

Compaq StorageWorks

Enterprise Virtual Array
HSV Controller
User Guide

Part Number: EK-E1HSV-UA. A01

First Edition August 2001

Product Version: VCS 1.0

This publication is for use by individuals responsible for operating and maintaining the Compaq StorageWorks Enterprise Virtual Array HSV Controller.

COMPAQ

© 2001 Compaq Computer Corporation.

Compaq, the Compaq logo, StorageWorks, and SANworks are trademarks of Compaq Information Technologies Group, L.P.

UNIX is a trademark of The Open Group.

All other product names mentioned herein may be trademarks of their respective companies.

Confidential computer software. Valid license from Compaq required for possession, use or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer Software, Computer Software Documentation, and Technical Data for Commercial Items are licensed to the U.S. Government under vendor's standard commercial license.

Compaq shall not be liable for technical or editorial errors or omissions contained herein. The information in this document is provided "as is" without warranty of any kind and is subject to change without notice. The warranties for Compaq products are set forth in the express limited warranty statements accompanying such products. Nothing herein should be construed as constituting an additional warranty.

Compaq service tool software, including associated documentation, is the property of and contains confidential technology of Compaq Computer Corporation. Service customer is hereby licensed to use the software only for activities directly relating to the delivery of, and only during the term of, the applicable services delivered by Compaq or its authorized service provider. Customer may not modify or reverse engineer, remove, or transfer the software or make the software or any resultant diagnosis or system management data available to other parties without Compaq's or its authorized service provider's consent. Upon termination of the services, customer will, at Compaq's or its service provider's option, destroy or return the software and associated documentation in its possession.

Printed in the U.S.A.

Enterprise Virtual Array HSV Controller User Guide
First Edition August 2001
Part Number: EK-E1HSV-UA. A01

Contents

About this Guide

Text Conventions	ix
Symbols in Text	xi
Symbols on Equipment	xi
Rack Stability	xii
Getting Help	xii
Compaq Technical Support	xiii
Compaq Website	xiii
Compaq Authorized Reseller	xiii

1 Introducing the HSV Series Controllers

Controller Enclosure Features	1-4
High Availability Features	1-5
Controller Pairs	1-5
Blowers	1-5
Cache Battery Assemblies	1-6
OCP	1-7
Element Replacement	1-7

2 Setting Up an HSV-Series Controller Pair

Setup Procedure Overview	2-1
Using the OCP	2-2
Displays	2-2
Startup Display	2-2
Initial Setup Display	2-3
OCP Pushbuttons	2-4
Node WWN	2-4
Procedure for Entering the WWN	2-6
Procedure for Entering the WWN Checksum	2-8
Procedure for Setting the Storage System Password	2-9

3 Controller Operations

An Overview of the HSV-Series Controller	3-2
Cabling	3-3
OCP Overview	3-4
LEDs	3-4
Navigation Pushbuttons	3-5
LCD	3-6
Displaying the Storage System Menu Tree	3-6
Displaying System Information	3-8
Versions System Information	3-9
Shutting Down the System	3-11
Restarting the System	3-14
Powering Off the System	3-15
Initializing the System	3-16
Password Options	3-18
Changing a Password	3-18
Clearing a Password	3-20

4 Power and Cooling

DC Power Supplies	4-1
Blowers	4-2

5 Controller Fault Management

Using the Element Manager GUI	5-1
GUI Termination Event Display	5-1
GUI Event Display	5-2
Fault Management Displays	5-4
Displaying Last Fault Information	5-4
Displaying Detailed Information	5-5

6 Replacement Procedures

ESD Protection	6-1
Common Replacement Procedures	6-2
Identifying the Spare Part Number	6-2
Replacing a Cache Battery	6-3
Determining the Status of a Cache Battery	6-3
Battery Assembly Replacement Guidelines	6-3
Battery Assembly Replacement Procedure	6-4

Replacing a Blower 6-6
Replacing a Fiber Optic Cable 6-8
Replacing a Transceiver 6-9

A Regulatory Notices

FCC Class A Certification A-1
Country-Specific Certifications A-2

B Specifications

Physical Specifications B-1
Power Specifications B-2
Environmental Specifications B-3

C Protecting Fiber Optic Connections

Glossary

Index

Figures

1-1	HSV-series controller—front view	1-1
1-2	Six drive enclosure storage system—front view	1-2
1-3	Twelve drive enclosure storage system—front view	1-3
1-4	Major HSV controller components	1-4
1-5	HSV110 controller—rear view	1-4
1-6	Controller blowers location	1-5
1-7	HSV controller cache battery assembly	1-6
1-8	OCP components	1-7
2-1	OCP displays and controls	2-2
2-2	Typical HSV110 controller startup display	2-3
2-3	Initial setup display	2-3
2-4	Pushbutton icons	2-4
2-5	Sample Node WWN label	2-4
2-6	Node WWN label location	2-5
3-1	Model 3220 controller location—front view	3-2
3-2	Model 3220 controller location—rear view	3-2
3-3	HSV controller connectors—rear view	3-3
3-4	Controller OCP	3-4
3-5	Navigation pushbutton icons	3-5
3-6	Default LCD displays	3-6
4-1	Controller blower	4-2
4-2	Blower location	4-2
5-1	GUI Termination Event display	5-2
5-2	Typical Element Manager Event display	5-2
6-1	Typical Compaq CRU product label	6-2
6-2	Accessing and opening the cache battery compartment	6-4
6-3	Replacing a battery assembly	6-4
6-4	Opening the blower compartment	6-6
6-5	Replacing a blower	6-7
6-6	Removing or installing a fiber optic cable	6-8
6-7	Removing or installing a transceiver	6-10
A-1	Typical enclosure certification label	A-2

Tables

1	Text Conventions	vii
2-1	WWN Pushbutton Functions	2-6
2-2	System Password Pushbutton Functions.	2-9
3-1	Controller Status Icons and LEDs.	3-4
3-2	System Password Pushbutton Functions.	3-8
3-3	Shutdown Methods	3-11
B-1	HSV-Series Controller Physical Specifications	B-1
B-2	Controller Power Supply AC Power Requirements	B-2
B-3	Controller Power Supply Output Specifications.	B-2

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">• Named Keys• Key Sequences	Bold	Home, Print Screen, Num Lock, Esc, PgUp A plus sign (+) between two keys means that you should press them simultaneously: Ctrl+A, Ctrl+Home, Alt+Ctrl+Del
<ul style="list-style-type: none">• Menu Items• Directory Names• Button Names• Dialog Box Names	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"> • User Input and System Responses (Output and Error Messages) • COMMAND NAMES • Drive Names 	<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 <variables> are displayed in angle brackets (< >) and all lower case.</p>	<p>User Input and System Responses:</p> <ul style="list-style-type: none"> • To exit from the program, type <code>Exit</code>. • At the prompt, type this command: <code>SHOW THIS_CONTROLLER</code> (no variable) • To see your settings, give the command: <code>SHOW <storage sets> FULL</code> (with variable) • You will see the <code>Continue?</code> message. <p>Command Names</p> <ul style="list-style-type: none"> • Use <code>SET THIS_CONTROLLER</code> to change parameters. • To manage storage, enter <code>RUN <i>sysmgr.exe</i></code> • (UNIX, AIX, Solaris): To list files, give the <code>ls</code> command. • Drive Names: Navigate to your CD-ROM drive (usually <code>D:</code> or <code>E:</code>).
<p><i>filenames</i></p>	<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>
<p>Menu Command Sequences</p>	<p>Initial Caps, with a right angle bracket (>) between items. Menu items are displayed as shown on screen.</p>	<p>To compare documents, choose: Tools > Documents > Compare.</p>
<p>URLs</p>	<p>Sans serif font.</p>	<p>http://www.compaq.com/storage</p>

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.

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>.

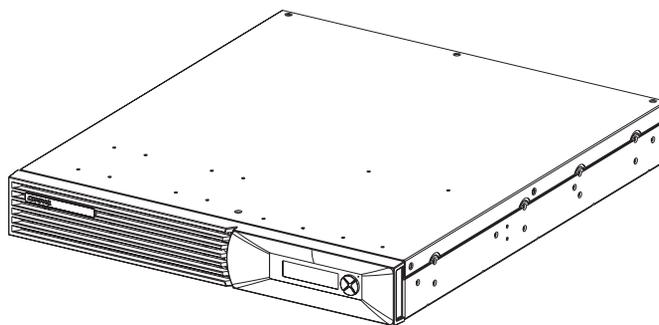
Compaq Authorized Reseller

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.

Introducing the HSV Series Controllers

This chapter describes the major features, purpose, and function of the HSV-series controllers (see Figure 1–1). Each Enterprise Storage System has a pair of these controllers (see ❶, Figure 1–2 and Figure 1–3).



