

# **Compaq StorageWorks**

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## **Enterprise Virtual Array Drive Enclosure EMU User Guide**

Part Number: EK-52EMU-UA. A01

**First Edition August 2001**

**Product Version:** VCS 1.0

This publication is for use by individuals responsible for installing and maintaining the Enterprise Virtual Array Drive Enclosure EMU.

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Enterprise Virtual Array Drive Enclosure EMU User Guide  
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Part Number: EK-52EMU-UA. A01

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# About this Guide

The following sections are covered:

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

## Text Conventions

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

**Table 1: Text Conventions**

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

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

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

## Symbols in Text

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



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

---



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

---

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

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

## Symbols on Equipment



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

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

---



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

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

---



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

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

---



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

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

---



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

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

---

## Rack Stability



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

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

## Getting Help

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

## Compaq Technical Support

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

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

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

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

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

## Compaq Website

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

## Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

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

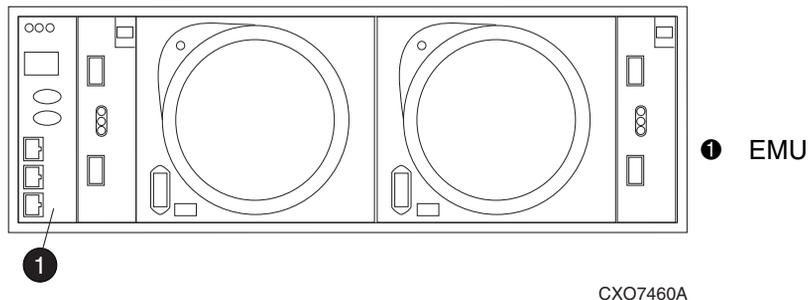


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## Introducing the Drive Enclosure EMU

**IMPORTANT:** The information in this publication is based upon Compaq Enterprise Virtual Array configurations. EMU functioning and operation in other configurations, such as a just-a-bunch-of disks, may differ.

This chapter provides a general *description* of the environmental monitoring unit (EMU) for Fibre Channel-Arbitrated Loop (FC-AL) drive enclosures. The EMU is fully SCSI-3 Enclosure Services (SES) compliant and mounts in the left rear bay of a disk enclosure (see ❶, Figure 1-1).



**Figure 1-1: EMU location**

## SCSI-3 Enclosure Services Functions

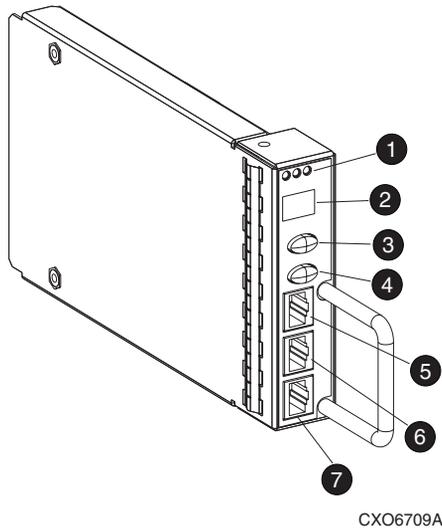
Each EMU contains an Enclosure Services Processor (ESP) that controls Enclosure Services Interface (ESI). In SES terms, the drive enclosure is a sub-enclosure that contains one or more devices, together with the associated power supplies, blowers, displays, the ESP, and auxiliary equipment (such as the I/O modules) required to support these devices.

All EMUs can transmit information to the host. However, only one EMU in each reporting group or on a loop will communicate directly with the host at a time. In SES terminology this EMU constitutes the *primary sub-enclosure*. The other EMUs are the *secondary sub-enclosures*. These designations are temporary and can change at any time—that is a secondary sub-enclosure can become a primary sub-enclosure, and vice-versa. The *SES SCSI-3 Enclosure Services Command Set (SES)*, *American National Standard for Information Services* discusses the SES functions in detail.

In this publication the term *enclosure* refers to the drive enclosure with all of the associated elements (EMU, power supplies, drives, blowers, and I/O modules). To avoid confusion, use of the SES terms *sub-enclosure*, *primary sub-enclosure*, and *secondary sub-enclosure* is limited in this publication.

## Controls and Displays

See Figure 1–2 for the location and function of the EMU displays, controls, and connectors.



**1 Status LEDs**

These three LEDs are visual indications of the EMU and enclosure status.

**2 Alphanumeric Display**

A two character, 7-segment alphanumeric display of the enclosure functions and status.

**3 Function Select (“top”) pushbutton**

The primary function of this pushbutton is to:

- Select a display group function.
- Modify the value of a display group function.

The LED is on when there is an error condition.

**4 Display Group Select (“bottom”) pushbutton**

The primary function of this pushbutton is to:

- Select a display group
- Move between display groups.

A secondary function is to control the audible alarm.

The LED is on when the audible alarm is muted or disabled.



**WARNING:** To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into the “RS232 ONLY” receptacle.

**5 RS232 ONLY**—A keyed, RJ45-type connector for use by Compaq Authorized Service Providers.

**6 LCD ONLY**—An unused RJ45-type connector.

**7 CAB ONLY**—A keyed, RJ45-type enclosure address bus connector.

**Figure 1–2: EMU controls and displays**

## EMU Functions

The primary functions of the EMU include:

- Using the enclosure services processor (ESP) to control the enclosure services interface (ESI) and communicate with the host controller
- Assigning the Enclosure Number (En), based upon the cabinet address bus feature
- Displaying the bay 1 loop ID
- Monitoring enclosure operation
- Detecting, reporting, recording, and displaying conditions
- Displaying EMU, enclosure, and element status
- Implementing automatic corrective actions for some conditions
- Providing enclosure status data to a graphical user interface (GUI)
- Reporting the World Wide Name and the logical address of all drives

**IMPORTANT:** Although the EMU can determine the logical address of a drive, the EMU can neither display nor change this information. The HSV element manage GUI can display the addresses from the EMU supplied status information.

## EMU Control Functions

The EMU pushbuttons (see Figure 1–2) control the following EMU functions:

- Recommending the bay 1 loop ID
- Disabling or enabling the audible alarm
- Muting or “unmuting” the audible alarm

**NOTE:** Disabling and muting the audible alarm are not the same. The disable function prevents the audible alarm from sounding, regardless of how many new conditions occur. The mute function temporarily disables the audible alarm until a new condition occurs.

