

# *Compaq StorageWorks*

## **Enclosure 4200 Family LVD Disk Enclosure**

User Guide

Part Number: EK-SW2ZS-UA. B01 / 148451-002

Second Edition (December 1999)  
Part Number: EK-SW2ZS-UA. B01 / 148451-002  
**Compaq Computer Corporation**

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# About This Guide

## Intended Audience

This publication is designed for use by Compaq StorageWorks users who are responsible for installing and maintaining the rack mounted (models 4214R and 4254R) and the tower mounted (models 4214T, and 4254T) Ultra2 SCSI low voltage differential (LVD) disk enclosures.

## How this Guide is Arranged

This manual discusses the product features and operations from the general to the specific. The major sections of this publication include:

### **Chapter 1, “Introducing the Enclosure”**

This chapter is a description of the LVD disk enclosure features and elements.

### **Chapter 2, “Starting the Enclosure”**

This chapter discusses operating an LVD disk enclosure.

### **Chapter 3, “I/O Modules”**

This chapter discusses the I/O modules functions, operation, and status displays.

## **Chapter 4, “Environmental Monitoring Unit”**

This chapter describes the EMU and the high availability fault bus.

## **Chapter 5, “Disk Drives”**

This chapter describes the disk drives, operation, and status reporting.

## **Chapter 6, “Enclosure Power and Cooling”**

The chapter describes the power supply and blower operation and status reporting.

## **Chapter 7, “Replacing CRUs”**

This chapter describes the procedures for replacing customer replaceable units (CRUs).

## **Appendix A, “Regulatory Notices”**

This appendix defines the country-specific regulatory standards for this product.

## **Appendix B, “Specifications”**

This appendix describes the physical, environmental, and electrical specifications of the LVD disk enclosure and elements.

## **Glossary**

The glossary defines terms common to this product.

## **Index**

An alphabetical reference to major subjects.

## Documentation Conventions

Table 1 is a list of the documentation conventions and symbols used in this publication.

---

**Table 1 Text Symbols**

---

### Text Entries

---

**Boldface type**—Boldface type indicates the first instance of terms being defined in the text, the glossary, or both.

*italic type*—Italic type indicates one of the following.

- Emphasis
  - A publication title
  - A glossary cross-reference to another glossary entry.
- 

### Special Information

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**WARNING:** *Warning* contains information essential to people's safety. It advises users to take or avoid a specific action could result in physical harm to the user.

---



**CAUTION:** A *Caution* contains information that the user needs to know to avoid damaging the software or hardware.

---

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

---

**NOTE:** A *note* includes information that emphasizes or supplements important points of the main text. A note supplies information that may apply only in special cases—for example, memory limitations, equipment configurations, or details that apply to specific versions of a program.

---

**Table 1 Text Symbols (Continued)**

Status LED Symbols	
	LED is OFF.
	LED is ON.
	LED is FLASHING

Table 2 is a list of the symbols that appear on devices and in this publication.

**Table 2 Device Symbols**

Enclosure Symbols	
	Enclosure LED label (Symbol definitions follow.)
	Enclosure Status (green)
	Enclosure Power (green)
	Enclosure Fault (amber) <b>NOTE:</b> This signal indicates there is an enclosure fault. This does not indicate that there is possibility of personal injury and is therefore NOT a WARNING.

**Table 2 Device Symbols (Continued)**

<b>EMU Symbols</b>	
	EMU Status LED symbol (green)
<b>I/O Module Symbols</b>	
	Power Status (ON) LED (green)
	Terminator Status LED (green)
	SCSI Bus A Connector
	Ultra2 SCSI Bus
	Input Connector
	SCSI Bus B Connector
	Ultra2 SCSI Bus
	Input Connector
<b>Drive LED Symbols</b>	
	Drive Activity LED
	Drive Online LED
	Drive FAILURE LED

## Related Documents

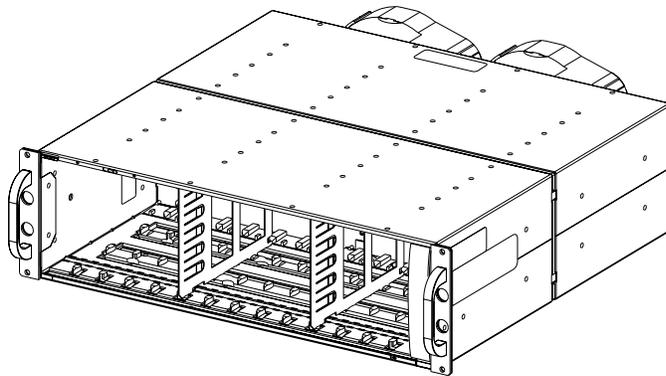
Table 3 lists publications that contain additional information relevant to the LVD disk enclosure products.

<b>Table 3 Related Publications</b>	
<b>Publication Title</b>	<b>Part Number</b>
<i>Compaq StorageWorks Disk Enclosure RETMA Rack Mounting Kit Installation Card</i>	127430-001
<i>Compaq StorageWorks Disk Enclosure RETMA Rack Mounting Template</i>	102943-001
<i>Hot-Pluggable Wide-Ultra2 SCSI Hard Drives Installation Card</i>	386195-001
<i>Compaq StorageWorks Replacing a Disk Enclosure Environmental Monitoring Unit Installation Guide</i>	148455-001
<i>Compaq StorageWorks Replacing a Disk Enclosure Power Supply Installation Guide</i>	148454-001
<i>Compaq StorageWorks Replacing a Disk Enclosure Ultra2 SCSI I/O Module Installation Guide</i>	148453-001
<i>Compaq StorageWorks Replacing a Disk Enclosure Variable Speed Fan Installation Guide</i>	148452-001
<i>Compaq StorageWorks Tower Model 4200T-Series User Guide</i>	122942-001

# Chapter 1

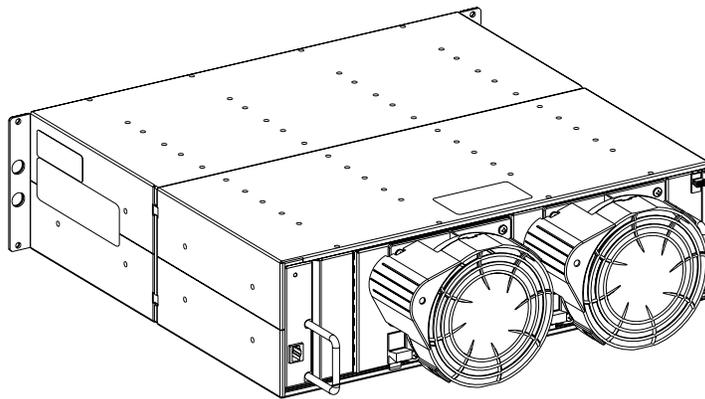
## Introducing the Enclosure

This chapter describes the StorageWorks Enclosure 4200 family of **low voltage differential (LVD)** disk enclosures (see Figure 1-1 and Figure 1-2). These enclosures support **Wide-Ultra** and **Wide-Ultra2 small computer system interface (SCSI)** protocols. The internal bus supports *only* LVD drives. The external bus (the enclosure to the host controller bus) supports either Wide-Ultra2 (LVD) and or Wide-Ultra **single-ended (SE)** SCSI protocols. The information in this publication is based on using the Wide Ultra2 LVD SCSI protocol, the most efficient means of transferring data.



CXO6854A

Figure 1-1. 14-drive enclosure



CXO7082A

Figure 1-2. Disk enclosure (rear view)

## Disk Enclosure Features

The Model 4214- and Model 4254-series enclosures support fourteen, 1-inch, 3.5-inch **form factor hard disk drives or drive blanks**. These enclosures are available in either a rack mountable version (4214R) or in a tower version (4214T). A rack (cabinet) mounted enclosure requires a RETMA 3U vertical opening (5.25-inches) where a “U” is 1.75 inches.



**CAUTION:** To ensure proper cooling, all drive bays must have either a drive or drive blank installed.

---

The enclosure provides several features, including:

- **Hot-pluggable drives, environmental monitoring unit (EMU), blowers, and power supplies** are replaceable without stopping SCSI bus data transfers.

**NOTE:** An element with a port colored latch, tab, or handle is hot pluggable.

- **Pluggable I/O module** and SCSI bus cables require stopping all data transfers, but do not require removing power before replacing.
- Depending upon the host controller, the I/O module is capable of supporting Wide-Ultra2 SCSI (LVD) or Wide-Ultra SCSI (SE) bus operations.

These 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 on the blower 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.

## SCSI Buses

The enclosure supports only Wide-Ultra2 SCSI, wide (16-bit), *internal* LVD buses. Depending on the host interface, the external SCSI bus, the bus from the I/O module to the host can be either Wide-Ultra or Wide-Ultra2, LVD or SE. The SCSI bus type determines the length of this bus, and therefore, the maximum cable length. The *standard* Compaq cable length of 12 ft (3.7 m) ensures satisfactory operation. As for all SCSI buses, the shorter the cable, the more efficient the bus operation.

**NOTE:** The maximum bus length is the inverse of the transmission speed. The faster the transmission rate, the shorter the bus length. For more information about the supported SCSI bus lengths, see Chapter 3.

Each enclosure has two internal SCSI buses, with half of the devices on each bus. The single-bus I/O module places all the devices on a single-bus of either 10 or 14 devices. The dual-bus I/O module maintains two internal buses with either 5 or 7 devices on each bus.

## High Availability

The high availability features of the enclosure are a function of the blowers and the power supplies.

### Variable Speed Blowers

All enclosures have two variable speed blowers. In all configurations, the failure of one blower automatically causes the other blower to operate at a high speed. This ensures that the failure of a *single* blower does not disable the enclosure.

## Power Supplies

In a single power supply configuration, the failure of a power supply disables the enclosure. Use the *optional* redundant power supply configuration to prevent this. In this configuration, the failure of a single power supply or blower does not disable the enclosure.

## 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 inducing errors, 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 LEDs
- Displaying the element status on the power supply, EMU, drive, and I/O module LEDs
- Detecting the installation of a blower, power supply, disk drive, or I/O module
- Detecting the blower removal of a blower, power supply, disk drive, or I/O module
- Sensing enclosure temperatures
- Sensing power supply voltage, current, and total power

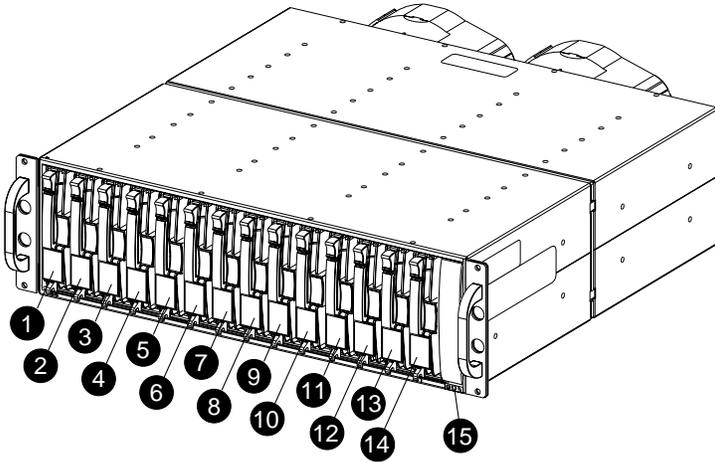
## Enclosure Layout

The physical layout of the enclosure is the same in a rack or a tower. The drives mount in the **bays** in the front of the enclosure. These bays are numbered from the left (bay ❶) to the right (see Figure 1-5 and Figure 1-3). 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 ❸ is drive 8, and so forth.



**CAUTION:** There is no direct correlation between the bay number and SCSI bus ID. The SCSI bus IDs are a function of the bus type (single or dual) and the number of drives. See Chapter 3 for SCSI bus IDs.

