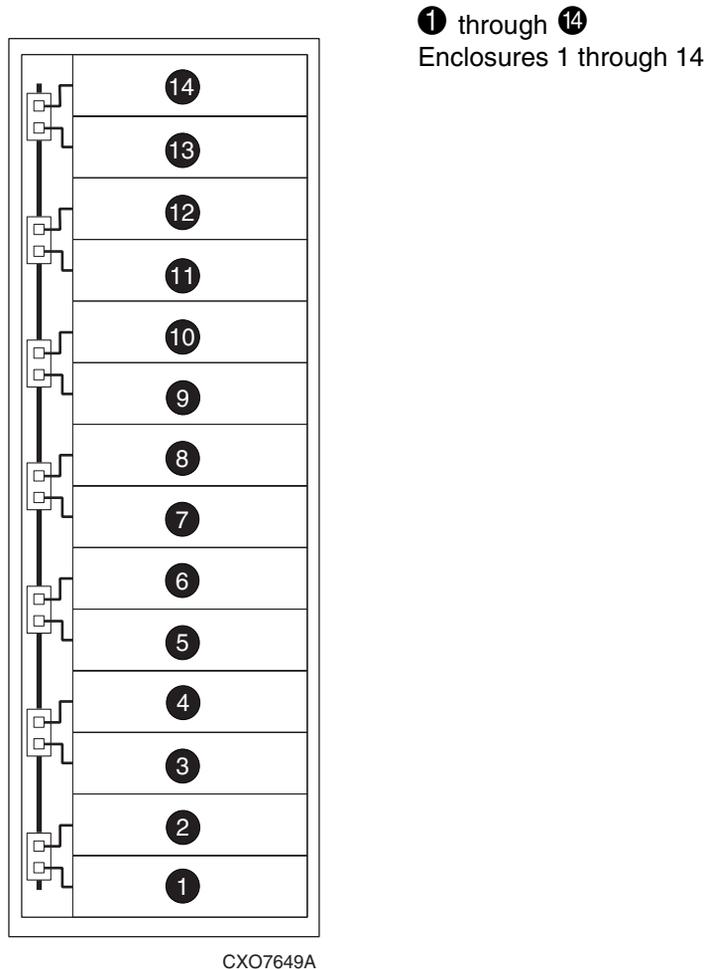
- ❽ Bottom terminator
- ❾ JB-to-Drive enclosure cable 15 in (381 mm), 1 of 12 cables  
or  
JB-to-Controller enclosure cable (381 mm)
- ❿ JB-to-JB cable 8.25 in (210 mm), 1 of 6 cables
- ⓫ Top terminator

**Figure 3–2: Enclosure address bus components and connections**

Based on the cable bus installation shown in Figure 3–2, the enclosures in a single-rack installation are numbered as shown in Figure 3–3.

**IMPORTANT:** The enclosure address bus does not differentiate between drive enclosures and controller enclosures.

The physical location of the enclosure address bus JB connector determines the address, not the enclosure type.



**Figure 3–3: Rack enclosure numbering**



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## Power Distribution

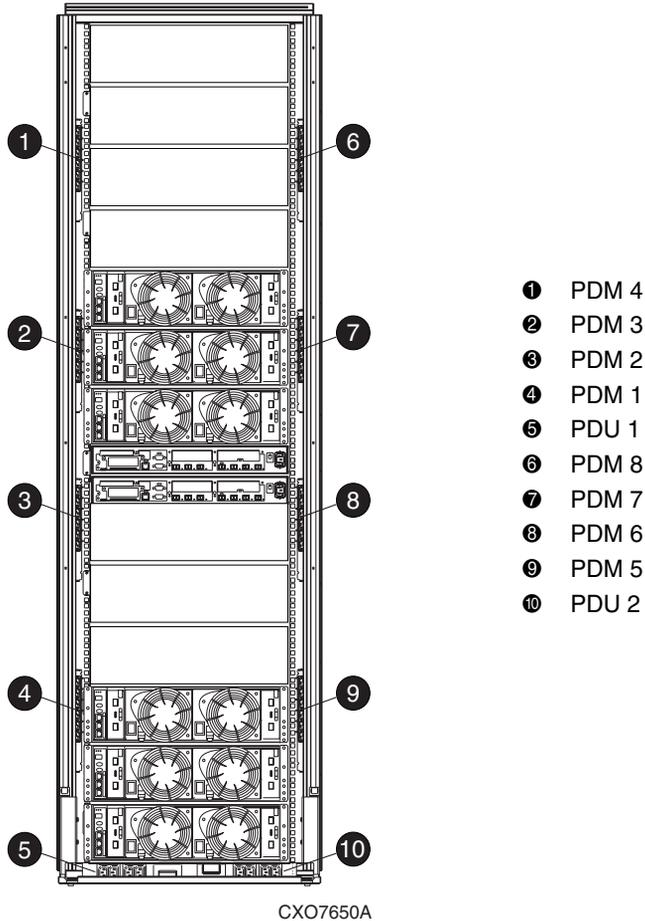
This chapter discusses in detail, the Enterprise Storage System rack power distribution, including AC power sources, PDU assemblies, PDMs, and the internal and external power cables.

### An Overview of Rack AC Power Distribution

The power distribution in an Enterprise Storage System rack is the same for all variants. The site AC input voltage is routed to the dual PDU assembly mounted in the rack lower rear. Each PDU distributes AC to a maximum of four PDMs mounted on the left and right vertical rails (see Figure 4–1).

- PDMs 1 through 4 connect to receptacles A through D on PDU 1. *Grey* power cords connect these PDMs to the number 1 drive enclosure power supplies and to the *upper controller enclosure*.
- PDMs 5 through 8 connect to receptacles A through D on PDU 2. *Black* power cords connect these PDMs to the number 2 drive enclosure power supplies and to the *lower controller enclosure*.

**IMPORTANT:** The locations of the PDUs and the PDMs are the same in all Enterprise Storage System racks.



**Figure 4–1: Rack AC power distribution**

## **PDU 1**

PDU 1 connects to AC power distribution source 1. A PDU 1 failure:

- Disables the power distribution circuit
- Removes power from PDMs 1, 2, 3, and 4
- Disables PS 1 in the drive enclosures
- Disables the upper controller power supply

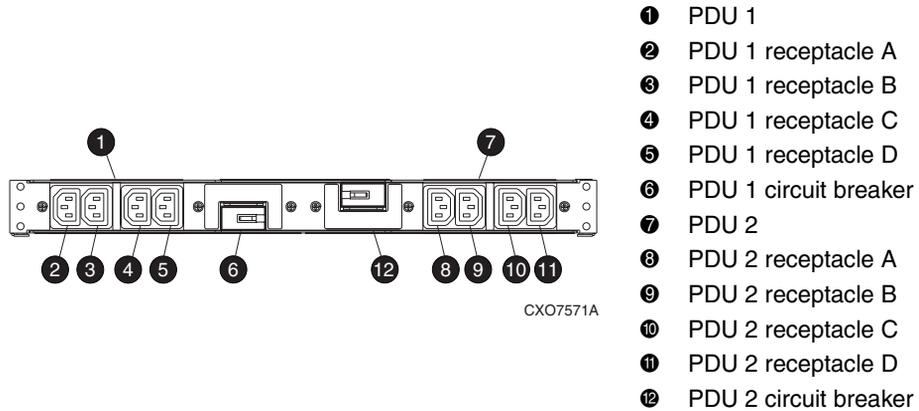
## **PDU 2**

PDU 2 connects to AC power distribution source 2. A PDU 2 failure:

- Disables the power distribution circuit
- Removes power from PDMs 5, 6, 7, and 8
- Disables PS 2 in the drive enclosures
- Disables the lower controller power supply

## PDU

The dual PDU assembly (see Figure 4–2) mounts in the lower rear of the rack. This assembly contains two PDUs: PDU 1 ❶ and PDU 2 ❷. Each PDU has a 250 VAC, 30A circuit breaker (❸ and ❹) and four IEC 320-C13 AC output power receptacles (❺ through ❻, and ❸ through ❹). The circuit breakers and AC receptacles are accessible when the PDU assembly is in the upright position.



**Figure 4–2: Dual PDU assembly major components**

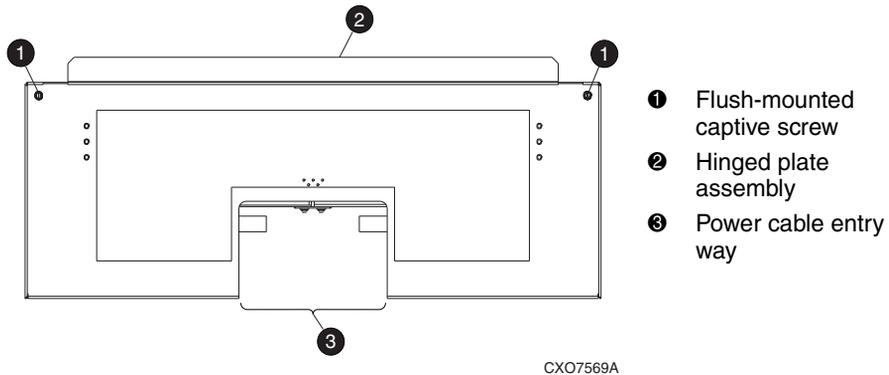
During normal operation, the hinged PDU assembly is in the upright position and the rear door is closed.