The EMU can flash all an element status LEDs to implement the locate function.

## EMU Monitoring Functions

The internal EMU circuitry monitors the enclosure and element functions listed in Table 1–1.

**Table 1–1: EMU Monitoring Functions**

Element	Monitored Functions	
<b>Blowers</b>	<ul style="list-style-type: none"> <li>• Installation</li> <li>• Removal</li> </ul>	<ul style="list-style-type: none"> <li>• Type</li> <li>• Speed (rpm)</li> </ul>
<b>Drives</b>	<ul style="list-style-type: none"> <li>• Installation</li> <li>• Removal</li> <li>• Bypass Status</li> </ul>	<ul style="list-style-type: none"> <li>• Loop ID</li> <li>• Temperature</li> <li>• Drive Fault</li> </ul>
<b>EMU</b>	<ul style="list-style-type: none"> <li>• Temperature</li> <li>• Operation</li> </ul>	<ul style="list-style-type: none"> <li>• Type</li> <li>• Revision level</li> </ul>
<b>Enclosure</b>	<ul style="list-style-type: none"> <li>• Enclosure power</li> <li>• Enclosure fault</li> </ul>	<ul style="list-style-type: none"> <li>• Backplane type</li> <li>• Backplane revision level</li> </ul>
<b>I/O Module</b>	<ul style="list-style-type: none"> <li>• Installation</li> <li>• Removal</li> <li>• Status</li> </ul>	<ul style="list-style-type: none"> <li>• Type</li> <li>• Revision Level</li> </ul>
<b>Power Supplies</b>	<ul style="list-style-type: none"> <li>• Installation</li> <li>• Removal</li> <li>• Status</li> <li>• Type</li> <li>• Revision level</li> </ul>	<ul style="list-style-type: none"> <li>• +5 V DC voltage and current</li> <li>• +12 V DC voltage and current</li> <li>• Total power</li> <li>• Temperature</li> </ul>
<b>Transceiver</b>	<ul style="list-style-type: none"> <li>• Type</li> </ul>	<ul style="list-style-type: none"> <li>• Link status</li> </ul>

## EMU LED Displays

The EMU LEDs (see Table 1–2) display the EMU status, the enclosure power status, and the enclosure fault status. The two green (EMU and enclosure power) and one amber (enclosure fault) LEDs are either on, off, or flashing. The three LEDs in the lower-right front corner of the enclosure also display this information.

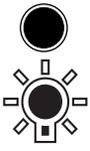
**NOTE:** The functions and the icons for both the EMU LEDs and the enclosure LEDs are identical. The enclosure fault LED colors may be different.

The LEDs on the enclosure, on the EMU, and in the EMU pushbuttons define the status of the enclosure and the EMU. The LEDs in the pushbuttons may be on when there is an active condition.

- When there is an error condition, the top pushbutton LED is on.
  - When there is a single error condition, the LED is on until you view the error condition.
  - When there are multiple errors, the LED is on until you view the last error condition.
- The bottom pushbutton LED is active only when the alarm is muted or disabled.

The EMU status LEDs are arranged horizontally above the alphanumeric display (see Table 1–2). There is an icon on the EMU label beneath the LEDs (see Table 1–2). These icons are the same as those on the front, lower right corner of the enclosure. When the EMU and the enclosure are operational the LEDs, from left to right, are flashing, on, and off.

**Table 1–2: EMU Status LEDs and Icons**

EMU “Heartbeat” (green LED)	Power (green LED)	Fault (amber LED)
		

## EMU Displays

The EMU uses a combination of LEDs, icons, the two-character alphanumeric display, and an audible alarm to indicate the operational status of the enclosure and the enclosure elements (see Table 1–3).

**Table 1–3: EMU Status Indicators**

Indicator	Function
audible alarm <sup>1</sup>	Any EMU detected conditions causes this indicator to sound.
EMU Icons <sup>2</sup> 	The EMU LEDs above the icons display the enclosure and EMU status.
Alphanumeric Display <sup>3</sup>	The two-character, 7-segment alphanumeric display can display decimal, alphabetical, or hexadecimal characters.

1. For information about the audible alarm, see Chapter 5, “Audible Alarm Operations.”
2. For a description of the LED functions, see Chapter 2, “Using the EMU LED Displays.”
3. For a description of the alphanumeric display functions, see Chapter 3, “Using the Alphanumeric Display.”

## Replacing an EMU

The EMU is classified as a “hot-pluggable” element that you can remove and replace without stopping data transfers or removing power. For EMU replacement procedures, see the *Enterprise Virtual Array Drive Enclosure User Guide*.

## Product Certification

The EMU can only be tested for compliance with country-specific standards as a part of an enclosure, not as a standalone element. Therefore, the EMU certification is part of the enclosure certification.

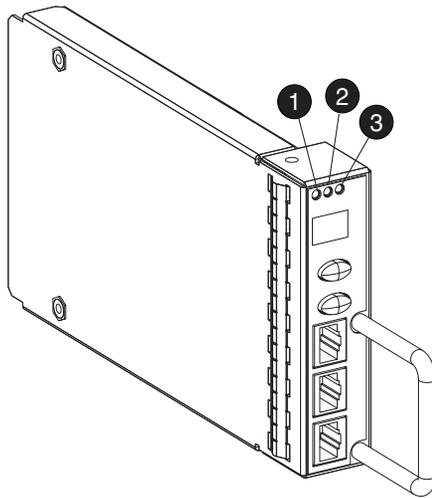


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## Using the EMU LED Displays

The EMU LEDs (see Figure 2–1) display the EMU status, the enclosure power status, and the enclosure fault status. The icons below the LEDs define the LED function. The two green (EMU and enclosure power) and one amber (enclosure fault) LEDs are either on, off, or flashing. The three LEDs in the lower-right front corner of the enclosure also display this information.

**NOTE:** The functions and the icons for both the EMU LEDs and the enclosure LEDs are identical. The LED colors may be different.



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### ❶ EMU Status LED



This flashing green LED is the “heartbeat” for an operational EMU.