---



- ①—⑩ Drive Bays
- ⑮— Enclosure Status LEDs  
(see Figure 1-4)

CXO6728A

Figure 1-3. 14-drive enclosure bays

The enclosure status LEDs are located in the front, lower-right corner of the enclosures (see Figure 1-4).

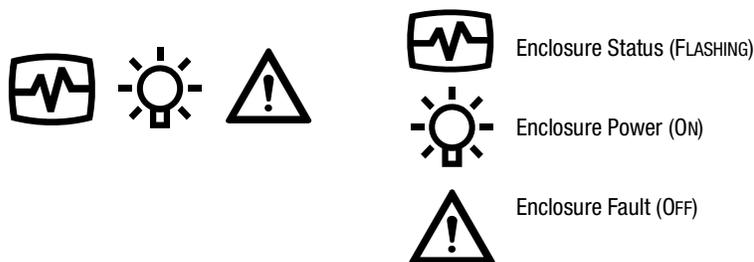


Figure 1-4. Enclosure status LEDs

The I/O module, power supplies, blowers, EMU, and cables mount in the rear of the enclosure (see Figure 1-5).

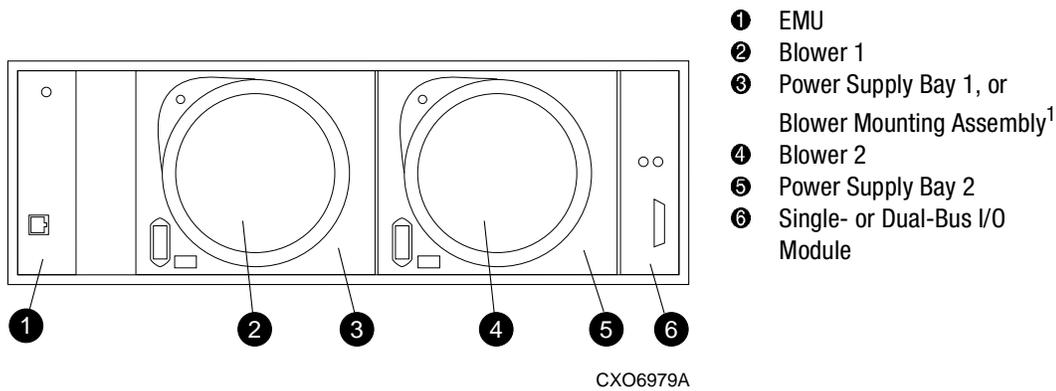


Figure 1-5. Rear -mounted elements

1. In a single power supply configuration, the blower mounts on the blower mounting assembly.

## Major Elements

The elements required for proper operation of each enclosure include:

- An EMU
- Two power supplies, or  
1 power supply and 1 blower mounting assembly
- Two blowers
- A single- or a dual-bus I/O module
- A disk drive or disk drive blank in each bay

## Element Functions

A full description of the individual elements and their functions can be found in the individual chapters.

## Element Replacement

The methods used to replace an element depend upon the following factors:

- **Could element replacement affect SCSI bus operation?**

When the element being replaced does not interrupt data transfer nor affect the operation of another element, the element is “**hot-pluggable.**”

If replacement of the element, could affect data transfers or the operation of another element, the element replacement method is “**pluggable.**”

- **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 stopping all data transfers the SCSI bus and *removing power* from the enclosure.

- **Are special tools or techniques required?**

When element replacement can be completed without employing special tools or techniques, then the element is a **customer replaceable unit (CRU)**.

When special tools or techniques are required to replace an element, then the unit is a **field replaceable unit (FRU)**. Only qualified, Compaq field service personnel are authorized to replace FRUs. There are no FRUs for these products.

Table 1-1 identifies the replacement method for each element.

<b>Table 1-1 CRU Replacement Methods</b>	
<b>Element</b>	<b>Method</b>
<b>Drive</b>	Hot-pluggable
<b>EMU</b>	Hot-pluggable
<b>Blower</b>	Hot-pluggable
<b>I/O Module</b>	Pluggable <sup>1</sup>
<b>Power Supply-Dual</b>	Hot-pluggable
<b>Power Supply-Single</b>	No Power Applied <sup>2</sup>
<b>SCSI Bus Cables</b>	Pluggable <sup>3</sup>

1. Replacing an I/O module requires stopping all data transfers.
2. In a single power supply configuration, the enclosure is disabled when the power supply fails.
3. Connecting or disconnecting a SCSI bus cable requires stopping all data transfers.

# Chapter 2

## Starting the Enclosure

With the enclosure installed in a rack or tower it is necessary to:

1. Connect the SCSI bus cables.
2. Apply power.
3. Verify proper operation.

### Connecting the SCSI Bus Cables

Connecting the enclosure to a host adapter or SCSI bus controller is simply a matter of connecting cables to the I/O module. All I/O modules have 68-pin, **very high density cable interconnect (VHDCI)** connectors.

Figure 2–1 shows the cable connectors for a single-bus configuration. Figure 2–2 shows the connectors for a dual-bus configuration.



**CAUTION:** Connecting or disconnecting a SCSI bus cable while data is being transferred causes the loss of data.

To prevent errors, always stop all data transfers on the SCSI bus before connecting or disconnecting a cable.

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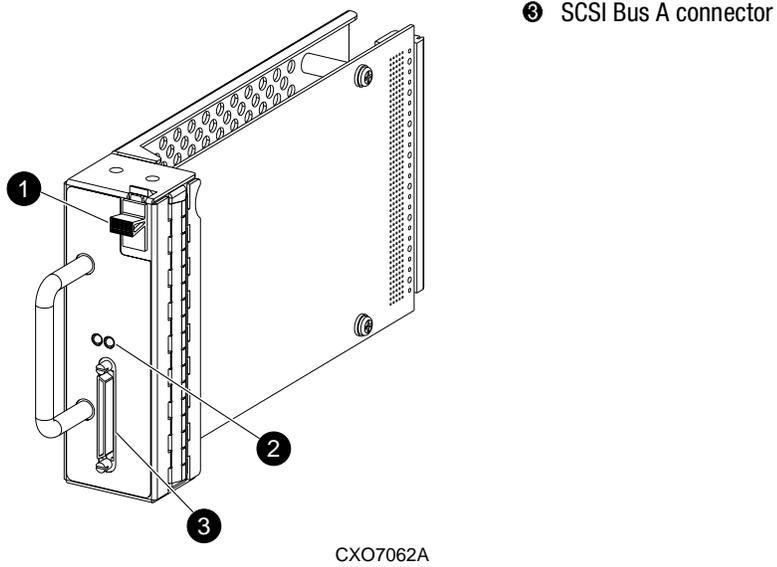
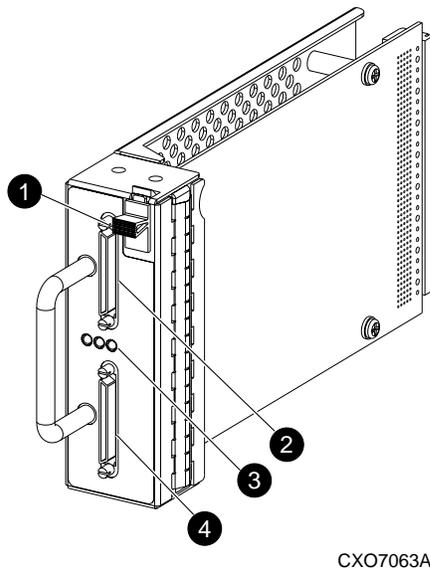


Figure 2-1. Single-bus I/O module cable connector



- ② SCSI Bus A connector
- ④ SCSI Bus B connector

Figure 2-2. Dual-bus I/O module cable connectors

The maximum cable length is a function of the bus type (LVD or SE). See Table 2-1 for the maximum Compaq supported SCSI bus cable lengths.

Table 2-1 Enclosure-Host Controller Maximum Cable Lengths		
Bus Type	Speed	Cable Length
<b>LVD Bus</b>		
Wide Ultra SCSI	40 Mb/s	12 m (39.4 ft)
Wide Ultra2 SCSI	80 Mb/s	12 m (39.4 ft)
<b>Single-Ended Bus</b>		
Wide Ultra SCSI	40 Mb/s	3.7 m (12 ft)

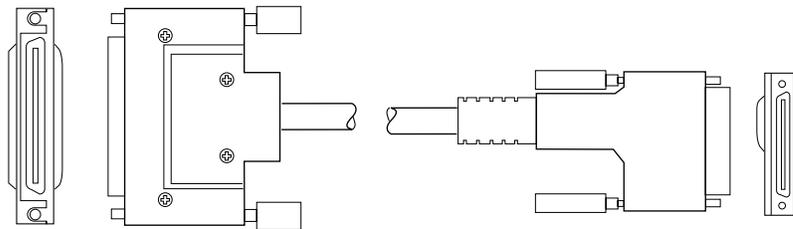
Table 2-2 describes the compatible host controller to LVD disk enclosure cables.

**Table 2-2 Drive Enclosure—Host Controller SCSI Cables**

Description	Length
<b>SCSI Cable—68-pin VHDCI to 68-pin VHDCI</b>	
68-conductor SCSI cable with: 2—VHDCI straight male connectors with thumb screws.	3 m (9.8 ft)
CXO5702B	
<b>SCSI Cable—68-pin VHDCI to 68-pin VHDCI</b>	
68-conductor SCSI cable with 2 Vertical Offset VHDCI straight plug connectors with jack screws	3.7 m (12 ft)
CXO6954A	

**Table 2-2 Drive Enclosure—Host Controller SCSI Cables (Continued)**

Description	Length
<b>Adapter Cable—68-pin High Density to 68-pin VHDCI</b>	
68-conductor SCSI cable with 1 High-Density straight plug connector with jack screws 1 Vertical Offset VHDCI straight plug connector with jack screws	3.7 m (12 ft)



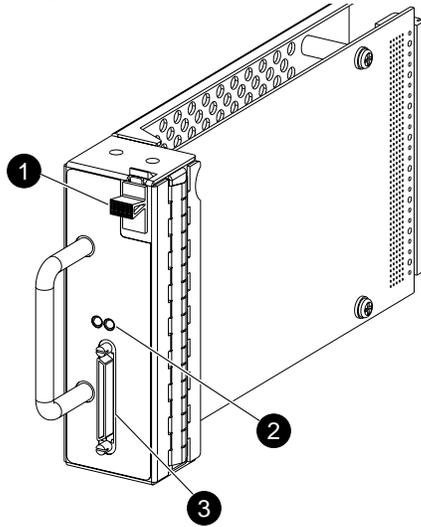
CXO6955A

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**Table 2-3 Installing SCSI Bus Cables**

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1. Stop all SCSI bus data transfers.
  2. Align the D-shaped cable connector with D-shaped I/O module connector ⑥
- 



3. Firmly seat the cable connector on the module connector.
  4. Finger tighten the thumbscrews to fully seat the connector.
  5. Restart data transfers over the SCSI bus.
- 

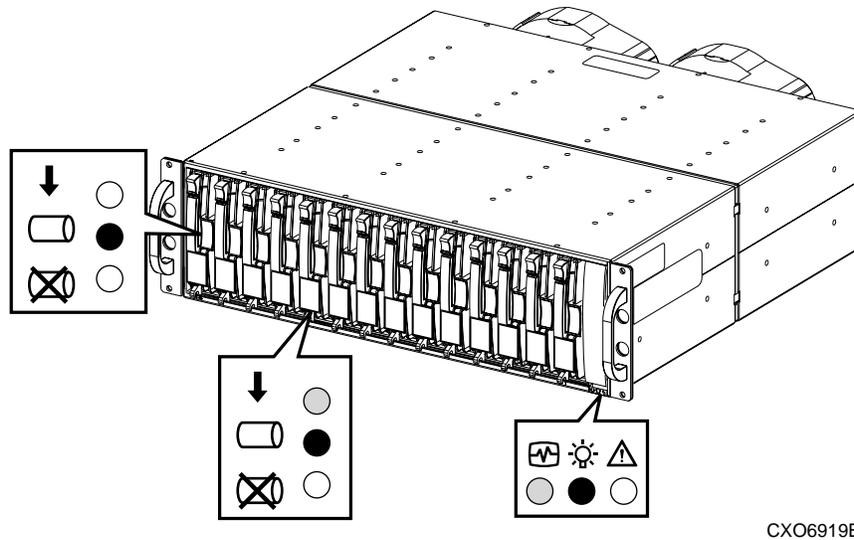
## Applying Power

There are no disk enclosure power control switches. Connecting an AC power cord from a power source to the power supply is all that is required. When a power supply has an AC input, it develops and distributes DC voltages within the enclosure.