To service either the PDU or the lower two drive enclosures (bus addresses 01 and 02), you must open the rear door and lower the PDU (see Figure 4–3).

To lower the unit:

1. Open the rear door.
2. Loosen the flush-mounted captive screws ❶ on the dual PDU assembly (see Figure 4–3).

3. Grasp the hinged plate assembly ❷ and pull the PDU assembly to the rear.



#### Figure 4-3: Lowering a dual PDU assembly

With the PDU assembly lowered, you have full access to drive enclosures 1 and 2.

To return the PDU assembly to the upright position:

1. Grasp the hinged plate assembly ❷ and raise the PDU assembly to the upright position.
2. Tighten the flush-mounted captive screws ❶ to secure the assembly to the rack.
3. Close the rear door.

## PDMs

There are eight PDMs mounted in the rear of each rack:

- Four mounted on the left vertical rail connect to PDU 1.
- Four mounted on the right vertical rail connected to PDU 2.

Each PDM has six AC receptacles and a thermal circuit breaker. The PDMs distribute the AC power from the PDUs to the enclosures.

There are two power sources for each controller pair and drive enclosure. Even when a single PDU fails, the system will remain operational.



**CAUTION:** The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition. Compaq supports only the AC power distributions defined in this publication.

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## Troubleshooting Rack Operation

This chapter discusses in detail, how to identify and correct Enterprise Storage System rack level problems.

### An Overview of Troubleshooting

Troubleshooting an Enterprise Storage System involves using the procedures in this chapter and those described in the following documents.

- The *Enterprise Virtual Array HSV Controller User Guide* describes how the transceiver LEDs, OCP LEDs and the LCD display controller-related conditions. This guide also describes a recommended corrective action for each condition.
- The *Enterprise Virtual Array Drive Enclosure EMU User Guide* describes how the EMU alphanumeric display and the EMU LEDs provide a detailed description of element conditions (drive, EMU, I/O modules, power supplies, and blowers). This guide also describes a recommended corrective action for each condition.
- The *Enterprise Virtual Array Drive Enclosure User Guide* describes how the drive enclosure elements (drives, EMU, I/O modules, power supplies, and blowers) use the element LEDs to display conditions.

Enterprise Storage System rack problems are identified and reported using one or more of the following methods.

- HSV Element Manager Graphical User Interface (GUI) display
- PDU circuit breakers state (On or Off)
- PDM thermal circuit breakers state (On or Off)

## Troubleshooting a Rack

The only rack electronic components subject to failure are the AC distribution circuits, including the PDUs and the PDMs. This includes the site power distribution circuits and the power cables. When a power loss occurs, the failure may or may not be reported as described in Chapter 4, “Power Distribution.”

If an overcurrent condition occurs, the associated circuit breaker will reset thereby removing power from the associated enclosures. An EMU can report the loss of AC input to a power supply.

However, the simultaneous loss of the AC input to both PDUs is not reported as a power problem. The HSV element manager GUI displays an unmapped status for all the enclosures. Therefore, identifying a rack power problem requires you to check the drive enclosures and the controller enclosures. Once you identify the problem, you can isolate the problem to the AC distribution, a PDU, or a PDM.

**IMPORTANT:** The loss of an AC input to one of the rack PDUs has the same symptom as the loss of the PDU or the failure of all the PDMs attached to a PDU.

If either a PDU or PDM fail, the primary indication will be the loss of power to one or more of the following:

- The upper controller enclosure
- The lower controller enclosure
- Some of the drive enclosure number 1 power supplies
- Some of the drive enclosure number 2 power supplies

## Troubleshooting the Rack AC Power Distribution

The basic types of rack AC power distribution problems involve one or more of the following conditions:

- Loss of AC input to a PDU
- Failure of a PDU
- Failure of a PDU receptacle
- Failure of a PDM
- Failure of a PDM receptacle

## Troubleshooting PDU Failures

The loss of an AC input, an overcurrent condition, or the failure of a PDU receptacle can disrupt AC power distribution within the rack.

**IMPORTANT:** Any power distribution problem can involve either an improperly connected power cord, or a circuit breaker that resets due to a momentary overload.

Therefore, Compaq recommends that before beginning any detailed troubleshooting procedure, you check that all power cords are connected correctly and that all the circuit breakers are set to the On state.

## Troubleshooting PDU AC Inputs

The loss of a PDU AC input disables all the associated PDMs and enclosures. For this condition, each EMU generates an error message indicating there is no AC input. However, the system will remain operational as long as one PDU has an AC input and there are no other problems associated with that PDU and the associated power distribution circuits.

The loss of the AC input to both PDUs completely disables the storage system and the EMUs could not transmit an error message through the controllers to the HSV Element Manager GUI. The HSV element manager GUI display will report the affected enclosures as unmapped.

The recommended corrective actions for these conditions are:

1. Verify the status of the AC power distribution circuit breaker.
  - a. If circuit breaker is in the open (Off) state, there was an overload on the circuit. Set the circuit breaker to On.
    - If the circuit breaker remains On, the problem no longer exists.
    - If the circuit breaker resets, check the PDU outputs for an overload condition (see “Correcting an Overload Condition”).
  - b. If the circuit breaker is in the On position and there is no power to the PDU, go to step 2.
2. Ask site maintenance personnel to verify the AC power distribution circuitry.

## Correcting an Overload Condition

An overload, even a momentary one, on any PDU output circuit can overload the PDU and cause the circuit breaker to reset. Complete the following procedure when the PDU circuit breaker is in the Off position.

1. Set the circuit breaker to the On position.  
If the circuit breaker remains in the On position, there was a momentary overload and no further action is required.
2. If the circuit breaker immediately resets the overload condition still exists. To isolate the problem, disconnect the AC power cords *one at a time* and label them so you know to which AC receptacle they connect.
3. With no power cords connected to the AC output receptacles, set the circuit breaker to the On position. If the circuit breaker immediately resets, there is an internal PDU problem that requires PDU replacement by a Compaq Authorized Service Provider.
4. If the circuit breaker remains in the On position, set the circuit breaker to the Off position, and connect the AC power cord to receptacle A. Set the circuit breaker to the On position.
  - If the circuit breaker resets there is a problem with the receptacle A power distribution circuit (PDM or enclosures).
  - If the circuit breaker remains in the On position, there is no problem in the receptacle A power distribution circuit.
5. Set the circuit breaker to the Off position, and connect the AC power cord to receptacle B. Set the circuit breaker to the On position.
  - If the circuit breaker resets, there is a problem with the receptacle B power distribution circuit (PDM or enclosures).
  - If the circuit breaker remains in the On position, there are no problems in the receptacle A or B power distribution circuits.
6. Set the circuit breaker to the Off position, and connect the AC power cord to receptacle C. Set the circuit breaker to the On position.
  - If the circuit breaker resets, there is a problem with the receptacle C power distribution circuit (PDM or enclosures).
  - If the circuit breaker remains in the On position, there is no problem in the receptacle A, B, or C power distribution circuits.

- If the circuit breaker remains in the On position, set the circuit breaker to the Off position, and connect the AC power cord to receptacle D. Set the circuit breaker to the On position.
  - If the circuit breaker resets, there is a problem with the receptacle D power distribution circuit (PDM or enclosures).
7. If the circuit breaker remains in the On position, there is no problem in the receptacle A, B, C, or D power distribution circuit.
  8. If you are unable to correct the problem, contact your Compaq Authorized Service Provider for support.

## Troubleshooting PDM Failures

The failure of a PDM can be caused by a PDU failure (see “Troubleshooting PDU Failures” on page 5–3) or by an overload on one or more PDM circuits.

**IMPORTANT:** Any power distribution problem can involve either an improperly connected power cord or a circuit breaker that resets due to a momentary overload.

Therefore, Compaq recommends that before beginning any detailed troubleshooting procedure, you check that all power cords are connected correctly and that all the circuit breakers are set to the On position.

To isolate and eliminate a power distribution problem involving a PDM, complete the following procedure.

1. Observe the drive enclosure power supply status LEDs. If a LED is Off, there is a problem.
2. Locate the associated PDM, and verify the circuit breaker is On.
3. Ensure that all power cords are properly connected.
4. Ensure that the PDM circuit breaker is On.
5. If you are unable to correct the problem, contact your Compaq Authorized Service Provider for support.

## Troubleshooting the Enclosure Address Bus

The enclosure address bus circuitry is not critical to Enterprise Storage System operation. A component failure does not cause any problem in storing or retrieving data. The major symptom of an enclosure address bus failure is the inability to map to either a controller or a drive enclosure location in the rack.

If this occurs, the HSV Element Manager GUI identifies the affected enclosures as unmappable hardware. The controllers and disk drives continue to function and data can still be written to or read from the drives.

