Compaq StorageWorks

Enterprise Virtual Array
Drive Enclosure
User Guide

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This publication is for use by individuals responsible for installing,
configuring, and maintaining an Enterprise Virtual Array Drive
Enclosure.

COMPAQ

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About this Guide

The following sections are covered:

- Text Conventions
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Text Conventions

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

Table 1: Text Conventions

Element	Convention	Examples
• **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**
• 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

• User Input and System Responses (Output and Error Messages)
• COMMAND NAMES
• Drive Names
	Initial Caps and `monospace font`.
	
	`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).
	
	Entered `<variables>` are displayed in angle brackets (< >) and all lower case.
		User Input and System Responses:
		• To exit from the program, type `Exit`.
		• At the prompt, type this command:
		`SHOW THIS_CONTROLLER`
		(no variable)
		• To see your settings, give the command:
		`SHOW <storagesets> FULL`
		(with variable)
		• You will see the `Continue?` message.
		Command Names
		• Use `SET THIS_CONTROLLER` to change parameters.
		• To manage storage, enter `RUN` `sysmgr.exe`
		• (UNIX, AIX, Solaris): To list files, give the `ls` command.
		• Drive Names:
		Navigate to your CD-ROM drive (usually `D:` or `E:`).

filenames	Unless case sensitive, use *lowercase italics*. 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.	To configure storage, edit *storageset.ini*. Changes are stored in *NewSystemConfigurationFile.ini*. (UNIX, AIX, Solaris): Errors are logged to *MixedCaseFile.txt*.
Menu Command Sequences	Initial Caps, with a right angle bracket (>) between items. Menu items are displayed as shown on screen.	To compare documents, choose: Tools > Documents > Compare.
URLs	Sans serif font.	http://www.compaq.com/storage

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 out 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.

1

Introducing the Drive Enclosure

IMPORTANT: The terms "Fibre" and "fiber" are not interchangeable.

Fibre is the international spelling that refers to the Fibre Channel standards for both optical and copper media.

Fiber refers to the optical media for implementing Fibre Channel.

This chapter describes the Enterprise Storage System Fibre Channel-Arbitrated Loop (FC-AL) drive enclosures (see Figure 1–1 and Figure 1–2). These enclosures support the FC-AL connections on both the external (host controller-to-enclosure) and the internal buses.

CXO7196A

WARNING: The physical size and weight of the rack requires a minimum of two people to move it. If one person tries to move the rack, there is a potential for injury.To ensure stability of the rack, always push on the lower half of the rack. Be especially careful when moving the rack over any bump (for example: doorsills, ramp edges, carpet edges, or elevator openings). When the rack is moved over a bump, there is a potential for it to tip over.

To safely and easily install the enclosure, remove the drives, power supplies and blowers, EMU, and I/O modules as described in Chapter 6, "Replacing CRUs." This reduces the enclosure weight to approximately 24 lb (11.0 kg). Even though a single person can lift this weight, the enclosure is difficult to install because of the physical size. Therefore, Compaq recommends a minimum of two people to install an empty enclosure in a rack.
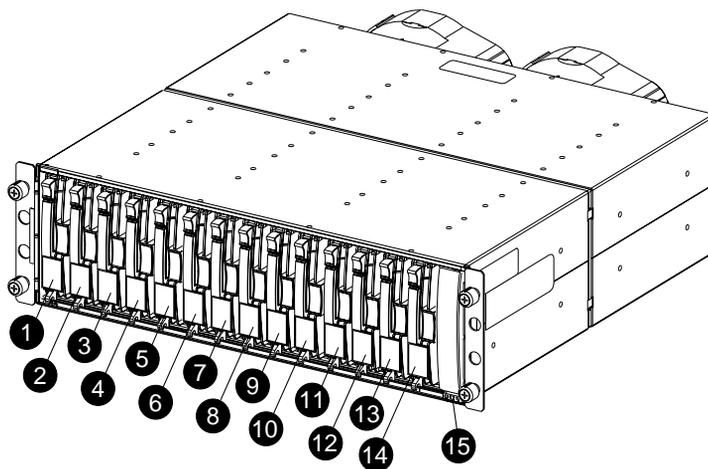
CXO7164A

❶ to ⓮ Drive Bays   ⓯ Enclosure Status Icons

Figure 1–1: Drive enclosure—front view

Use Figure 1–2 to locate the rear-mounted enclosure elements.
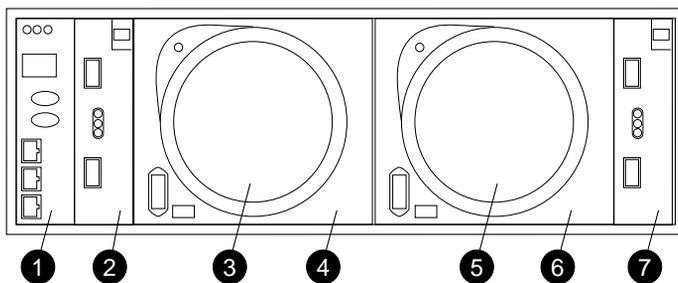
CXO7484A

❶ EMU   ❺ Blower 2
❷ I/O Module B   ❻ Power supply 2
❸ Blower 1   ❼ I/O module A
❹ Power Supply 1

Figure 1–2: Drive enclosure–rear view

IMPORTANT: The Enterprise Storage System Fibre Channel implementation uses a low-power laser transceiver or gigabit (Gb) interface converter (GBIC) that does not pose a threat to the human eye.

Enterprise Storage System

The drive enclosure is one major component of both the 6- (see Figure 1–3) and 12-drive enclosure (see Figure 1–4) Enterprise Storage Systems.

The other major components of the Enterprise Storage System are:

- The Enterprise Storage System rack. The *Enterprise Virtual Array Rack User Guide* provides a detailed description of the rack including configurations, installation, and operation.

- The HSV controller. The *Enterprise Virtual Array HSV Controller User Guide* provides a detailed description of the rack including configurations, installation, and operation.

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CXO7646A
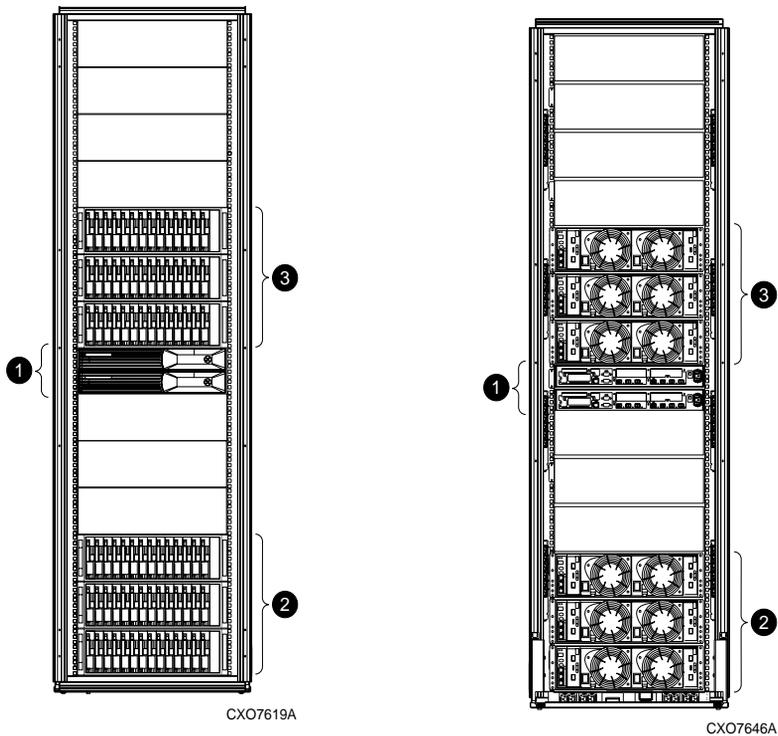
Front View   **Rear View**

❶   HSV controller pair Bus Address 07
❷   Disk drive enclosures 1–3 Bus Addresses 01–03
❸   Disk drive enclosures 4–6 Bus Addresses 08–10

Figure 1–3: 6-Drive enclosure Enterprise Storage System

CXO7620A   CXO7607A

Front View   **Rear View**
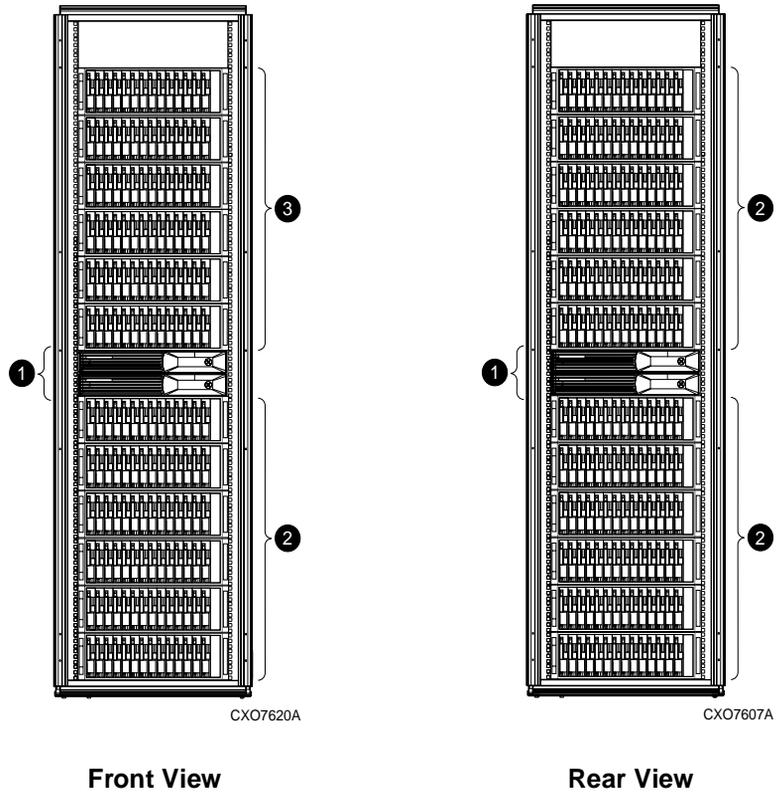
❶   HSV controller pair Bus Address 07
❷   Disk drive enclosures 1–6 Bus Addresses 01–06
❸   Disk drive enclosures 7–12 Bus Addresses 08–13

Figure 1–4: 12-Drive enclosure Enterprise Storage System

Enclosure Major Components

The major components of the enclosure are:

- The I/O modules that are the interface between the drives and the host controllers (see Chapter 3, "FC-AL I/O Modules").