### ❷ Enclosure Power Status LED



This green LED is on when both the +5 V DC and +12 V DC are correct.

### ❸ Enclosure Fault LED



This amber LED is normally off. The LED is on when there is an enclosure error condition.

**Figure 2–1: EMU Status LEDs**

## EMU Pushbutton LEDs

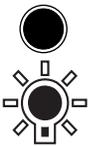
The LEDs in the pushbuttons define error conditions and the state of the audible alarm.

- When there is an error condition, the top pushbutton LED is on.
  - When there is a single error condition, the LED is on until you view the error condition.
  - When there are multiple errors, the LED is on until you view the last error condition.
- The bottom pushbutton LED is on only when the alarm is muted or disabled.

## Analyzing the EMU LED Displays

The EMU status LEDs are arranged horizontally above the alphanumeric display (see Table 2–1). There is an icon on the EMU label beneath each LED (see Table 2–1). These icons are the same as those on the front, lower right corner of the enclosure. When the EMU and the enclosure are operational the LEDs, from left to right, are flashing, on, and off.

**Table 2–1: Using the EMU Status LEDs to Analyze Operation**

EMU “Heartbeat” (green LED)	Power (green LED)	Fault (amber LED)
		

You can determine the EMU and enclosure status by analyzing the EMU LED displays in Table 2–2.

Table 2–2: EMU LED Displays

LED Display	Status and Recommended Actions	
LED LEGEND		
Off 	On 	Flashing 
	The EMU locate function is active. This display has precedence over all others. Fault conditions cannot be displayed when the locate function is active.	
	The EMU is operational. The enclosure power (both +5 V DC and +12 V DC) is present and correct. There are NO enclosure faults.	
	The EMU is operational. There is an enclosure fault. Check the alphanumeric display error code for detailed information about the problem.	
	The EMU is operational. This display may be present when power is initially applied to the enclosure. Should this display fail to clear within a few seconds, this could indicate there is a problem with the disk drive +12 VDC power supply. <b>NOTE:</b> When the +5 VDC is incorrect, all the LEDs are off.	
	There is an EMU fault There is no enclosure fault.	
	There is an EMU fault There is no enclosure fault.	
	There is an enclosure fault. Either +5 VDC is incorrect, or both +5 VDC and +12 VDC are incorrect. Other error conditions may exist.	



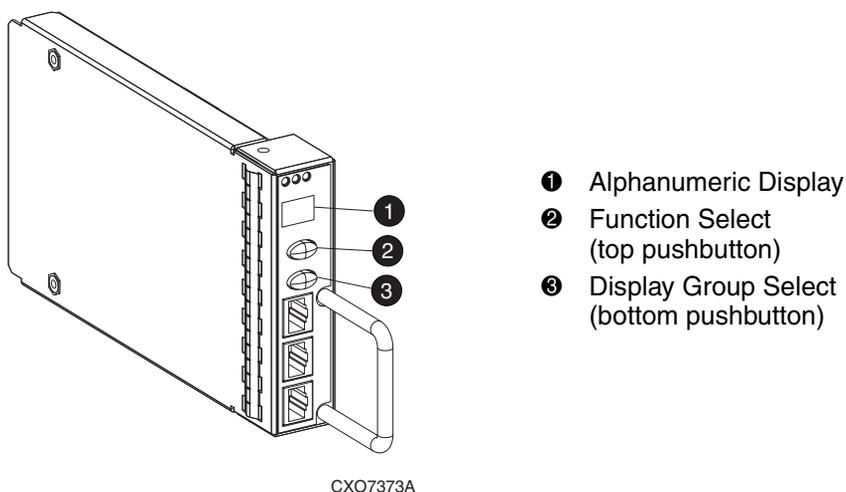
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## Using the Alphanumeric Display

This chapter describes the general purpose, function, and operation of the EMU alphanumeric display. Detailed information about specific displays are contained in:

- Chapter 4, “Using the Enclosure Number Feature”
- Chapter 6, “Using the Condition Reporting Feature”
- Chapter 7, “Using the Loop ID Feature”
- Chapter 8, “Using the Reporting Group Feature”

The two-character alphanumeric display is located at the top of the EMU (see ❶, Figure 3–1). This 7-segment display that provides information about multiple enclosure functions. The pushbuttons control the data displayed or entered.



**Figure 3–1: Alphanumeric display and controls**

## Alphanumeric Display Description

This two-character alphanumeric display (see ❶, Figure 3–1), is 7-segment display that provides information about multiple enclosure functions. The top-level display (*En*, *Li*, *rG*, *Au*, and *Er*) is the display group.

The function of the other displays is display-group dependent. The default display is the *En*, a decimal number in the range *00* through *14*. The pushbuttons allow you to select the alphanumeric display or to enter data.

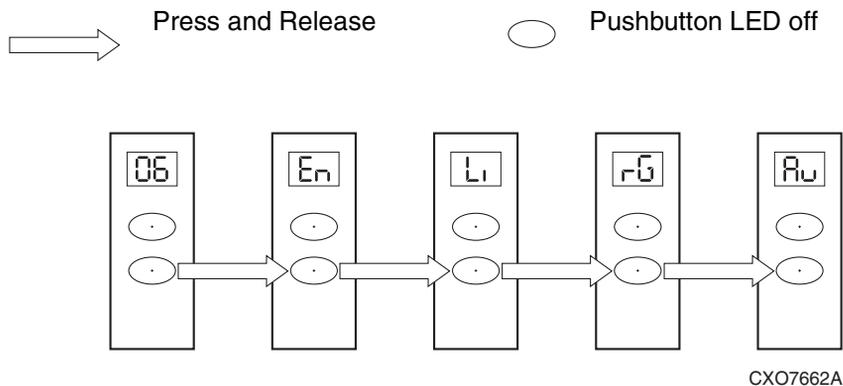
- The bottom pushbutton (see ❸, Figure 3–1) enables you to sequentially move between and select a display group.

See Table 3–1 for a description of these display groups.

- The top pushbutton, (see ❷, Figure 3–1) enables you to move between the levels within a display group.

## Display Groups

As shown in Figure 3–2, whenever you press and release the bottom pushbutton, the alphanumeric display selects a different display group.