The failure of any of the following enclosure address bus components could affect enclosure address bus operation:

- The lower enclosure address bus terminator
- Any of the enclosure address bus JBs, connectors, or cables between the JBs
- Any of the cables connecting the drive or controller enclosures to a JB

The primary indicators of a enclosure address bus failure are:

- The EMU displays an enclosure address of 00
- The HSV element manager identifies one or more enclosures, either drive or controller, as unmappable hardware

## Terminator Failures

The failure of the lower terminator is extremely unlikely. However, failure of the lower terminator effectively removes the enclosures from the system. The symptoms of such a failure are:

- The HSV Element Manager GUI identifies all the enclosures in the rack as unmappable hardware.
- Each drive enclosure EMU displays an enclosure number of 00.

Contact your Compaq Authorized Service Provider and report the problem.

## JB Failures

The JB-related failures that could disable enclosure numbering for multiple enclosures include:

- Failure of either input (bottom) or output (top) JB connector
- Failure of either cable between JBs

If either of these conditions occur:

- All enclosures mounted below the affected JB display a valid enclosure number (for example, 01 through 06, or 08 through 13). The GUI identifies these enclosures as mappable.
- All the enclosures mounted above, or connected to the affected JB, display the enclosure number 00. The GUI will identify these enclosures as unmappable hardware.

If there is a cable problem, use the following procedure.

1. Ensure that the cable connecting the affected JB to the JB directly below is correctly installed. Disconnect and remove the cable.
2. Connect the cable to both JBs and observe the drive enclosure EMU displays for valid enclosure numbers. If the numbers remain 00, remove this cable.
3. Remove the cable connecting two functioning JBs, and install the cable removed in step 2. Observe the drive enclosure EMU displays for valid enclosure numbers. If the numbers are valid, the cable is not the problem. There is either a JB or JB connector problem. Install the second cable.
4. If you are unable to correct the problem, contact your Compaq Authorized Service Provider for support.

## Single Enclosure Address Bus Failures

The failure of a JB connector or the cable connecting an enclosure to the JB could cause an enclosure address bus failure for a single enclosure. If this happens, the following symptoms occur:

- One drive enclosure displays 00 as the enclosure number.
- The GUI identifies one enclosure as unmappable hardware.

## **Drive Enclosure Failure**

Complete the following procedure to correct a drive enclosure problem.

1. Identify the enclosure affected either from the HSV element manager GUI display or an EMU display of 00.
2. Disconnect the cable between the JB and the enclosure. Connect and fully seat the cable.
3. Observe either the HSV element manager GUI display or the EMU display for a valid enclosure number display (01 through 14).
4. If the problem still exists, you can exchange the affected enclosure cable with the cable for a properly functioning enclosure.
5. Observe either the HSV element manager GUI display or the EMU display for a valid enclosure number display (01 through 14).
6. If you are unable to correct the problem, contact your Compaq Authorized Service Provider for support.

## **Controller Enclosure Failure**

Complete the following procedure to correct a controller enclosure problem.

1. Identify the enclosure affected from the HSV element manager GUI display.
2. Disconnect the cable between the JB and the enclosure. Connect and fully seat the cable.
3. Observe the HSV element manager GUI display for a controller enclosure number display.
4. Replace the controller “Y” cable to isolate the problem. Observe the HSV element manager GUI display for a mappable controller enclosure number 07 display.
5. If you are unable to correct the problem, contact your Compaq Authorized Service Provider for support.

Table 5–1 lists some of the possible symptoms and possible causes of enclosure address bus failures. In most cases, the only available corrective action is to replace the terminator, the JB, or a cable. In this table:

- The “JB No” column identifies that JB for each enclosure.
- The “EMU” column defines the EMU enclosure number display.

**Table 5–1: Possible Enclosure Address Bus Failures**

**LEGEND:**

**00**—Invalid Drive Enclosure Number

**01**—Valid Drive Enclosure Number

Symptoms and Possible Causes	JB No	EMU
<p><b>Symptoms</b></p> <ul style="list-style-type: none"> <li>• Address of ALL drive enclosures is 00.</li> <li>• HSV element manager reports all drive and controller enclosures as unmappable.</li> </ul> <p><b>Possible Causes</b></p> <ul style="list-style-type: none"> <li>• Defective Bottom Terminator.</li> <li>• Failure of JB 1.</li> </ul>	7	00
	6	00 00
	5	00 00
	4	00
	3	00 00
	2	00 00
	1	00 00

**Table 5–1: Possible Enclosure Address Bus Failures (Continued)**

**LEGEND:**

**00**—Invalid Drive Enclosure Number

**01**—Valid Drive Enclosure Number

Symptoms and Possible Causes	JB No	EMU
<p><b>Symptoms</b></p> <ul style="list-style-type: none"> <li>Address of ONE drive enclosure is 00.</li> <li>HSV element manager reports the same drive enclosure as unmappable.</li> </ul> <p><b>Possible Causes</b></p> <ul style="list-style-type: none"> <li>Defective JB 5 to drive enclosure 09 cable.</li> <li>Defective lower connector on JB 5.</li> </ul>	7	13
	6	12 11
	5	10 <b>00</b>
	4	08
	3	06 05
	2	04 03
	1	02 01
<p><b>Symptoms</b></p> <ul style="list-style-type: none"> <li>Address of TWO or more drive enclosures is 00.</li> <li>HSV element manager reports the same drive enclosures and the controller enclosures as unmappable.</li> </ul> <p><b>Possible Causes</b></p> <ul style="list-style-type: none"> <li>Defective cable between JB 3 and JB 4</li> <li>Defective output connector on JB 3</li> <li>Defective input connector on JB 4.</li> </ul>	7	00
	6	00 00
	5	00 00
	4	00
	3	06 05
	2	04 03
	1	02 01

**Table 5–1: Possible Enclosure Address Bus Failures (Continued)**

**LEGEND:**

**00**—Invalid Drive Enclosure Number

**01**—Valid Drive Enclosure Number

Symptoms and Possible Causes	JB No	EMU
<p><b>Symptoms</b></p> <ul style="list-style-type: none"> <li>• The drive enclosure addresses are valid.</li> <li>• HSV element manager reports HSV controller as unmappable.</li> </ul> <p><b>Possible Causes</b></p> <ul style="list-style-type: none"> <li>• The JB 4 to controller cable is defective.</li> <li>• The lower JB 4 enclosure connector is defective.</li> </ul>	7	13
	6	11
	5	10 09
	4	08
	3	06 05
	2	04 03
	1	02 01

## Removing and Installing a Rack Door

If it is necessary to replace an enclosure, a JB, a PDM, or a PDU, it may be necessary to remove either the front or the rear door (see Figure 5–1). To remove a door:

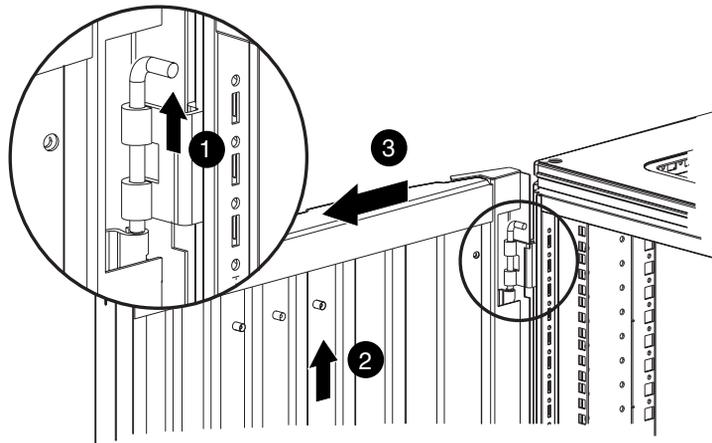
1. Open the door.
2. Lift up on the top hinge release **1**.
3. Tilt the door out **3** and lift up **2** to remove the bottom door pin.
4. Lift the door out and away from the rack.



**CAUTION:** Store the door in the upright position, taking care to protect the front panel from damage.

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After servicing the system, complete the following procedure to install a door:



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**Figure 5–1: Removing and installing a door**

1. Position the door to engage the bottom door pin.
2. Tilt the door in and lift up on the top hinge pin. Align the hinge pin with the hinge, and release.

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## Regulatory Notices

This appendix describes the country-specific regulatory notices applicable to this product.

### FCC Class A Certification

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, which are designed to provide reasonable protection against such radio frequency interference.

Operation of this equipment in a residential area may cause interference, in which case the user at the user's own expense will be required to take whatever measures may be required to correct the interference.