CXO7541A

Figure 1–1: HSV-series controller—front view

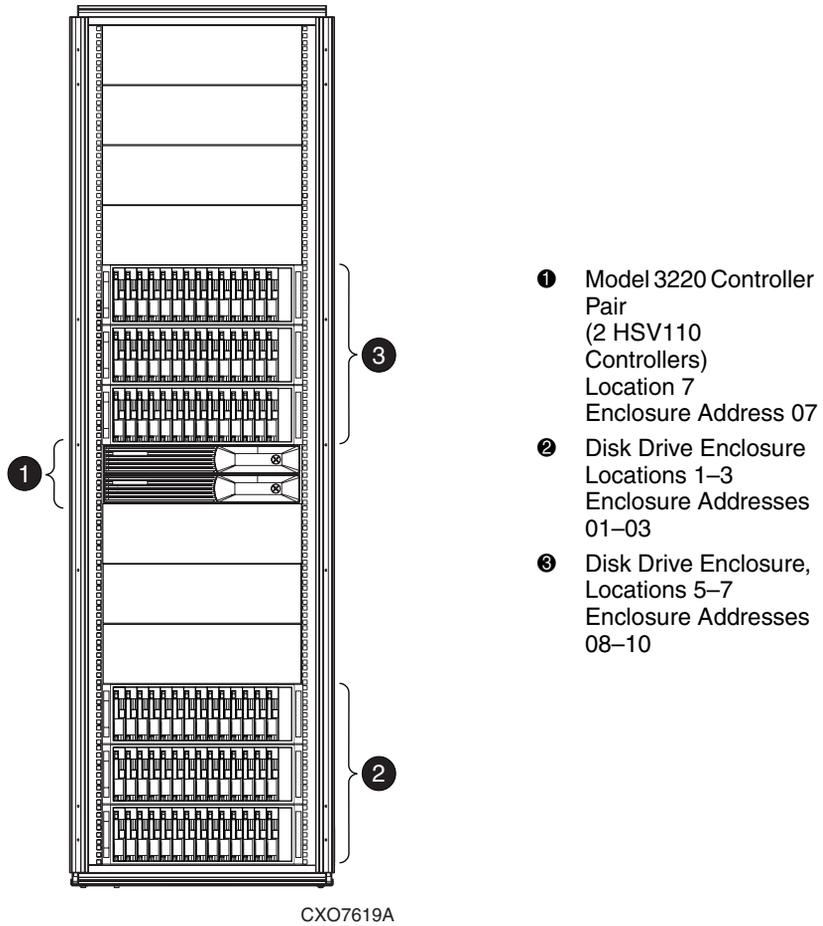


Figure 1-2: Six drive enclosure storage system—front view

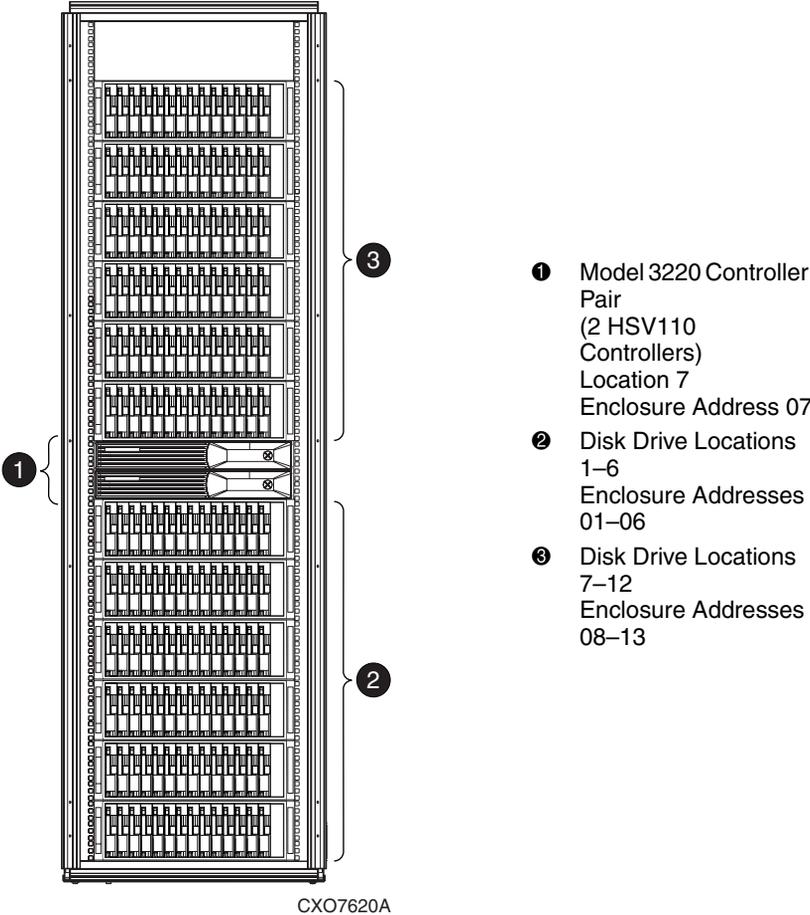


Figure 1–3: 12-Drive enclosure storage system—front view

Controller Enclosure Features

The major controller features on the front of the controller (see Figure 1–4) are:

- A removable bezel ❶ that provides access to the blower compartment and the cache battery assembly compartment.
- The blower compartment ❷ that contains two blowers that cool the controller.
- The Operator Control Panel (the OCP) ❸ that includes four status LEDs, a liquid crystal display (LCD), and a four position pushbutton switch. By using the OCP pushbuttons and the LCD, you can display information about the controller, and, in some cases, enter controller operational data.

Located behind the OCP is a cache battery compartment, which contains two lead-acid battery assemblies.

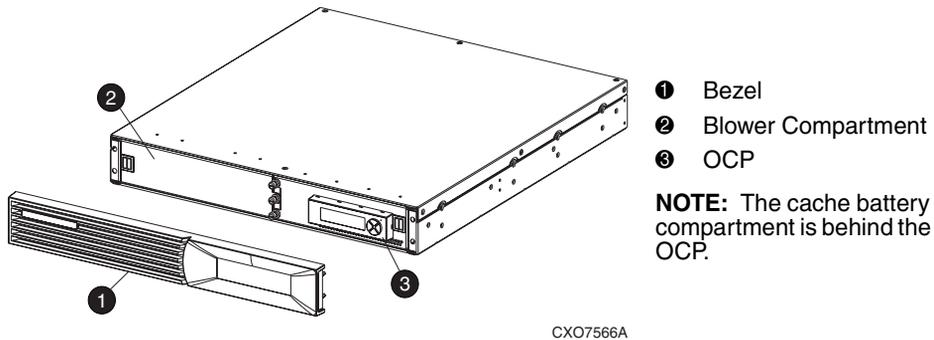


Figure 1–4: Major HSV controller components

On the rear of the controller (see Figure 1–5) are the data and power connections. The data connections are the interface to the disk drive enclosures, the other controller, and the fabric (host) or the Compaq SANworks HSV Element Manager.

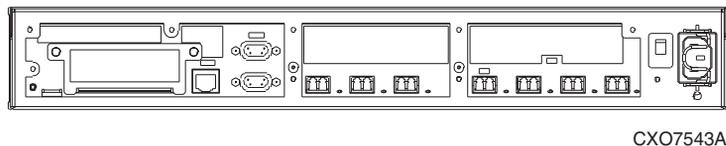


Figure 1–5: HSV110 controller—rear view

High Availability Features

The HSV-series controllers ensure high availability of the Enterprise Storage System in the following ways.

Controller Pairs

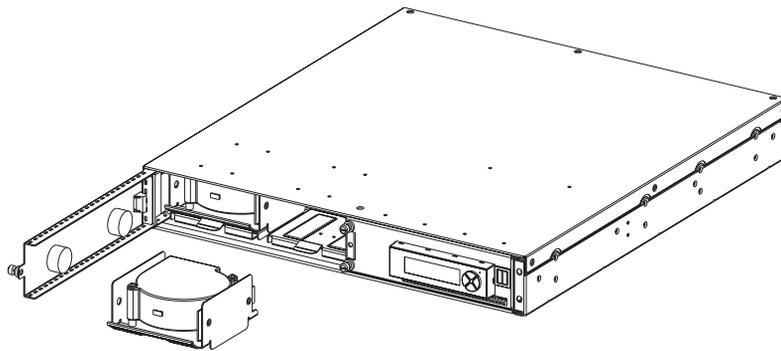
Mounting two interconnected HSV-series controllers ensures that the failure of a controller element (such as a power supply, transceiver, fiber optic cable, Fibre Channel port, and so forth) does not disable the system. The complete data redundancy includes two Loop A and two Loop B data paths.

Even the failure of a controller power supply would not disable the system. A single controller can fully support an entire system until the defective controller, or controller element, is repaired.

The internal power supply provides the DC voltages required for controller operation. The controller power supply is not field replaceable. If a power supply fails, you must replace the affected controller enclosure.

Blowers

The two controller blowers are physically located in the left front of the controller enclosure (see Figure 1–6).



CXO7542A

Figure 1–6: Controller blowers location

If a blower fails, you can replace it without shutting down the system.

Cache Battery Assemblies

Each HSV-series controller has two lead-acid cache battery assemblies that provide power to the cache memory dual in-line memory modules (DIMMs). Each battery assembly has three lead-acid, nonspillable cells. *When both battery assemblies are fully charged*, they can provide power to the DIMMs for up to 96 hours.

These cells are mounted in a plastic case, which is the battery assembly (see Figure 1–7).

- The orientation label is located in the upper left corner at the rear of the case.
- The battery assembly amber status LED ❶ is located in the lower right corner at the rear of the case.

The battery assemblies are located in a compartment behind the OCP.

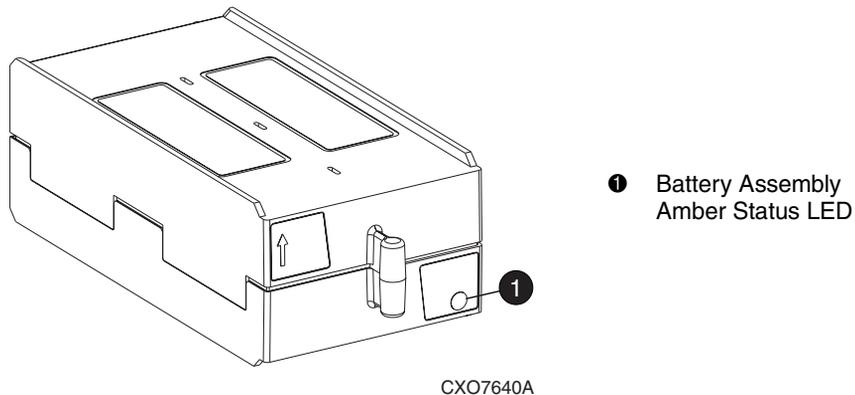


Figure 1–7: HSV controller cache battery assembly

OCP

The OCP (see Figure 1–8) is an interface between you and the controller. Much of the information provided here duplicates information displayed on the Element Manager graphical user interface (GUI). Even if you cannot observe the GUI, or if the GUI is not functioning, the controller status is available on the OCP. You can use the OCP LEDs, the LCD, and the pushbuttons to determine the controller status.

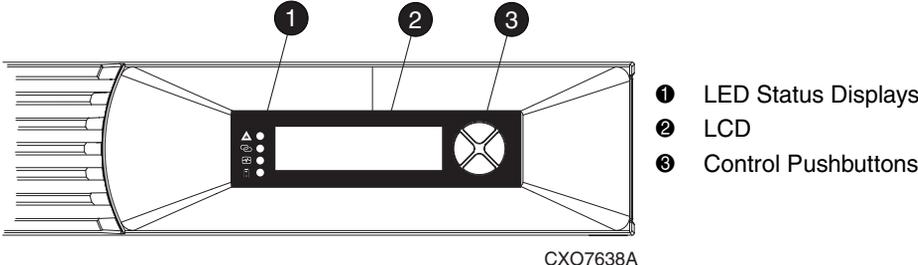


Figure 1–8: OCP components

The function and operation of these displays and controls are described in Chapter 3, “Controller Operations.”

Element Replacement

The only customer replaceable units (CRUs) or elements, are the blowers, the batteries, the transceivers, and the cables. The failure of any other controller element, including the power supply, requires replacing the controller enclosure.

Setting Up an HSV-Series Controller Pair

During the initial installation of an Enterprise Storage System, you must set up the controller pair. This chapter describes the processes and procedures for setting up the controller pair.

NOTE: The OCP procedures that define other controller functions are described in Chapter 3, “Controller Operations.”