## Verifying Operation

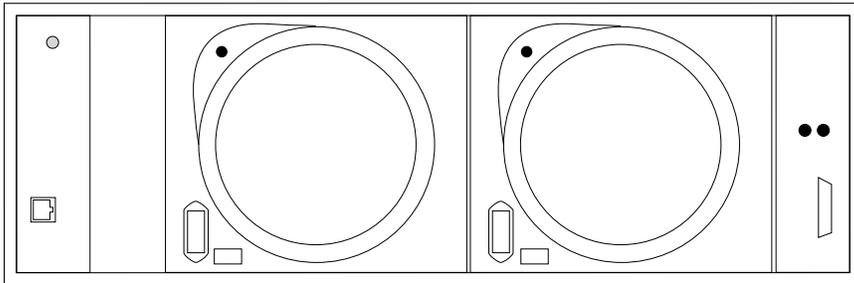
Elements begin operating when power is applied. Check the enclosure status LEDs in the front, lower right corner (see Figure 2-3). If the display is not exactly as shown, there is an element error condition. Check the drive and enclosure status LEDs on the front and the EMU, power supplies, blowers, and I/O module status LEDs on the rear (see Figure 2-4) to determine the defective element.

**NOTE:** Either of drive displays in Figure 2-3 indicate a properly functioning disk.



CXO6919B

Figure 2-3. Typical front status LEDs



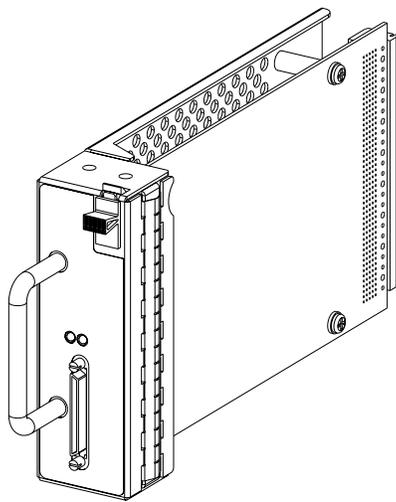
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Figure 2-4. Rear status LEDs

# Chapter 3

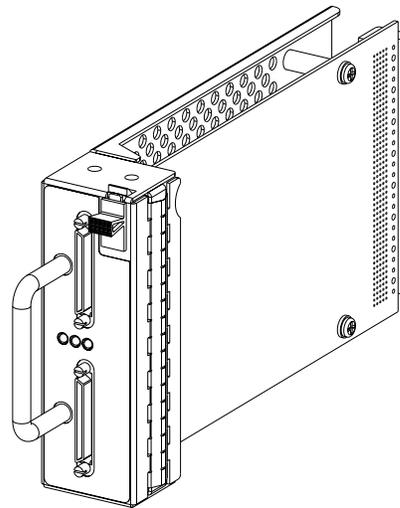
## I/O Modules

This chapter discusses the operation and function of the single- (see Figure 3–1) and dual-bus (see Figure 3–2) LVD disk enclosure pluggable I/O modules (commonly referred to as the “module”). The first part discusses the general and common features of all modules. Individual sections discuss the single-bus and dual-bus module functions and features.



CXO7054A

Figure 3–1. Single-bus I/O module



CXO7053A

Figure 3–2. Dual-bus I/O module

## Common Features

The following features are common to both the single- and the dual-bus I/O modules.

These modules are pluggable elements. Replacing either I/O modules or the cables requires stopping all data transfers to prevent the loss of data.



**CAUTION:** To prevent the loss of data it is necessary to stop all data transfers when connecting or disconnecting a SCSI bus cable or removing and installing an I/O module.

---

Each enclosure requires an I/O module for operation with a wide (16-bit) Ultra2 LVD SCSI controller. The module is the CRU that connects the enclosure to the host controller through a 68-pin, VHDCI connector and a SCSI bus cable. This module can support a maximum of 14 drives in a single enclosure or on a single-bus.

Each enclosure has two SCSI buses. Half of the drive bays are on each bus. The I/O module type (single- or dual-bus) determines the enclosure bus configuration.

- When using the single-bus I/O module with all the addressable devices on the same bus (SCSI bus A). This configuration requires one controller or host adapter.
- When using the dual-bus I/O module half the addressable devices are on SCSI bus A and the other half are on SCSI Bus B. This configuration requires two controllers or host adapters.

See “Single-Bus SCSI Address Maps” and “Dual-Bus SCSI Address Maps” for information about the drive SCSI bus addresses.

## Configuring the Enclosure SCSI Bus

Installing an I/O module automatically configures the enclosure for either single- or dual-bus operation. Such installation automatically changes the drive SCSI bus IDs.



**CAUTION:** To avoid the possibility of losing data, always backup data before installing a different type I/O module.

---

## Module Power Protection

A +5 VDC sensor in the module detects overcurrent conditions. Should this error occur, the sensor disconnects the voltage from the module and the power LED is OFF. This disables the module until one of the following conditions occurs:

- The overcurrent condition no longer exists.
- The defective module is replaced.

## SCSI Bus Termination

A SCSI bus is defined by two bus terminators. The *external bus* has terminators on the controller and on the module. Each *internal bus* has a terminator on the module and on the backplane. The module connects the external bus and the internal bus together. On each module, there is a green LED (see Figure 3-5) that defines the status of the module external bus terminator as either terminated or unterminated.

When the module external SCSI bus is unterminated (the associated LED is OFF) data cannot be transferred.

## Status LEDs

The green LEDs display the status of the external SCSI bus terminators and the I/O module power.

### Terminator LED

The I/O module label identifies the SCSI bus LED with a letter (A or B) above the LED and the terminator symbol below the LED.



- The LED is ON when the external SCSI bus is terminated and usable.
- The LED is OFF when the external SCSI bus is unterminated, and therefore unusable.

### Power LED

This LED displays the status of the module power. The module label has an asterisk symbol adjacent to power LED.



- The LED is ON when the module +5 VDC is correct.
- The LED is OFF when the module +5 VDC is incorrect or missing.

## SCSI Bus Connectors

The I/O module label identifies each 68-pin, VHDCI SCSI bus connector with one of the labels shown in Figure 3-3 and Figure 3-4:



Figure 3-3. SCSI Bus A connector symbol



Figure 3-4. SCSI Bus B connector symbol

## Replacing an I/O Module

To replace an I/O module, you must complete the procedures outlined in Chapter 6, “Replacing CRUs.”

## Single-Bus Module

This section describes the components and unique features of the single-bus module. This module (see Figure 3-5) has *one* VHDCI connector and *two* LEDs.

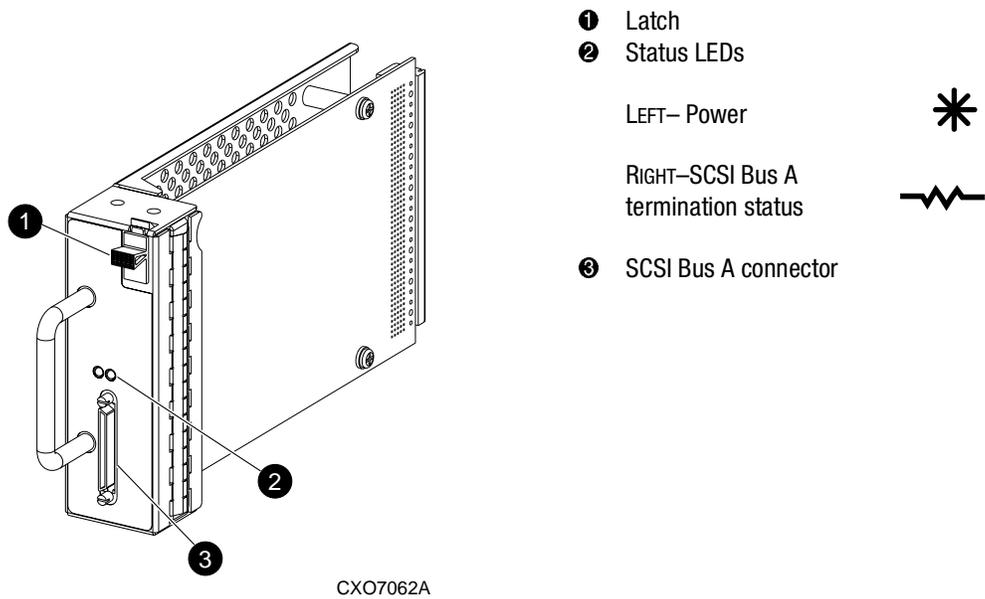


Figure 3-5. Single-bus I/O module components

## Single-Bus I/O Module Status Displays

Table 3-1 describes the single-bus I/O module LED status displays.

Table 3-1 Single-Bus Status LED Displays		
	LED is ON	
		
<b>When the I/O module is operational, the display may be</b>		
		SCSI bus is terminated (LED ON) Module power present (LED ON)
<b>When the I/O module is nonoperational, the display may be</b>		
		SCSI bus is unterminated (LED OFF) Module power present ( <b>LED ON</b> ).
		No module power (All LEDs OFF) Module nonoperational

## Single-Bus SCSI Address Maps

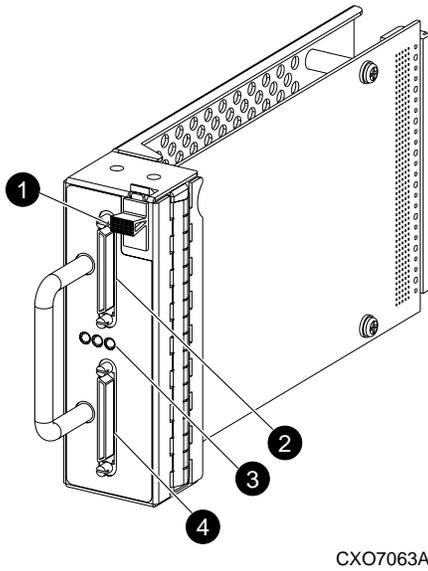
The module assigns a SCSI address to each drive bay in the enclosure using a SCSI address map (see Table 3-2).

**Table 3-2 Single Bus SCSI Bus IDs**

Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<b>14-Disk Enclosure</b>														
<b>SCSI ID</b>	00	01	02	03	04	05	08	09	10	11	12	13	14	15

## Dual-Bus I/O Module

This section describes the unique features and components of the dual-bus module. This module (see Figure 3-6) is easily identifiable by the *two* VHDCI connectors and the *three* LEDs.



- ❶ Latch
- ❷ SCSI Bus A connector
- ❸ Status LEDs

LEFT—Power



MIDDLE—SCSI bus A termination status



RIGHT—SCSI bus B termination status



- ❹ SCSI Bus B connector

Figure 3-6. Dual-bus I/O module components

## Dual-Bus I/O Module Status Displays

Table 3-3 describes dual-bus I/O module status LEDs displays.