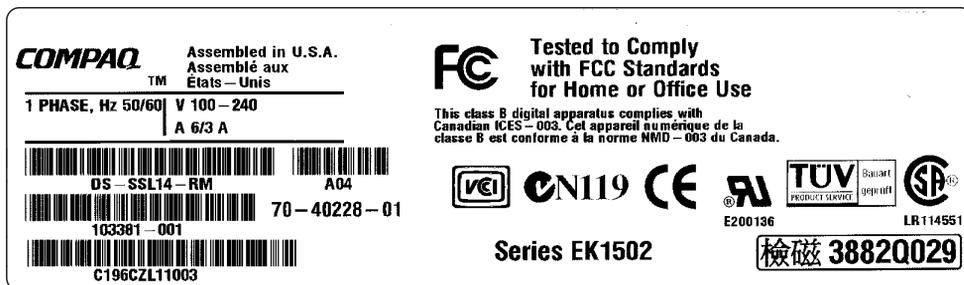
Any modifications to this device—unless expressly approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

**IMPORTANT:** Additional information on the need to interconnect the device with shielded (data) cables or the need for special devices, such as ferrite beads on cables, is required if such means of interference suppression was used in the qualification test for the device. This information will vary from device to device and needs to be obtained from the Compaq EMC group or the product manager.

## Country-Specific Certifications

Compaq tests electronic products for compliance with country-specific regulatory requirements, either as an individual item or as part of an assembly. The product label (see Figure A–1) specifies the regulations with which the product complies.

**NOTE:** Elements without an individual product certification label are qualified as part of the *next higher* assembly (for example, enclosure, rack, or tower).



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**Figure A–1:** Typical enclosure certification label

**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.

# B

## Specifications

This appendix defines the physical, environmental, and power specifications of the Enterprise Storage System rack.

### Physical Specifications



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**WARNING:** The weight of the drive enclosure with the elements installed always requires at least two individuals to move. Compaq recommends using a fork lift or a hand truck to move an enclosure in the shipping container.

Table B-1 defines the dimensions and weights of the Enterprise Storage System racks.

**Table B-1: Enterprise Storage System Rack Physical Specifications**

	Installed	Shipping (Carton and Pallet)
<b>Height</b>	1999 mm (78.7 in)	2118 mm (83.4 in)
<b>Depth</b>	909 mm (35.8 in)	1219 mm (48 in)
<b>Width</b>	602 mm (23.7 in)	812 mm (32 in)
<b>Weight</b>	588.8 kg (1,298 lb)	627.8 kg (1,384 lb)

## Environmental Specifications

To ensure optimum product operation, you must maintain the operational environmental specifications listed in Table B–2. The ambient temperature (the enclosure air intake or room temperature) is especially critical.

**Table B–2: Environmental Operating Specifications**

<b>Ambient temperature:</b> +10°C to +35°C (+50°F to +95°F) with an average rate of change of 1°C/hour maximum and a step change of 3°C or less. Maintaining the <i>optimum ambient temperature</i> within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications.
<b>Relative humidity:</b> 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing).
<b>Air quality:</b> Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
<b>Heat dissipation:</b> 12,708 BTUs per hour.

When shipping, or placing this product in short term storage, Compaq recommends maintaining the environmental conditions listed in Table B–3.

**Table B–3: Environmental Shipping or Short Term Storage Specifications**

Ambient temperature: –40°C to +66°C (–40°F to +151°F)
Relative humidity: 10% to 80% (noncondensing)
Altitude: 15,240 m (50,000 ft)

## Power Specifications

Table B-4 defines the AC power specifications for the Enterprise Storage System PDUs, PDMs, drive enclosure power supplies, and controller enclosure power supplies.

**Table B-4: Enterprise Storage System AC Power Specifications**

Nominal Input Voltage	Specifications
<b>60 Hz Service</b>	
202 VAC Voltage Range Power Receptacle	<b>Japan</b> 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
208 VAC Voltage Range Power Receptacle	<b>North America</b> 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30
240 VAC Voltage Range Power Receptacle	<b>Europe</b> 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
<b>50 Hz Service</b>	
202 VAC Voltage Range Power Receptacle	<b>Japan</b> 180-220 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
220 VAC Voltage Range Power Receptacle	<b>North America</b> 190-235 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30
230 VAC Voltage Range Power Receptacle	<b>North America</b> 200-244 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30
240 VAC Voltage Range Power Receptacle	<b>Europe</b> 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309

The power consumption of an Enterprise Storage System is 3,724W.



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# Glossary

This glossary defines *Compaq StorageWorks™* Enterprise Virtual Array terms used in this publication or related to this product and is not a comprehensive glossary of computer terms.

## **µm**

A symbol for micro meter; one millionth of a meter. For example, 50 µm is equivalent to 0.000050 m.

## **3U**

A unit of measurement representing three “U” spaces. “U” spacing is used to designate panel or enclosure heights. Three “U” spaces is equivalent to 5.25 inches (133 mm).

*See also* **rack-mounting unit**.

## **active virtual disk**

A virtual disk (VD) is a simulated disk drive created by the controllers as storage for one or more hosts. An active virtual disk is accessible by one or more hosts for normal storage. An active virtual disk and its snapshot, if one exists, constitute a virtual disk family. An active virtual disk is the only necessary member of a virtual disk family.

*See also* **virtual disk, virtual disk copy, virtual disk family, and snapshot**.

## **adapter**

*See* **controller**.

## **AL\_PA**

Arbitrated Loop Physical Address. A 1-byte value the arbitrated loop topology uses to identify the loop ports. This value becomes the last byte of the address identifier for each public port on the loop.

### **allocation policy**

Storage system rules that govern how virtual disks are created. Allocate Completely and Allocate on Demand are the two rules used in creating virtual disks.

- Allocate Completely—The space a virtual disk requires on the physical disks is reserved, even if the virtual disk is not currently using the space.
- Allocate on Demand—The space a virtual disk requires on the physical disks is not reserved until needed.

### **ambient temperature**

The air temperature in the area where a system is installed. *Also* called intake temperature or room temperature.

### **ANSI**

American National Standards Institute. A non-governmental organization that develops standards (such as SCSI I/O interface standards and Fibre Channel interface standards) used voluntarily by many manufacturers within the United States.

### **arbitrated loop**

A Fibre Channel topology that links multiple ports (up to 126) together on a single shared simplex media. Transmissions can only occur between a single pair of nodes at any given time. Arbitration is the scheme that determines which node has control of the loop at any given moment.

### **arbitrated loop physical address**

See **AL\_PA**.

### **arbitrated loop topology**

See **arbitrated loop**.

### **array**

All the physical disk drives in a storage system that are known to and under the control of a controller pair.

### **array controller**

See **controller**.

**asynchronous**

Events scheduled as the result of a signal requesting the event or that which is without any specified time relation.

**audible alarm**

The environmental monitoring unit (EMU) alarm that sounds when there is a disk drive enclosure element condition report. The audible alarm can be muted or disabled.

**backplane**

An electronic printed circuit board that distributes data, control, power, and other signals to element connectors.

**bad block**

A data block that contains a physical defect.

**bad block replacement**

A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller and is transparent to the host.

**bail lock**

Part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.

**baud**

The maximum rate of signal state changes per second on a communication circuit. If each signal state change corresponds to a code bit, then the baud rate and the bit rate are the same. It is also possible for signal state changes to correspond to more than one code bit so the baud rate may be lower than the code bit rate.

**bay**

The physical location of an element, such as a drive, I/O module, EMU or power supply in a drive enclosure. Each bay is numbered to define its location.

### **bidirectional**

*Also* called Bi-Di. The movement of optical signals in opposite directions through a common fiber cable such as the data flow path typically on a parallel printer port. A parallel port can provide two-way data flow for disk drives, scanning devices, FAX operations and even parallel modems.

### **block**

*Also* called a sector. The smallest collection of consecutive bytes addressable on a disk drive. In integrated storage elements, a block contains 512 bytes of data, error codes, flags, and the block address header.

### **blower**

A variable speed airflow device that pulls air into an enclosure or element. It usually pulls air in from the front and exhausts the heated air out the rear.

### **cabinet**

An alternate term used for a rack.

### **cable assembly**

A fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode fiber optic cable assemblies with either LC or SC type connectors.

- When there is a connector on only one end of the cable, the cable assembly is referred to as a pigtail.
- When there is a connector on both ends of the cable, the cable assembly is referred to as a jumper.

### **CAC**

Corrective Action Code. An HSV Element Manager graphical user interface (GUI) display component that defines the action required to correct a problem.

### **cache**

High-speed memory that sets aside data as an intermediate data buffer between a host and the storage media. The purpose of cache is to improve performance.

*See also* **read cache**, **write cache**, *and* **mirrored cache**.

**cache battery**

A rechargeable unit mounted within a controller enclosure that supplies back-up power to the cache module in case of primary power shortage.

**cache battery LED**

1. An orange light emitting diode (LED) that illuminates on the controller operator control panel (OCP) to define the status of the HSV Controller cache batteries.
2. An amber status LED that illuminates on a cache battery. When illuminated, it indicates that one or more cache battery cells have failed and the battery must be replaced with a new battery.

**carrier**

A drive enclosure compatible assembly containing a disk drive or other storage devices.

**client**

A software program that uses the services of another software program. The HSV Element Manager client is a standard internet browser.