Setup Procedure Overview

The *Enterprise Virtual Array Initial Setup User Guide* provides detailed instructions for applying power and connecting the system to the fabrics. Once these procedures are complete, you can use the OCP to set up the controller pair. The controller pair setup involves:

- Entering the 16-character Node WWN
- Entering the two-character checksum
- Entering the *optional* system password

IMPORTANT: Completing these procedures on either HSV-series controller automatically completes the procedure on the other controller.

Using the OCP

To set up an HSV-series controller pair, you use the OCP to display information and enter data.

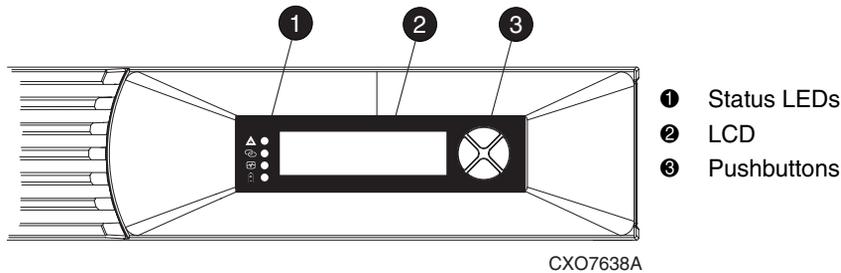


Figure 2-1: OCP displays and controls

Displays

The OCP has LEDs and a liquid crystal display (LCD).

The status LEDs ❶ indicate the internal status of the controller, as described in Chapter 3, “Controller Operations.” During initial setup, the status LEDs may not be fully operational.

Each LCD ❷ row displays 20 alphanumeric characters.

Startup Display

Resetting or applying power to the storage system controller pair creates the display shown in Figure 2-2.

- The first line defines the controller model number.
- The second line is a series of asterisks.
An asterisk is displayed when one of the 20 startup procedures is *successfully* completed. After completing all the startup procedures, the display changes, as shown in Figure 2-3.

```
HSV110 Startup
*****
```

Figure 2–2: Typical HSV110 controller startup display

Initial Setup Display

The Initial Setup display (see Figure 2–3) is active after the startup procedure is complete.

```
Storage System Name:
<No Storage System>
```

Figure 2–3: Initial setup display



CAUTION: An Enterprise Storage System cannot operate properly with the Element Manager until you enter a valid WWN (see “Node WWN”).

The Element Manager can enter a storage system name thereby establishing an option for a system password.

You can use the Element Manager to create the Storage System Name; the OCP simply displays it. This name is required for operation. Compaq recommends that each storage system have a unique name to easily identify the different storage systems.

OCP Pushbuttons

The four OCP pushbuttons enable you to select and display different controller information. In some cases you can enter data. The information you display or the data you enter depends on the active LCD function.

To simplify presentation and to avoid confusion, the pushbutton reference names, regardless of labels, are *left*, *right*, *top*, and *bottom* (see Figure 2–4).

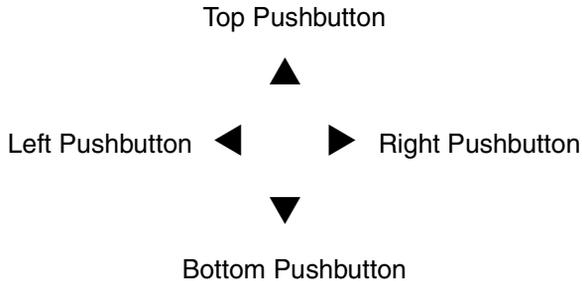


Figure 2–4: Pushbutton icons

Node WWN

Enterprise Storage System operations require that each *controller pair* have a unique Node WWN. This 16-character alphanumeric name identifies the system on the World Wide Web (WWW). Compaq assigns the WWN to each storage system prior to shipment. The *Enterprise Virtual Array World Wide Name Label* document defines the WWN for each storage system. The Node WWN labels, similar to the one shown in Figure 2–5, specify the system-specific WWN and checksum.



CXO7545A

Figure 2–5: Sample Node WWN label



CAUTION: The controller pair WWN is unique to a controller pair, and cannot be used for any other controller pair or device anywhere in the world. Figure 2–6 shows the location of the WWN label on a controller pair.

This is the only WWN applicable to any controller installed in a specific physical location, even a replacement controller.

Once a WWN is assigned to a controller, it cannot be changed as long as that controller is part of the same storage system.



CXO7601A

Figure 2–6: Node WWN label location

The requirements for entering the WWN are:

- Applying power to the system
- No Storage System name assigned

You must complete the procedures described in the section titled “Procedure for Entering the WWN.”

IMPORTANT: If you enter an incorrect WWN or checksum, the system will reject the data and you must repeat the procedure.

Procedure for Entering the WWN

Table 2–1 defines the pushbutton functions when entering the WWN or the WWN checksum.

Table 2–1: WWN Pushbutton Functions

▲	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Select a WWN or checksum character by scrolling up through the character list one character at a time. <p>If you select an incorrect character, you can use either ▲ or ▼ to select the correct character.</p>
▶	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Accept the current character and select the next character. <p>If you accept an incorrect character, you can move through all 16 characters, one character at a time, until you display the incorrect character. You can then change the character.</p>
▼	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Select a WWN or checksum character by scrolling down through the character list one character at a time. <p>If you select an incorrect character, you can use either ▲ or ▼ to the select correct character.</p>
◀	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> Accept all the WWN or checksum characters.

Complete the following procedure to assign the WWN to each pair of controllers.



CAUTION: Applying power to the rack when the controller power switches are on can prevent proper controller initialization.

The following procedure will enter the WWN 5000-1FE1-0000-0000.

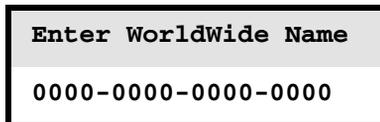
1. Place the power switches on both controllers to the Off position.
2. Apply power to the rack.

- On both controllers, place the power switch to On.

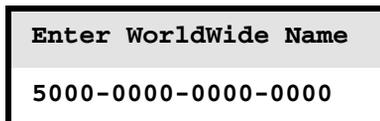
NOTE: This display may not occur for up to two minutes.



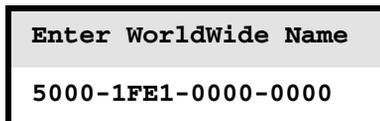
- The WWN entry display has a 0 in each of the 16 positions.



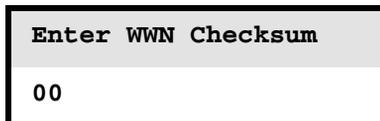
- Press ▲ or ▼ until the first character display is 5.
Press ► to accept this character and select the next.



- Repeat Step 5 to enter the remaining characters
000-1FE1-0000-0000.



- Press ◀ to enter the WWN and select the checksum entry mode.



See the section titled “Procedure for Entering the WWN Checksum” for details.

Procedure for Entering the WWN Checksum

The second part of the WWN entry procedure is to enter the 2-character checksum, HS, as follows.

1. Verify the initial WWN checksum displays 0 in both positions.

```
Enter WWN Checksum
00
```

2. Press ▲ or ▼ until the character H displays.
Press ► to accept H and select the second character.

```
Enter WWN Checksum
H0
```

3. Press ▲ or ▼ until the second character displays S.
Press ◀ to accept the checksum and exit.

```
Enter WWN Checksum
H0
```

4. Verify that the default display is automatically selected. This indicates the checksum is valid.

```
Storage System Name:
<No Storage System>
```

```
Node WorldWide Name:
5000-1FE1-0000-0000
```

If you enter an incorrect WWN or checksum, the system will reject the data and you must repeat the procedure.

IMPORTANT: An active (flashing) display, an error condition, or a user entry (pressing a pushbutton) overrides the default display.

When none of these conditions exist, the default display appears after approximately 15 seconds.

This completes the mandatory procedures for setting up a controller. The Element Manager entry of a storage system name usually requires you to complete the procedures in the section titled “Procedure for Setting the Storage System Password.”

Procedure for Setting the Storage System Password

The eight-character, alphanumeric storage system password feature enables you to restrict certain functions to selected Element Managers. Table 2–2 describes the pushbutton functions when using the password feature.

Table 2–2: System Password Pushbutton Functions

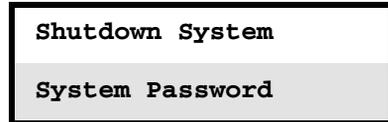
▲	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Select a password character by scrolling up through the character list one character at a time. <p>If you select an incorrect character, you can use ▼ to select the correct character.</p>
▶	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Move from the default display to the system menu tree. • Move from the system password display to the password entry display. • Accept the current character and select the next character. <p>If you accept an incorrect character, you can loop through the display, one position at time, to select the character to be changed.</p>
▼	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Select a password character by scrolling down through the character list one character at a time. <p>If you select an incorrect character, you can use ▲ to the select correct character.</p>
◀	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Accept all the password characters.

Complete the following procedure to set the password using the pushbuttons as described in Table 2–2.

The following procedure will enter JWMfzJjP as the password.

1. Determine a unique, eight-character password using the letters upper- or lowercase letters A through Z.
2. With either of the default menus (Storage System Name, or Node WorldWide Name) displayed, press any pushbutton to select the menu tree.

3. Press ▼ to cycle through the displays until System Password is active (flashing).



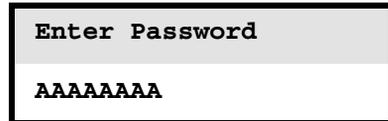
Press ► to select the system password function.

4. When the System Password function is flashing:

Press ► to select the change password function.

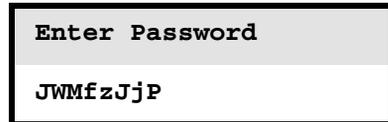


The default Enter Password function displays the default password, AAAAAAAAAA.

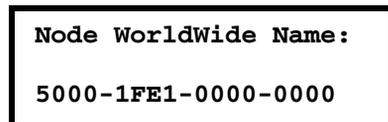
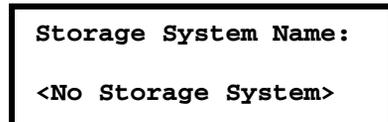


5. Enter the first character of the new password by pressing the ▲ or ▼ until J displays.
6. Press ► to accept this character and select the next character.

7. Repeat the process to enter the remaining password characters, WMfzJjP.



8. Press ◀ twice to enter the password and return to the default menu display.



The controller pair setup is complete.