- The disk drives that are the Enterprise Storage System storage devices (see Chapter 4, "Disk Drives").

- The power supplies that convert an AC input voltage into DC voltages for enclosure operation (see Chapter 5, "Enclosure Power and Cooling").

- The blowers that cool the enclosure by drawing air in from the front of the enclosure and exhausting it out the rear (see Chapter 5, "Enclosure Power and Cooling").

- The environmental monitoring unit (EMU) that constantly monitors the operation of the enclosure and the elements and displays element status. Whenever the EMU detects a condition that could affect operation, it not only generates a local alarm, but also reports the condition to the controller. The purpose, function, and operation of this complex element is fully described in *Enterprise Virtual Array Drive Enclosure EMU User Guide.*

The drive enclosure is a 2.125-Gb, dual loop, 14-drive enclosure. See Table 1–1 for a list of the major elements.

Table 1–1: 14-Drive Enclosure Major Elements

Dual-Loop I/O module A	Power Supplies: 2 each
Dual-Loop I/O module B	AC power cords: 2 each
2 Gb transceivers: 4 each	Blowers: 2 each
Drive Blanks: 14 each	50 micron, 2 m (6.6 ft) multimode cables: 4 each

Drive Enclosure Features

> △ **CAUTION:** The FC-AL enclosure supports only Compaq supplied FC-AL drives. Installing a parallel SCSI drive creates an error condition.

The 14-drive enclosure mounts in a rack with a 3U (5.25 inch or 133.35 mm) vertical opening. The rack hole pattern must conform to the EIA, formerly RETMA, standard.

> △ **CAUTION:** The individual drive power consumption must be less than 24 W. To ensure proper cooling, all drive bays must have either a drive or drive blank installed.

The enclosure provides several features, including:

- Replacing disk drives, the environmental monitoring unit (EMU), blowers, and power supplies does not interrupt data transfers. These elements are hot-pluggable.

- An element with a port-wine-colored latch, tab, or handle is hot-pluggable.

> △ **CAUTION:** Connecting or disconnecting an I/O module, transceiver, or fiber cable may interrupt data transfers on the associated loop. Data transfers on the other loop are not affected.

The FC-AL drive enclosures do not support the following storage devices:

- Tape drives
- CD-ROMs
- Solid state drives

The enclosure has guides that ensure the drives, EMU, I/O module, and power supplies (the enclosure elements) align and properly mate with the backplane connectors. A blower guide post ensures that the blower properly mates with the power supply. The elements and the metal enclosure provide electromagnetic interference (EMI) suppression and control air flow within the enclosure.

FC-AL Buses

Each drive enclosure is connected to two independent, external FC-AL buses, or loops through I/O module A and I/O module B. The HSV controller establishes these loops. The I/O modules establish the internal enclosure buses and all the drives connect to both loop A and loop B. I/O module A connects to loop A and I/O module B connects to loop B.

For detailed information about the FC-AL buses, see Chapter 2, "Configuring the FC-AL Disk Drive Enclosure" and Chapter 3, "FC-AL I/O Modules."

High Availability

The high-availability enclosure features are a function of the number of operational blowers and power supplies. One operational power supply and one operational blower are all that is required to keep the enclosure fully functional.

Blowers

All enclosures have two blowers. If one blower fails, the other blower automatically operates at a higher speed. Therefore, the enclosure is operational as long as there is a single operational blower.

Power Supplies

The FC-AL enclosure uses the redundant power supply configuration (two power supplies). This prevents the failure of a single power supply from disabling the enclosure. A single power supply can support all enclosure operations.

$\triangle$ **CAUTION:** To ensure proper enclosure cooling, to provide complete power redundancy, and to eliminate the enclosure power supplies as possible single points of failure, each supply connects to a different rack power distribution circuit. Each circuit is controlled by a power distribution unit (PDU) that connects to a different building AC power distribution circuit.

Data Integrity

Data integrity could be compromised if data transfers occur when there is no DC power to the I/O module or the drives. To avoid this condition, the power pins on these elements are longer than the data pins. This ensures that power is always present when a data transfer occurs.

Status Monitoring and Display

The major status monitoring capabilities of these enclosures include:

- Displaying the enclosure status on the enclosure icons

- Displaying the blower, power supply, EMU, drive, and I/O module status on the element LEDs

- Detecting the installation of blowers, power supplies, drives, or I/O modules

- Detecting the removal of blowers, power supplies, drives, or I/O modules

- Sensing enclosure internal temperatures

- Sensing power supply voltage, current, and total power

- Sensing ambient temperature

NOTE: The ambient temperature is the temperature at the enclosure air intake or the room temperature.

Enclosure Layout

The drives mount in the bays in the front of the enclosure (see Figure 1–5). These bays are numbered from the left (bay ❶) to the right. The common method of referring to a drive is by the bay number. The drive in bay ❶ is drive 1, the drive in bay ❽ is drive 8, and so forth.

NOTE: There is no direct correlation between the bay number and loop ID. See *Enterprise Virtual Array Drive Enclosure EMU User Guide* for more information about the enclosure loop IDs.

The enclosure status icons are located in the lower-right, front corner ❿.
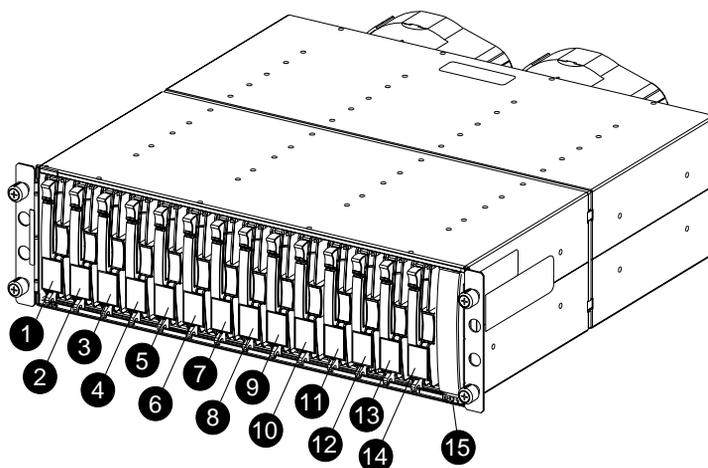
CXO7164A

❶ to ❿ Drive Bays   ❿ Enclosure Status Icons (see the section titled "Enclosure Status Icons")

Figure 1–5: 14-Drive enclosure bay numbering

Enclosure Status Icons

The enclosure status LEDs are located on the enclosure backplane. These LEDs illuminate the status icons (see Table 1–2) in the front, lower-right corner of the enclosures (see ❺, Figure 1–5).

Table 1–2: Enclosure Status Icon Displays

Icon	Off	On	Flashing
EMU "Heartbeat" Icon (green LED)			
Power Icon (green LED)			
Enclosure Status Icon (orange LED			

Major Enclosure Elements

The elements required for proper operation of an enclosure include:

- An EMU
- Two power supplies
- Two blowers
- An I/O module A
- An I/O module B
- A drive or drive blank in each bay

Element Replacement Methods

The method used to replace an element depends upon the following factors:

- *Does the controller support replacing elements with power applied?*
  The primary factor in determining the replacement method used is what the controller supports.

  Compaq identifies hot-pluggable elements with a port wine-colored latch, tab, or handle.

  Review the controller documentation to ensure that the controller supports replacing an element with power applied.

- *Can element replacement affect FC-AL bus operation?*
  When the element being replaced does not interrupt data transfer or affect the operation of any other element, and the controller supports replacement with power applied, the element is hot-pluggable.

> △ **CAUTION:** Replacing an I/O module, a fiber optic cable, or a transceiver will interrupt data transfers on a loop. To ensure at least one loop is operational, only replace one of these elements *per drive enclosure* at a time

IMPORTANT: Even though an individual element meets all the hot-pluggable or pluggable criteria, if the controller does not support replacing a customer replaceable unit (CRU) with power applied, or if replacing the element interrupts data transfers, you must disconnect the drive enclosure from the affected loop before replacing.

- *Are there any personal safety issues involved?*
  Whenever there is an issue involving personal safety, such as an electrical hazard, then the element replacement requires *removing power* from the enclosure.

  Replacing the FC-AL enclosure elements does not involve electrical hazards.

- *Are special tools, techniques, or training required?*
  When replacing an element does not require special tools, techniques, or training (such as system configuration), the element is a CRU.

  When replacing an element requires special tools, techniques, or training, then the unit is a field replaceable unit (FRU). Only qualified, Compaq approved service providers are authorized to replace FRUs.

  Based on these definitions, the Enterprise Storage System drive enclosure elements are CRUs.

2

Configuring the FC-AL Disk Drive Enclosure

IMPORTANT: The configuration rules in the *Enterprise Virtual Array Initial Setup User Guide* have precedence over the rules in this publication.

This chapter provides an overview of the FC-AL drive enclosure subsystem configuration. This overview includes considerations and the procedures for configuring a subsystem for operation in a dual-loop, multiple-enclosure Enterprise Storage System configuration.

Basic Enterprise Storage System Configurations

The basic Enterprise Storage System configuration consists of a rack, a controller enclosure with a pair of controllers, and 6 or 12 drive enclosures mounted in a rack. The *Enterprise Virtual Array Initial Setup Guide* defines these Compaq supported configurations. The location of the controller enclosure (see Figure 2–1) is in the middle of the rack ❶.