**communication logical unit number (LUN)**

*See console LUN.*

**Compaq SANWorks HSV Element Manager**

*See HSV Element Manager.*

**Compaq StorageWorks**

The Compaq trademarked name used to describe the set of rack-mounted enclosures containing controllers, transceivers, I/O modules, EMUs, disk drives, cables, blowers, and power supplies used to design and configure a solution-specific storage system.

**condition report**

A three-element code generated by the EMU in the form where *et.* is the element type (a hexadecimal number), *en.* is the element number (a decimal number), and *ec* is the condition code (a decimal number).

### **console LUN**

A SCSI-3 virtual object that makes a controller pair accessible by the host before any virtual disks are created. *Also* called a communication LUN.

### **console LUN ID**

The ID that can be assigned when a host operating system requires a unique ID. The console LUN ID is assigned by the user, usually when the storage system is initialized.

*See also* **console LUN**.

### **controller**

A hardware/firmware device that manages communications between host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.

### **controller enclosure**

A unit that holds one or more controllers, power supplies, blowers, cache batteries, transceivers, and connectors.

### **controller event**

A significant occurrence involving any storage system hardware or software component reported by the controller to the HSV Element Manager.

### **controller fault LED**



An amber fault LED that illuminates on the controller OCP to indicate when there is an HSV Controller fault.

### **controller heartbeat LED**



A green LED that flashes on the controller OCP to indicate that the HSV controller is operational.

### **controller pair**

Two interconnected controller modules which together control a physical disk array. A controller pair and the disk array together constitute a storage system.

**corrective action code**

*See CAC.*

**CRITICAL Condition**

A disk drive enclosure EMU condition that occurs when one or more disk drive enclosure elements have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Some enclosure elements may be able to continue normal operations. Only an UNRECOVERABLE condition has precedence. This condition has precedence over NONCRITICAL errors and INFORMATION condition.

**CRU**

Customer Replaceable Unit. A storage system element that a user can replace without using special tools or techniques, or special training.

**customer replaceable unit**

*See CRU.*

**data entry mode**

The state in which controller information can be displayed or controller configuration data can be entered. On the Enterprise Storage System, the controller mode is active when the LCD on the HSV Controller OCP is flashing.

**default disk group**

The first disk group created at the time the system is initialized. The default disk group can contain the entire set of physical disks in the array or just a few of the disks.

*See also disk group.*

**Detailed Fault View**

An HSV Controller OCP display that permits a user to view detailed information about a controller fault.

**device channel**

A channel used to connect storage devices to a host I/O bus adapter or intelligent controller.

**device ports**

Controller pair device ports connected to the storage system's physical disk drive array through the FC-AL. *Also* called a device-side port.

**device-side ports**

*See* **device ports**.

**DIMM**

Dual Inline Memory Module. A small circuit board holding memory chips.

**dirty data**

The write-back cached data that has not been written to storage media even though the host operation processing the data has completed.

**disk drive**

A carrier-mounted storage device supporting random access to fixed size blocks of data.

**disk drive blank**

A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

**disk drive enclosure**

A unit that holds storage system devices such as disk drives, power supplies, blowers, I/O modules, transceivers or EMUs.

**disk drive enclosure event**

A significant operational occurrence involving a hardware or software component in the disk drive enclosure. The disk drive enclosure EMU reports these events to the controller for processing.

**disk failure protection**

A method by which a controller pair reserves drive capacity to take over the functionality of a failed or failing physical disk. For each disk group, the controllers reserve space in the physical disk pool equivalent to the selected number of physical disk drives.

**disk group**

A physical disk drive set or pool in which a virtual disk is created. A disk group may contain all the physical disk drives in a controller pair array or a subset of the array.

**disk migration state**

A physical disk drive operating state. A physical disk drive can be in a stable or migration state:

- **Stable**—The state in which the physical disk drive has no failure nor is a failure predicted.
- **Migration**—The state in which the disk drive is failing, or failure is predicted to be imminent. Data is then moved off the disk onto other disk drives in the same disk group.

**disk replacement delay**

The time that elapses between a drive failure and when the controller starts searching for spare disk space. Drive replacement seldom starts immediately in case the “failure” was a glitch or temporary condition.

**drive blank**

*See* **disk drive blank**.

**drive enclosure**

*See* **disk drive enclosure**.

**dual-loop**

A configuration where each drive is connected to a pair of controllers through two loops. These two Fibre Channel loops constitute a loop pair.

**dual power supply configuration**

*See* **redundant power configuration**.

**EIA**

Electronic Industries Alliance. A standards organization specializing in the electrical and functional characteristics of interface equipment.

## **EIP**

Event Information Packet. The event information packet is an HSV element hexadecimal character display that defines how an event was detected. *Also* called the EIP type.

## **electromagnetic interference**

See **EMI**.

## **electrostatic discharge**

See **ESD**.

## **element**

1. In a disk drive enclosure, a device such as an EMU, power supply, disk, blower, or I/O module. The object can be controlled, interrogated, or described by the enclosure services process.
2. In the Compaq Open SAN Manager, a controllable object, such as the Compaq StorageWorks Enterprise Storage System.

## **Element Manager GUI**

The graphical user interface (GUI) through which a user can control and monitor a storage system. The HSV Element Manager software can be installed on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent. The client for the agent is a standard browser.

## **EMI**

Electromagnetic Interference. The impairment of a signal by an electromagnetic disturbance.

## **EMU**

Environmental Monitoring Unit. An element which monitors the status of an enclosure, including the power, air temperature, and blower status. The EMU detects problems and displays and reports these conditions to a user and the controller. In some cases, the EMU implements corrective action.

## **enclosure**

A unit used to hold various storage system devices such as disk drives, controllers, power supplies, blowers, an EMU, I/O modules, or blowers.

**enclosure address bus**

An Enterprise Storage System bus that interconnects and identifies controller enclosures and disk drive enclosures by their physical location. Enclosures within a reporting group can exchange environmental data. This bus uses junction boxes and cables to assign enclosure numbers to each enclosure. Communications over this bus do not involve the FC-AL bus and are, therefore, classified as out-of-band communications.

**enclosure services**

Those services that establish the mechanical environmental, electrical environmental, and external indicators and controls for the proper operation and maintenance of devices with an enclosure as described in the *SES SCSI-3 Enclosure Services Command Set (SES), Rev 8b, American National Standard for Information Services*.

**Enclosure Services Interface**

See **ESI**.

**Enclosure Services Processor**

See **ESP**.

**Enterprise Virtual Array**

The Enterprise Virtual Array is a product that consists of one or more storage systems. Each storage system consists of a pair of HSV controllers and the disk drives they manage. A storage system within the Enterprise Virtual Array can be formally referred to as an Enterprise Storage System, or generically referred to as the storage system.

**Enterprise Virtual Array rack**

A unit that holds controller enclosures, disk drive enclosures, power distribution supplies, and enclosure address buses that, combined, comprise an Enterprise Storage System solution. *Also* called the Enterprise Storage System rack.

See *also* **rack**.

**environmental monitoring unit**

See **EMU**.

**error code**

The portion of an EMU condition report that defines a problem.

**ESD**

Electrostatic Discharge. The emission of a potentially harmful static electric voltage as a result of improper grounding.

**ESI**

Enclosure Services Interface. The SCSI-3 engineering services interface implementation developed for Compaq StorageWorks products. A bus that connects the EMU to the drives.

**ESP**

Enclosure Services Processor. An EMU that implements an enclosure's services process.

**event**

Any significant change in the state of the Enterprise Storage System hardware or software component reported by the controller to the HSV Element Manager.

*See also controller event, disk drive enclosure event, management agent event, and termination event.*

**Event Information Packet**

*See EIP.*

**Event Number**

*See Evt No.*

**Evt No.**

Event Number. A sequential number assigned to each Software Code Identification (SWCID) event. It is a decimal number in the range 0-255.

**exabyte**

A unit of storage capacity that is the equivalent of  $2^{60}$  bytes or 1,152,021,504,606,846,976 bytes. One exabyte is equivalent to 1,024 petabytes.

**fabric**

A Fibre Channel fabric switch or two or more interconnected Fibre Channel switches allowing data transmission.

**fabric port**

A port which is capable of supporting an attached arbitrated loop. This port on a loop will have the AL\_PA hexadecimal address 00 (loop ID 7E), giving the fabric the highest priority access to the loop. A loop port is the gateway to the fabric for the node ports on a loop.

**failover**

The process that takes place when one controller assumes the workload of a failed companion controller. Failover continues until the failed controller is operational.

**fan**

The variable speed airflow device that cools an enclosure or element by forcing ambient air into an enclosure or element and forcing heated air out the other side.

*See also blower.*

**Fault Management Code**

*See FMC.*

**FC-AL**

Fibre Channel Arbitrated Loop. The American National Standards Institute's (ANSI) document which specifies arbitrated loop topology operation.

**FC HBA**

Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter.

*See also FCA.*

**FCA**

Fiber Channel Adapter. An adapter used to connect the host server to the fabric. *Also* called a Host Bus Adapter (HBA) or a Fibre Channel Host Bus Adapter (FC HBA).