Controller Operations

This chapter is an overview of the HSV110 controller operations, including:

- LED displays
- Connectors

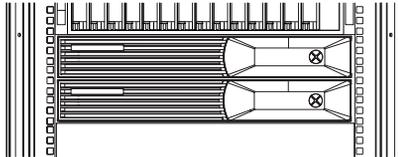
This chapter also describes the procedures for using the OCP to:

- Display system information
- Display condition messages
- Change passwords
- Shut down the system

IMPORTANT: This chapter does not discuss the procedures for entering the WWN or system password. Chapter 2, “Setting Up an HSV-Series Controller Pair” describes these procedures in detail.

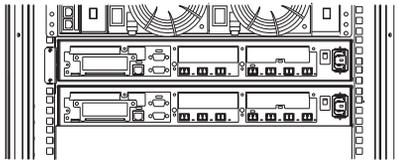
An Overview of the HSV-Series Controller

The HSV-series controller is the interface between the Element Manager and a storage system. A storage system is composed of one HSV controller pair and either 6 or 12 disk drive enclosures. Each Model 3220 Controller consists of two HSV110 controllers (see Figure 3–1 and Figure 3–2).



CXO7636A

Figure 3–1: Model 3220 controller location—front view



CXO7637A

Figure 3–2: Model 3220 controller location—rear view

Cabling

All data cables and power cables attach to the rear of the HSV controller (see Figure 3–3). Adjacent to each data connector (see 4, 5, 6, 7, 8, 9, and 10) is a two-colored LED that defines the link status.

- When the green LED is On, the link can communicate.
- When the amber LED is On, the link cannot communicate.

IMPORTANT: These LEDs do not indicate whether there is communication on the link, only whether the link can transmit and receive data.

NOTE: In Figure 3–3, the connectors are identified by the label printed on the controller. The information in the parentheses defines the connector function.

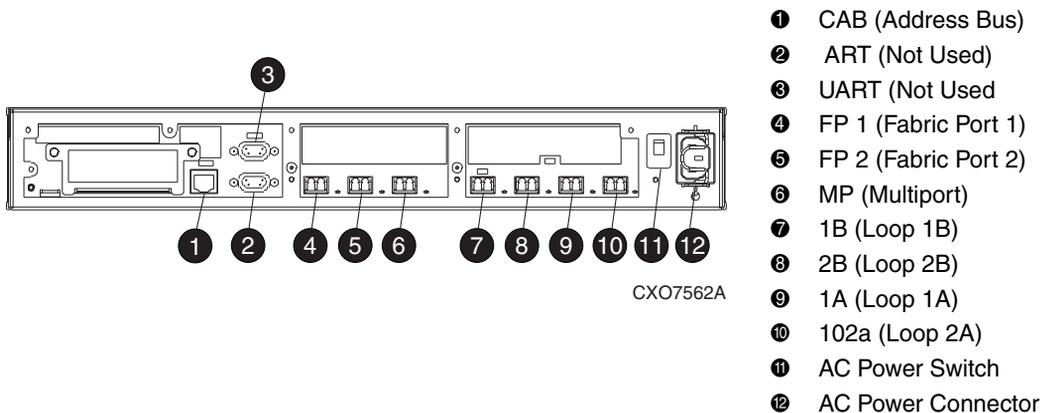


Figure 3–3: HSV controller connectors—rear view

IMPORTANT: The cables between the controller and the disk drives use LC connectors on both ends of the cable. The cable between the controller and a host have an LC connector on the controller end and an SC connector on the host end. See the Release Notes for details about this cable and how to order it.

OCP Overview

The OCP (see Figure 3–4) displays system information (status, error conditions, and so forth) and lets you enter data or isolate problems.

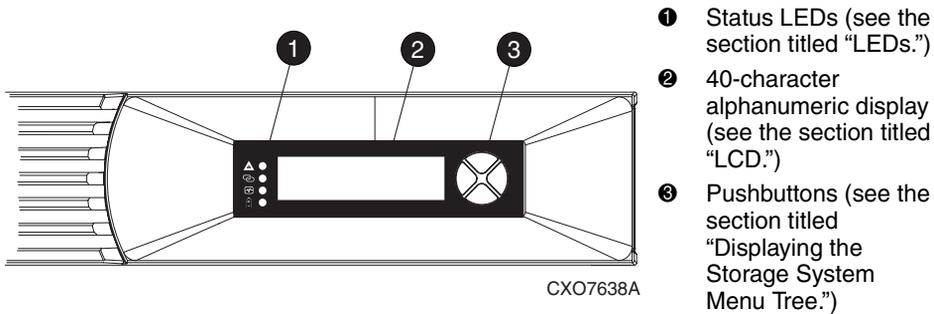


Figure 3–4: Controller OCP

LEDs

The status LEDs indicate the internal status of the controller, as described in Table 3–1. During initial setup, the status LEDs may not be fully operational.

The following sections define the alphanumeric displays modes, including the possible displays, the valid LED displays, and the pushbutton functions.

Table 3–1: Controller Status Icons and LEDs

	<p>Fault LED When the amber LED to the right of this icon is On or Flashing, there is a controller problem. Check either the Element Manager GUI or the LCD Fault Management displays for a definition of the problem and recommended corrective action.</p>
	<p>Host Link LED When the green LED next to this icon is On, there is a link between the storage system and a host. When the red LED next to this icon is Off, there is no link between the storage system and a host.</p>
	<p>Controller “Heartbeat” LED When the green LED next to this icon is Flashing slowly, a heartbeat, the controller is operating normally. When this LED is not Flashing, there is a problem.</p>

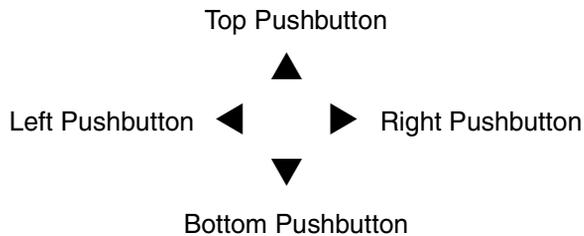
Table 3–1: Controller Status Icons and LEDs (Continued)

	Cache Battery Assembly LED When the red LED next to this icon is Off, the battery assembly is charged. When this LED is On, the battery assembly is discharged.
---	--

Navigation Pushbuttons

The information displayed by the OCP, the data you can enter, and the navigation pushbutton functions depend on the alphanumeric display mode.

To simplify presentation and to avoid confusion, the pushbutton reference names, regardless of labels, are *left*, *right*, *top*, and *bottom* (see Figure 3–5).

**Figure 3–5: Navigation pushbutton icons**

LCD

The two LCD rows display up to 20 alphanumeric characters per row. The LCD alternates between displaying the Storage System Name and the Node WorldWide Name (see Figure 3–6).

IMPORTANT: An active (flashing) display, an error condition message, or a user entry (pressing a pushbutton) overrides the default display.

When none of these conditions exist, the default display is active after approximately 15 seconds.

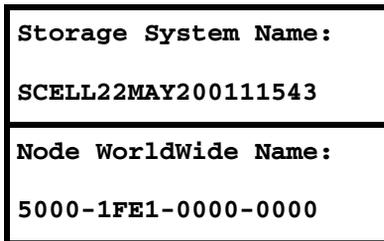


Figure 3–6: Default LCD displays

Displaying the Storage System Menu Tree

The Storage System Menu Tree lets you select information to be displayed (for example, System Information, Fault Management) or select procedures to implement (Shutdown System, System Password). To display this tree, press ▲, ▼, ◀, or ▶ when either of the default displays is active.

- When you select either System Information or Fault Management, you can display, but not change, product information.
- Selecting Shutdown System lets you implement the procedure for shutting down the system in a logical, sequential manner. Using the Shutdown System procedure maintains data integrity and avoids the possibility of losing or corrupting data.
- Selecting System Password lets you create a system password to ensure that only authorized personnel can modify system operation and functions from the OCP.

Use the following procedure to select and navigate the storage system menu tree.

1. The default display alternates between the Storage System Name display and the Node WorldWide Name display.

Push any pushbutton (◀ ▶ ▼ ▲) to select the Storage System Menu Tree display.

Storage System Name:

SCELL22MAY200111543

Node WorldWide Name:

5000-1FE1-0000-0000

2. System Information is the active display.

Press ▼ to sequence down through the tree.

Press ▲ to sequence up through the tree.

Press ▶ to select an active display.

Press ◀ to select the default display

System Information

Fault Management

System Information

Fault Management

Shutdown System

System Password

Shutdown System

System Password

Displaying System Information

IMPORTANT: The purpose of this information is to assist the Compaq Authorized Service Provider when servicing your system.

The system information displays show the system configuration including the virtual controller software (VCS) version, the OCP firmware and application programming interface (API) versions, and the enclosure address bus programmable integrated circuit (PIC) configuration. You can only view, *not change*, this information.

When there is no activity for approximately 15 seconds, the display automatically returns to the default display.

NOTE: Activity is either an active error report or pressing a pushbutton.

Table 3–2 defines the pushbutton functions.

Table 3–2: System Password Pushbutton Functions

▼	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Move from the Versions VCS display to the Versions OCP display • Move from the Versions OCP display to the Versions Address Bus PIC display
▲	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Move from the Versions OCP display to the Versions VCS display • Move from the Versions PIC display to the Versions OCP display
▶	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Move from the System Information display to the Versions VCS display • Move from the Versions VCS display to the VCS detail display • Move from the Versions OCP display to the OCP detail display • Move from the Versions PIC display to the detailed PIC display
◀	<p>Use this pushbutton to:</p> <ul style="list-style-type: none"> • Move from the System Information display to the default display • Move from the Versions display to the System Information display • Move from VCS detail display to the Versions VCS display • Move from the OCP detail display to the Versions OCP display • Move from the PIC detail display to the Versions PIC display

Versions System Information

When you press ▼, the active display is Versions. From the Versions display you can determine the:

- VCS (virtual controller software) revision level
- OCP firmware revision level
- PIC (programmable integrated circuit) firmware revision level for:
 - Address Bus PIC
 - Battery PIC
 - PowerPC Processor
 - Quasar
 - glue FPGA (field programmable gate array) PIC
 - Surge

NOTE: The PIC terms PowerPC Processor, Quasar, glue FPGA, and Surge are for development purposes and have no significance for normal operation.

If the requested version information is not available, the display is always <NOT AVAILABLE>. Use the following procedure to select and display System Information.

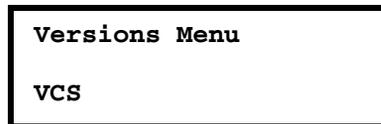
NOTE: When viewing the software or firmware version information, pressing ◀ displays the Versions Menu tree.

1. The default display alternates between the Storage System Name display and the Node WorldWide Name display.
Press any pushbutton to select the Storage System Menu Tree display.
2. Press ▶ to go to step 3, VCS.
Press ▼ to select Fault Management.