CXO7607A
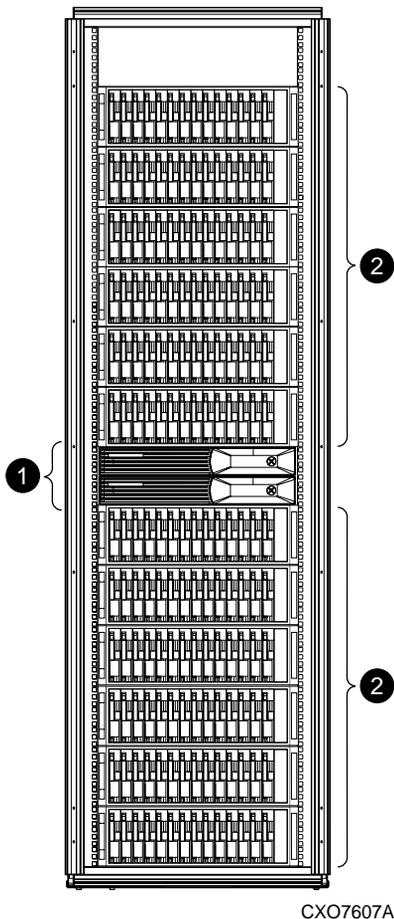
Figure 2–1: Typical rack configuration–front view

The operation and function of both the A and B FC-AL I/O modules are identical. All I/O modules have two bidirectional ports that can function as either an input or an output port. The input port connects to the *controller* or *the previous drive enclosure* in the loop, while the output port connects to the *next* enclosure on the loop, either a disk drive or a controller.

There are many possible configurations and cable routing schemes defined for the Enterprise Storage System. To ensure proper operation, Compaq recommends identifying the transceivers using the numbering system shown in Figure 2–2. The *Enterprise Virtual Array Initial Setup User Guide* clearly defines the interconnections

❹ Loop B Top Port   ❷ Loop A Top Port

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❸ Loop B Bottom Port   ❶ Loop A Bottom Port
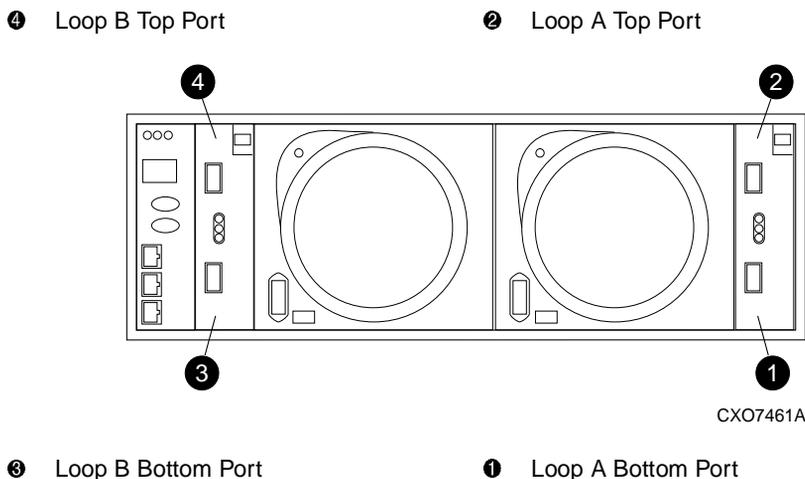
Figure 2–2: I/O module port (transceiver) locations

Fiber Optic Components

The Enterprise Storage System Fibre Channel implementation is a 2 Gb (2.125 Gbps) short wavelength. The fibre optic components are:

- The Enterprise Storage System 2 Gb transceiver is internationally approved as a Class 1 laser safe product that features optical emission levels that do not harm the human eye.

- The orange, 50-micron fiber optic cable is available in multiple lengths.

Table 2–1 defines the fiber optic transceivers and cables furnished with the Fibre Channel drive enclosures. For more information about this product, including additional cables and transceivers use the procedures described in the "About this Guide" to access the Compaq product website.

IMPORTANT: The controller enclosure to drive enclosure cables are supplied with the controller.

Table 2–1: 2 Gb Fiber Optic Components

Short Wavelength Transceiver
CXO7435A
Electrical-to-Fiber Optic Interface Compliance: Fibre Channel FC-PH-2 physical layer option 100-M5-SN-1   **Transfer rate:** 2.125 Gb   **Cable diameter:** 50 μm diameter   **Laser frequency and type:** 780 nm (non-OFC)   **Optical connector interface:** Dual LC   **Quantity required:** 2 per I/O module (4 per enclosure)
Fiber Optic Cable Assembly
CXO7436A
Small Form Factor (LC-to-LC) connectors: Duplex, 2 conductor, 50 micron (50 μm) multimode, 50/125, 1.6 zip   **Length:** 2 m (6.6 ft)   **Quantity required:** 2 per I/O module
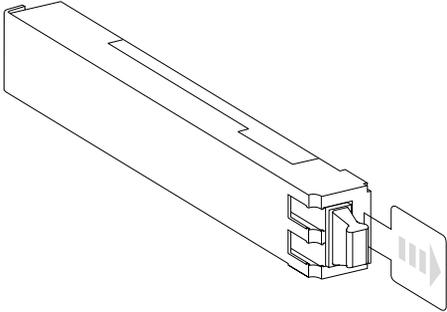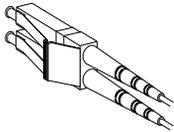
To ensure optimum operation, the fiber optic components (that is, the transceivers, the fiber optic cable connectors, and the fiber within the cable) require protection from contamination and mechanical hazards. Failure to provide this protection can reduce the amount of light passing through a component, thereby degrading operation. Actions that can avoid degradation include:

- To avoid breaking the fiber within the cable, do not:
    — Kink the cable.
    — Use a cable bend-radius of less than 30 mm (1.18 inches).
- To avoid deforming, or possibly breaking the fiber within the cable, do not place heavy objects on the cable.
- To avoid contaminating the optical connectors:
    — Do not touch the connectors.
    — Never leave the connectors exposed to the air.
    — Install a dust cover on each transceiver and fiber cable connector when they are disconnected.

If an open connector is exposed to dust, or there is any doubt about the cleanliness of the connector, clean the connector as described in Appendix C, "Protecting Fiber Optic Connections."

Loop Configurations

The Compaq supported configuration is a dual-loop with either 6 or 12 drive enclosures per loop. This configuration eliminates single-points-of-failure. Limiting the total number of enclosures reduces the transmission delays inherent in longer loops.

$\triangle$ **CAUTION:** Keeping the loops completely separate ensures that the failure of a single component (controller, I/O module, transceiver, or cable) does not stop data transmissions to all the active drives.
Therefore, only connect the loop A cables to an I/O module A and the loop B cables to an I/O module B.

Initializing the Fibre Channel Loop

Initializing the Fibre Channel loops automatically assigns an AL_PA to the drives in each enclosure. Although Compaq recommends assigning a specific group of sequential loop IDs to each enclosure (see *Enterprise Virtual Array Drive Enclosure EMU User Guide)* this may not always be possible for several reasons.

The following sections are a general description of the loop initialization process.

Enterprise Storage System Loop Initialization

In an Enterprise Storage System configuration the HSV element manager graphical user interface (GUI) provides the means for initializing the loops.

Verifying Enclosure Operation

All the elements in the enclosure begin operating when power is applied. Check the enclosure status LEDs in the front, lower right corner (see Figure 2–3). If the display is not exactly as shown there is an error condition. Check the drive status LEDs on the front, and the EMU, power supplies, blowers, and I/O module status LEDs on the rear (see Table 2–2) to determine the defective element.

NOTE: Either of the drive displays in Figure 2–3 indicates a properly functioning disk.

CXO7486A
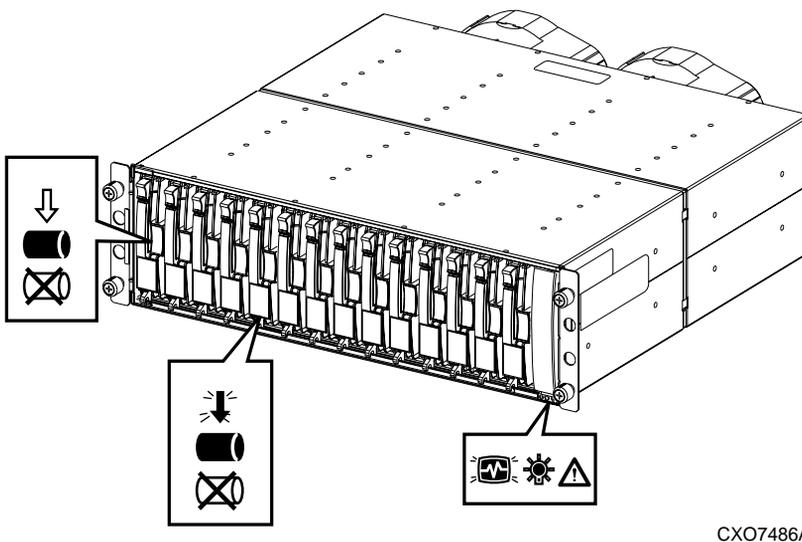
Figure 2–3: Typical operational LED status displays—enclosure front

See Table 2–2 for the location and state of the status LEDs on the rear of the enclosure.

Table 2–2: Operational LED Status Display–Enclosure Rear View

CXO7658A
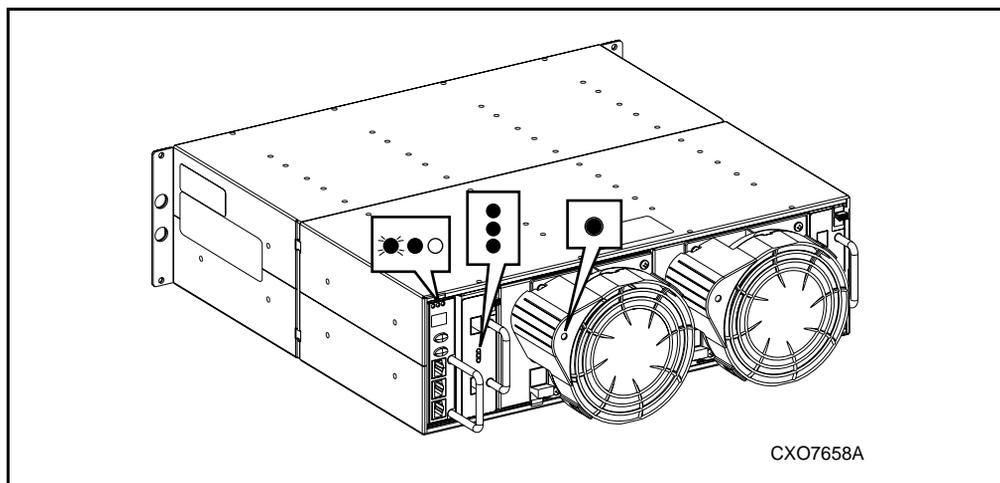
Table 2–2: Operational LED Status Display–Enclosure Rear View (Continued)

EMU LEDs and Icons
The enclosure power (both the +5 VDC and +12 VDC) is present and correct. There are NO enclosure faults.