**Figure 3–2: Selecting a display group**

Table 3–1 is a general description of the display groups.

**IMPORTANT:** 7-segment display limitations preclude displaying uppercase characters *B, K, M, N, Q, R, S, T, V, W, X, Y, or Z*, or the lowercase characters *a, e, f, g, j, k, l, m, n, p, q, s, t, v, w, x, y, or z*.

The lowercase characters *b, c, d, h, i, o, r, and u* displays are similar to the actual characters.

**Table 3–1: EMU Display Groups**

Display	Display Group	Description
<b>En</b>	Enclosure Number	The enclosure number is the default display and is a decimal number in the range <i>00</i> through <i>14</i> . See Chapter 4, “Using the Enclosure Number Feature,” for detailed information
<b>Li</b>	Bay 1 Loop ID	This display group has a single sublevel display that defines the enclosure bay 1 loop ID. Valid loop IDs are in the range <i>00</i> through <i>7F</i> . See Chapter 7, “Using the Loop ID Feature,” for detailed information.
<b>rG</b>	Reporting Group	This display group has two, 2-digit displays that define the reporting group number in the range <i>0000</i> through <i>4095</i> . See Chapter 8, “Using the Reporting Group Feature,” for detailed information.
<b>Au</b>	Audible Alarm	This display group provides control over the audible alarm or horn. The sublevel displays are audible alarm enabled ( <i>0n</i> ) or audible alarm disabled ( <i>0F</i> ). See Chapter 5, “Audible Alarm Operations,” for detailed information.

**IMPORTANT:** Regardless of what is being displayed, anytime you press and release the bottom pushbutton (see ❸, Figure 3–1), the display will change to *En, Li, rG, Au, or Er*.

A flashing alphanumeric display indicates that the user can edit an address, state, or view a condition report. The following chapters describe the display and edit functions of each group.



---

## Using the Enclosure Number Feature

This chapter provides a general description of the purpose, function, and operation of the EMU enclosure number (*En*) feature.

### En Description

In a single rack configuration, the *En* is a decimal number in the range *00* through *14* which is automatically assigned by the enclosure address bus.

By default, the two-character alphanumeric display shows this number. Pressing the bottom pushbutton changes the display to *En*, the *En* display mode.

When the display is *En*, pressing and releasing the top pushbutton displays the *En*.

A display of *00* indicates that the enclosure is not connected to the enclosure address bus. When this condition exists, there is no EMU-to-EMU communication over the enclosure address bus. This configuration is known as “just-a-bunch-of-disks,” or a JBOD configuration.

A display of *01* through *14* indicates that the enclosure is physically connected to the enclosure address bus and can exchange information with other enclosures on the enclosure address bus. The decimal number indicates the physical position of the enclosure in relation to the bottom of the rack.

- *01* is the address of the enclosure connected to the bottom connector in the first (bottom) junction box (JB).
- *14* is the address of the enclosure closest to end of the bus, the top connector in the last (upper) JB.

**IMPORTANT:** The enclosure address bus connection determines the *En*. For a single rack, the display is a decimal number in the range *01* through *14*. You can only display, never change the *En* value, value.

Unless there is an error condition, the display automatically returns to the *En* (*01* through *14*) one minute after a pushbutton was last pressed.

The En is a decimal number in the range *00* through *14*. By default, the two-character alphanumeric display shows this number. Pressing the bottom pushbutton changes the display to *En*, the En display mode.

For JBOD configurations the enclosure *En* display is always *00*. You can only display, not change, the *En* value.

Unless there is an error condition, the display automatically returns to the En (*01* through *14*) one minute after a pushbutton was last pressed.

## Enclosure Address Bus

The enclosure address bus is composed of cables and JBs that interconnects the drive enclosures and controller enclosures to provide a means for managing and reporting environmental conditions within the cabinet. The EMUs collect the data for the associated enclosure.

The drive enclosure numbers are always assigned by the enclosure address bus. Connecting the EMU CAB ONLY connector to a enclosure address bus JB automatically establishes an En of *01* through *14*. Any drive enclosure not connected to the enclosure address bus has the same En, *00*.

**IMPORTANT:** The En is automatically assigned. There is no provision for you to manually assign an enclosure number.

Another function of the enclosure address bus is to provide communications within a reporting group. A reporting group is an HSV controller pair and the associated drive enclosures. The HSV controller pair assigns a unique decimal reporting group number to all EMUs on each redundant FC-AL loop pair.

For more information about the reporting group number, see Chapter 8, “Using the Reporting Group Feature.”

## Enclosure Numbering

Based on the cable bus installation shown in Figure 4-2, the enclosures are numbered as shown in Figure 4-1.