<b>Table 3-3 Dual-Bus Status LED Displays</b>		
 LED is ON	 LED is OFF	 LED is FLASHING
<b>When the I/O module is operational and the external SCSI bus is terminated, the display may be:</b>		
	Module power present (LED ON) SCSI bus A terminated (LED ON) SCSI bus B terminated (LED ON)	
<b>When the I/O module is operational and the external SCSI bus is unterminated, the display may be:</b>		
	Module power present (LED ON) SCSI bus A unterminated (LED OFF) SCSI bus B terminated (LED ON)	
	Module power present (LED ON) SCSI bus A terminated (LED ON) SCSI bus B unterminated (LED OFF)	
	Module power present (LED ON) Backplane Terminator A unterminated (LED OFF) Backplane Terminator B unterminated (LED OFF)	
<b>When the I/O Module is nonoperational, the display may be:</b>		
	No module power (All LEDs OFF) Module nonoperational	

## Dual-Bus SCSI Address Maps

The module assigns a SCSI address to each drive bay in the enclosure using a SCSI address map (see Table 3-4).

**Table 3-4 Dual Bus SCSI Bus IDs**

Bay	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<b>14-Disk Enclosure</b>														
<b>SCSI ID</b>	<b>SCSI Bus A</b>							<b>SCSI Bus B</b>						
	00	01	02	03	04	05	08	00	01	02	03	04	05	08



# Chapter 4

## Environmental Monitoring Unit

The Compaq StorageWorks Environmental Monitoring Unit, the EMU, (see Figure 4-1) is an integral part of every Model 4200 series LVD enclosure. This element performs several functions, including monitoring the enclosure operation, detecting and indicating errors, and displaying the EMU and enclosure status.

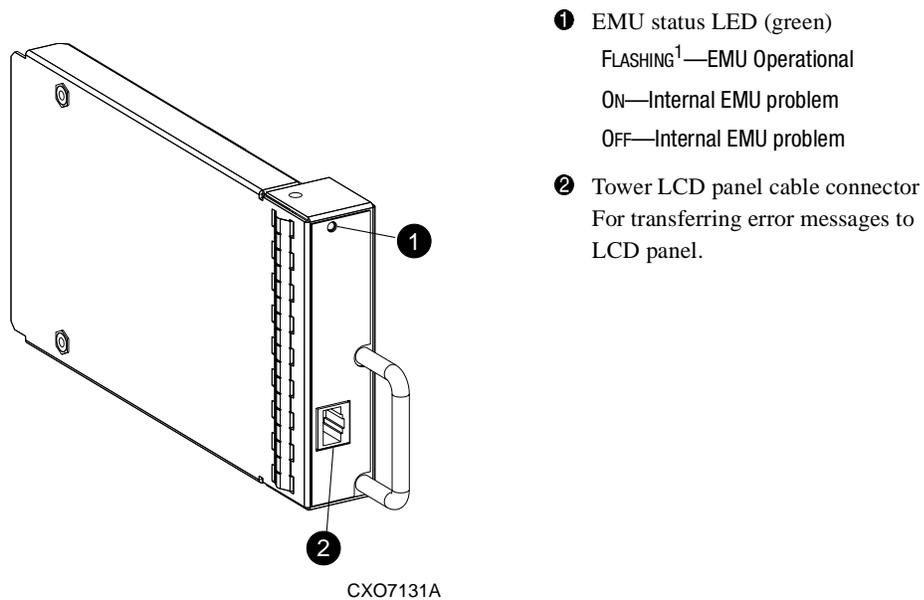


Figure 4-1. Model 4200-series LVD disk enclosure EMU

1. When FLASHING rapidly, the EMU is operational and there is a single-ended drive installed in the enclosure.

The EMU mounts in the bay at the left rear of the enclosure (see Figure 4-2).

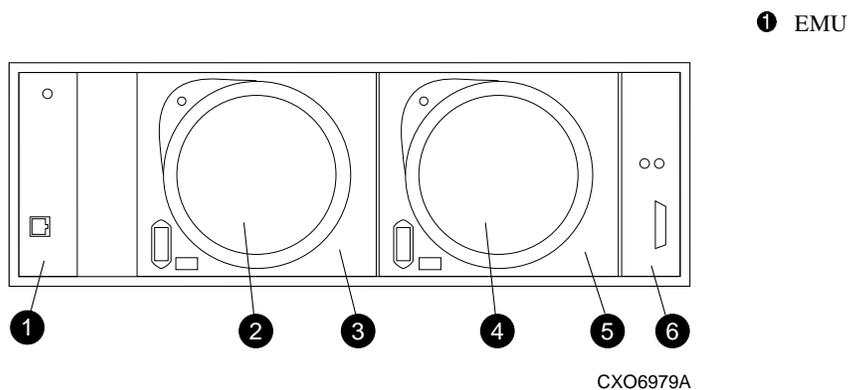


Figure 4-2. Model 4200-series LVD disk enclosure EMU location

## Functions

The EMU functions include:

- In conjunction with the I/O module, assigning device SCSI bus addresses
- Monitoring the enclosure operation
- Detecting and reporting errors
- Displaying the EMU and enclosure status
- Controlling the LEDs
- In conjunction with Compaq SCSI adapter or RAID controller, implementing enclosure services protocols to report status

The enclosure functions and operations the EMU monitors include:

- Temperature
- Power Supplies
- Blowers
- Drives
- EMU internal functions

## Status LEDs

The EMU status LED (see Figure 4-1) displays the status of the EMU and notifies the user when there is a single-ended drive installed. The three status LEDs (see Figure 4-3) display the status of the EMU and the enclosure, the enclosure power, and an enclosure fault.

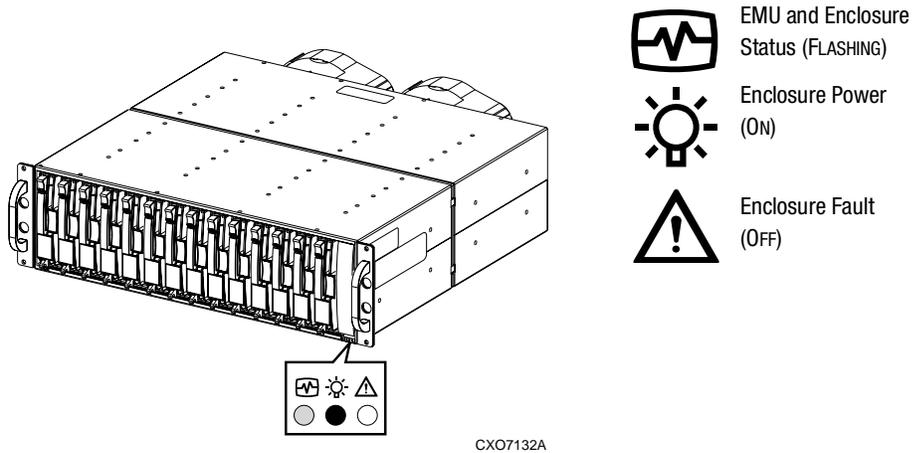


Figure 4-3. Drive and Enclosure status LEDs

The EMU also monitors the drive, power supply, and blower LEDs. The operation of these LEDs are described in the individual element chapters.

## Temperature

The EMU monitors the internal temperature using enclosure mounted sensors.

- When the enclosure *internal* temperature is 45°C (113°F) or more, the EMU turns ON the amber Enclosure Fault LED.
- A power supply automatically shutdown if the internal power supply temperature exceeds 85°C (180°F).
- When the Compaq Insight Manager (CIM) is installed, it reports an alarm condition when the *ambient* temperature reaches 50°C (122°F).

**NOTE:** The internal enclosure temperature and the ambient temperature are not the same. The ambient temperature is the air temperature in an area where the enclosure is installed. It is also referred to as the enclosure intake air temperature, or room temperature. The enclosure internal temperature may be significantly higher.

## Fault Bus

The active enclosure management services protocol is determined by the Compaq SCSI adapter or the RAID controller attached to the enclosure. The fault bus is a protocol supported by the EMU.

The Ultra2 SCSI bus controllers and adapters can control RAID subsystems, such as those using StorageWorks Model 4200 LVD disk enclosures. Although the bus is a data interchange facility it does not provide the features necessary to permit a controller to monitor enclosure and storage device status. The fault bus provides this function. The LVD enclosure family and the EMU support the fault bus as described in the following sections.

The LVD enclosure implementation of the fault bus consists of the enclosure status (SHELF\_OK), the device swap (SWAP L), and two fault signals (FAULT\_DATA and FAULT\_CLK) signals. These signals provide the controller with the capability to effectively monitor specific RAID storage subsystem faults. These fault signals can, in conjunction with the EMU, control the device status LEDs to provide visual indications of error conditions.

## Enclosure Status Signal

This fault bus signal (SHELF\_OK) changes state to indicate a change in either an enclosure power supply or cooling blower status.

This signal is asserted (high) when all the power supplies and blowers are operating properly. Should any power supply or blower be operating outside of a specified range this signal level is low until the fault is corrected.

### Device Swap Signal

This fault bus signal (SWAP) detects the removal or insertion of a storage device on a SCSI bus causing the signal to generate a logic low pulse. The SWAP signal for each SCSI bus indicates a change in the status of the storage devices on that bus.

### Device Fault Signal

The EMU can control the device status LEDs in the following manner:

- When the controller detects a device fault, it can cause the EMU to FLASH the specific device status LED at a *fast* rate.
- The controller can cause the EMU to FLASH a specific device status LED at a *slow* rate to identify or “locate” a device.

## Replacing an EMU

To replace an EMU, you must complete the procedures outlined in Chapter 6, “Replacing CRUs.”



# Chapter 5

## Disk Drives

The enclosure supports Compaq hot-pluggable, Wide-Ultra2 SCSI, LVD disk drives. This chapter describes the disk drive features, functions, and characteristics.

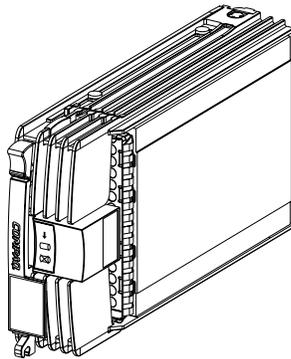
The 14-disk enclosure supports 1.0-inch, 3.5-inch form factor drives mounted in a carrier Figure 5-1.



**CAUTION:** Controlling airflow within the enclosure requires installing a disk drive or a drive blank in each drive bay.

To avoid overheating, never remove more than 1 drive or drive blank from an operating enclosure at the same time.

---



CXO6696A

Figure 5-1. 1-Inch disk drive

## Status Reporting

All drives have three status LEDs (see Figure 5-2) to define the operational status of the drive. To determine the drive status you must observe all three LEDs (see Table 5-1).