I/O Module A and I/O Module B LEDs
The upper port is operational, the power is correct, and the lower port is operational.
There is a data transfer on the upper port, the power supply is operational, and the lower port is operational.
The upper port is operational, the power is correct, and there is a data transfer on the lower port
There is a data transfer through this enclosure to another enclosure, and the power is correct

Power Supply and Blower LEDs
Both the power supply and the blower are operational.

3

FC-AL I/O Modules

This chapter describes the two I/O modules (see Figure 3–1 and Figure 3–2) that are the interface between the drive enclosure elements and the host controller. They route data to and from the drives using Loop A and Loop B, the dual-loop configuration.

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CXO7420A
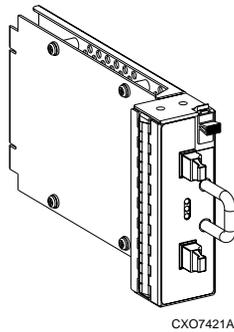
Figure 3–1: I/O module B
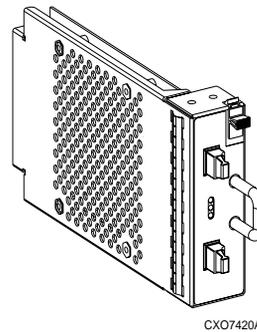
Figure 3–2: I/O module A

The Compaq Enterprise Storage System only supports dual-controller, dual-loop operation. Each controller is connected to both the I/O module A and I/O module B in each drive enclosure.

I/O Modules

The A and B I/O modules are similar in appearance and function in the same manner, but they *are not* interchangeable. The physical differences between the modules ensure that you can install only:

- The A module (❶, Figure 3–3) at the right end of the enclosure, behind drive bay 1.

- The B module (❷, Figure 3–3) at the left end of the enclosure, next to the EMU.

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| ❷ | I/O module B | ❶ | I/O module A |
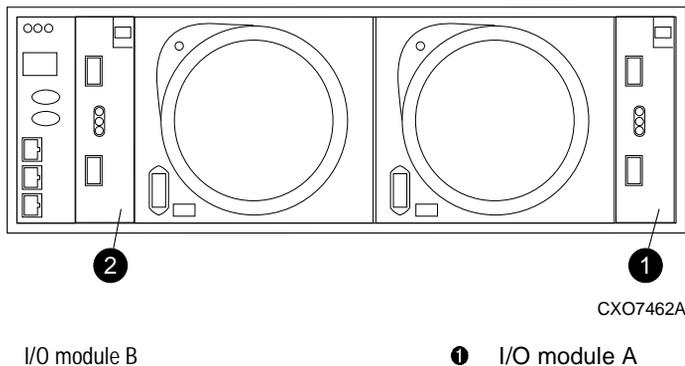
Figure 3–3: I/O module locations

Fibre Channel Loop Components

The I/O modules are major components in the Fibre Channel loop. Each module has two ports that can both transmit and receive data or bidirectional operation. Activating a port requires connecting a transceiver to the port. The FC-AL enclosures use short wavelength, fiber optic transceivers with 50 micron (µm) diameter, multimode fiber cables. The port function depends upon the loop (see Figure 3–4).

❹   Loop B Top Port   ❷   Loop A Top Port

CXO7461A

❸   Loop B Bottom Port   ❶   Loop A Bottom Port
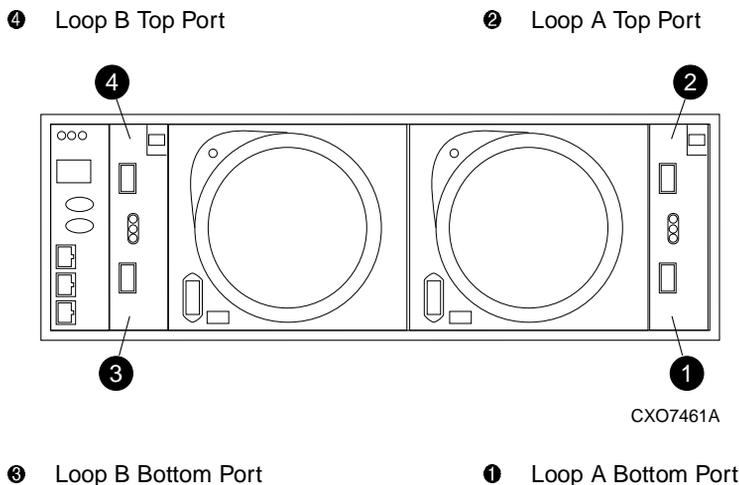
Figure 3–4: Input and output ports

⚠ **CAUTION:** To protect the connectors, always install the dust covers whenever a transceiver or a fiber cable is disconnected.
When connecting a transceiver or giver cable, remove, *but do not discard*, the dust covers or dust caps.

I/O Module Power

The I/O module +5 VDC power sensing device protects the modules against overcurrent conditions. If the +5 VDC current exceeds 2.5 A rms (nominal), the sensor opens, removing the +5 VDC input from the I/O module, thereby disabling the module until:

• The defective I/O module is replaced.

• The overcurrent condition no longer exists.

NOTE: A disabled I/O module cannot transfer data and disconnects all the drives in the enclosure from the loop and also disconnects the "downstream" enclosures from the loop.

I/O Module Status Displays

The three green LEDs on the A and B I/O modules display the status (see Figure 3–5). The LED status displays for an operational I/O module are shown in Table 3–1. Table 3–2 shows the status displays for a nonoperational I/O module.

❶ Top port status LED
❷ Power status LED
❶ Bottom port status LED

CXO7488A
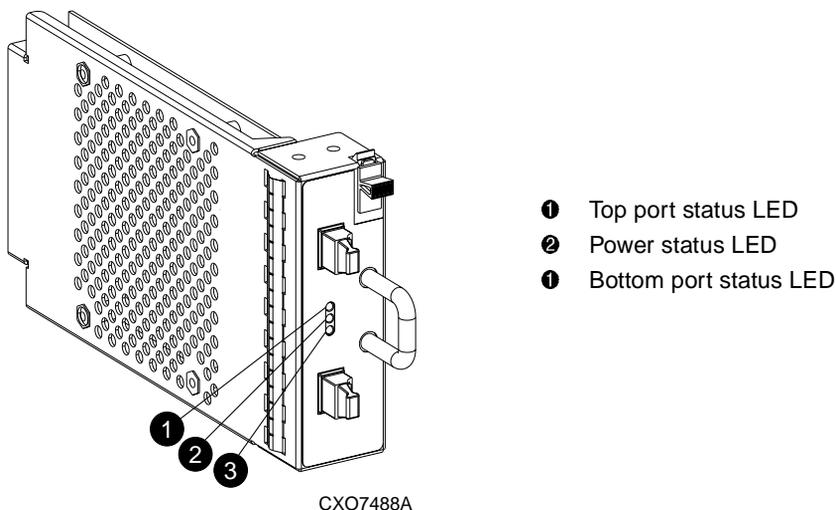
Figure 3–5: I/O module status LEDs

Table 3–1: Operational I/O Module LED Status Displays

● ●̶ ●	Top Port—FC-AL signal detected Power—Flashes for one minute. The LED is On constantly; Bottom Port—FC-AL signal detected. This display can occur during *the first minute after* initial power application.
●̶ ● ●̶	Top Port—FC-AL signal detected Power—Present Bottom Port—FC-AL signal detected This display can occur *one minute after* the initial application of power.
●̶ ●̶ ●̶	When the locate function is active all three LEDs flash in synchronization. **IMPORTANT:** The locate function overrides all other LED functions. Therefore, it is possible there is an error.

Table 3–2: Nonoperational I/O Module Status Displays

● ● ○	Top Port—FC-AL signal detected Power—Present (After one minute the power LED will be On constantly) Bottom Port—No FC-AL signal detected Check transceiver and fiber cable connections.
○ ● ●	Top Port—No FC-AL signal detected Power—Present Bottom Port—FC-AL signal detected Check transceiver and fiber cable connections.
●̶ ● ●	Top Port—EMU detected possible transceiver problem Power—Present Bottom Port—FC-AL signal detected Check transceiver and fiber cable connections.
● ● ●̶	Top Port—FC-AL signal detected Power—Present Bottom Port—EMU detected possible transceiver problem Check transceiver and fiber cable connections.

Table 3–2: Nonoperational I/O Module Status Displays (Continued)

◯	No I/O module power
	I/O module is nonoperational
◯	Check power supplies. If power supplies are operational, replace I/O
◯	module.

4

Disk Drives

This chapter describes the features, functions, and characteristics of Compaq hot-pluggable disk drives. The Compaq-supplied disk drives conform to the enclosure initiated Enclosure Services Interface (ESI).

The 14-drive enclosure supports only 1-inch, 3.5-inch form factor drives that consume less than 24 W of power.

CAUTION: Controlling air flow within the enclosure requires installing a drive or a drive blank in each drive bay.
To avoid overheating, never remove more than one drive or drive blank from an operating enclosure at the same time.
To prevent overheating and ensure proper operation, Compaq recommends installing a drive of equal or greater capacity, or a drive blank, as soon as possible.