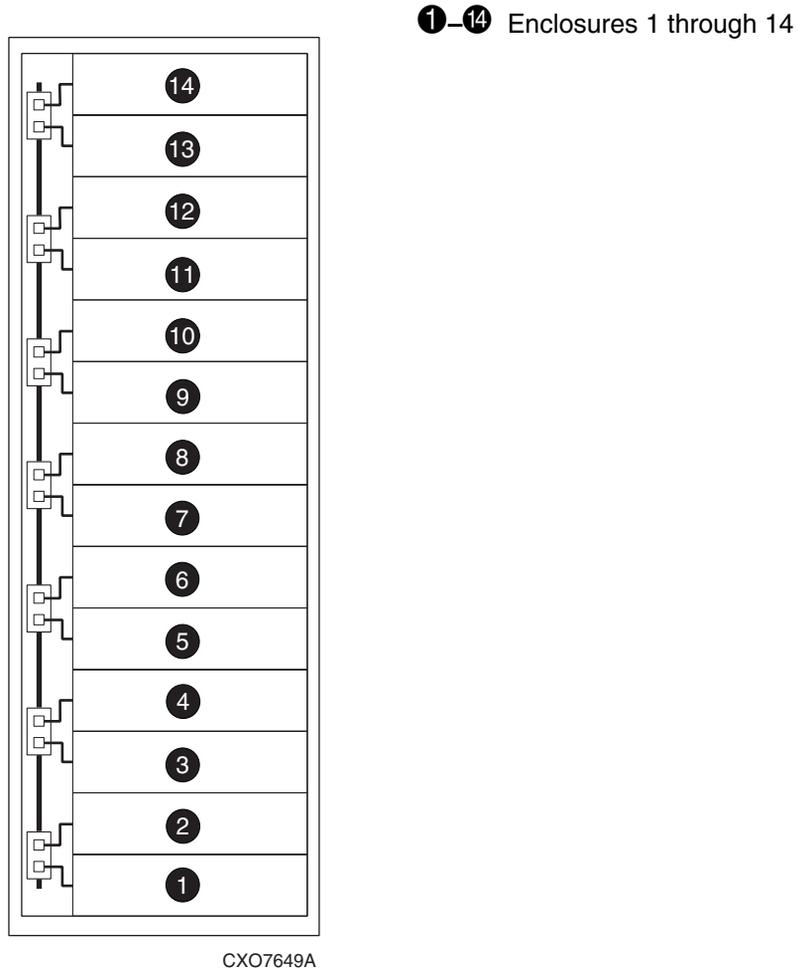
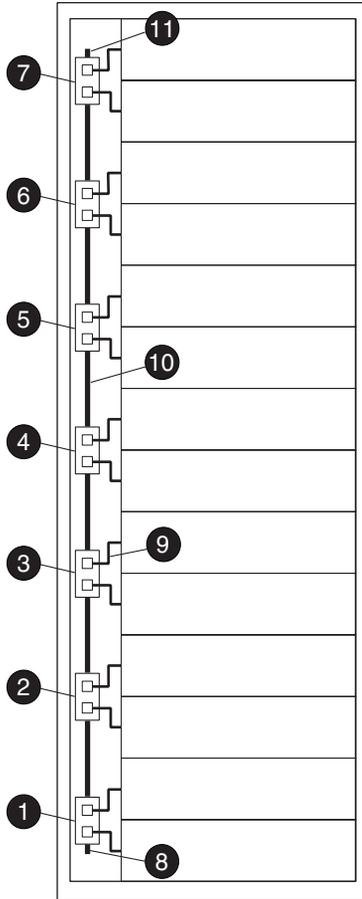


Figure 4-1: Enclosure numbering—rear view

## Enclosure Address Bus Connections

Connecting the enclosures to the cabinet JBs establishes the enclosure address bus. The enclosures are automatically numbered, based on their physical distance from the bottom terminator. Figure 4–2 shows the typical configuration of a 42U cabinet with 14 enclosures (3U high).



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### Junction Boxes (JB)

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

### Components

- ❸ Bottom Terminator
- ❹ JB-to-Enclosure Cable  
381 Mm (15 in), 1 of 14 cables
- ❺ JB-to-JB Cable  
210 mm (8.25 in), 1 of 6 cables
- ❻ Top Terminator

Figure 4–2: Enclosure address bus components—rear view

---

## Audible Alarm Operations

Whenever there is an error condition, the audible alarm automatically sounds until all errors are corrected. You have the option of either muting or disabling the alarm. Using these options establish the following conditions:

- A disabled audible alarm *cannot sound*.
- Even when muted, *any new condition* causes the alarm to sound.

### Audible Alarm Patterns

The duration and number of times the audible alarm sounds, the sound pattern, is a function of the error condition type. See Table 5–1 for the duration and the approximate relationship of these alarms. The most severe, active error condition controls the alarm pattern.

**Table 5–1: Audible Alarm Sound Patterns**

Condition Type	Cycle 1	Cycle 2
<b>UNRECOVERABLE</b>		
<b>CRITICAL</b>	■ □ ■ □ ■ □	■ □ ■ □ ■ □
<b>NONCRITICAL</b>	■ □ ■ □	■ □ ■ □
<b>INFORMATION</b>	■ □	■ □

Legend ■ Alarm On □ Alarm Off

### Controlling the Audible Alarm

You can control the alarm with the pushbuttons. This includes muting, enabling, and disabling. When there is an error condition, the alphanumeric display is *Er*, the alarm sounds, and you can:

- Correct all errors, thereby silencing the alarm until a new error occurs.
- “Mute,” or *temporarily* disable, the alarm by pressing and holding the bottom pushbutton (see Figure 5–1). The alarm remains off until another error occurs, or until you enable (“unmute”) the alarm (see Figure 5–2). When a *new* error occurs, the alarm sounds and the pushbutton LED is off.

Using the mute feature ensures that you are aware of the more severe errors and provides you with the capability of correcting them promptly.

- Disable the alarm to prevent any error condition from sounding the alarm (see Figure 5–3).

**IMPORTANT:** Disabling the alarm does not prevent the EMU alphanumeric display from displaying Er. Nor does it prevent the HSV element manager from displaying the error condition report.

When the alarm is enabled (*on*), the bottom pushbutton LED is off.

## How to Mute or Unmute the Audible Alarm

When there is an error condition and you have determined that either:

- the error does not require implementing immediate corrective action,  
or
- you cannot implement corrective (for example, you require a replacement element)

You can mute audible alarm by completing the following procedure.

1. To mute the alarm press and hold the bottom pushbutton until the LED is on.

**LEGEND**

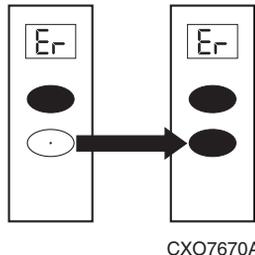
Press and Hold



Pushbutton LED off

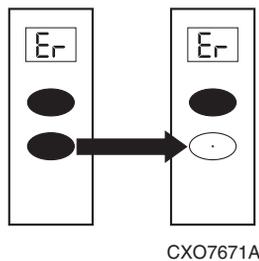


Pushbutton LED on

**Figure 5-1: Muting the audible alarm**

A muted alarm will remain off until there is a new condition report, or you unmute the alarm.

2. To unmute the alarm, press and hold the bottom pushbutton until the LED is off. When there is a new error condition, the alarm will sound.