*See also FC HBA*

**FCC**

Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

**FCP**

Fibre Channel Protocol. The mapping of SCSI-3 operations to Fibre Channel.

**fiber**

The optical media used to implement Fibre Channel.

**fiber optics**

The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.

**fiber optic cable**

A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is noted for its properties of electrical isolation and resistance to electrostatic contamination.

**fibres**

The international spelling that refers to the Fibre Channel standards for optical media.

**Fibre Channel**

A data transfer architecture designed for mass storage devices and other peripheral devices that require very high bandwidth.

**Fibre Channel adapter**

See **FCA**.

**field replaceable unit**

See **FRU**.

**flush**

The act of writing dirty data from cache to a storage media.

**FMC**

Fault Management Code. The HSV Element Manager display of the Enterprise Storage System error condition information.

**form factor**

A storage industry dimensional standard for 3.5-inch (89 mm) and 5.25-inch (133 mm) high storage devices. Device heights are specified as low-profile (1-inch or 25.4 mm), half-height (1.6-inch or 41 mm), and full-height (5.25-inch or 133 mm).

**FPGA**

Field Programmable Gate Array. A programmable device with an internal array of logic blocks surrounded by a ring of programmable I/O blocks connected together through a programmable interconnect.

**frequency**

The number of cycles that occur in one second expressed in Hertz (Hz). Thus, 1 Hz is equivalent to one cycle per second.

**FRU**

Field Replaceable Unit. A hardware element that can be replaced in the field. This type of replacement can require special training, tools, or techniques. Therefore, FRU procedures are usually performed only by an authorized service provider.

**Gb**

Gigabit. A measurement of the rate at which the transfer of bits of data occurs. Sometimes referred to as Gbps. Nominally, a Gb is a transfer rate of 1,000,000,000 ( $10^9$ ) bits per second.

For Fibre Channel transceivers or FC loops the Gb transfer rates are:

- 1 Gb is a transmission rate of 1,062,500,000 bits per second.
- 2 Gb is a transmission rate of 2,125,000,000 bits per second.

## **GB**

Gigabyte. A unit of measurement defining either:

- A data transfer rate.  
*See also GBps*
- A storage or memory capacity of 1,073,741,824 ( $2^{30}$ ) bytes.

## **GBIC**

Gigabit Interface Converter.

*See transceiver.*

## **Gbps**

Gigabits per second. A measurement of the rate at which the transfer of bits of data occurs. Nominally, a Gb is a transfer rate of 1,000,000,000 ( $10^9$ ) bits per second.

*See also Gb.*

## **GBps**

Gigabytes per second. A measurement of the rate at which the transfer of bytes of data occurs. A GBps is a transfer rate of 1,000,000,000 ( $10^9$ ) bytes per second.

*See also GB.*

## **Giga (G)**

The notation to represent  $10^9$  or 1 billion (1,000,000,000).

## **gigabaud**

An encoded bit transmission rate of one billion ( $10^9$ ) bits per second.

## **gigabit**

*See Gb.*

## **gigabit per second**

*See Gbps.*

**graphical user interface**

*See* GUI.

**GUI**

Graphical User Interface. Software that displays the status of a storage system and allows its user to control the storage system.

**HBA**

Host Bus Adapter.

*See* FCA.

**host**

A computer that runs user applications and uses (or can potentially use) one or more virtual disks created and presented by the controller pair.

**Host Bus Adapter**

*See* FCA.

**host computer**

*See* host.

**host link LED**

The HSV Controller display that indicates the status of the storage system Fibre Channel links.

**host ports**

A connection point to one or more hosts through a Fibre Channel fabric. A host is a computer that runs user applications and that uses (or can potentially use) one or more of the virtual disks that are created and presented by the controller pair.

**host-side ports**

*See* host ports.

### **hot-pluggable**

A method of element replacement whereby the complete system remains operational during element removal or insertion. Replacement does not interrupt data transfers to other elements.

### **HSV Element Manager**

See **Element Manager**.

### **hub**

A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. It is used to improve the manageability of physical cables.

### **I/O module**

Input/Output module. The enclosure element that is the FC-AL interface to the host or controller. I/O modules are bus speed specific; either 1 Gb or 2 Gb.

### **IDX**

A 2-digit decimal number portion of the HSV controller termination code display that defines one of 32 locations in the Termination Code array that contains information about a specific event.

See also **param** and **TC**.

### **in-band communication**

The method of communication between the EMU and controller that utilizes the FC-AL bus.

See also **out-of-band communication**.

### **INFORMATION condition**

A disk drive enclosure EMU condition report that may require action. This condition is for information only and does not indicate the failure of an element. All condition reports have precedence over an INFORMATION condition.

### **initialization**

A process that prepares a storage system for use. Specifically, the system binds controllers together as an operational pair and establishes preliminary data structures on the disk array. Initialization also sets up the first disk group, called the default disk group.

**input/output module**

*See I/O module.*

**intake temperature**

*See ambient temperature.*

**interface**

A set of protocols used between components such as cables, connectors, and signal levels.

**JBOD**

Just a Bunch of Disks. A number of disks connected to one or more controllers.

**just a bunch of disks**

*See JBOD.*

**K**

Kilo. A scientific notation denoting a multiplier of one thousand (1,000).

**KB**

Kilobyte. A unit of measurement defining either storage or memory capacity.

1. For storage, a KB is a capacity of 1,000 ( $10^3$ ) bytes of data.
2. For memory, a KB is a capacity of 1,024 ( $2^{10}$ ) bytes of data.

**laser**

A device that amplifies light waves and concentrates them in a narrow, very intense beam.

**Last Fault View**

An HSV Controller display defining the last reported fault condition.

**Last Termination Error Array**

*See LTEA.*

**LCD**

Liquid Crystal Display. The indicator on a panel that is associated with an element. The LCD is usually located on the front of an element.

## **LED**

Light Emitting Diode. A semiconductor diode, used in an electronic display, that emits light when a voltage is applied to it.

### **light emitting diode**

See **LED**.

## **link**

A connection between ports on Fibre Channel devices. The link is a full duplex connection to a fabric or a simplex connection between loop devices.

## **logon**

Also called login, it is a procedure whereby a user or network connection is identified as being an authorized network user or participant.

## **loop**

See **arbitrated loop**.

## **loop ID**

Seven-bit values numbered contiguously from 0 to 126 decimal and represent the 127 valid AL\_PA values on a loop (not all 256 hexadecimal values are allowed as AL\_PA values per FC-AL).

## **loop pair**

A Fibre Channel attachment between a controller and physical disk drives. Physical disk drives connect to controllers through paired Fibre Channel arbitrated loops. There are two loop pairs, designated loop pair 1 and loop pair 2. Each loop pair consists of two loops (called loop A and loop B) that operate independently during normal operation, but provide mutual backup in case one loop fails.

## **LTEA**

Last Termination Event Array. A two-digit HSV Controller number that identifies a specific event that terminated an operation. Valid numbers range from 00 to 31.

**LUN**

Logical Unit Number. A SCSI convention used to identify elements. The host sees a virtual disk as a LUN. The LUN address a user assigns to a virtual disk for a particular host will be the LUN at which that host will see the virtual disk.

**management agent**

The HSV Element Manager software that controls and monitors the Enterprise Storage System. The software can exist on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent.

**management agent event** significant occurrence to or within the management agent software, or an initialized storage cell controlled or monitored by the management agent.

**Mb**

Megabit. A term defining a data transfer rate.

*See also Mbps.*

**MB**

Megabyte. A term defining either:

- A data transfer rate.  
*See also MBps.*
- A measure of either storage or memory capacity of 1,048,576 ( $2^{20}$ ) bytes.

**Mbps**

Megabits per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 ( $10^6$ ) bits per second.

**MBps**

Megabytes per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 ( $10^6$ ) bytes per second.

**mean time between failures**

*See MTBF.*

**Mega**

A notation denoting a multiplier of 1 million (1,000,000).

**metadata**

Information that a controller pair writes on the disk array. This information is used to control and monitor the array and is not readable by the host.

**micro meter**

See  $\mu\text{m}$ .

**mirrored caching**

A process in which half of each controller's write cache mirrors the companion controller's write cache. The total memory available for cached write data is reduced by half, but the level of protection is greater.

**mirroring**

The act of creating an exact copy or image of data.

**MTBF**

Mean Time Between Failures. The average time from start of use to first failure in a large population of identical systems, components, or devices.

**multi-mode fiber**

A fiber optic cable with a diameter large enough (50 microns or more) to allow multiple streams of light to travel different paths from the transmitter to the receiver. This transmission mode enables bidirectional transmissions.

**Network Storage Controller**

See NSC.

**NONCRITICAL Condition**

A disk drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure does not affect continued normal operation of the enclosure. All devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly may be reduced if additional failures occur. UNRECOVERABLE and CRITICAL errors have precedence over this condition. This condition has precedence over INFORMATION condition. Early correction can prevent the loss of data.

**node port**

A device port that can operate on the arbitrated loop topology.