Drive Status Reporting

The three status icons (see Figure 4–1) on the front of each drive define the drive operational status. The LEDs that illuminate these icons are located on the enclosure backplane. To determine the drive status, you must observe the icons described in the following sections.
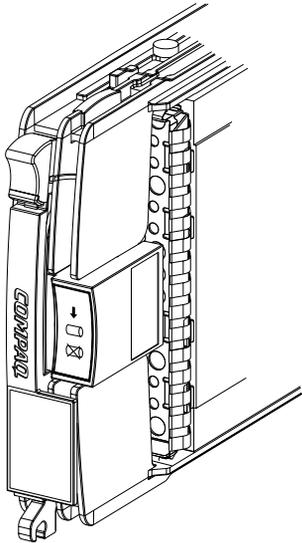
CXO7167A

Figure 4–1: Drive icons

The following sections describe the purpose of each of the icons.

Drive Activity Icon

The green LED for this icon is controlled by the disk drive. Neither the HSV controller nor the EMU can control the LED. This prevents this LED from Flashing when the locate function is active.

This LED is off when there is no bus activity.

Drive On-line Icon

The green LED for this icon is controlled by the disk drive. Neither the HSV controller nor the EMU can control the LED. This prevents this LED from Flashing when the locate function is active.

The LED may be Off when:

- There is no controller on the bus
- +5.1 VDC is not available
- The drive is not properly installed in the enclosure

Drive Failure Icon

The orange LED flashes in synchronization with the other two LEDs in response to the EMU locate command.

Depending on the host controller, the LED for this icon can flash when the controller detects an error condition.

Drive Status

The two green and one red LEDs are either On, Off, or Flashing. In some configurations, the host controller can control the status LEDs. The operational drive LED status displays are shown in Table 4–1. See Table 4–2 for the nonoperational drive status LED displays.

⚠ **CAUTION:** The Drive Activity and the on-line LED are controlled by the drive, and cannot be overridden by the Enterprise Storage System controller. The result is the status of the LED being either Off, Flashing, or On.

A LED may flash either slowly or rapidly to assist in identifying a defective drive.

Table 4–1: Operational Drive Status Displays

	This display at *initial startup* may mean the operational drive is not being accessed. If the display does not change within a few minutes, the drive is nonoperational and should be replaced. *DO NOT* replace unless the system has completed initial startup and the other drives are operational.
	The operational drive is not being accessed.
	The drive locate function is active. DO NOT replace the drive while the locate function is active. NOTE: Depending on controller revision level, the Drive Activity LED may be either On, Off, or Flashing. The Online LED may be either Flashing slowly or On. The Drive Failure LED may be either On or Flashing slowly.
	The drive is operational and active. The drive is configured as part of an array. DO NOT replace an active drive.

Table 4–2: Nonoperational Drive Status Displays

	The drive is nonoperational. There is no power to the drive. Drive may be replaced.

Recommended Corrective Actions:

1. Check power supplies for proper operation.

2. Replace if defective.

3. Replace drive.

	There is a drive error and the drive is not active. Check the storage system graphical user interface (GUI) for a definition of the problem. Drive may be replaced

Recommended Corrective Actions:

1. Verify drive loop continuity.

2. Replace drive.

Drive Power

The drive voltage backplane sensors (+5.1 VDC and +12.1 VDC) can detect a drive overcurrent condition. When there is a drive overcurrent condition, the sensor disconnects the voltage from the drive to prevent writing data to the drive. The drive is disabled until one of the following conditions occurs:

*   The defective drive is replaced.

*   The overcurrent condition no longer exists.

Drive Blank

To maintain the proper enclosure air flow, there must be a drive or a drive blank in each drive bay. The function of the drive blanks (see Figure 4–2) is to control air flow within a bay.
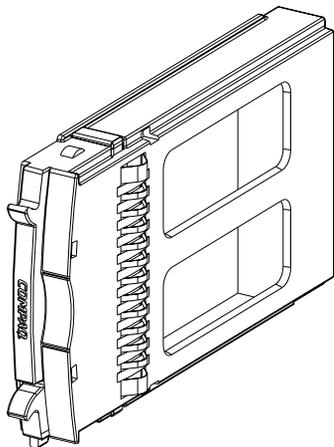
CXO6824A

Figure 4–2: Drive blank

Replacing a Drive or Drive Blank

To replace a disk, you must complete the procedures outlined in Chapter 6, "Replacing CRUs."

The disk replacement kit contains detailed replacement instructions.

> ⚠ **CAUTION:** Never remove more than one drive at a time, as this can cause the enclosure to overheat.
> To prevent overheating and ensure proper operation, Compaq recommends installing a drive of equal or greater capacity, or a drive blank, as soon as possible.

NOTE: For the latest information and instructions about Compaq FC hard drives, such as compatibility and installation instructions, refer to "About this Guide."

5

Enclosure Power and Cooling

This chapter describes the function and general operation of the enclosure power supplies and blowers. Figure 5–1 identifies the major power supply assembly components.
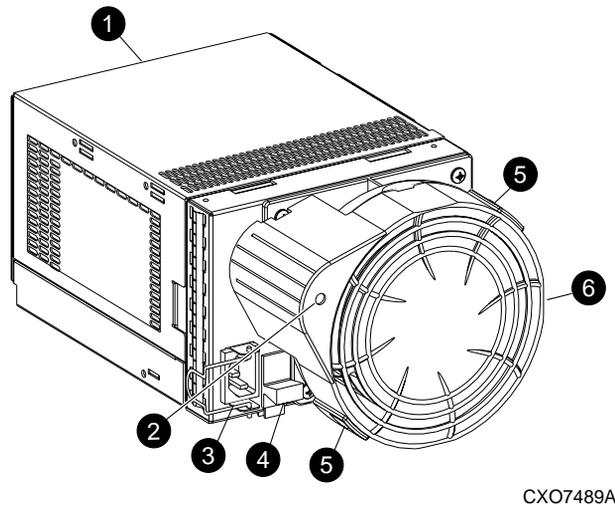
CXO7489A

❶	Power supply Assembly	❹	Module Latch (port-wine colored)
❷	Power supply and Blower Status LED	❺	Blower Tabs (port-wine colored)
❸	AC Input Connector with Bail	❻	Blower Element

Figure 5–1: Power supply and blower assembly components

Enclosure Power

The two power supplies mount in the rear of the enclosure. The supplies are auto-ranging and operate on a country-specific AC input voltage of 202 to 240 VAC ±10%, 50 to 60 Hz, ±5%, (188 to 264 VAC, 47 to 63 Hz).

The DC outputs of this power supply are:

- +5.1 VDC for the EMU, I/O module, backplane, and drives
- +12.1 VDC for the drives
- +12.5 VDC for the blower

The nominal output of each power supply is 499 W, with a peak output of 681 W. A single power supply can support an enclosure with a full complement of disks, blowers, EMU, and I/O module.

The power supply circuitry provides protection against:

- Overloads
- Short circuits
- Overheating

Power supply status and diagnostic information is reported to the EMU with voltage, current, and temperature signals.

See Appendix B, "Specifications" for the enclosure power specifications.

Temperature Sensing

The power supply temperature sensor provides a temperature range signal to the EMU. The EMU can use this signal to set the blower speed.

The power supply internal temperature can also set the speed of the blower. The higher the power supply temperature, the faster the speed of the blower. Should the power supply temperature exceed a preset value, the power supply automatically shuts down.

Blower Interface

The blower mounts on the rear of the power supply. A power supply connector is the interface between the blower and the enclosure for:

- Blower speed control to the blower
- Blower speed to the EMU through the power supply

- Power supply high speed enable
- Blower operating voltage

Blowers

The power supply-mounted blowers cool the enclosure by circulating air through the enclosure and the elements. The rate at which air moves (the air flow) determines the amount of cooling and is a function of blower speed (rpm). These blowers, under the control of the EMU or the associated power supply, can operate at multiple speeds. This ensures that when the enclosure temperature changes the blowers can automatically adjust the air flow.

Should a blower be operating too slowly or stopped (a "blower failure"), internal circuitry automatically causes the operational blower to operate at a higher speed. Simultaneously, the error condition is reported to you in several ways, including the power supply LED, the audible alarm, the enclosure fault LEDs, and the EMU alphanumeric display.

Should both blowers fail, the power supplies automatically shutdown.

NOTE: The failure of a power supply +12.5 VDC circuit disables the associated blower.

Power Supply and Blower Status Reporting

The green status LED on the blower displays the status of both the power supply and the blower. See Table 5–1 for definitions of the LED displays.

Table 5–1: Power Supply and Blower Status LED Displays

When the blower and the power supply are operational, the display may be:
⬤ Both the power supply and the blower are operational.
☀⬤ Either the power supply or the blower locate function is active.

Table 5–1: Power Supply and Blower Status LED Displays (Continued)

When either the blower or the power supply is nonoperational the display is:
◯ Either the power supply or the blower is nonoperational. When there is a blower problem, the other blower runs at a higher speed. **Recommended Corrective Actions** 1. Check power supplies for proper operation. Replace if defective. 2. Check blower for proper operation. Replace if defective.

Replacing a Power Supply or Blower

To replace a power supply or blower you must complete the procedures outlined in Chapter 6, "Replacing CRUs."

As long as there is one operational power supply, you can replace a defective power supply without stopping data transfers. This is true whether the power supply has failed or is failing.

6

Replacing CRUs

This chapter describes the procedures for replacing CRUs. Information about initial enclosure installation, ESD protection, and common replacement procedures is also presented.

ESD Protection

When you replace a CRU, you must take precautions to prevent the possibility of electrostatic discharge (ESD) 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.

> △ **CAUTION:** The hot-pluggable power supplies, blowers, and drives DO NOT require halting Fibre Channel data transfers.
> Replacing a pluggable I/O module, transceiver, or a fiber cable always interrupts data transfers on the Fibre Channel loop.
> Review the controller documentation to determine if replacing an I/O module, transceiver or fiber cable requires removing power.

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 for shipment.