**Figure 5-2: Unmuting the audible alarm**

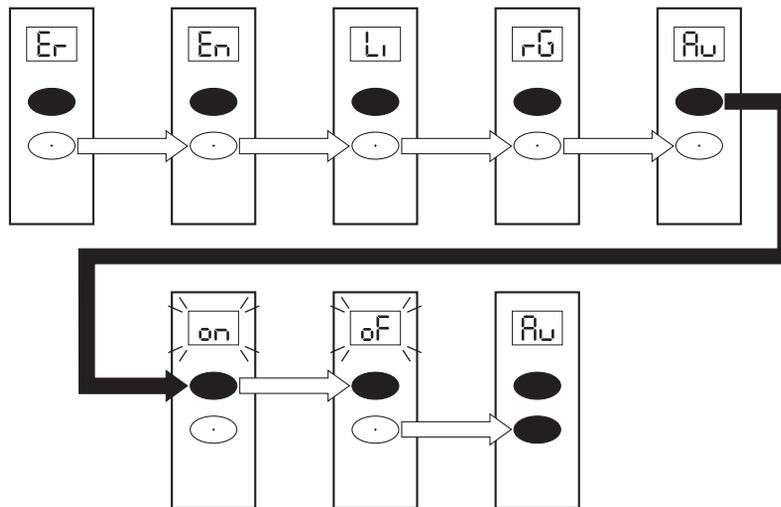
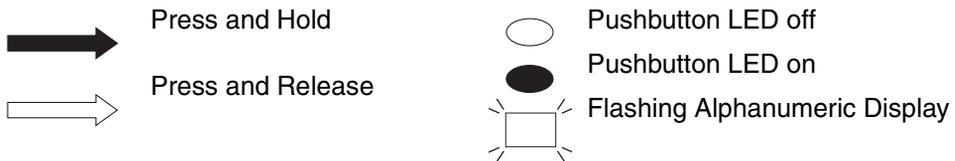
## How to Disable the Audible Alarm

Disabling the audible alarm affects only a single enclosure. This action does not affect condition report displays on either the EMU alphanumeric display nor the HSV element manager GUI.

Complete the following procedure to disable the alarm.

1. Press and release the bottom pushbutton until the alphanumeric display is *Au* (see Figure 5–3).

### LEGEND



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**Figure 5–3: Disabling the audible alarm**

2. Press and hold the top pushbutton until the alphanumeric display is a flashing *on* (Audible Alarm on).

**IMPORTANT:** When the alarm display is flashing, pressing and holding the top pushbutton causes the display to rapidly change between *on* and *oF*.

Pressing and releasing the top pushbutton causes the display to select the next state.

3. Press and release the top pushbutton to change the display to a flashing *oF* (Audible Alarm off).
4. Press and release the bottom pushbutton to accept the change and display *Au*. The bottom pushbutton LED is now on.



**CAUTION:** A disabled audible alarm (the bottom pushbutton LED is on) cannot sound for any error condition. All errors will be displayed on the HSV element manager GUI and the EMU alphanumeric display.

Compaq recommends that rather than disabling the audible alarm, you use the mute function (see the section titled “How to Mute or Unmute the Audible Alarm”).

When you use the disable function, you should enable the audible alarm as soon as possible (see the section titled “How to Enable the Audible Alarm”).

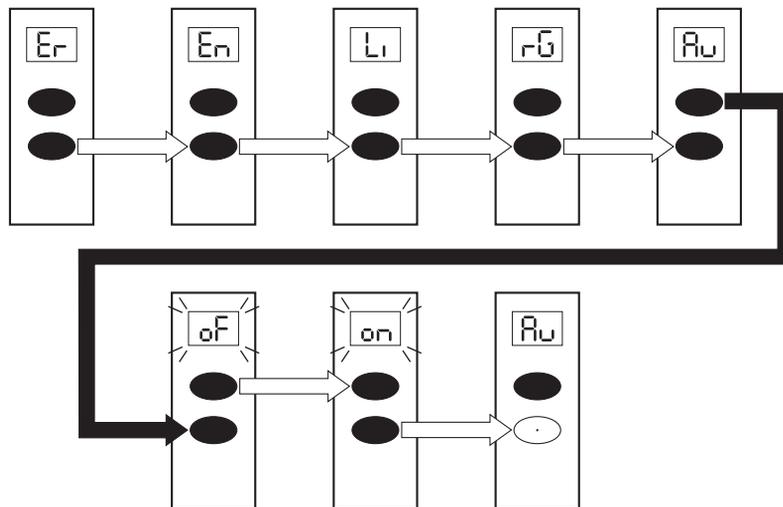
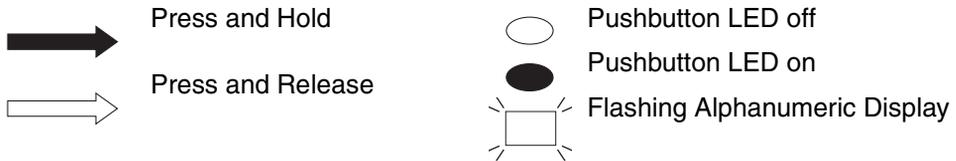
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## How to Enable the Audible Alarm

Complete the following procedure to enable the alarm.

1. Press and release the bottom pushbutton until the alphanumeric display is *Au* (see Figure 5-4).

### LEGEND



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**Figure 5-4: Enabling the audible alarm**

2. Press and hold the top pushbutton until the alphanumeric display is a flashing *oF* (Audible Alarm off)

**IMPORTANT:** When the alarm display is *flashing*, pressing and holding the top pushbutton causes the display to rapidly change between *on* and *oF*. Pressing and releasing the top pushbutton causes the display to select the next state.

3. Press and release the top pushbutton to change the display to a flashing *on* (Audible Alarm on).
4. Press and release the bottom pushbutton to accept the change and to display *Au*. The bottom pushbutton LED is now off.



---

## Using the Condition Reporting Feature

The EMU reports errors to the user by changing the alphanumeric display to *Er* and sounding the audible alarm. A condition report has precedence over all other displays.

**IMPORTANT:** An error is always generates a condition report. Not all condition reports are generated by errors.

### Condition Report Terminology

Each EMU detected condition generates a condition report containing the following information:

- Element type (et)
- Element number (en)
- Error code (ec)

Each condition report:

- Appears on the EMU alphanumeric display
- Sounds the audible alarm
- Is stored in the error queue
- Is provided to the HSV controller for processing and display on the HSV element manager.