**non-OFC (Open Fibre Control)**

A laser transceiver whose lower-intensity output does not require special open Fibre Channel mechanisms for eye protection. The Enterprise Storage System transceivers are non-OFC compatible.

**NSC**

Network Storage Controller. The HSV Controllers used by the Enterprise Storage System.

**NVRAM**

Nonvolatile Random Access Memory. Memory whose contents are not lost when a system is turned off or if there is a power failure. This is achieved through the use of UPS batteries or implementation technology such as flash memory. NVRAM is commonly used to store important configuration parameters.

**occupancy alarm level**

A percentage of the total disk group capacity in blocks. When the number of blocks in the disk group that contain user data reaches this level, an event code is generated. The alarm level is specified by the user.

**OCP**

Operator Control Panel. The element that displays the controller's status using LEDs and an LCD. Information selection and data entry is controlled by the OCP pushbuttons.

### **operator control panel**

See **OCP**.

### **OSM**

Open SAN Manager. A centralized, appliance-based monitoring and management interface that supports multiple applications, operating systems, hardware platforms, storage systems, tape libraries and SAN-related interconnect devices. It is included and resides on the SANWorks Management Appliance, a single aggregation point for data management.

### **out-of-band communication**

Communication between an enclosure and reporting group elements that does not use the FC-AL bus, such as the enclosure address bus.

See also **in-band communication**.

### **param**

That portion of the HSV controller termination code display that defines:

- The 2-character parameter identifier that is a decimal number in the 0 through 30 range.
- The 8-character parameter code that is a hexadecimal number.

See also **IDX** and **TC**.

### **parity**

A method of checking if binary numbers or characters are correct by counting the ONE bits. In odd parity, the total number of ONE bits must be odd; in even parity, the total number of ONE bits must be even. Parity information can be used to correct corrupted data.

### **parity bit**

A binary digit added to a group of bits that checks to see if there are errors in the transmission.

### **parity check**

A method of detecting errors when data is sent over a communications line. With even parity, the number of ONE bits in a set of binary data should be even. With odd parity, the number of ONE bits should be odd.

**password**

A security interlock whose purpose is to allow:

- a management agent control only certain storage systems
- only certain management agents control a storage system

**PDM**

Power Distribution Module. A thermal circuit breaker equipped power strip that distribute power from a PDU to Enterprise Storage System elements.

**PDU**

Power Distribution Unit. The rack device that distributes conditioned AC or DC power within a rack.

**petabyte**

A unit of storage capacity that is the equivalent of  $2^{50}$ , 1,125,899,906,842,624 bytes or 1,024 terabytes.

**physical disk**

A disk drive mounted in a disk drive enclosure that communicates with a controller pair through the device-side Fibre Channel loops. A physical disk is hardware with embedded software, as opposed to a virtual disk, which is constructed by the controllers. Only the controllers can communicate directly with the physical disks.

The physical disks, in aggregate, are called the array and constitute the storage pool from which the controllers create virtual disks.

**physical disk array**

*See array.*

**port**

A Fibre Channel connector on a Fibre Channel device.

**port\_name**

A 64-bit unique identifier assigned to each Fibre Channel port. The port\_name is communicated during the login and port discovery processes.

**port-wine colored**

A Compaq convention of applying the color of port wine to a CRU tab, lever, or handle to identify the unit as hot-pluggable.

**power distribution module**

See **PDM**.

**power distribution unit**

See **PDU**.

**power supply**

An element that develops DC voltages for operating the storage system elements from either an AC or DC source.

**preferred address**

An AL\_PA which a node port attempts to acquire during loop initialization.

**preferred path**

A preference for which controller of the controller pair manages the virtual disk. This preference is set by the user through the element manager when creating the virtual disk. A host can change the preferred path of a virtual disk at any time. The primary purpose of preferring a path is load balancing.

**protocol**

The conventions or rules for the format and timing of messages sent and received.

**pushbutton**

A switch that is engaged or disengaged when it is pressed.

**quiesce**

The act of rendering bus activity inactive or dormant. For example, “quiesce the SCSI bus operations during a device warm-swap.”

**rack**

A floor-standing structure primarily designed for, and capable of, holding and supporting storage system equipment. All racks provide for the mounting of panels per Electronic Industries Alliance (EIA) *Standard RS-310-C*.

**rack-mounting unit**

A measurement for rack heights based upon a repeating hole pattern. It is expressed as “U” spacing or panel heights. Repeating hole patterns are spaced every 1.75 inches (44.45 mm) and based on EIA’s *Standard RS-310-C*. For example, a 3U unit is 5.25-inches (133.35 mm) high, and a 4U unit is 7.0-inches (177.79 mm) high.

**read caching**

A cache method used to decrease subsystem response times to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives. Reading data from cache memory is faster than reading data from a disk. The read cache is specified as either on or off for each virtual disk. The default state is on.

**read ahead caching**

A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives.

**reconstruction**

The process of regenerating the contents of a failed member data. The reconstruction process writes the data to a spare set disk and incorporates the spare set disk into the mirrorset, striped mirrorset or RAID set from which the failed member came.

**redundancy**

1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally work independently but can take over for the other in case of failure.
2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

### **redundant power configuration**

A capability of the Enterprise Storage System racks and enclosures to allow continuous system operation by preventing single points of power failure.

- For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.
- For a controller or disk drive enclosure, two power supplies ensure that the DC power is available even when there is a failure of one supply, one AC source, or one power conditioning unit. Implementing the redundant power configuration provides protection against the loss or corruption of data.

### **reporting group**

An Enterprise Storage System controller pair and the associated disk drive enclosures. The Enterprise Storage System controller assigns a unique decimal reporting group number to each EMU on its loops. Each EMU collects disk drive environmental information from its own sub-enclosure and broadcasts the data over the enclosure address bus to all members of the reporting group. Information from enclosures in other reporting groups is ignored.

### **room temperature**

*See* **ambient temperature**.

### **SCSI**

1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.
2. The communication protocol used between a controller pair and the hosts. Specifically, the protocol is FC-AL or SCSI on a Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

### **SCSI-3**

The ANSI standard that defines the operation and function of Fibre Channel systems.

### **SCSI-3 Enclosure Services**

*See* **SES**.

**selective presentation**

The process whereby a controller presents a virtual disk only to the host computer authorized access.

**serial transmission**

A method of transmission in which each bit of information is sent sequentially on a single channel rather than simultaneously as in parallel transmission.

**SES**

SCSI-3 Enclosures Services. Those services that establish the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure.

**short wave**

A 2 Gb Compaq StorageWorks Fibre Channel system that transmits data using multi-mode fiber cables (orange) at distances up to 984 ft (300 m).

**small computer system interface**

*See* SCSI.

**SMART**

Self-Monitoring, Analysis, and Reporting Technology. An industry standard for running internal diagnostics on disk drives and making predictive failure analysis. If a physical disk drive reports an imminent failure, the controllers redistribute data to other drives. The SMART message is reported and should trigger the immediate corrective action to replace the drive.

**snapshot**

A temporary virtual disk (VD) that reflects the contents of another virtual disk at a particular point in time. A snapshot operation is only done on an active virtual disk. Only one snapshot of an active virtual disk can exist at any point. The active disk and its snapshot constitute a virtual family.

*See also* **active virtual disk**, **virtual disk copy**, *and* **virtual disk family**.

**solutions rack**

A rack containing controller enclosures, disk drive enclosures, power distribution, enclosure address buses, and so forth that provide a specific solution such as the Modula Solutions rack or the Enterprise Storage System rack.

*See also* **rack**.

**spin down**

A process that begins when disk drive power is removed and data transfer stops. The process ends when the head retracts and the media stops rotating. Until this occurs, the disk drive cannot be moved.

**spin up**

A process that begins when a disk drive's power is initiated and ends when the drive is determined to be operational and ready for data transfer operations.

**SSN**

Storage System Name. An HSV Element Manager-assigned, unique 20-character name that identifies a specific storage system.

**storage carrier**

*See* **carrier**.

**storage pool**

The aggregated blocks of available storage in the total physical disk array.

**storage system**

The controllers, storage devices, enclosures, cables, and power supplies and their software.

**Storage System Name**

*See* **SSN**.

**switch**

An electro-mechanical device that initiates an action or completes a circuit.

**TB**

Terabyte. A term defining either:

- A data transfer rate.  
*See also TBps.*
- A measure of either storage or memory capacity of 1,099,5111,627,776 ( $2^{40}$ ) bytes.

**TBps**

Terabytes per second. A data transfer rate of 1,000,000,000,000 ( $10^{12}$ ) bytes per second.

**TC**

Termination Code. An Enterprise Storage System controller 8-character hexadecimal display that defines a problem causing controller operations to halt.

*See also* **IDX** and **param**.

**Termination Code**

*See* **TC**.

**termination event**

Occurrences that cause the storage system to cease operation.

**terminator**

Interconnected elements that form the ends of the transmission lines in the enclosure address bus.

**topology**

An interconnection scheme that allows multiple Fibre Channel ports to communicate. Point-to-point, arbitrated loop, and switched fabric are all Fibre Channel topologies.