Determining CRU Part Numbers

All elements have a Compaq 6–3 spare part number on the product label (see Figure 6–1). This nine character number appears immediately below the REPLACE WITH COMPAQ SPARE statement. The first six characters (123479) identify the element. The last three characters (–002) define the revision level. The replacement element revision level must be the same as, or greater than, the number on the element being replaced. The higher the revision level, the later the revision.

CXO7083A

Figure 6–1: Typical Compaq product label

How to Replace a Disk Drive

NOTE: For the latest information and instructions about Compaq disk drives, such as compatibility and installation instructions, go to the Compaq website: http://www.compaq.com

Complete the following procedure to replace a disk drive.

> ⚠ **CAUTION:** Remove only one drive at a time to avoid overheating the enclosure and install a drive of equal or greater capacity or a drive blank.

1. Push in on the disk drive Ejector Button ❶ (see Figure 6–2), and pivot the Release Lever ❷ to the full, open position.
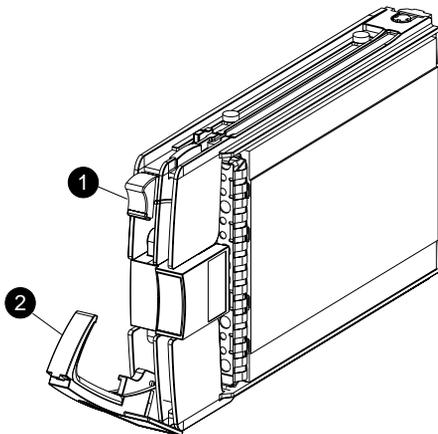
CXO6826A

Figure 6–2: Removing a drive

2. Pull on the drive until it is disconnected from the backplane connector.

3. plane connector.

> ⚠ **CAUTION:** The carrier can be dropped due to the rapidly rotating media. Remove the carrier from the enclosure when the media has stopped rotating. This takes approximately 30 seconds.
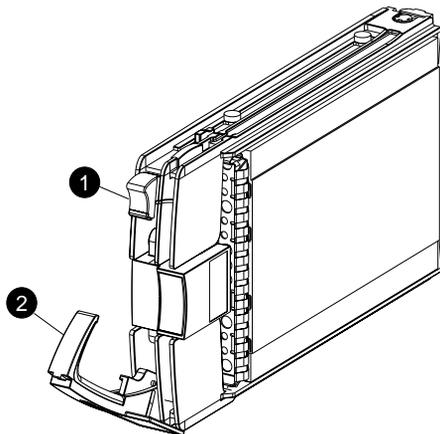
4. When you are sure that the media is no longer spinning, completely remove the drive from the enclosure.

5. Insert the replacement drive into the enclosure until the drive is against the backplane connector.

6. Push in on the replacement drive while pivoting the Release Lever ❷ to the full upright position.

7. Push the Release Lever in until the lever engages the Ejector Button ❶, and the drive is fully seated in the backplane connector.

8. Observe the drive status LEDs to ensure the replacement drive is functioning properly. Refer to your drive enclosure user guide for specific details.

How to Install a Drive Blank

Complete the following procedure to replace a disk drive with a drive blank.

1. Push in on the disk drive port wine-colored Ejector Button ❶ (see Figure 6–3) and pivot the Release Lever ❷ to the full, open position.

CXO6826A

Figure 6–3: Removing a drive to install a drive blank

2. Pull on the drive to disconnect from the backplane connector.

⚠ **CAUTION:** The rapidly rotating media could cause you to drop the carrier. To prevent this, do not remove the carrier from the enclosure until the media has stopped rotating. This usually takes just a few seconds

3. When you are sure that the media is no longer spinning, remove the drive from the enclosure.

4. Insert the drive blank (see Figure 6–4) into the enclosure bay until the locking tabs engage the enclosure.
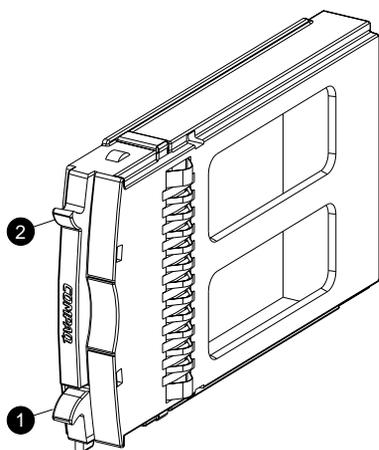
CXO7359A˚

Figure 6–4: Installing and removing a drive blank

How to Remove a Drive Blank

Complete the following procedure to remove a drive blank.

1. Grasp the drive blank by the two tabs (❶ and ❷, Figure 6–4).

2. Lift up on the bottom tab ❶ and pull the blank out of the enclosure.

How to Replace a Power Supply

Complete the following procedure to replace a power supply.

> ⚠ **CAUTION:** Removing a power supply significantly changes the air flow within the enclosure. The enclosure could shut down because of overheating unless the power supply is replaced within *7 minutes*

1. To remove a power supply assembly, move the power cord bail lock ❶, Figure 6–5, to the left. Disconnect the AC power cord ❷ from the supply.

2. While lifting up on the power supply port wine-colored module latch ❸, grasp the blower element ❹ and pull the power supply out of the enclosure.
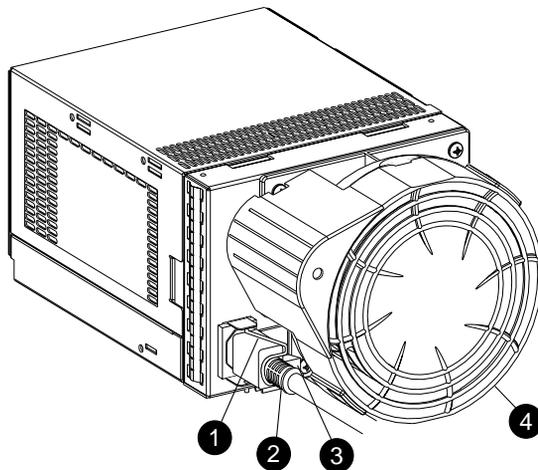
CXO7490A

Figure 6–5: Replacing a power supply

3. Move the power cord bail lock to the right.

> **CAUTION:** Be sure to return the cord bail lock to the right position. If the bail lock remains in the left position damage to other elements could occur when removing the power supply.

IMPORTANT: Replacement power supply assemblies do not include a blower assembly. To complete the power supply replacement, you must either remove an operational blower from the defective power supply assembly or order a replacement blower assembly.

4. To remove a blower, push in on the two port wine-colored blower tabs ❶, Figure 6–6, while pulling the blower element away from the power supply.
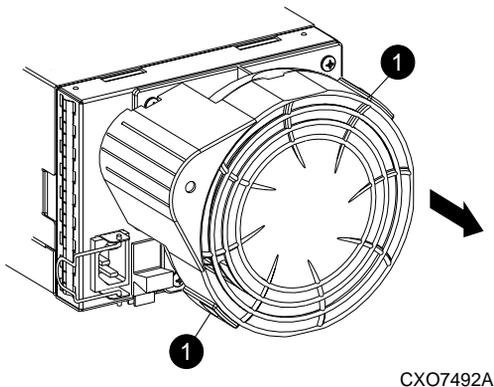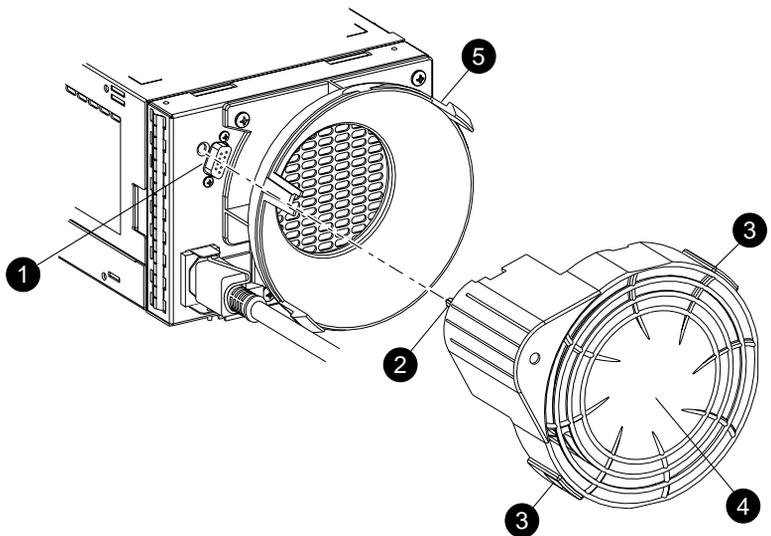

CXO7492A

Figure 6–6: Removing a blower from a defective power supply

⚠️ **CAUTION:** Pressing on the center section of the blower ❹ can damage the blades or the housing. To prevent this, only press on the outer edge of the blower.

5. To install a blower on the replacement supply, align the blower guide post ❷, Figure 6–7, with the mounting hole adjacent to the power supply connector ❶. Slide the blower into the blower base ❺ until the tabs ❸ snap into place.

CXO7493A

Figure 6–7: Installing a blower on a replacement power supply

6. To install the replacement power supply assembly, lift up on power supply module latch ❶, and push in on the blower base ❹, until the assembly is fully seated in the enclosure. Insert the AC power cord ❷ into the AC connector, and move the bail lock ❶ to the right to secure the cord.

7. Observe the power supply for proper operation:

    • The blower starts operating immediately

    • The blower LED is On

    • The blower on the other supply is no longer operating at high speed.

How to Replace a Blower

NOTE: The power supply design ensures that removing a blower does not change the air flow within the enclosure. However, do not remove a blower until the replacement blower is available.

Complete the following procedures to replace a variable speed blower.

⚠ **WARNING: The blower blades rotate at a high speed and do not *immediately* stop when power is removed. Never touch the blades while they are moving.**

1. To remove a blower from a power supply, push in on the two port wine-colored blower tabs ❶, Figure 6–8, while pulling the blower element away from the power supply.

IMPORTANT: The blower is hot pluggable. Therefore it is not necklaces to disconnect the AC power cord from the power supply assembly.