Storage System Name:
SCELL22MAY200111543
Node WorldWide Name:
5000-1FE1-0000-0000

System Information
Fault Management

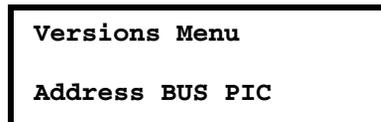
3. Press ► to display the VCS version.
Press ▼ to go to step 4, OCP.



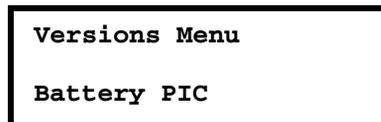
4. Press ► to display the OCP versions menu.
Press ▼ to go to step 5, Address Bus PIC.



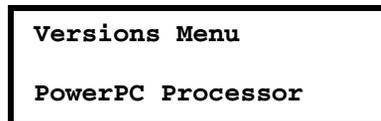
5. Press ► to display the Address Bus PIC.
Press ▼ to go to step 6, Address Bus PIC.



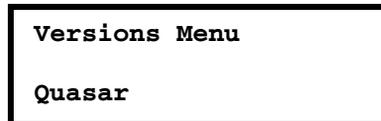
6. Press ► to display the Battery PIC.
Press ▼ to go to step 7, PowerPC Processor.



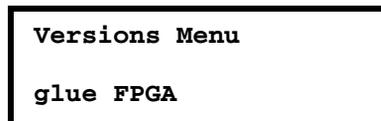
7. Press ► to PowerPC Processor.
Press ▼ to go to step 8, Quasar.



8. Press ► to display the Quasar version
Press ▼ to go to step 9, glue FPGA version.



9. Press ► to display the glue FPGA version.
Press ▼ to go to step 10, surge PIC.



10. Press ► to display the surge version.

Versions Menu

surge

Shutting Down the System



CAUTION: When powering off the system for more than 96 hours:

1. Use the Compaq SANWorks HSV Element Manager to power off the system.
2. Remove all batteries from the controllers when shutting down the system for more than 36 hours.

When reactivating the system:

1. Power on the system.
2. Install the batteries.

You can use the shutdown system function to implement the following methods:

- Restarting the system (see “Restarting the System” on page 3–14)
- Turning off the power “Powering Off the System” on page 3–15).
- Initializing the system “Initializing the System” on page 3–16)

To ensure that you do not mistakenly activate a shutdown procedure, the default state is always NO, indicating *do not implement this procedure*. Implementing any shutdown method requires you to complete at least two actions.

Table 3–3: Shutdown Methods

LCD Prompt	Description
RESTART	Implementing this procedure establishes communications between the storage system and the Element Manager. This procedure is used to restore the controller to an operational state where it can communicate with the Element Manager.

Table 3–3: Shutdown Methods (Continued)

LCD Prompt	Description
POWER OFF	Implementing this procedure initiates the sequential removal of controller power. This ensures no data is lost. The reasons for implementing this procedure include replacing a disk drive enclosure.
INITIALIZE	Implementing this procedure will cause the loss of all data. For a detailed discussion of this procedure, see the section titled “Initializing the System.”

Use the following procedure to select the Shutdown System display and execute a shutdown procedure.

1. The default display alternates between the Storage System Name display and Node WorldWide Name display.
Push any pushbutton to go to step 2, System Information.

Storage System Name: SCELL22MAY200111543
Node WorldWide Name: 5000-1FE1-0000-0000

2. Press ▼ to go to step 3, Fault Management.

System Information
Fault Management

3. Press ▼ to go to step 4, Shutdown System.
Press ▲ to select System Information.

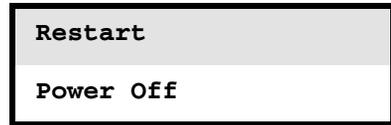
System Information
Fault Management

4. Press ► to go to step 4, Restart.
Press ▲ to go to step 3, Fault Management

Shutdown System
System Password

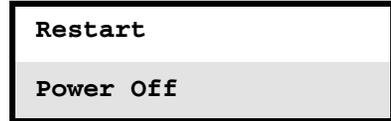
5. Press ► to display the Restart menu.

Press ▼ to go to step 6, Power Off.



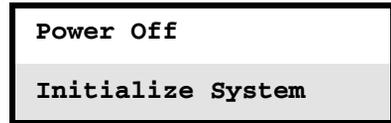
6. Press ► to display the Restart.

Press ▼ to go to step 7, Initialize System.



7. Press ► to display the Initialize System menu.

Press ▲ to go to step 6, Power Off.



Once you have selected the Shutdown System function, you can select and execute a shutdown method as described in the following sections.

Restarting the System

To restore the controller to an operational state, use the following procedure to restart the system.

1. Press **▶** to go to step 2, Restart.

Shutdown System
System Password

2. Press **▶** to display step 3, RESTART SYSTEM NO.
Press **▼** to go to Power Off.

Restart
Power Off

3. Press **◀** to accept NO and go to step 1.
Press **▼** to go to step 4; RESTART SYSTEM YES

RESTART SYSTEM	NO
-----------------------	-----------

4. Press **◀** to accept YES and to go to step 5, HSV110 Startup.

RESTART SYSTEM	YES
-----------------------	------------

5. No user input is required. The system will automatically initiate the startup procedure and proceed to step 6.

HSV110 Startup

6. The system automatically loads the Storage System name and Node WorldWide Name information from the operational controller.

Storage System Name:
SCELL22MAY200111543
Node WorldWide Name:
5000-1FE1-0000-0000

Powering Off the System

Use the following procedure to remove power from the controller pair, save the data, and remove the storage system from the Element Manager

IMPORTANT: Implementing this procedure removes power from the controller pair and all associated drive shelves. To restore power to the controller system, you must cycle both PDU breakers in the enclosure.

1. Press **▶** to go to step 2, Restart.

Shutdown System
System Password

2. Press **▼** to go to step 3, Power Off.

Restart
Power Off

3. Press **▶** to go to step 4, POWER OFF SYSTEM

Press **▼** to select Initialize System.

Restart
Power Off

4. Press **◀** to accept NO and go to Step 3.

Press **▼** to go to step 5, POWER OFF SYSTEM YES

POWER OFF SYSTEM	NO
-------------------------	-----------

5. Press **◀** to accept YES.

Press **▲** to select NO and return to step 4.

POWER OFF SYSTEM	YES
-------------------------	------------

Initializing the System

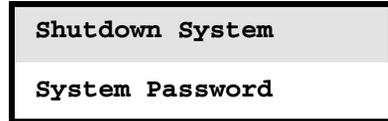
Initializing the system is another way to shut down the system. This action will cause the loss of all storage system data. Since the Element Manager cannot communicate with the disk drive enclosures, the stored data cannot be accessed. This destroys the storage system and all the data.



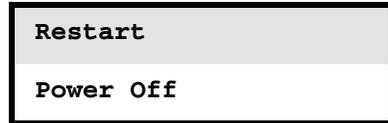
CAUTION: Initializing the system destroys all user data. Any data stored on the system will be permanently destroyed. The WWN will remain in the controller unless both controllers are powered Off. The password will be lost. If the controllers remain powered On until you create another storage system (initialize via GUI) you will not have to re-enter the WWN.

Use the following procedure to initialize the system.

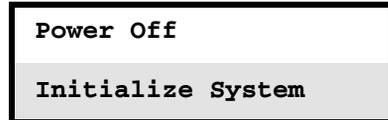
1. Press **▶** to go to step 2, Restart.



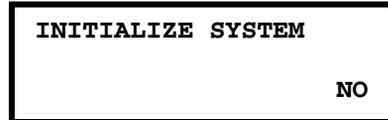
2. Press **▼** to select Power Off.



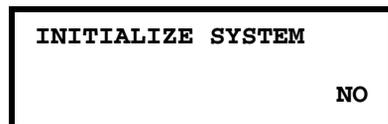
3. Press **▼** to select Initialize System and go to step 4.



4. Press **▶** to select INITIALIZE SYSTEM NO and go to step 5.



5. Press **◀** to accept NO and go to step 4.
Press **▼** to go to Step 6, INITIALIZE SYSTEM YES.



6. Press ◀ to accept YES and to go to Step 7, REALLY INIT SYSTEM NO

INITIALIZE SYSTEM

YES

7. Press ◀ to accept NO and go to step 6.
Press ▼ to go to step 8, REALLY INIT SYSTEM YES.

REALLY INIT SYSTEM?

NO

8. Press ◀ to accept YES and go to step 9.
Press ▲ to go to step 7, REALLY INIT SYSTEM NO

REALLY INIT SYSTEM?

YES

9. Press ◀ to accept NO and go to step 8.
Press ▼ to go to step 10, PROCEED YES.

DATA WILL BE LOST

PROCEED?

NO

10. Press ◀ to accept YES and go to step 11.
Press ▲ to go to step 9, PROCEED no.

DATA WILL BE LOST

PROCEED?

YES

The system is initialized.

SYSTEM INIT

IN PROCESS

Password Options

The password entry options are:

- Enter a password during storage system initialization (see “Setting Up an HSV-Series Controller Pair.”)
- Show the current password. The actual password is not displayed, instead an indicator informs you of whether a password has been set.
- Change a password (see the section titled “Changing a Password”).
- Remove password protection (see the section titled “Clearing a Password”).

Changing a Password

For security reasons, you may need to change a storage system password. First you must select a new, unique, eight-character password, using the uppercase letters A through Z and the lowercase letters a through z.

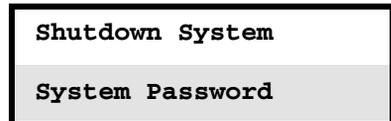
After selecting the new password, use the following procedure to change the password.



CAUTION: Changing a system password on the controller requires changing the password on any element manager with access to this system.

1. Press **▶** to go to step 2, Change Password.

Press **▲** to go to Shutdown System.



2. Press **▶** to go to step 3, CHANGE PASSWORD NO.

Press **▼** to go to Clear Password



3. Press **◀** to accept NO and go to step 2.

Press **▼** to go to step 4, CHANGE PASSWORD

YES.



4. Press ◀ to accept YES and go to step 5.

Press ▲ to go to step 3, CHANGE PASSWORD NO.

CHANGE PASSWORD?

YES

5. To enter the first character, press either ▲ or ▼ to select an uppercase or lowercase character.

Press ▶ to accept a character and select the next password character.

The character display changes to an asterisk.

6. Repeat step 5 for the remaining seven characters.

Press ◀ to accept the password and go to step 7,

CHANGE PASSWORD YES.

Enter Password

***AAAAAAA**

7. Press ◀ to go step 8, System Password.

CHANGE PASSWORD?

YES

8. The system will automatically return to the default display.

Shutdown System

System Password

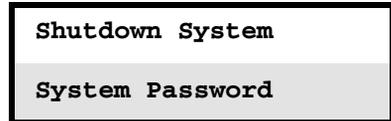
Clearing a Password

Use the following procedure to remove storage system password protection.