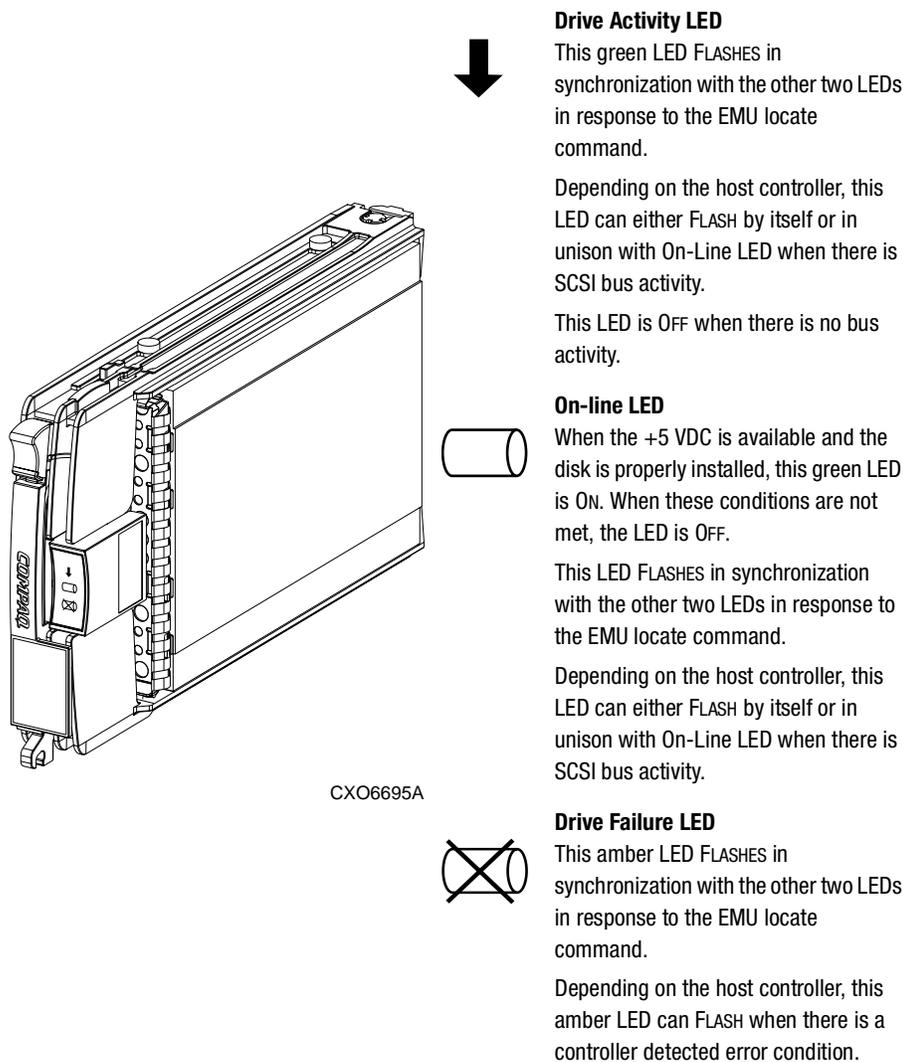


Figure 5-2. Disk drive LEDs display

## Drive Status

The two green and one amber LEDs are either ON, OFF, or FLASHING. Since the status LED displays are easily interpreted, they are the most commonly used indicators of drive status. In some configurations, the host controller can control the status LEDs. The symbols for these conditions are shown in Table 5-1.

**Table 5-1 Drive LED Status Displays**

 LED is ON	 LED is OFF	 LED is FLASHING
Display	Status	Drive Replacement
<b>When the drive is operational the display may be one of the following:</b>		
     	<b>When this display occurs at initial startup it may mean:</b> The operational drive is not being accessed. The drive status is one of the following: <ul style="list-style-type: none"> <li>■ The drive is a replacement drive to be rebuilt,</li> <li>■ The drive is an inactive spare disk.</li> <li>■ The drive is spinning up during POST.</li> <li>■ The SCSI controller cannot control LED.</li> </ul> It should change within a few minutes, otherwise the drive is nonoperational.	DO NOT REPLACE DRIVE
     	The operational drive is not being accessed. Drive is being rebuilt or Array Capacity expansion in progress	Do not replace drive
     	The operational drive is not being accessed. The drive is configured as part of an array	Do not replace drive
     	Drive selected using the Array Configuration Utility.	Do not replace drive
     	The drive is operational and active. The drive is configured as part of an array	Drive may be replaced

**Table 5-1 Drive LED Status Displays (Continued)**

 LED is ON  LED is OFF  LED is FLASHING		
Display	Status	Drive Replacement
     	The operational drive is being accessed, or spinning-up. The drive status is one of the following: <ul style="list-style-type: none"> <li>■ Replacement drive to be rebuilt,</li> <li>■ The drive is an inactive spare disk.</li> <li>■ The drive is spinning up during POST.</li> <li>■ The SCSI controller cannot control LED.</li> </ul>	Do not replace drive
     	The operational drive is being accessed. The drive status is one of the following: <ul style="list-style-type: none"> <li>■ Drive is being rebuilt</li> <li>■ Array Capacity expansion in progress</li> </ul>	Do not replace drive
     	The drive is operational and active The drive is configured as part of an array.	Do not replace drive
<b>When the drive is nonoperational, the display may be one of the following:</b>		
     	The drive is nonoperational. There is no power to the drive.	Drive may be replaced
     	There is a drive error and the drive is not active. Check the GUI for a definition of the problem.	Drive may be replaced

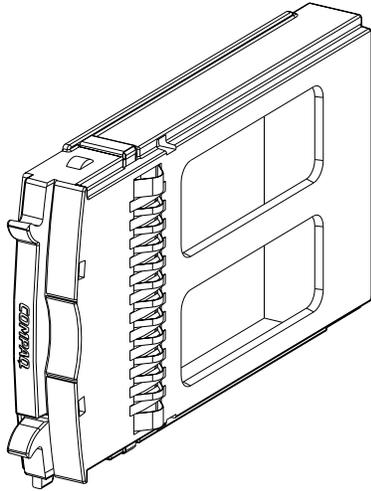
## Drive Power

Backplane overcurrent sensors monitor the +5 VDC and +12VDC drive voltages. When there is a drive overcurrent condition the sensor disconnects the voltage from the drive. This disables the drive, ensuring that no data is written to it. 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 airflow, there must be a drive or a drive blank in each drive bay. The function of the drive blank Figure 5-1 is to control airflow within a bay.



CXO6824A

Figure 5-3. 1-Inch drive blank

## Replacing a Disk

To replace a disk, you must order a replacement using the spare part number (see Chapter 6, “Replacing CRUs”).

The disk replacement kit contains detailed replacement instructions.



**CAUTION:** Removing more than one disk drive at a time can cause the enclosure to overheat. Never remove more than one disk drive at a time.

---

**NOTE:** Removing a drive from the enclosure affects the air flow in the enclosure. This can result in an overheating condition that could affect disk reliability. Compaq recommends installing a disk drive of equal or greater capacity, or a disk drive blank as soon as possible.

**NOTE:** For the latest information and instructions about Compaq hard drives, such as compatibility and installation instructions, refer to the Technical Information area of the following Compaq website:

<http://www.compaq.com/products/servers/storage/enterprise-class.html>

# Chapter 6

## Enclosure Power and Cooling

This chapter describes the function and general operation of the enclosure power supply and Blowers. See Figure 6–1 for major component locations.

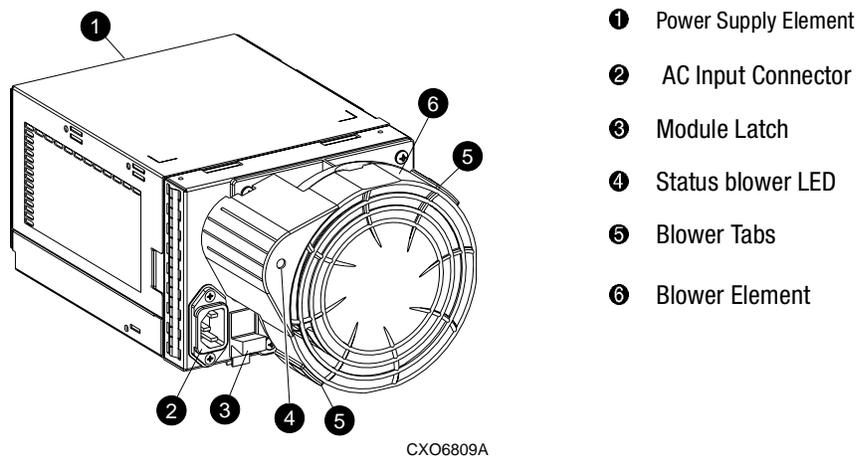


Figure 6–1. Power supply and blower assembly components

## Enclosure Power

The power supply and blower assembly mount in the rear of the enclosure. The supply is auto-ranging and operates on an AC input voltage of 100 to 240 VAC  $\pm 10\%$ , 50 to 60 Hz  $\pm 5\%$  (90 to 264 VAC, 47 to 63 Hz).

The DC outputs of this 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 supply is 377W, with a peak output of 475W. Either power configuration, single or dual, can support an enclosure with a full complement of disks, blowers, EMU, and I/O module.

- A single power supply, the standard configuration, supports *sequential drive spin-up*.
- The Compaq recommended dual power supply configuration can support *simultaneous drive spin-up*.

The power supply circuitry provides protection against:

- Overloads
- Short circuits
- Thermal protection against cooling system faults.

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

See Appendix B, “for the enclosure power specifications.

## Power Options

The enclosure can accommodate one or two power supplies. One power supply is sufficient to power the enclosure with a full complement of drives.

**NOTE:** Installing two power supplies, a redundant power configuration, eliminates the power supply as a single point of enclosure failure. This is the preferred, high-availability configuration. For complete power redundancy, each supply should be connected to a separate AC power source.

The blower mounting assembly is the element for mounting the second blower. This element has no power circuitry. It does contain a circuit board for processing signals to and from the blower.

## Temperature Sensing

The power supply uses the internal temperature of the supply to set the speed of the blower. The power supply blank can also set the blower speed. 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 is shut 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. The interface signals include:

- 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 elements. The rate at which air moves, the airflow, determines the amount of cooling. This airflow is a function of blower speed (rpm). These blower 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 airflow.

Should a blower fail<sup>1</sup>, EMU and power supply circuitry automatically increase the speed of the operational blower to high speed. Simultaneously, the error condition is reported to the user in several ways.

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

---

1. Operating at too low a speed or stopped.

## Status Reporting

The green status LED on the blower displays the status of either the power supply or the blower. See Table 6-1 for definitions of the LED displays.

Table 6-1 Power Supply and Blower Status Displays	
LED	Status
<b>Operational Status</b>	
	Both the power supply and the blower are operational.
	The EMU is locating either the power supply or the blower.
<b>Nonoperational Status</b>	
	Either the power supply or the blower is nonoperational. When there is a blower problem, the other blower runs at high-speed.

## Replacing a Power Supply or Blower

To replace a power supply or blower, you must order a replacement using the spare part number (see Chapter 7, “Replacing CRUs”).



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

Each power supply or blower replacement kit contains detailed replacement instructions.

# Chapter 7

## Replacing CRUs

Each replacement CRU kit contains detailed replacement instructions. This chapter describes the general replacement procedures.

### Ordering a CRU

To order a CRU, you must use the Compaq spare part number. This number is located in the upper-right corner of the product label (see Figure 7-1).



CXO7083A

Figure 7-1. Typical CRU product label

This the first six characters of the part number identify the CRU. The last three define the revision level.

### 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-safe container.

2. Do not remove the CRU from the static-free container until you are ready to install it.
3. Avoid touching the CRU connector pins, leads, or circuitry.

## Basic Replacement Procedures

The procedures in Table 7-1 apply to all the CRU replacement procedures.



**CAUTION:** The hot-pluggable power supplies, blowers, EMU, and drives DO NOT require halting all data transfers on the SCSI bus.

Replacing an I/O module or a SCSI bus cable *always requires* halting all data transfers on the SCSI bus.

---

**Table 7-1 Common Replacement Procedures**

---

1. *Always* transport and store CRUs in a static-safe container.

---

**Before starting the replacement procedure**

---



**CAUTION:** To prevent ESD damage, *never* touch the CRU connector pins, leads, or circuitry.

2. Remove the defective CRU from the enclosure.
3. Remove the replacement CRU from the static safe container and verify that it is a compatible replacement (refer to Figure 7-1).
4. Align the CRU with the enclosure guide slots.
5. Slide the CRU into the enclosure until it is against the backplane connector.
6. Fully seat the CRU in the enclosure and verify that it is operating properly.