CXO7492A
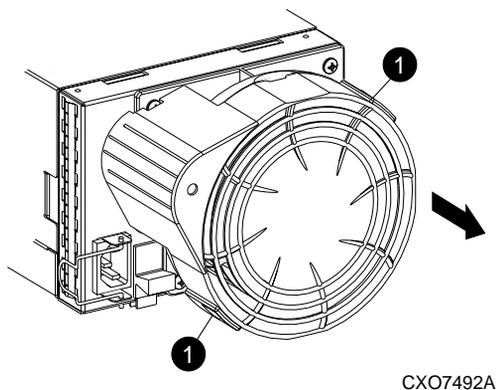
Figure 6–8: Removing a blower

2. To install a blower on a power supply, align the blower guide post ❷, Figure 6–9, with the mounting hole adjacent to the power supply connector ❶. Slide the blower into the blower base ❺ until the tabs snap into place in the blower assembly ❸.

CXO7493A
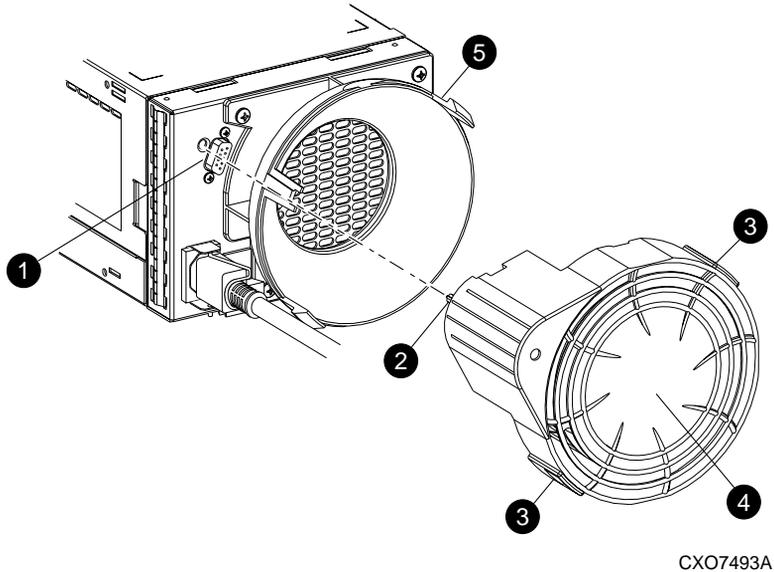
Figure 6–9: Installing a blower

> ⚠ **CAUTION:** Pressing on the center section of the blower ❹ can damage the blades or the housing. To prevent this, only press on the outer edge of the blower.

3. Make sure the following operational blower indications occur:

• The blower starts operating immediately.

• The blower LED is On.

How to Replace an EMU

Complete the following procedure to replace an EMU.

1. To remove an EMU, disconnect the cables from EMU connectors ❶, ❷, and ❸, Figure 6–10.

CXO7374A

Figure 6–10: Disconnecting the EMU Cables

2. Grasp the port wine-colored EMU handle ❶, Figure 6–11 and pull the EMU out of the enclosure.

CXO7330A

Figure 6–11: Removing an EMU

3. Insert the replacement EMU in the enclosure.

4. Fully seat the EMU in the backplane connector.

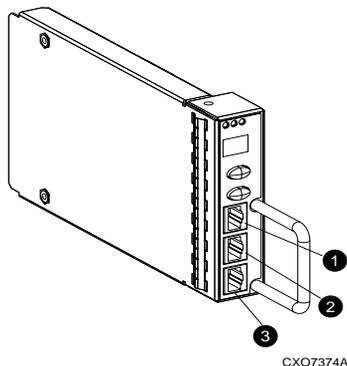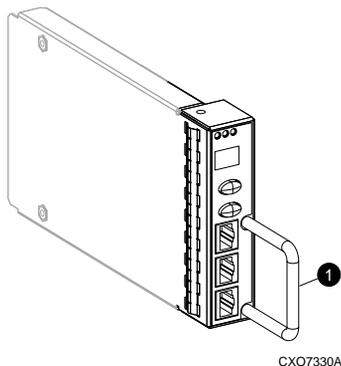**IMPORTANT:** Until the EMU is fully seated, a reset state exists and the EMU cannot operate. The EMU "heartbeat" will be Off, and the alphanumeric display may be *8.8.*

The EMU "heartbeat" LED should be flashing.

5. Connect the cables in the same order you removed them in Step 1.

NOTE: The cable connector keys ensure you cannot insert them in the wrong connector.

How to Replace an I/O Module

NOTE: The procedure for replacing an I/O module is the same for both I/O module A and I/O module B.

Complete the following procedure to replace an I/O module.

⚠ **CAUTION:** Connecting or disconnecting an I/O module. transceiver, or fiber cable during data transfers interrupts data transmission on either Loop A or Loop B. As long as one loop is operational, the Enterprise Storage System can transfer data to any disk drive. To avoid the loss of data, never disconnect an I/O module, transceiver, or fiber cable on *both loops* at the same time.

⚠ **CAUTION:** Removing an I/O module significantly changes the air flow within the enclosure, and could cause overheating. Therefore, always replace the I/O module as soon as possible.

1. Ensure a current system back up is available.

2. Remove the cable from the transceiver ❶, Figure 6–12, from the I/O module by pressing on the cable release while pulling on the cable connector.

⚠ **CAUTION:** The cable and transceiver cannot be removed as a unit. The cable connector activates a lock on the transceiver that prevents the transceiver from being removed.

> ⚠ **CAUTION:** Be sure you do not grasp both the transceiver tab and the cable connector at the same time. Pulling on the tab while the connector is still in the transceiver could break off the tab.
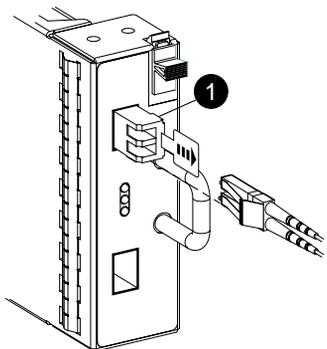
CXO7660A

Figure 6–12: Removing a cable

3. Install a dust cap on the cable connector.

4. Label the cable by location (that is, top or bottom).

5. Pull on the transceiver tab to remove the transceiver ❶, from the I/O module.

6. Place a dust cap on the transceiver fiber optic cable connectors.

7. Insert a dust cap into the I/O module transceiver port.

8. Repeat steps 2 through 7 on the other cable and transceiver.

9. While grasping the I/O module handle ❷, Figure 6–13, press down on the I/O module latch ❶. Pull the I/O module out of the enclosure.
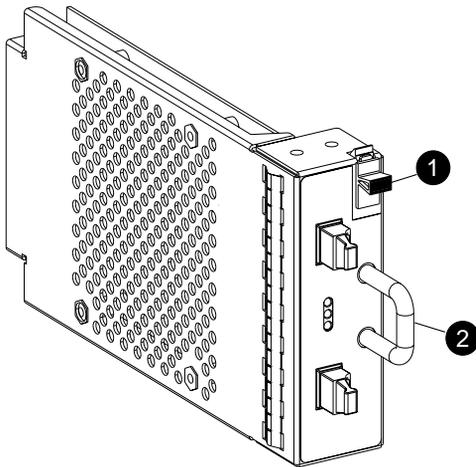
CXO7494A

Figure 6–13: Removing an I/O module

10. Grasping the *replacement* I/O module by the handle ❷, align the module with drive enclosure bay. Press the I/O module latch ❶ down and push the I/O module into the enclosure. Ensure the module is fully seated in the backplane connector.

11. Remove the dust caps from the replacement I/O module and the transceivers.

12. Install the transceivers into the I/O module.

13. Remove the dust caps from one of the fiber optic cable connectors.

14. Insert the cable into the correct transceiver (top or bottom).

15. Remove the label from the cable.

16. Repeat steps 13 through 15 for the other fiber optic cable.

17. Verify proper operation by observing the I/O module status LEDs.

How to Replace a Fiber Optic Cable

NOTE: The procedure for replacing a fiber optic cable is the same for both input or output cables.

Complete the following procedure to replace a fiber optic cable.

⚠ **CAUTION:** This replacement procedures is based on replacing one fiber cable at a time. Replacing more than one cable at the same time could result the loss of data, or the creation of a nonsupported configuration

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1. Disconnect the defective cable from the transceiver ❶, Figure 6–13, by pressing on the cable connector release and pulling the cable out of the transceiver.

2. Install the dust caps on both the transceiver and cable.

3. Repeat step 1 and 2 at the other end of the cable.

4. Remove the dust caps from one replacement cable connector and a transceiver. Insert the cable connector into the transceiver.

5. Repeat step 4 at the other end of the cable.

6. Verify proper operation by observing the I/O module status LEDs.

A

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).
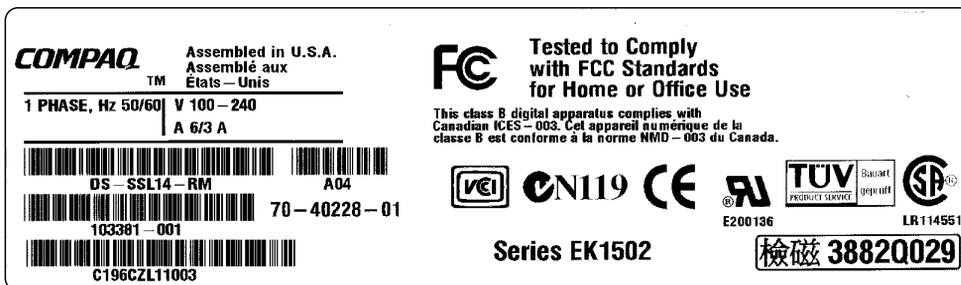
CXO7084A

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, environmental, and power specifications of the drive enclosure and the elements.

Physical Specifications

This section describes the physical specifications of the drive enclosure and the elements.

CXO7196A

WARNING: An assembled enclosure (all elements installed) weighs more than 65 lb (29.5 kg) and requires a minimum of two individuals to move.