The following sections define the condition types, condition reports, and the interaction between conditions.

## Enclosure and Element Conditions

The EMU constantly monitors enclosure and element operation and notifies the user of conditions that could affect operation. These errors are grouped according to their severity, into the following types:

- Unrecoverable condition
- Critical condition
- Noncritical condition
- Information condition

See Enterprise Virtual Array” for definitions of individual condition reports.

When the audible alarm is not muted or disabled, each condition generates a unique audible alarm as described in Chapter 5, “Audible Alarm Operations.”

### UNRECOVERABLE Condition

This most severe condition is active when one or more enclosure elements have failed and have disabled some enclosure functions. The enclosure may be incapable of correcting, or bypassing the failure, and requires repairs to correct the error.

This type condition requires immediate corrective action by the user.

An UNRECOVERABLE condition establishes the following conditions:

- This condition has precedence over CRITICAL and NONCRITICAL errors.
- This condition has precedence over INFORMATION condition.
- The audible alarm is on continuously, as shown in Table 5–1.



**CAUTION:** Compaq recommends implementing corrective action *immediately* for an UNRECOVERABLE condition to maintain data integrity.

---

### CRITICAL Condition

A CRITICAL condition is less severe than an UNRECOVERABLE condition. This condition occurs when one or more elements inside the enclosure 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. Other elements within the enclosure may be able to continue normal operations.

Prompt correction to prevent system degradation is recommended.

A **CRITICAL** condition establishes the following conditions:

- An **UNRECOVERABLE** condition has precedence over this condition.
- This condition has precedence over **NONCRITICAL** errors.
- This condition has precedence over **INFORMATION** condition.
- When this condition is the most severe condition active, the audible alarm sounds three times per alarm cycle, as shown in Table 5–1.

## **NONCRITICAL Condition**

A **NONCRITICAL** condition is less severe than either an **UNRECOVERABLE** condition or a **CRITICAL** condition. This condition occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of these elements *do 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 should other errors occur.

Early correction to prevent system degradation is recommended.

A **NONCRITICAL** condition establishes the following conditions:

- An **UNRECOVERABLE** condition has precedence over this condition.
- A **CRITICAL** condition has precedence over this condition.
- This condition has precedence over **INFORMATION** condition.
- When this condition is the most severe error active, the audible alarm sounds two times per alarm cycle, as shown in Table 5–1.

## INFORMATION Condition

This message advises you that a condition exists that does not reduce the capability of an element *at this time*. However, the condition can become an error and require corrective action. Effectively an INFORMATION condition provides you an early warning. This enables you to prepare to implement corrective action before an element fails.

- Correction of the reported problem may be delayed.
- An INFORMATION condition is the least severe of all the condition reports.
- When only an INFORMATION condition is active, the audible alarm sounds once per alarm cycle as shown in Table 5–1.

## Error Queue

The EMU stores each condition report in the error queue until the problem is corrected, or for at least 15 seconds after the error is reported. This ensures that when there are multiple errors or a recurring error, each can be displayed. The complete report is stored and you recall any report using a combination of the top and bottom pushbuttons. Correcting the error removes the condition report from the error queue.

Each report in the queue contains the element type, the element number, and the error code. To remove information from this queue requires either clearing the error or replacing the EMU.

The EMU displays the error queue information based on:

- The severity of the error
- The time of the error occurred

This hierarchical display ensures that the most severe errors have precedence over less severe errors. The earliest reported condition within an error type has precedence over errors reported later. For example, should there be errors at all levels the EMU displays them as follows:

1. UNRECOVERABLE errors in the sequence they occurred.
2. CRITICAL errors in the sequence they occurred.
3. NONCRITICAL errors in the sequence they occurred.
4. INFORMATION condition in the sequence they occurred.

**IMPORTANT:** When you are viewing an error, the occurrence of a more severe error takes precedence and the display changes to the most severe error.

The most severe error in the queue always has precedence, regardless of how long less severe errors have been in the queue.

## Condition Report Format

Each condition report identifies the element affected (type and number), and the primary problem (the error code). Appendix A, “Analyzing Condition Reports,” provides detailed information about each condition report, to include recommended corrective actions.

- **Element Type**  
This two-digit *hexadecimal* display defines the element type reporting the problem. The format for this display is *e.t.* with a period after each character. *0.1.* through *F.F.* are valid element types.
- **Element Number**  
The second display is a two-digit *decimal number* that defines the element reporting the problem. The format for this display is *en.* with a period after the second character.
- **Error Code**  
The third display is a two-digit *decimal number* that defines the specific error code. The format for this display is *ec* without any periods.

## Navigating the Error Display

An active error changes the alphanumeric display to *Er* and activates the error menu. The pushbutton functions are now dedicated to error display.

For example, should the following conditions exist:

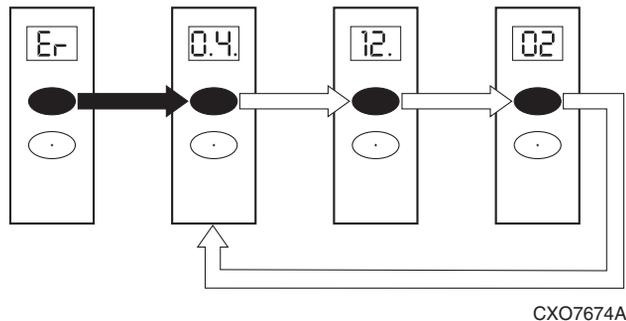
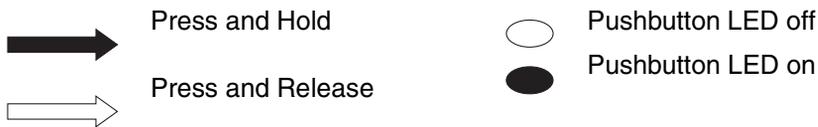
- There high temperature CRITICAL condition for the disk drive in bay 9.
- There is a EMU NVRAM write failure NONCRITICAL condition.

As soon as one of these conditions is reported the alphanumeric display is *Er*, the top pushbutton LED is on, and the audible alarm is beeping three times per cycle.