---

**After replacing the CRU**

---

7. Place the defective CRU in the static safe container for shipment.
-

## Initial Installation

When you are installing an enclosure in a rack or tower you must observe the following warning.



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

To safely and easily install the enclosure requires removing the drives, power supply and blowers, EMU, and I/O module. This reduces the enclosure weight to approximately 24 lb (11.3 kg). Even though a single person can lift this weight, the physical size makes it very difficult to install.

Compaq requires a minimum of two individual to install an empty enclosure in a rack or tower.

The handles cannot support the weight of the enclosure. Only use these handles to position the enclosure in the mounting brackets. DO NOT use the handles to lift the enclosure.

---

Use the procedures in the following sections to remove all the elements to make the enclosure easier to handle. Once the enclosure is mounted you can replace the elements.

## Replacing a Drive

If a disk drive fails, you must replace it with a drive or a drive blank using the procedure in Table 7-2.

**NOTE:** For the latest information and instructions about Compaq hard drives, such as compatibility and installation instructions, refer to the Technical Information area of the following Compaq website.

<http://www.compaq.com/products/servers/storage/enterprise-class.html>



**CAUTION:** Removing more than one disk drive at a time can cause the enclosure to overheat. Never remove more than one disk drive at a time.

Removing a drive from the enclosure affects the air flow in the enclosure. This can result in an overheating condition that could affect disk reliability. Compaq recommends installing a disk drive of equal or greater capacity, or a disk drive blank as soon as possible

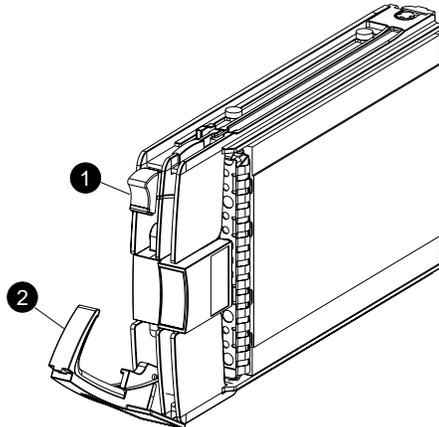
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**Table 7-2 Installing a Drive**

---

1. Press the Ejector button ❶ in and pivot the Release Lever ❷ to the full, open positions.



CXO6826A

- 
2. Pull out on the drive until it is disconnected from the backplane connector.  
**DO NOT REMOVE THE DRIVE FROM THE ENCLOSURE WHILE THE MEDIA IS ROTATING.**
-

---

**Table 7-2 Installing a Drive (Continued)**

---

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

---

  4. Insert the replacement drive or the drive blank part-way into the until it is against the backplane connector

---

  5. To install a drive blank, press it firmly in to seat it in the connector

---

  6. To install a drive, push in on the drive while pivoting the Release Lever ② to the full upright position.

---

  7. Push the Release Lever in until it engages the Ejector button ①.

---

  8. Observe the drive status LEDs (see Chapter 6) to ensure the replacement drive is functioning properly.
-

## Replacing the Variable Speed Blower

**NOTE:** Removing a blower does not change the airflow within the enclosure. However, do not remove a blower until the replacement blower is available.

Complete the procedures in Table 7-3 to replace a variable speed blower.

---

**Table 7-3 Blower Replacement Procedure**

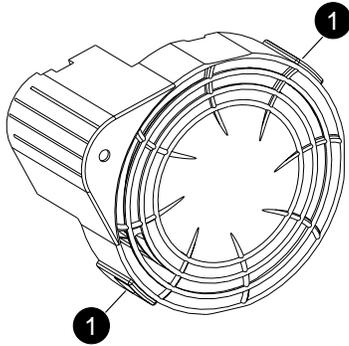
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**WARNING:** The blower blades rotate at a high speed and do not stop *immediately* when power is removed. Avoid touching the rotating blades when removing the blower.

---

1. Remove the blower from the power supply by pushing in on the two blower tabs ❶ and while pulling the blower element to the rear.



CXO6852A

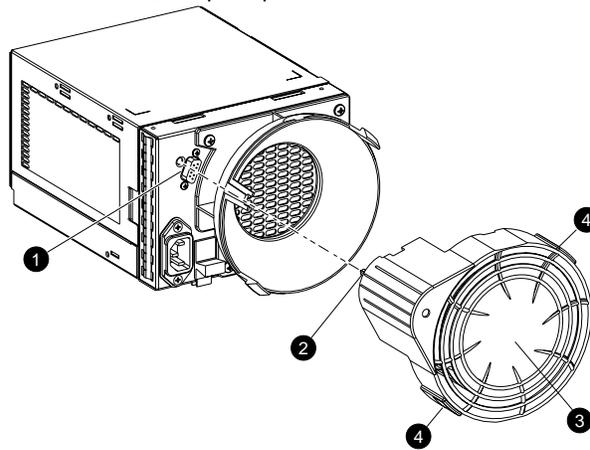
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**Table 7-3 Blower Replacement Procedure (Continued)**



**CAUTION:** Pressing on the center section of the blower ④ can damage the blades. Only press on the outer shroud when installing the blower.

2. Align the blower guide post ② with power supply connector ①. Slide the blower into blower base until the tabs ④ snap into place.



CXO6853A

3. The following are indications that the replacement blower is operating properly.
  - The blower starts operating immediately.
  - The blower LED is ON.

## Replacing the EMU

**NOTE:** Removing an EMU significantly changes the airflow within the enclosure. Therefore, always replace it as soon as possible.

The basic procedure for replacing an EMU is the same regardless of the system.

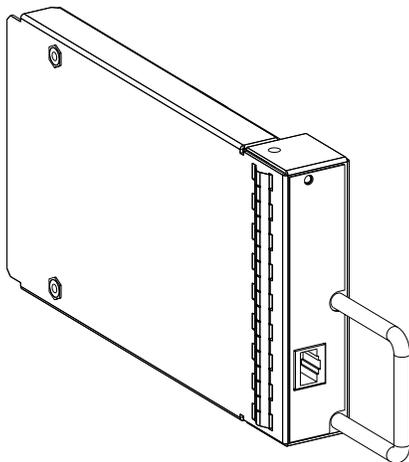
Complete the procedures in Table 7-3 to replace an EMU.

---

**Table 7-4 EMU Replacement Procedure**

---

1. Grasp the EMU handle and pull the EMU out of the enclosure.



CXO6911A

- 
2. Insert the replacement EMU in the enclosure.
  3. Press the EMU firmly in to seat it in the connector
  4. The EMU should start operating immediately.
-

## Replacing a Power Supply



**CAUTION:** Removing a power supply significantly changes the airflow within the enclosure. The system could shutdown unless the power supply is replaced within 5 minutes.

**NOTE:** Replacement power supply assemblies do not include a variable speed blower. Therefore you must remove the operational blower from the defective power supply and install it on the new supply *before you remove the defective power supply*.

Complete the procedures in Table 7-3 to replace a power supply.

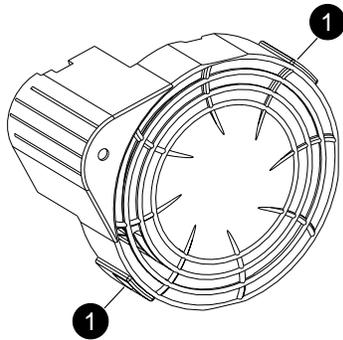
**Table 7-5 Power Supply Replacement Procedure**

1. When you are replacing the supply in a single power supply configuration *before it has failed*, you must stop all data transfers.
2. Disconnect the AC power cord from the defective supply.



**WARNING:** The blower blades rotate at a high speed and do not stop *immediately* when power is removed. Avoid touching the rotating blades when removing the blower.

3. Remove the operational blower from the defective power supply by pushing in on the two blower tabs ❶ and while pulling the blower element to the rear.



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**Table 7-5 Power Supply Replacement Procedure (Continued)**

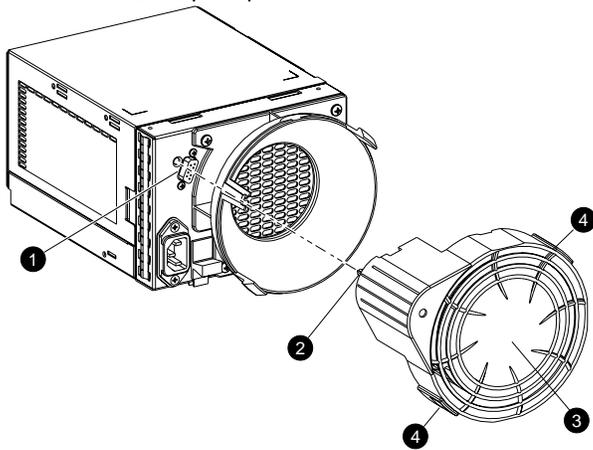
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**CAUTION:** Pressing on the center section of the blower **3** can damage the blades. Only press on the outer shroud when installing the blower.

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4. Align the blower guide post **2** with power supply connector **1**. Slide the blower into blower base until the tabs **4** snap into place.

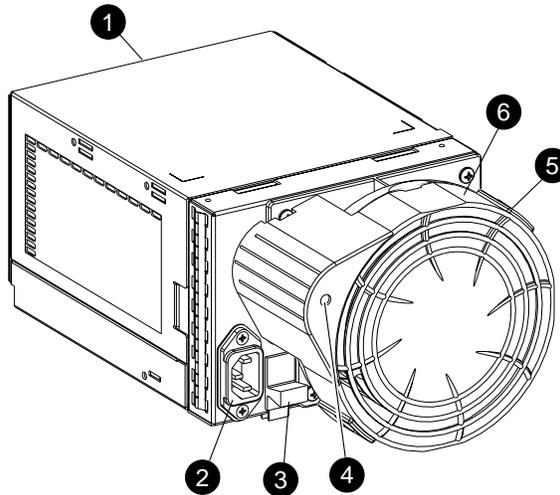


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**Table 7-5 Power Supply Replacement Procedure (Continued)**

5. While lifting up on the module latch **④**, grasp the blower element shell **⑥** and pull the power supply to the rear.



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**CAUTION:** Pressing in on the center section of the blower shroud can damage the blower blades. To avoid damaging the blower, only press on the outer portion of the blower shroud.

6. While lifting up on the module latch **④**, push in on the power supply **①** and the outer blower shroud **⑥** until it is fully seated in the enclosure
7. Press the module latch down to secure the supply in the enclosure.
8. Connect the AC power cord and 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 be operating at high-speed.

## Replacing the I/O Module



**CAUTION:** Interrupting the SCSI bus by replacing an I/O module could cause the loss of data. Therefore, you must stop all SCSI bus data transfers before replacing a module.

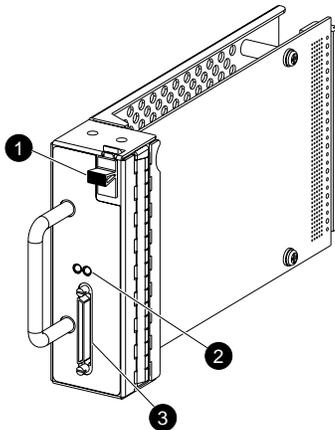
You must stop transfers on *both SCSI buses* when the enclosure is configured for *dual bus* operation.

**NOTE:** Removing an I/O module significantly changes the airflow within the enclosure. Therefore, always replace it as soon as possible.

The basic procedure for replacing an I/O module is the same regardless type. Complete the procedure in Table 7-3 to replace an I/O module.

**Table 7-6 I/O Module Replacement Procedure**

1. After backing up the stored data, stop all data transfers.
2. Stop all transfers on the SCSI bus.
3. Disconnect the SCSI bus cable from the module connector . For a dual-bus I/O module, label the cables as remove them.
4. While grasping the module handle, press down on the module latch  and pull the module out of the enclosure.