CAUTION: Changing a system password on the controller requires changing the password on any element manager with access to this system.

1. Press **▶** to go to step 2, Change Password.
Press **▲** to go to Shutdown System.
2. Press **▼** to go to Clear Password
3. Press **▼** to select Clear Password
4. Press **◀** to keep the password and go to step 3.
Press **▼** to go to step 4, CLEAR PASSWORD YES.
5. Press **◀** to clear the password and go to step 5.
Press **▲** to keep the current password and go to step 3, CLEAR PASSWORD NO.
6. The system will automatically return to the default display.



Power and Cooling

This chapter describes the internal power supplies and the blowers that provide the operating voltages and cooling for the HSV-series controller.

DC Power Supplies

The power supply in each controller develops the DC voltages required for controller operation. Nominal input voltage is from 202-240 VAC, 50-60 Hz. The single power supply generates the necessary 3.3 VDC, 5.0 VDC, and 12.0 VDC system voltages. If the power supply fails, you must replace the controller assembly.

A controller power supply failure would cause the Element Manager GUI to report that the controller enclosure is no longer part of the system.

Blowers

The two controller blowers (see Figure 4–1) are located in the left front of the controller enclosure, behind the bezel.

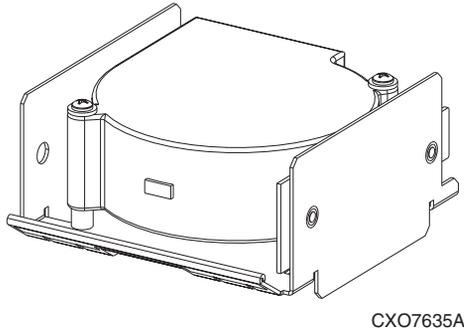


Figure 4–1: Controller blower

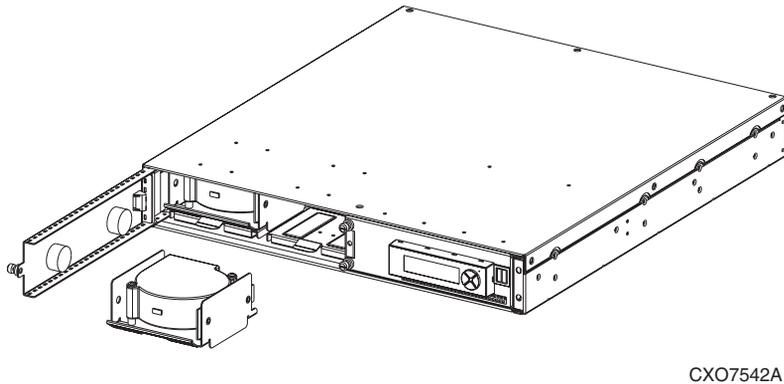


Figure 4–2: Blower location

You can replace a failed blower (see Figure 4–2) without shutting down the system using the procedures described in Chapter 6, “Replacement Procedures.” An amber light on the blower indicates that the blower is operating at a slow speed or has failed and requires replacement.

Controller Fault Management

This chapter describes how the controller displays events and termination event information. Termination Event information is displayed on the LCD. The Element Manager GUI enables you to view controller events. This chapter also discusses how to identify and correct problems.

Once you create a storage system as described in Chapter 2, “Setting Up an HSV-Series Controller Pair,” an error condition message has priority over other controller displays.

The Element Manager GUI provides detailed descriptions of the storage system error conditions, or faults. The Fault Management displays provide similar information on the LCD, but not in as much detail. Whenever possible, refer to the GUI for fault information.

Using the Element Manager GUI

The Element Manager GUI display provides detailed information about each event affecting system operation in either a Termination Event display or an Event display. These displays are similar, but not identical.

GUI Termination Event Display

A problem that generates the Termination Event display prevents the system from performing a specific function or process. You can use the information in this display (see Figure 5–1) to diagnose and correct the problem.

IMPORTANT: The major differences between the Termination Event display and the Event Display are:

- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.
- The Event display includes an EIP type field; it does not include a Code Flag field.
- The Event display includes a Corrective Action Code field.

Date	Time	SWC ID	Evt No	Code Flag	Description
------	------	-----------	-----------	--------------	-------------

Figure 5–1: GUI Termination Event display

The fields in the Termination Event display include:

- Date—The date the event occurred.
- Time—The time the event occurred.
- SWCID—Software Identification Code. A hexadecimal number in the range 0-FF that identifies the controller software component reporting the event.
- Evt No—Event Number. A hexadecimal number in the range 0-FF that is the software component identification number.
- Code Flag—An internal code that includes a combination of other flags.
- Description—The condition that generated the event. This field may contain information about an individual field’s content and validity.

GUI Event Display

A problem that generates the Event display reduces the system capabilities. You can use the information in this display (see Figure 5–2) to diagnose and correct problems.

IMPORTANT: The major differences between the Event Display and the Termination Event display are:

- The Event display includes an EIP type field; it does not include a Code Flag field.
- The Event display includes a Corrective Action Code (CAC) field.
- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.

Date	Time	SWC ID	Evt No	CAC	EIP Type	Description
------	------	-----------	-----------	-----	-------------	-------------

Figure 5–2: Typical Element Manager Event display

The Event display provides the following information:

- Date—The date the event occurred.
- Time—The time the even occurred.
- SWCID—Software Identification Code. A number in the range 1–256 that identifies the internal firmware module affected.

- Evt No—Event Number. A hexadecimal number in the range 0-FF that is the software component identification number.
- CAC—Corrective Action Code. A specific action to complete to correct the problem.
- EIP Type—Event Information Packet Type. A hexadecimal character that defines the event information format.
- Description—The problem that generated the event.

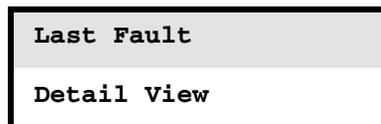
Fault Management Displays

When you do not have access to the GUI, you can display and analyze termination codes (TCs) on the OCP LCD display. When the Fault Management display is active (flashing), you can either display the last fault or display detailed information about the last 32 faults reported.

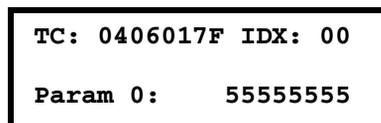
Displaying Last Fault Information

Complete the following procedure to display Last Fault information:

1. When the Fault Management display is active (flashing), press ► to select the Last Fault menu.



2. Press ► to display the last fault information.



The first line of the TC display contains the eight-character TC error code and the two-character IDX (index) code. The IDX is a reference to the location in the TC array that contains this error.

The second line of the TC display identifies the affected parameter with a two-character parameter number (0-30), the eight-character parameter code affected, and the parameter code number.

3. Press ◀ to return to the Last Fault menu.

Displaying Detailed Information

The Detail View menu lets you examine detailed fault information stored in the Last Termination Event Array (LTEA). This array stores information for the last 32 termination events.

Complete the following procedure to display the LTEA information about any of the last 32 termination events:

1. When the Fault Management display is active (flashing), press ▼ to select the Detail View menu.

```

Last Fault
Detail View
  
```

The LTEA Selection menu is active (LTEA 0 is displayed).

```

DONE
LTEA [0]
  
```

2. Press ▼ or ▲ to increment to a specific error, LTEA N, in this example.

```

LTEA [N]
  
```

3. Press ► to observe data about the selected error, LTEA N, in this example.

```

TC: XXXXXXXX IDX: xx
Param [N]: nnnnnnnn
  
```

Replacement Procedures

This chapter describes the procedures for replacing customer replaceable units (CRUs), including the cache battery assembly, the blowers, the transceivers, and the fiber optic cables. Information about initial enclosure installation, ESD protection, and common replacement procedures is also presented.



CAUTION: You are only authorized to replace the units described in this chapter. Customer replaceable units (CRUs) are restricted to those items that do not require special tools, techniques, or training.

ESD Protection

When you replace a CRU, you must take precautions to prevent electrostatic discharge (ESD) from damaging sensitive electronic items.

1. *Always* transport and store CRUs in a static-free container.
2. Do not remove the CRU from the static-free container until you are ready to install the CRU.
3. Avoid touching the CRU connector pins, leads, or circuitry.

Common Replacement Procedures

The following procedures are common to all CRU replacement procedures.

1. Always implement all the ESD protection procedures.
2. Remove the defective CRU from the enclosure.
3. Remove the replacement CRU from the static-free container. Check the label to ensure that the CRU is a compatible replacement (see Figure 6–1).
4. Align the CRU with the enclosure guide slots.
5. Slide the CRU into the enclosure until the CRU is against the backplane connector.
6. Fully seat the CRU in the enclosure and verify that the CRU is operating properly.
7. Place the defective CRU in the static-free container.

Identifying the Spare Part Number

All CRUs have a Compaq 6–3 spare part number on the CRU product label (see Figure 6–1) beneath the entry *Compaq Spare*. The first six characters (123479) identify the CRU. The last three characters (–002) define the revision level.



CXO7083A

Figure 6–1: Typical Compaq CRU product label

Replacing a Cache Battery

Use the information in this section to replace a cache battery.

Determining the Status of a Cache Battery

The status of a cache battery is reported in two ways. First, internal monitoring circuits provide information to the controller, which passes this information to the *Compaq SANworks™* HSV Element Manager software. Second, a status LED in the lower right corner of the cache battery specifies the condition of cache battery cells. This status LED is normally off. If any cell fails, an amber status LED will be on. When the amber LED is on, you must replace the cache battery.

Battery Assembly Replacement Guidelines



CAUTION: To prevent battery drain, when powering off the system for more than 96 hours:

Use the Compaq SANworks HSV Element Manager to power off the system, or follow the controller power off procedures detailed in the HSV Controller user guide.

Remove both cache batteries from both controllers.

When reactivating the system, power on the system first, and then install cache batteries.

Replacing a cache battery requires you to comply with the following conditions:

- Only replace a cache battery when the controller is power applied.
 - Replace any cache battery when the amber status LED is on.
-



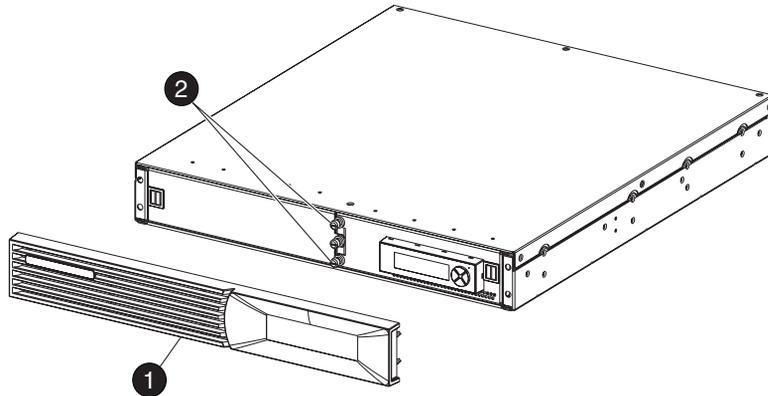
CAUTION: It is possible that the failure in one cache battery can cause the status LED in the other cache battery to illuminate. If this occurs, you must replace both cache batteries. There is no way to isolate a cache battery failure problem to a single cache battery.