To safely and easily install the enclosure remove the drives, power supplies and blowers, EMU, and I/O modules as described in Chapter 6, "Replacing CRUs." This reduces the enclosure weight to approximately 24 lb (11.0 kg). Even though a single person can lift this weight, the enclosure is difficult to install because of the physical size. Therefore, Compaq recommends that a minimum of two individuals install an empty enclosure in a rack.

Table B–1 defines the dimensions and weights of the enclosure.

Table B–1: Drive Enclosure Physical Specifications

	Empty	**Installed**	**Shipping**	
			Carton	**Carton & Pallet**
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.				
Height	131 mm (5.16 in)	131 mm (5.16 in)	641 mm (25.25 in)	768 mm (30.25 in)
Width	505 mm (19.875 in)	505 mm (19.875 in)	318 mm (12.5 in)	610 mm (24 in)
Depth	448 mm (17.625 in)	448 mm (17.625 in)	597 mm (23.5 in)	1016 mm (40 in)
Weight	10.9 kg (24 lb)	30.9 kg (68 lb)	43.6 kg (96 lb)	49 kg (108 lb)

Table B–2 defines the dimensions of the elements (that is, EMU, blowers, I/O module, drives, and power supply).

Table B–2: Drive Enclosure Elements Physical Specifications

Specification	**Installed**	**Shipping Carton**
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.		
Height	114 mm (4.5 in)	210 mm (8.25 in)
Width	241 mm (9.5 in)	330 mm (13.5 in
Depth	35 mm (1.375 in)	108 mm (4.25 in)
Weight	0.6 kg (1.3 lb)	0.91 kg (2 lb)
Blower		
Height	140 mm (5.5 in)	191 mm (7.5 in)
Width	159 mm (6.25 in)	203 mm (8.0 in)
Depth	83 mm (3.25 in)	229 mm (9.0 in)
Weight	0.45 kg (1.0 lb)	0.91 lb (2.0 lb)

Table B–2: Drive Enclosure Elements Physical Specifications (Continued)

Specification	Installed	Shipping Carton
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.		
I/O Module		
Height	114 mm (4.5 in)	210 mm (8.25 in)
Width	412 mm (1.625 in)	108 , (4.25 in)
Depth	241 mm (9.5 in)	330 mm (13.0 in)
Weight	0.59 kg (1.3 lb)	0.77 kg (1.7 lb)
Disk Drive		
Height	114 mm (4.5 in)	216 mm (8.5 in)
Width	26 mm (1.025 in)	114 mm (4.5 in)
Depth	241 mm (9.5 in)	330 mm (13.0 in)
Weight	0.59 kg (1.3 lb)	1.0 kg (2.3 lb)
Power Supply (without blower)		
Height	114 mm (4.5 in)	286 mm (11.25 in)
Width	159 mm (6.25 in)	330 mm (13.0 in)
Depth	241 mm (9.5 in)	419 mm (16.5 in)
Weight	1.82 kg (4.0 lb)	3.86 kg (8.5 lb)

Environmental Specifications

To ensure optimum product operation you must maintain the operational environmental specifications listed in Table B–3. The ambient temperature, that is the enclosure air intake or room temperature, is especially critical.

Table B–3: Environmental Operating Specifications

Ambient temperature: +10°C to +35°C (+50°F to +95°F) with an average rate of change of 1°C/hour maximum and a step change of 3°C or less. Maintaining the *optimum ambient temperature* within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications.
Relative humidity: 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Air quality: Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Heat dissipation: 1600 BTUs per hour

When shipping, or placing this product in short term storage, Compaq recommends maintaining the environmental conditions listed in Table B–4.

Table B–4: Environmental Shipping or Short Term Storage Specifications

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

Power Specifications

The input voltage to the drive enclosure power supplies is a function of the country-specific input voltage to Enterprise Storage System rack power distribution units (PDUs). Table B–5 defines the AC input power available to the drive enclosure power supplies.

> ⚠ **CAUTION:** The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition. The *Enterprise Virtual Array Rack User Guide* defines the Compaq supported AC power distributions.

Table B–5: Enterprise Storage System AC Input Line Voltages

Specification	Minimal	Nominal	Maximum
60 Hz Service			
AC Line Frequency	57 Hz	60 Hz	63 Hz
AC Line Voltage–Japan	180 VAC	202 VAC	220 VAC
AC Line Voltage–North America	180 VAC	208 VAC	220 VAC
AC Line Voltage–Europe	208 VAC	240 VAC	254 VAC
50 Hz Service			
AC Line Frequency	47 Hz	50 Hz	53 Hz
AC Line Voltage–Japan	180 VAC	202 VAC	220 VAC
AC Line Voltage–North America	190 VAC	220 VAC	235 VAC
AC Line Voltage–North America	200 VAC	230 VAC	244 VAC
AC Line Voltage–Europe	208 VAC	240 VAC	254 VAC

Table B–6 defines the AC input current and wattage to the power supplies.

Table B–6: AC Input Current and Wattage

Nominal			Maximum	
Input Voltage	**Amps**	**Watts**	**Amps**	**Watts**
60 Hz Input				
100 VAC–JBOD	4.35	436	6.41	641
208 VAC–North America	2.03	419	2.94	609
50 Hz Input				
120 VAC–JBOD	3.59	419	5.27	633
220 VAC–North America	1.92	418	2.78	608
230 VAC–North America	1.92	418	2.78	608
240 VAC–Europe	1.76	416	2.55	607

Table B–7 and Table B–8 define the output voltage and current specifications of the power supply.

Table B–7: Output Voltage and Current Specifications

Specification	Range		
	Minimum	**Nominal**	**Maximum**
+5.1 VDC			
Initial Voltage Steady state current	+5.13 VDC 1.0A	+5.18 VDC N/A	+5.23 VDC 26.0A
_12.2 VDC (Disk Drive Voltage)			
Initial Voltage Steady state current	+12.13 VDC 1.0A	+12,25 VDC N/A	+12.37 VDC 26.0A
+12.5 VDC (Blower Voltage)			
Initial Voltage Steady state current	+12.25 VDC 0.0A	+12.50 VDC N/A	+12.75 VDC 2.0A

Table B–8: Dual Power Supply Configuration Power Specifications

Voltage	Current (A)	Power (W)
Maximum Continuous Current		
+5.1 VDC (with a minimum +12.2 VDC load of 0A) +12.2 VDC (with a minimum +5 VDC load of 4A) +12.5 VDC	26A 28A 2A	132W 342W 25W
	Total	499W
Maximum Peak Current (Simultaneous Seek Activity)		
+5.1 VDC +12.2 VDC +12.5 VDC	26A 43A 2A	132W 524 W 25S
	Total	681W

C

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 if a connector has not been protected by a dust cover for an extended period of time, clean the connector.

- **How to Clean**

  a. Wipe the connector with a lint-free tissue soaked with 100% isopropyl alcohol

  b. Wipe the connector with a dry, lint free tissue.

  c. 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 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 *e.t.* 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 in 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.

fibre

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) bits per second.

See also **GB.**

Giga (G)

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

gigabaud

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

gigabit

See **Gb.**

gigabit per second

See **Gbps.**

graphical user interface

See **GUI.**

GUI

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

HBA

Host Bus Adapter.

See **FCA.**

host

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

Host Bus Adapter

See **FCA.**

host computer

See **host.**

host link LED

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

host ports

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

host-side ports

See **host ports.**

hot-pluggable

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

HSV Element Manager

See **Element Manager.**

hub

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

I/O module

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

IDX

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

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

in-band communication

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

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

INFORMATION condition

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

initialization

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

input/output module

See **I/O module.**

intake temperature

See **ambient temperature.**

interface

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

JBOD

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

just a bunch of disks

See **JBOD.**

K

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

KB

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

1. For storage, a KB is a capacity of 1,000 (10^3) bytes of data.

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

laser

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

Last Fault View

An HSV Controller display defining the last reported fault condition.

Last Termination Error Array

See **LTEA.**

LCD

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

LED

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

light emitting diode

See **LED.**

link

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

logon

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

loop

See **arbitrated loop.**

loop ID

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

loop pair

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

LTEA

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

LUN

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

management agent

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

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

Mb

Megabit. A term defining a data transfer rate.

See also **Mbps.**

MB

Megabtye. 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 pattern are spaced every 1.75 inches (44.45 mm) and based on EIA's *Standard RS-310-C*. For example, a 3U unit is 5.25-inches (133.35 mm) high, and a 4U unit is 7.0-inches (177.79 mm) high.

read caching

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

read ahead caching

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

reconstruction

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

redundancy

1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally work independently but can take over for the other in case of failure.

2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

redundant power configuration

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

- For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.

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

reporting group

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

room temperature

See **ambient temperature.**

SCSI

1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.

2. The communication protocol used between a controller pair and the hosts. Specifically, the protocol is FC-AL or SCSI on a Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

SCSI-3

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

SCSI-3 Enclosure Services

See **SES.**

selective presentation

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

serial transmission

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

SES

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

short wave

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

small computer system interface

See **SCSI.**

SMART

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

snapshot

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

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

solutions rack

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

See also **rack.**

spin down

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

spin up

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

SSN

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

storage carrier

See **carrier.**

storage pool

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

storage system

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

Storage System Name

See **SSN.**

switch

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

TB

Terabyte. A term defining either:

• A data transfer rate.

   See also **TBps.**

• A measure of either storage or memory capacity of 1,099,5111,627,776 (2^{40}) bytes.

TBps

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

TC

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

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

Termination Code

See **TC.**

termination event

Occurrences that cause the storage system to cease operation.

terminator

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

topology

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

transceiver

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

uninitialized system

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

See also **initialization.**

units

See **rack-mounting units.**

UNRECOVERABLE Condition

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

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

unwritten cached data

Also called unflushed data.

See also **dirty data.**

UPS

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

VD

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

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

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

virtual disk

See **VD.**

virtual disk copy

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

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

virtual disk family

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

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

virtual disk snapshot

See **snapshot.**

Vraid0

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

Vraid1

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

Vraid5

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

World Wide Name

See **WWN.**

write back caching

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

write caching

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

WWN

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

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