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**Table 7-6 I/O Module Replacement Procedure (Continued)**

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5. Slide the replacement module into the enclosure.

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6. While grasping the module handle, press the module latch  down and push the module into the enclosure until it is fully seated.

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7. Connect the cable connector to the same connectors (see Step 2).

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8. Activate the SCSI bus and observe the LEDs to verify that the module is functioning properly.

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# *Appendix A*

## **Regulatory Notices**

### **FCC Class B Certification**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

Any changes or modifications made to this equipment may void the users authority to operate this equipment.

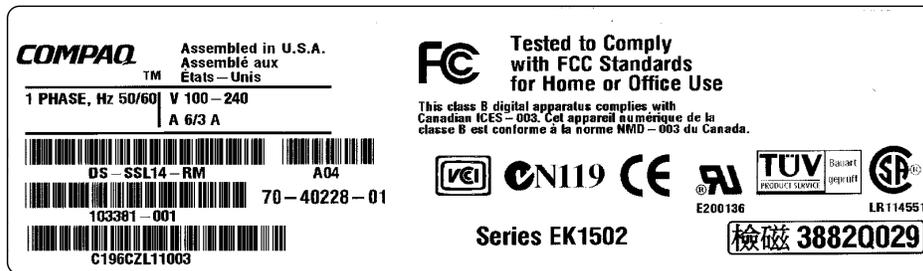
This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## Country-Specific Certifications

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

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



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Figure A-1. Typical enclosure certification label

**NOTE:** The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

# *Appendix B*

## Specifications

This appendix defines the physical, environmental, and power specifications and the environmental specifications of the disk enclosure and the elements.

### Physical Specifications



**WARNING:** The weight of the disk enclosure with the elements installed always requires at least two individuals to move it. Compaq recommends using fork lifts or hand trucks to move an enclosure in its shipping container.

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Table B-1 defines the dimensions and weights of the enclosure. Table B-2 defines the dimensions of the EMU, blowers, I/O module, and power supply.

**Table B-1 Disk Enclosure Physical Specification**

	Horizontal Orientation		Vertical Orientation	
	Empty	Installed	Shipping Carton	Shipping Carton and Pallet
<b>Height</b>	5.16 in (13.1 cm)	5.16 in (13.1 cm)	25.25 in (64.1 cm)	30.25 in (76.8 cm)
<b>Depth</b>	17.625 in (44.8 cm)	17.625 in (44.8 cm)	23.5 in (59.7 cm)	40.0 in (101.6 cm)
<b>Width</b>	19.875 in (50.5cm)	19.875 in (50.5cm)	12.5 in (31.8 cm)	24 in (61 cm)
<b>Weight</b>	24 lb (11 kg)	68 lb (31 kg)	96 lb (44 kg)	108 lb (49 kg)

**Table B-2 Element Physical Specifications**

	Vertical Orientation	Horizontal Orientation
	Installed	Shipping Carton
<b>Environmental Monitoring Unit (EMU)</b>		
<b>Height</b>	4.5 in (11.4 cm)	8.5 in (21.6 cm)
<b>Depth</b>	9.5 in (24.1 cm)	13.0 in (33.0 cm)
<b>Width</b>	1.375 in (3.5 cm)	4.5 in (11.4 cm)
<b>Weight</b>	1.3 lb (0.6 kg)	2.3 lb (1.0 kg)
<b>Variable Speed Blower (without power supply)</b>		
<b>Height</b>	5.5 in (14.0 cm)	7.5 in (19.0 cm)
<b>Depth</b>	3.25 in (6.4 cm)	8.75 in (22.2 cm)
<b>Width</b>	6.25 in (15.9 cm)	8.0 in (20.3 cm)
<b>Weight</b>	1.0 lb (0.5 kg)	2.0 lb (0.9 kg)

**Table B-2 Element Physical Specifications (Continued)**

	Vertical Orientation	Horizontal Orientation
	Installed	Shipping Carton
<b>I/O Module</b>		
<b>Height</b>	4.5 in (12.7 cm)	8.5 in (21.6 cm)
<b>Depth</b>	9.5 in (24.1 cm)	13.0 in (33.0 cm)
<b>Width</b>	1.625 in (4.1 cm)	4.5 in (11.4 cm)
<b>Weight</b>	1.3 lb (0.6 kg)	2.3 lb (1.0 kg)
<b>Power Supply (without blower)</b>		
<b>Height</b>	4.5 in (12.7 cm)	11.5 in (29.2 cm)
<b>Depth</b>	9.5 in (24.1 cm)	16.75 in (42.6 cm)
<b>Width</b>	6.25 in (15.9 cm)	13.0 in (33.0 cm)
<b>Weight</b>	4.0 lb (1.8 kg)	6.0 lb (2.7 kg)

## Environmental Specifications

To ensure optimum product operation you must maintain the operational environmental specifications listed in Table B-3. Especially critical is the ambient temperature.

**Table B-3 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 supports disk 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 this product, or placing it in short term storage, Compaq recommends maintaining the environmental conditions listed in Table B-4.

**Table B-4 Shipping or Short Term Storage Specifications**

<b>Ambient Temperature:</b> -40°C to +66°C (-40°F to +150°F)
<b>Relative humidity:</b> 10% to 80% noncondensing
<b>Altitude:</b> 15,240 m (50,000 ft)

## Power Specifications

Table B-5 defines the AC and DC power specifications for the disk enclosure power supplies.

**Table B-5 AC and DC Power Specifications**

<b>AC Power Specifications</b>			
	<b>Range</b>		
	<b>Minimum</b>	<b>Nominal</b>	<b>Maximum</b>
<b>Frequency (±5%)</b>	47 Hz	50 to 60 Hz	63 Hz
<b>Voltage (±10%)</b>	90 VAC	100 to 240 VAC	264 VAC
<b>DC Power Specifications</b>			
<b>Power</b>	Not Applicable	377 W	475 W
<b>+5 VDC</b>			
<b>Initial Voltage</b>	5.10 VDC	+5.15 VDC	5.20 VDC
<b>Steady State Current</b>	Not Applicable	20.0 A	28.0 A
<b>+12 VDC (Disks)</b>			
<b>Initial Voltage</b>	12.13 VDC	12.25 VDC	12.37 VDC
<b>Steady State Current</b>	Not Applicable	20.0 A	31.5 A
<b>+12.5 VDC (Blowers)</b>			
<b>Initial Voltage</b>	12.25 VDC	12.50 VDC	12.75 VDC
<b>Steady State Current</b>	Not Applicable	Not Applicable	2.5 A

## Glossary

<b>3U</b>	A panel or enclosure that is 5.25 inches (133.35 mm) high.
<b>AC</b>	Alternating current. The abbreviation for alternating current. <i>DO NOT</i> use ac.
<b>AC distribution</b>	The method of distributing AC power within a StorageWorks enclosure, tower, or rack (cabinet).
<b>AC power supply</b>	<i>See power supply.</i>
<b>ambient temperature</b>	The air temperature in an area where a system is installed. Also referred to as rack or enclosure intake air temperature, or room temperature.
<b>array controller</b>	<i>See controller.</i>
<b>backplane</b>	An electronic printed circuit board that distributes bus, data, control, power, and other signals to element connectors.
<b>bay</b>	The physical location of an element, such as a disk drive, I/O module, EMU, power supply, and so forth, in an enclosure. Each bay is numbered to define its location within a single bus or a dual bus.
<b>blower</b>	The variable speed air flow device, similar to a fan, that creates air flow within the enclosure to cool the elements.
<b>bus ID</b>	<i>See SCSI ID.</i>
<b>bus length</b>	The length of a SCSI bus is the distance between two terminators.
<b>cabinet</b>	A DIGITAL classic term for the StorageWorks enclosure with exterior panels, and doors into which cable distribution units, enclosures, blowers, and cables are mounted to form a storage subsystem. <i>See also rack.</i>

<b>carrier</b>	The container in which storage devices are mounted to form CRUs. Carriers are available in 3.5-inch form-factors for both low-profile (1.0-in) and half-height (1.6-in) disks.
<b>CE-Mark</b>	A European Economic Community (EEC) certification label that identifies electronic devices authorized for sale within member nations.
<b>compatible device</b>	A storage device that has been tested in a specific enclosure and found to be compatible
<b>controller</b>	1. A hardware–firmware device which manages communications on behalf of host systems over the SCSI bus to devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support. 2. A stand-alone device which connects a host adapter to the storage SCSI bus. This device provides RAID functionality, typically has multiple SCSI bus ports, performs the lower layers of the SCSI protocol, and normally operates in the initiator role. <i>See also <b>array controller</b>.</i>
<b>controller enclosure</b>	A StorageWorks enclosure containing a controllers, cache modules, power supplies, and blowers with either I/O modules or SCSI bus connectors.
<b>CRU</b>	Customer replaceable unit. An enclosure element that the customer can replace without using special tools or techniques.
<b>customer replaceable unit</b>	<i>See <b>CRU</b>.</i>
<b>device ID</b>	<i>See <b>SCSI ID</b>.</i>
<b>differential SCSI bus</b>	A bus in which the signal level is determined by the potential difference between two wires. A differential bus is more robust and less subject to electrical noise than is a single-ended bus. Differential buses may be either low voltage (LVD) or high voltage (HVD).
<b>disk</b>	A storage device supporting random access to fixed size blocks of data
<b>disk array controller</b>	<i>See <b>controller</b>.</i>
<b>disk enclosure</b>	A Compaq enclosure dedicated to supporting disk drives. Such an enclosure includes the power supplies, blowers, I/O modules, and an EMU.

<b>drive blank</b>	A carrier that is required to control airflow within the enclosure whenever there is less than a full complement of disk drives in an enclosure. The only function of a drive blank is to control airflow within the disk enclosure.
<b>dual bus</b>	An enclosure that is configured with two independent buses connected to separate controllers.
<b>dual power</b>	<i>See</i> <b>redundant power configuration</b> .
<b>dual power configuration</b>	<i>See</i> <b>redundant power configuration</b> .
<b>electromagnetic compliance</b>	<i>See</i> <b>EMC</b> .
<b>electromagnetic interference</b>	<i>See</i> <b>EMI</b> .
<b>electrostatic discharge</b>	<i>See</i> <b>ESD</b> .
<b>element</b>	<p>An object in an enclosure such as an EMU, power supply, disk, blower, I/O module, and so forth. The object can be controlled, interrogated, or described by the enclosure services process.</p> <p>An object related to an enclosure. The object can be controlled, interrogated, or described by the enclosure services process.</p>
<b>EMC</b>	Electromagnetic Compliance.
<b>EMI</b>	Electromagnetic interference (EMI) is the impairment of a signal by an electromagnetic disturbance
<b>EMU</b>	Environmental monitoring unit. An element which monitors the status of an enclosure including the power, air temperature, blower status, and so forth. It detects problems and displays and reports these conditions to the user and the controller. In some cases, corrective actions are implemented.
<b>enclosure</b>	A chassis containing a set of disk drives, power supplies, blowers, an EMU, I/O modules, and so forth.
<b>enclosure I/O module</b>	<p>The enclosure element that connects the enclosure to a differential or single-ended SCSI bus.</p> <p><i>See also</i> <b>differential I/O module</b> and <b>single-ended I/O module</b>.</p>

<b>environmental monitoring unit</b>	<i>See</i> <b>EMU</b> .
<b>ESD</b>	Electrostatic discharge (ESD). The discharge of a potentially harmful static electric voltage which is a result of improper grounding.
<b>fan</b>	<i>See</i> blower.
<b>fault bus</b>	The StorageWorks implementation of an additional high-availability subsystem monitoring capability for storage devices. This bus enables controllers to illuminate the device status LED when the controller detects a problem. In some configurations, this bus notifies the controller of the removal or replacement of a device.
<b>FCC</b>	Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.
<b>form factor</b>	An industry dimensional standard for 3.5-inch and 5.25-inch storage devices. Device heights are specified as low-profile (1.0-inch), half-height (1.6-in), and full-height (___-in)
<b>FRU</b>	Field Replaceable Unit. A hardware element that can be replaced in the field. This type replacement can require special training, tools, or techniques. Therefore, these procedures are usually performed only by customer service engineers.
<b>GUI</b>	Graphical User Interface. A system that displays the status of a and enables the user to control the StorageWorks subsystem. For example, the StorageWorks Command Console (SWCC).
<b>high availability fault bus</b>	<i>See</i> <b>fault bus</b> .
<b>host</b>	The primary or controlling computer. bus extender, bus expander, adapter, or controller to which storage is attached.
<b>host adapter</b>	A device that connects the host system I/O bus (for example, a PCI bus) to the storage SCSI bus. A host adapter performs the lower layers of the SCSI protocol and normally operates in the initiator role.
<b>host computer</b>	<i>See</i> <b>host</b> .