**transceiver**

The device that converts electrical signals to optical signals at the point where the fiber cables connect to the FC elements such as hubs, controllers, or adapters. *Also* called a Gigabit Interface Converter (GBIC).

**uninitialized system**

A state in which the storage system is not ready for use.

*See also* **initialization**.

**units**

*See* **rack-mounting units**.

**UNRECOVERABLE Condition**

A disk drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have failed and have disabled the enclosure. The enclosure may be incapable of recovering or bypassing the failure and will require repairs to correct the condition.

This is the highest level condition and has precedence over all other errors and requires immediate corrective action.

**unwritten cached data**

*Also* called unflushed data.

*See also* **dirty data**.

**UPS**

Uninterruptible Power Supply. A battery-operated power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.

**VD**

Virtual Disk. A simulated disk drive created by the controllers as storage for one or more hosts. The virtual disk characteristics, chosen by the storage administrator, provide a specific combination of capacity, availability, performance, and accessibility. A controller pair simulates the characteristics of the virtual disk by deploying the disk group from which the virtual disk was created.

The host computer sees the virtual disk as “real,” with the characteristics of an identical physical disk.

*See also* **active virtual disk, virtual disk copy, virtual disk family, and virtual disk snapshot**

**virtual disk**

*See* **VD**.

**virtual disk copy**

A clone or exact replica of another virtual disk at a particular point in time. Only an active virtual disk can be copied. A copy immediately becomes the active disk of its own virtual disk family.

*See also* **active virtual disk**, **virtual disk family**, and **virtual disk snapshot**

**virtual disk family**

A virtual disk and its snapshot, if a snapshot exists, constitute a family. The original virtual disk is called the active disk. When you first create a virtual disk family, the only member is the active disk.

*See also* **active virtual disk**, **virtual disk copy**, and **virtual disk snapshot**.

**virtual disk snapshot**

*See* **snapshot**.

**Vraid0**

A virtualization technique that provides no data protection. Data host is broken down into chunks and distributed on the disks comprising the disk group from which the virtual disk was created. Reading and writing to a Vraid0 virtual disk is very fast and makes the fullest use of the available storage, but there is no data protection (redundancy) unless there is parity.

**Vraid1**

A virtualization technique that provides the highest level of data protection. All data blocks are mirrored or written twice on separate physical disks. For read requests, the block can be read from either disk, which can increase performance. Mirroring takes the most storage space because twice the storage capacity must be allocated for a given amount of data.

### **Vraid5**

A virtualization technique that uses parity striping to provide moderate data protection. Parity is a data protection mechanism for a striped virtual disk. A striped virtual disk is one whose data to and from the host is broken down into chunks and distributed on the physical disks comprising the disk group in which the virtual disk was created. If the striped virtual disk has parity, another chunk (a parity chunk) is calculated from the set of data chunks and written to the physical disks. If one of the data chunks becomes corrupted, the data can be reconstructed from the parity chunk and the remaining data chunks.

### **World Wide Name**

*See* **WWN**.

### **write back caching**

A controller process that notifies the host that the write operation is complete when the data is written to the cache. This occurs before transferring the data to the disk. Write back caching improves response time since the write operation completes as soon as the data reaches the cache. As soon as possible after caching the data, the controller then writes the data to the disk drives.

### **write caching**

A process when the host sends a write request to the controller, and the controller places the data in the controller cache module. As soon as possible, the controller transfers the data to the physical disk drives.

### **WWN**

World Wide Name. A unique Fibre Channel identifier consisting of a 16-character hexadecimal number. A WWN is required for each Fibre Channel communication port.

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# Index

12-disk drive enclosures configuration 2-4  
12-Drive enclosure storage system 1-4  
12-Drive enclosure storage system layout 2-5  
6-disk drive enclosures configuration 2-2

## A

AC power distribution 4-1  
    troubleshooting 5-2  
air quality, operating specifications B-2  
altitude, shipping B-2  
ambient temperature  
    operating B-2  
    shipping B-2  
    short term storage B-2  
authorized reseller, Compaq xi

## B

BTU specifications B-2  
button names, convention defined vii

## C

Caution, symbol and definition ix  
certification product labels A-2  
command names, convention defined viii  
Compaq  
    authorized reseller xi  
    authorized service provider x  
    technical support xi  
    website xi  
configurations  
    Enterprise Storage System 2-1  
    single rack 1-4  
        12-disk drive enclosures 2-4  
        6-disk drive enclosures 2-2

    basic 1-3  
    full 1-4  
connectors  
    enclosure address bus 3-3, 3-4  
    power IEC 309 receptacle 1-5  
    power NEMA L6-30R 1-5  
controller enclosures 3-3  
conventions  
    button names, defined vii  
    command names, defined viii  
    dialog box names, defined vii  
    directory names, defined vii  
    drive names, defined viii  
    filenames, defined viii  
    key sequences, defined vii  
    keyboard keys, defined vii  
    menu command sequences, defined viii  
    menu items, defined vii  
    named keys, defined vii  
    system responses, defined viii  
    URLs, defined viii  
    user input, defined viii  
Country-Specific Certifications A-2

## D

dialog box names, convention defined vii  
directory names, convention defined vii  
disk drive MTBF specifications B-2  
doors 1-11  
    closing 1-11  
    opening 1-11  
drive enclosures 3-3  
    enclosure address bus 3-3  
    troubleshooting 5-8

drive names, convention defined viii

## E

electrical shock hazard, symbol and definition ix

enclosure address bus 3-1

connectors 3-3, 3-4

controller enclosures 3-3, 5-8

drive enclosures 3-3, 5-8

overview 3-1

possible failures 5-9

single rack 3-2

troubleshooting 5-6

controller 5-8

drive enclosure, single 5-7

JB failures 5-7

terminator failures 5-6

Enterprise Storage System

configurations 1-2, 2-1

rack 1-1

racks 1-1

environmental specifications

air quality B-2

ambient temperature

operating B-2

shipping B-2

short term storage B-2

heat dissipation B-2

relative humidity B-2

operating B-2

shipping B-2

short term storage B-2

shipping B-2

short term storage B-2

equipment symbols ix

excessive weight, symbol and definition x

## F

fibre channel disk drive enclosures 1-10

filenames, convention defined viii

fork lift, using B-1

Full Single-Rack Configuration 1-4

## G

getting help x

Compaq technical support xi

Compaq website xi

## H

help, getting x

hot surface, symbol and definition x

HSV controller enclosures 1-9

## I

Important, defined ix

intake temperature See ambient temperature

## K

key sequences, convention defined vii

keyboard keys, convention defined vii

## L

labels

product certification A-2

## M

menu command sequences, convention defined viii

menu items, convention defined vii

moving enclosure WARNING B-1

MTBF B-2

multiple power source, symbol and definition x

## N

named keys, convention defined vii

network interface connection, symbol and definition ix

Note, defined ix

## O

overload conditions 5-4

## P

PDMs 1-8, 4-6, 5-5

PDU 1-7, 4-4, 5-3

AC input 5-3

correcting an overload condition 5-4

PDU 1 4-3

- PDU 2 4-3
- troubleshooting 5-3
- power connectors
  - IEC 309 receptacle 1-5
  - NEMA L6-30R 1-5
- power distribution unit. See PDU.
- power distribution 1-5, 4-1
  - AC power overview 4-1
- power distribution modules. See PDM.
- product certification A-2
- product certification label A-2

**R**

- rack
  - doors 1-11
    - installing 5-12
    - removing 5-12
  - PDMs 1-8
  - stability x
  - troubleshooting 5-1
- rack AC power distribution 4-1
- relative humidity
  - operating B-2
  - shipping B-2
  - short term storage B-2
- room temperature See ambient temperature

**S**

- shipping container, moving B-1
- shipping specifications
  - altitude B-2
  - ambient temperature B-2
  - relative humidity B-2
- short term storage specifications
  - altitude B-2
  - ambient temperatue B-2
  - relative humidity B-2
- single-rack enclosure address bus 3-2
- specifications
  - disk drive MTBF B-2
  - environmental B-2
  - operating B-2
  - shipping B-2

- short term storage B-2
- symbols
  - in text ix
  - on equipment ix
- system responses, convention defined viii

**T**

- technical support xi
- terminator failures 5-6
- text symbols ix
- troubleshooting
  - AC power 5-2
  - enclosure address bus 5-6
    - controller enclosures 5-8
    - drive enclosures 5-8
    - terminators 5-6
  - JB failures 5-7
  - overload conditions 5-4
  - PDMs 5-5
  - PDU failures 5-3
  - rack 5-1, 5-2

**U**

- URLs, convention defined viii
- user input, convention defined viii
- using fork lift B-1
- using hand truck B-1

**W**

**WARNINGS**

- electrical shock hazard symbol, defined ix
- enclosure moving B-1
- excessive weight symbol, defined x
- hot surface symbol, defined x
- multiple power source symbol, defined x
- network interface connection symbol, defined ix
- shipping container B-1
- symbol and definition ix

websites

- Compaq StorageWorks xi
- Compaq technical support xi