- Once a failed battery is removed, it can never be installed again. Process a failed cache battery as described on the cache battery label.

Battery Assembly Replacement Procedure

Complete the following procedure to replace a cache battery assembly.

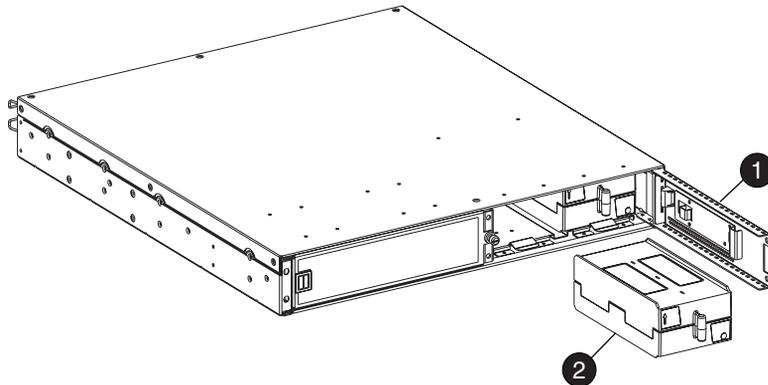
1. Grasp the bezel (❶, Figure 6–2) at both ends. Then pull the bezel away from the controller.



CXO7567A

Figure 6–2: Accessing and opening the cache battery compartment

2. Loosen the battery compartment door captive thumbscrews (❷, Figure 6–2).
3. Pull out on the cache battery door (❶, Figure 6–3) until it is in the full, open position.



CXO7641A

Figure 6–3: Replacing a battery assembly

4. Remove any battery assembly with an amber status LED that is On. If both cache batteries show the amber status LED, then you must remove both batteries from the compartment, together at the same time, prior to installing two new cache batteries.



CAUTION: If the amber status LED is illuminated on both batteries, you must first remove the two failing cache batteries, and then install the new cache batteries. Failure to remove both batteries showing an amber LED, together at the same time, prior to installing the new batteries, may cause the original failure to be propagated to the newly installed cache battery.

5. Align the replacement cache battery  edge connector with the controller connector. Insert the cache battery into the controller until the cache battery is fully seated.

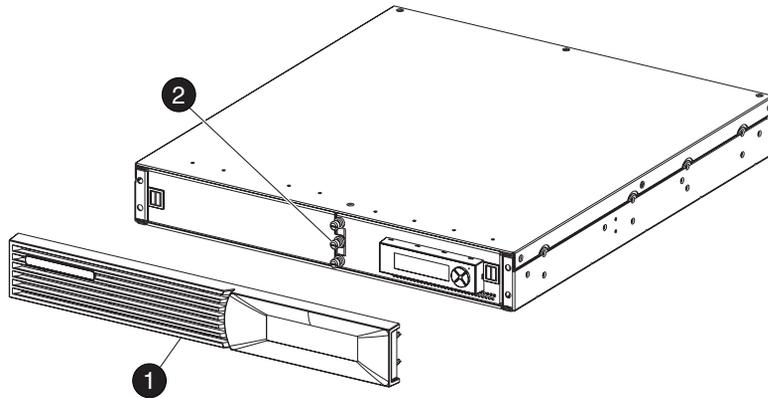
When inserting the cache battery into a controller with power applied, the amber status LED in the lower right corner will initially be on. Based on the system operation, it may remain on for up to two minutes, after which time, it will turn off.

6. Repeat step 5 for the second cache battery if you are replacing both batteries and then proceed to step 7. If replacing only one cache battery, proceed to step 7.
7. Close the cache battery door, and finger tighten the cache battery door captive thumbscrews.
8. Align the bezel mounting studs with the controller enclosure mounting holes. Firmly press on the bezel until it is fully seated on the controller enclosure.
9. Allow between 4–8 hours for the battery to become fully charged.

Replacing a Blower

The controller reports blower failures to the GUI. The amber LED on the upper right corner of the blower is On when there is failure, but may not be visible with the bezel installed. Complete the following procedure to replace a controller blower.

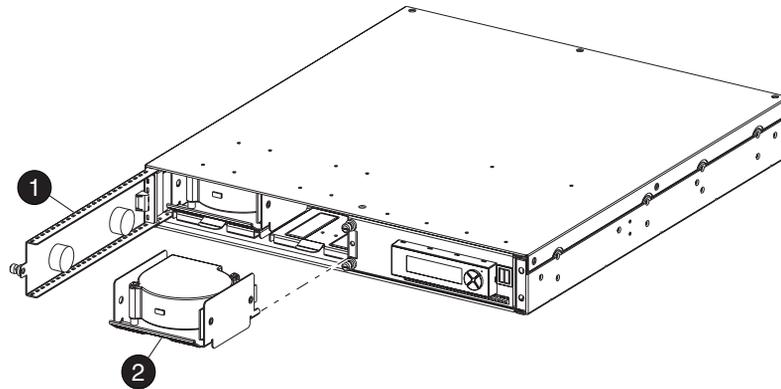
1. Grasp the bezel (❶, Figure 6–4) at both ends, and pull the bezel away from the controller.



CXO7642A

Figure 6–4: Opening the blower compartment

2. Loosen the blower door captive thumbscrew (❷, Figure 6–4).
3. Open the blower door (❶, Figure 6–5).
4. Remove the defective blower (❷, Figure 6–5).
5. Align the replacement blower with the controller enclosure connector.
6. Slide the blower in until it is fully seated in the backplane connector.



CXO7643A

Figure 6–5: Replacing a blower

The blower should start operating as soon as it is fully seated.

NOTE: The amber status LED can remain active for up to thirty seconds after a new battery assembly is installed.

7. Close the blower door and finger tighten the captive thumbscrew.
8. Align the bezel mounting studs with the controller enclosure mounting holes.
9. Firmly press on the bezel until it is fully seated on the controller enclosure.

Replacing a Fiber Optic Cable

Complete the following procedure to replace a fiber optic cable.



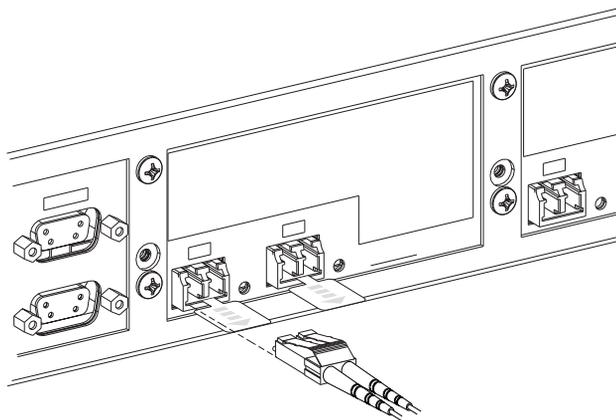
CAUTION: This replacement procedure is based on replacing fiber optic cables one at a time. Replacing more than one cable at the same time could result in a non-supported configuration.

1. Firmly grasp the fiber optic cable connector (❶, Figure 6–6) at the top and bottom making sure you are pressing the release mechanism on the connector.



CAUTION: The transceiver cannot be removed while the fiber optic cable is installed. When you grasp the fiber optic cable connector, you may also grasp the transceiver tab. If you pull on both the connector and the tab, you may break off the tab.

2. Pull the fiber optic connector out of the transceiver.



CXO7644A

Figure 6–6: Removing or installing a fiber optic cable

3. Repeat steps 1 and 2 at the other end of the cable.
4. Verify the dust covers have been removed, then align the replacement fiber optic cable connector with the transceiver and push the connector into the transceiver.
5. Repeat step 4 at the other end of the cable.

Replacing a Transceiver

Complete the following procedure to replace a transceiver.

1. Firmly grasp the fiber optic cable connector (see Figure 6–6) at the top and bottom making sure that you are pressing the release mechanism.



CAUTION: The transceiver cannot be removed while the fiber optic cable is installed. When you grasp the fiber optic cable connector, you may also grasp the transceiver tab. If you pull on both the connector and the tab, you may break off the tab.

2. Pull the fiber optic connector out of the transceiver using gentle downward pressure on the plastic connector release tab. Place a dust cover on any exposed optical surfaces.
3. After disconnecting the fiber optic cable, grasp the transceiver tab and remove the transceiver (see Figure 6–7)

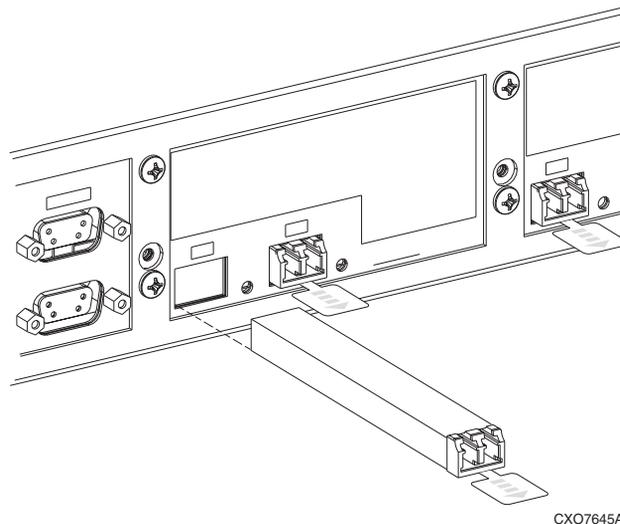


Figure 6–7: Removing or installing a transceiver

4. Insert the replacement transceiver into the transceiver connector. Push in to firmly seat the transceiver.
5. Align the replacement fiber optic cable connector with the transceiver. Push the connector into the transceiver.

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.

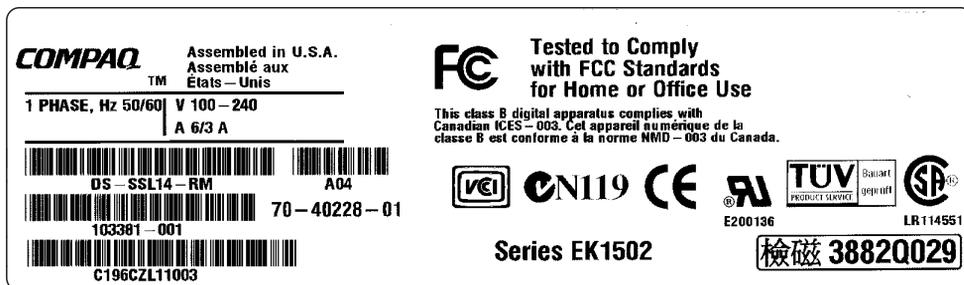
Any modifications to this device—unless expressly approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

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).