<b>host controller</b>	A device that connects the host system I/O bus (for example, a PCI bus) to the storage SCSI bus. A host controller provides RAID functionality, typically has multiple SCSI bus ports, performs the lower layers of the SCSI protocol, and normally operates in the initiator role.
<b>hot-pluggable</b>	<p>An element that can be replaced without removing power from the enclosure or interrupting the transfer of data over the SCSI bus. Compaq disk drives are hot pluggable.</p> <p><i>See also</i> <b>pluggable</b>.</p> <p><b>NOTE:</b> The array controller must support this replacement method.</p>
<b>I/O module</b>	The enclosure element that is the interface to the host or controller. It may include SCSI bus converter circuitry. I/O modules are bus specific (that is, wide or narrow; SCSI, Ultra SCSI, or Ultra2 SCSI; single or dual bus; and either single-ended or differential).
<b>initiator</b>	A SCSI device (usually a host system) that requests an operation to be performed by another SCSI device (a target).
<b>input/output module</b>	<i>See</i> <b>I/O module</b> .
<b>JBOD</b>	Just a bunch of disks. A rack configuration composed of disk enclosures without a controller enclosure.
<b>just a bunch of disks</b>	<i>See</i> <b>JBOD</b> .
<b>LED</b>	Light emitting diode. A diode that illuminates to define the status. The standard states are ON, OFF, or FLASHING.
<b>light emitting diode</b>	<i>See</i> <b>LED</b> .
<b>low profile</b>	A storage device that's height is a maximum of 1.0 inches.
<b>low voltage differential</b>	<i>See</i> <b>LVD</b> .
<b>LVD</b>	Low Voltage Differential. A bus in which the signal level is determined by the potential difference between two wires.
<b>maintenance terminal</b>	The operator terminal used to identify an HS-family controller, to enable its host paths, to define its subsystem configuration, and to check its status. The HS-family maintenance terminal interface is designed to accept any terminal conforming to EIA-423. The maintenance terminal is only required to configure a storage subsystem and is not required for normal operations.

<b>mean time between failures</b>	<i>See</i> <b>MTBF</b> .
<b>modular carrier</b>	<i>See</i> <b>carrier</b> .
<b>mounting brackets</b>	The brackets used for mounting StorageWorks enclosures in a cabinet.
<b>mounting rail</b>	The surface of a rack on which panels mount. (Per <i>EIA Standard RS-310-C</i> .)
<b>MTBF</b>	Mean time between failures. The time interval (hours) which may be expected between failures of operating equipment.
<b>nonvolatile</b>	<i>See</i> <b>NV</b> .
<b>NV</b>	Nonvolatile. A term used to describe memory, the contents of which survive loss of power.
<b>NVRAM</b>	Nonvolatile Random Access Memory
<b>pedestal</b>	<i>See</i> <b>tower</b> .
<b>pluggable</b>	A method of element replacement whereby the complete system remains on-line during element removal or insertion. There is no data transfers over the enclosure buses during removal or insertion of an element. No booting or loading of code is permitted except on the element being inserted. User applications that are not dependent upon the elements on the affected SCSI bus are not noticeably impacted. <i>See also</i> <b>hot-pluggable</b> .
<b>port</b>	(1) A logical route for data in and out of a controller. A port can contain one or more channels, all of which contain the same type data. (2) The hardware and software that connects a host controller to a CI, SCSI, or SDI bus.
<b>power supply</b>	The enclosure element that develops that DC voltages for operating the enclosure elements from either an AC or DC source.
<b>qualified device</b>	<i>See</i> supported device.
<b>rack</b>	A floor-standing structure primarily designed for, and capable of, supporting equipment. All racks provide for the mounting of panels. (per <i>EIA Standard RS-310-C</i> ).
<b>radio frequency interference</b>	<i>See</i> <b>RFI</b> .

<b>RAID</b>	Redundant array of independent disks. A set of storage techniques devised to increase the performance and availability of a storage subsystem.
<b>redundant array of independent disks</b>	<i>See RAID.</i>
<b>redundant power configuration</b>	A capability of StorageWorks cabinet and enclosures to ensure there is no single point of power failure. (1) For a cabinet two AC power sources and two power conditioning units distributed primary and redundant AC power to enclosure power supplies. (2) For a enclosure, the primary and redundant enclosure power supplies ensure 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.
<b>RETMA mounting pattern</b>	The repeating mounting pattern in a <i>vertical mounting rail</i> established by Radio, Electronics, and Television Manufacturers Association, the predecessor of the Electronics Industry Association (EIA). This pattern repeats every 1.75 in and is referred to as a unit. Therefore, a 3U pattern is 5.25 inches; a 4U pattern is 7.00 inches, and so forth.
<b>RFI</b>	Radio frequency interference. The impairment of a signal by an unwanted radio signal or radio disturbance.
<b>SCS</b>	System Communication Services. A delivery protocol for packets of information (commands or data) to or from the host.
<b>SCSI</b>	Small computer system interface (SCSI). An 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.
<b>SCSI bus</b>	An unbroken path consisting of conductors (in cables or on backplanes) and connectors. Every bus must have two terminators, one at each end.
<b>SCSI bus connection</b>	Any connector which is used to create a SCSI bus segment. SCSI bus connectors are defined by both their function and their physical placement. There are only two functions allowed: bus-path and stub. There are numerous physical placement descriptions, for example, device stub connectors and terminator bus-path connectors.
<b>SCSI device</b>	A host computer adapter, a peripheral controller, or an intelligent peripheral that can be attached to the SCSI bus.

<b>SCSI ID</b>	(1.) The bit-significant representation of the SCSI addressing referring to one of the signal lines numbered 0 through 7 for an 8-bit bus or 0 through 15 for a 16-bit bus. Also referred to as “target ID”. (2.) The unique device identification number assigned to each target or initiator on a single SCSI bus. The valid address range for a wide bus is 0 through 15.
<b>SCSI port</b>	(1) Software: The channel that controls communications to and from a specific SCSI bus in the system. (2) Hardware: The name of the logical socket at the back of the system unit to which a SCSI device is connected.
<b>single power configuration</b>	A cabinet or rack AC power configuration in which there is only one AC power source or power conditioning device (such as a CDU or PDU) to distribute AC power.
<b>single-ended SCSI bus</b>	A bus in which each signal’s logic level is determined by the voltage of a single wire in relation to ground. Also referred to SE.
<b>slot</b>	<i>See bay.</i>
<b>small computer system interface</b>	<i>See SCSI</i>
<b>spin-down</b>	The process that begins when power is removed from a storage drive and data transfer stops, and ends when the drive is stopped and can be moved. In the case of disk drives, the heads are retracted and the media is stopped.
<b>spin-up</b>	The process that begins when power is applied to a storage drive, and ends when the drive is determined to be operational and ready for data transfer operations.
<b>split bus</b>	<i>See dual bus.</i>
<b>storage array</b>	An integrated set of storage devices.
<b>storage carrier</b>	<i>See carrier.</i>
<b>storage sets</b>	A grouping of disk drives that make up a new distinct container.
<b>storage subsystem</b>	The controllers, storage devices, enclosures, cables, and power supplies that form a mass storage subsystem.
<b>storage subsystem high availability fault bus</b>	<i>See fault bus.</i>

<b>StorageWorks</b>	The Compaq set of enclosure products that allows customers to design and configure their own storage subsystem. Elements include power, packaging, and interconnections in a StorageWorks enclosure. Storage devices, power supplies, I/O modules, EMUs, and array controllers may be integrated therein to form storage subsystems. System-level enclosures to house the enclosures are also included.
<b>StorageWorks high availability fault bus subsystem</b>	<i>See</i> <b>fault bus</b> .
<b>subsystem array strategy</b>	<i>See</i> storage subsystem.
<b>supported device</b>	A strategy, including packaging, devices, and controllers, that provides an integrated storage subsystem solution.
<b>target</b>	(1) A device that has been fully evaluated in an “approved” StorageWorks configuration (that is, enclosure, cabinet, power supply, cabling, and so forth) and is in complete compliance with country-specific standards (for example, FCC, CE-Mark, CSA, TÜV, VDE, and so forth) and with all Compaq standards. (2) A device supported by a controller or host operating system.
<b>target ID</b>	A SCSI device that performs an operation requested by an initiator.
<b>terminator</b>	<i>See</i> <b>SCSI ID</b> .
<b>tower</b>	Interconnect elements that form the ends of the transmission lines in bus segments. A SCSI domain must have at least one segment and therefore at least two terminators, <i>except</i> for special cases where the electrical transmission lines are very short and only one termination or pull-up is required.
	A freestanding, floor mounted unit containing a disk enclosure in the vertical orientation. This unit can function as a stand-alone storage subsystem.

<b>Ultra SCSI</b>	<p>The Ultra SCSI improvements over Fast SCSI include the following:</p> <ul style="list-style-type: none"><li>• Maximum transfer rate increases from 10 MHz to 20 MHz.</li><li>• Maximum wide bus bandwidth increases from 20 MB/sec to 40 MB/sec.</li><li>• VHDCI (very high density cable interconnect) cables and connectors are significantly thinner and smaller.</li></ul> <p>Also known as FAST 20.</p>
<b>Ultra2 SCSI</b>	<p>A wide SCSI bus that transfers data at rates up to 80 Mbytes/sec (FAST 40) when operating as a low voltage differential bus. There is no provision for this bus to operate in the narrow mode.</p>
<b>units</b>	<p>The modular unit “U” on which panel heights is based on the vertical RETMA mounting pattern of 1.750 inches (44.45 mm). (Per <i>EIA Standard RS-310-C.</i>)</p>
<b>universal AC input power supply</b>	<p>A StorageWorks power supply that produces +5 V DC and +12 V DC power from a range of AC input voltages and frequencies. <i>See also enclosure power supply.</i></p>
<b>VHDCI</b>	<p>Very High Density Cable Interconnect. A 68-pin interface with connectors on 0.8 mm centers. Required for Wide-Ultra2 SCSI configurations.</p>
<b>wide SCSI bus</b>	<p>A parallel SCSI bus that transmits data over 16 lines.</p>
<b>Wide-Ultra SCSI</b>	<p>A SCSI bus that can operate either as an LVD or SE bus. This bus transfers data at rates up to 40 MB/s when using the LVD protocol. When using SE the maximum transfer rate is 20 MB/s.</p>
<b>Wide-Ultra2 SCSI</b>	<p>A wide SCSI bus that transfers data at rates up to 80 MB/s when operating using the LVD protocol. There is no provision for this bus to operate in the narrow mode.</p>

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