CXO7084A

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, power, and environmental specifications of the HSV-series controller enclosure and the customer replaceable elements.

Physical Specifications

Table B-1 defines the dimensions of the controller and the customer replaceable units (CRUs).

Table B-1: HSV-Series Controller Physical Specifications

Specification	Installed	Shipping
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm.		
HSV-Series Controller Enclosure		
Height	62 mm (2.45 in)	267 mm (10.5 in)
Width	502 mm (19.75 in)	762 mm (30 in)
Depth	444 (17.49 in)	762 mm (30 in)
Weight	10.4 kg (23 lb)	12.7 kg (28 lb)
Cache Battery Assembly		
Height	57 mm (2.25 in)	108 mm (4.25 in)
Width	184 mm (7.25 in)	324 mm (12.75 in)
Depth	83 mm (3.25 in)	162 mm (6.375 in)
Weight	1.3 kg (2.8 lb)	1.5 kg (3.4 lb)
Blower		
Height	55 mm (2.125 in)	165 mm (6.5 in)
Width	116 mm (4.625 in)	216 mm (8.5 in)
Depth	105 mm (4.125 in)	216 mm (8.5 in)
Weight	0.4 kg (0.8 lb)	0.92 kg (2 lb)

Power Specifications

Table B–2 and Table B–3 define the HSV-series controller power supply input power requirements and output power specifications.

Table B–2: Controller Power Supply AC Power Requirements

AC Input Voltage			Frequency		
Minimum	Nominal	Maximum	Minimum	Nominal	Maximum
180 VAC	202 VAC	220 VAC	47 Hz	50 Hz	53 Hz
	208 VAC		57 Hz	60 Hz	63 Hz
208 VAC	240 VAC	254 VAC			

Table B–3: Controller Power Supply Output Specifications

Voltage Specification	Minimum	Nominal	Maximum
+3.3 VDC			
Output Voltage Steady state current Power	3.23 VDC	3.30 VDC	3.36 VDC 18A ¹ 59.4W
+5.0 VDC			
Output Voltage Steady state current Power	4.90 VDC	5.00 VDC	5.10 VDC 4A 20.0W
+12.0 VDC			
Output Voltage Steady state current Power	11.4 VDC	12.0 VDC	12.6 VDC 2A 4.0W
Total Current			24A
Total Power			65.4W

1. +3.3 VDC steady state current requires a minimum 5.0V load of 1A.

Environmental Specifications

There are no HSV-series controller environmental specifications. See the storage system environmental specifications the *Enterprise Virtual Array Rack User Guide* for this information.

Protecting Fiber Optic Connections

This appendix describes the procedures and processes for protecting and cleaning fiber optic connectors.

Contamination of the fiber optic connectors on either a transceiver or a cable connector can impede the transmission of data. Therefore, protecting the connector tips against contamination or damage is imperative. The tips can be contaminated by touching them, by dust, or by debris. They can be damaged when dropped. To protect the connectors against contamination or damage use the dust covers or dust caps provided by the manufacturer. These covers are removed during installation and installed whenever the transceiver or cables are disconnected. Cleaning the connectors should remove contamination.

The transceiver dust caps protect the transceivers from contamination. The transceivers protect the I/O modules from contamination.



CAUTION: To protect the connectors, always install the dust covers or dust caps whenever a transceiver or a fiber cable is disconnected. Remove, *but do not discard*, the dust covers or dust caps from transceiver or fiber cable connectors only when they are connected.

To minimize the risk of contamination or damage, implement the following guidelines:

- **Dust Covers**
Remove *and retain* the dust covers and dust caps when installing an I/O module, a transceiver or a cable. Install the dust covers when disconnecting a transceiver or cable.
- **When to Clean**
Any time you think a connector may be contaminated, or a connector has not been protected by a dust cover for an extended period of time, clean the connector.

- **How to Clean**

1. Wipe the connector with a lint-free tissue soaked with 100% isopropyl alcohol
2. Wipe the connector with a dry, lint free tissue.
3. Dry the connector with moisture-free compressed air.

One of the many sources for cleaning equipment specifically designed for fiber optic connectors is:

Alcoa Fujikura Ltd.
1-888-385-4587 (North America)
011-1-770-956-7200 (International)

Glossary

This glossary defines *Compaq StorageWorks*TM 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. A 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 μm .

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.

Index

12.0 VDC 4-1
12-Drive enclosures storage system 1-3
3.3 VDC 4-1
5.0 VDC 4-1
6-drive enclosures storage system 1-2

A

AC input voltages 4-1

B

Basic Replacement Procedures 6-2
battery 3-9
blowers 4-2

- location 1-5, 4-2
- replacement 1-5, 4-2
- replacement procedures 6-6

C

cabling controller 3-3
cache batteries 1-6

- compartment 1-4
- replacement procedures 6-4

cache battery assemblies See cache batteries
cache battery assembly See cache batteries
certification product labels A-2
checksum 2-1
cleaning fiber optic connectors C-1

- how to C-2

configurations

- 12-disk drive enclosures 1-3
- 6-disk drive enclosures 1-2

configuring

- controller enclosures 2-1
- controller pair 2-1

password 2-1
storage system name 2-3
WWN 2-1

connections

- protecting fiber optics
 - connectors C-1

connectors

- controller 3-3
- controller locations 3-3

controlle

- location rack front 3-2

controller

- cabling 3-3
- connectors 3-3
- data connectors 1-4
- enclosure 1-4
- enclosure components 1-4
- heartbeat status icon 3-4
- information 1-7
- LEDs 3-3
- link 3-3
- link LEDs 3-3
- location rack rear 3-2
- operations 3-1
- overview 3-2
- power connectors 1-4
- setting up 2-1
- status icons
 - battery 3-5
 - link status 3-4
- status LEDs 3-4
 - battery 3-5
 - fault 3-4

- link status 3–4
- cooling 4–1
- Country-Specific Certifications A–2
- CRUs 1–7
 - part numbers 6–2
 - product label 6–2
 - replacement procedures 6–2
- D**
- data connectors 1–4
- DC power supplies 4–1
- DC voltages 4–1
- default display 3–6
- detail view menu 5–5
- displays 2–2
- dust covers C–1
- E**
- element manager GUI
 - event display 5–2
 - termination event display 5–1
- enclosure certification label A–2
- environmental specifications B–3
- ESD protection 6–1
- event GUI display 5–2
- event information 5–1
- F**
- fault management 3–6, 5–1
 - displaying events 5–1
 - displays
 - last fault information 5–4
 - OCP 5–4
 - termination event management 5–1
- FCC Class A certification A–1
- features
 - cache batteries 1–6
 - controller enclosures 1–4
 - controller pairs 1–5
 - high availability 1–5
 - LCD 1–4
 - LEDs 1–4
 - OCP 1–4

- pushbuttons 1–4
- removable bezel 1–4
- fiber optics
 - cable replacement procedure 6–8
 - cleaning connectors C–1
 - protecting connectors C–1
- field programmable array See FPGA
- firmware version display 3–8
- H**
- heartbeat status icon 3–4
- high availability
 - cache batteries 1–6
 - controller pairs 1–5
 - features 1–5
- HSV controller See controller
- I**
- icons
 - battery status 3–5
 - pushbuttons 3–5
- IDX code display 5–4
- initializing the system 3–16
- introducing the HSV series controllers 1–1
- L**
- labels
 - CRU product 6–2
 - enclosure certification A–2
 - product certification A–2
- last fault information displays 5–4
- LCD 1–4, 1–7, 3–4, 3–6
 - default display 3–6
- LEDs 1–7
 - battery status 3–5
 - displays 3–1
- link status icon 3–4
- link status LED 3–4
- O**
- OCP 1–4, 1–7, 3–4
 - displays 2–2, 2–3
 - displays and controls 2–2

- fault management displays 5–4
- features 1–4
- firmware version 3–9
- initial setup 2–3
- initial setup display 2–3
- LCD 1–7, 2–2, 3–6
- LEDs 1–4, 1–7
- pushbutton icons 2–4
- pushbuttons 1–4, 2–4, 3–4
- startup display 2–3
- status LEDs 3–4
- using 2–2

Operator Control Panel See OCP

P

- part numbers 6–2
- password 2–1, 3–18
 - changing 3–18
 - changing procedure 3–18
 - clearing 3–18, 3–20
 - clearing procedure 3–20
 - entering 3–18
 - options 3–18
 - removing 3–18
- specifications
 - physical B–1
- PIC 3–9
 - address bus 3–9
 - glue FPGA 3–9
 - power PC processor 3–9
 - quasar 3–9
 - surge 3–9
- power 4–1
 - connectors 1–4
 - specifications B–2
- power and cooling 4–1
- product certification A–2
- product certification label A–2
- programmable integrated circuit See PIC
- protecting fiber optic connectors C–1
 - cleaning supplies C–2
 - dust covers C–1

- how to clean C–2
- pushbuttons 1–7, 3–4, 3–5
 - definition 3–5
 - icons 2–4, 3–5

R

- regulatory notices A–1
- replacement procedures
 - blowers 6–6
 - cache batteries 6–4
 - common 6–2
 - CRUs 6–2
 - ESD protection 6–1
 - fiber optic cable 6–8
 - part number label 6–2
 - part numbers 6–2
 - transceiver 6–9

S

- setup procedure overview 2–1
- shutdown system 3–6
- software version display 3–8, 3–9
- specifications
 - enclosure B–1
 - power B–2
- startup display 2–3
- status icons fault 3–4
- status LEDs 3–4
 - controller heartbeat 3–4
 - fault 3–4
- storage system menu tree 3–6
 - fault management 3–6
 - system information 3–6
- storage system name 2–3
- system information 3–6
 - firmware version 3–8
 - software version 3–8
 - versions 3–9
- system menu tree
 - shut down system 3–6
 - system password 3–6
- system password 2–1, 3–6

T

TC display 5-4

TC error code 5-4

 parameter code number 5-4

 parameter display 5-4

termination event GUI display 5-1

termination event information 5-1

transceivers replacement procedures 6-9

U

Using the OCP 2-2

V

version information

 displaying 3-8

 firmware 3-8, 3-9

 OCP firmware 3-9

 software 3-8, 3-9

 VCS 3-9

 virtual controller software 3-9

W

WWN 2-1