Refer to Figure 6–1 and complete the following procedure to analyze the disk drive condition report.

1. To move from the error display to the element type (temperature sensor) display, press and hold the top pushbutton.

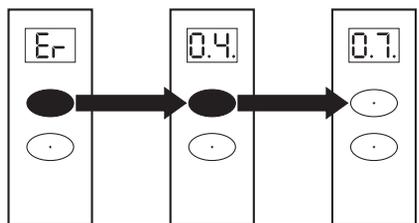
### LEGEND



**Figure 6–1: Displaying a disk drive CRITICAL high temperature condition**

2. To move from the temperature sensor element type display to the element number 12 display (disk drive 9), press and release the top pushbutton.

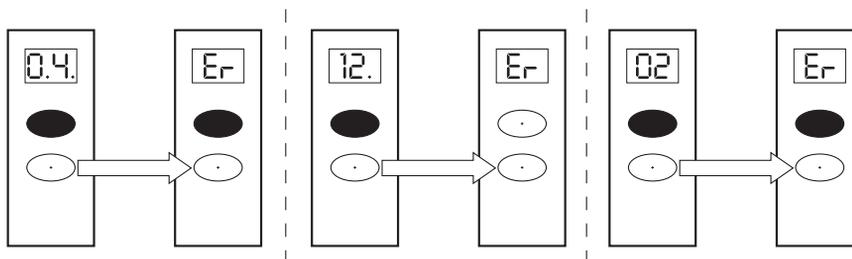
3. To move from the disk drive 9 element display to the error code (CRITICAL high temperature) display, press and release the top pushbutton.
4. To move from the error code back to the element type, press and release the top pushbutton.
5. Pressing and holding the top pushbutton allows you to move from either the element type display, the element number display, or the error code display to the next most severe element type display, the EMU.



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**Figure 6–2: Moving between element types**

6. Pressing and releasing the bottom pushbutton (see Figure 6–3) allows you to move from either the element type display, the element number display, or the error code display directly to the *Er* display.



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**Figure 6–3: Moving to the Er display group**

## **Condition Report Analysis**

As described in Enterprise Virtual Array,” condition report analysis involves:

1. Identifying the element.
2. Determining the major problem.
3. Defining additional problem information.

---

## Using the Loop ID Feature

This chapter describes how the Fibre Channel addresses (AL\_PAs) are assigned and defines the available hexadecimal addresses. This information *is not required* to operate a FC-AL drive enclosure. This section does not provide a detailed analysis of processes involved in assigning addresses to storage devices.

**IMPORTANT:** The EMU has the capability of requesting a new loop ID for the first bay in an enclosure. Implementing this option in an Enterprise Storage System may cause problems. Therefore, procedures for recommending different loop IDs are not documented.

### Loop ID Overview

Fibre Channel arbitrated loop physical addresses (AL\_PAs), are assigned *by arbitration* and usually will not change. The loop ID is a hexadecimal number that identifies the recommended AL\_PA. By selecting loop ID (*Li*) and then pressing and releasing the top pushbutton you can view the enclosure bay 1 loop ID.

The first initialization of the Enterprise Virtual Array usually assigns loop IDs sequentially to every bay in an enclosure, including bays with a disk drive blank. This sequential assignment depends on when the drives initialize.

Adding or replacing drives requires additional negotiation that may not result in sequential loop IDs within an enclosure.

## Assigning FC-AL Addresses

Fibre Channel takes a flexible approach to address assignment and management by eliminating the need to manually set any address. The interconnecting topology or the ports associated with a topology actually assign the addresses. The topology routing information also manages the assignment of addresses.

**IMPORTANT:** Physically moving a device could cause the address associated with a port to change. To ensure positive identification of each port, Fibre Channel requires each node to also have a Fibre Channel name.

Fibre Channel addresses (AL\_PAs) are not *permanently* assigned to a specific device or enclosure bay. Each time the loop is initialized, all the addresses are assigned, based on multiple factors.

## SCSI Bus and Fibre Channel Addressing Differences

There are significant differences between SCSI and Fibre Channel addressing including:

- Topology (the scheme for connecting devices)
- Available addresses
- Address assignment

SCSI uses a multi-drop bus interconnection topology that limits the user to the characteristics provided by a specific interconnect (for example, SCSI, Fast SCSI, Ultra SCSI, Ultra2 SCSI, Ultra3 SCSI, single-ended, low voltage differential, and so on). The maximum number of addresses available per bus is 16. With two addresses reserved for controllers, this limits the number of storage devices per bus to 14. The SCSI bus addresses are typically assigned based upon the physical location of a storage device in an enclosure. A device address changes only when:

- A device is moved to a different physical location.
- When the bus configuration is changed between single- and dual-bus.

Unlike SCSI, Fibre Channel can use multiple topologies (point-to-point, switched fabric, or arbitrated loop). The discussions in this user guide are limited to the arbitrated loop topology.

Any arbitrated loop can use from 2 to 127 addresses (corresponding to loop IDs 0 through 126). However, because each port on the loop causes a signal delay, using fewer than 127 devices tends to improve performance.

**NOTE:** There must be a minimum of two devices in a loop, a transmitter and a receiver. Loop IDs 7C, 7D, 7E are reserved and not available for assignment to a storage device.

Unlike the SCSI bus ID, which is fixed by the physical location of a storage device in an enclosure, the Fibre Channel physical address is temporary. The AL\_PA is negotiated each time the Enterprise Virtual Array initializes.

## Address Assignment Overview

All address assignments, except the Fibre Channel names, are made automatically by the arbitrated loop protocol. By setting the loop ID you enable the EMU to recommend an AL\_PA for each drive.

## Fibre Channel Names

The unique names assigned to each drive enclosure backplane, the EMU, and to each drive during manufacture are sometimes referred to as Fabric\_Name, Port\_Name, World Wide Name (WWN), or world wide ID (WW ID). This name does not change. Fibre Channel uses this name to identify a specific device to include its physical location. The enclosure WWN is also associated with the EMU. The EMU does not have its own unique WWN. Fibre Channel automatically associates an address with each Fibre Channel drive or enclosure name at initialization.

**NOTE:** Compaq uses the term World Wide Name, or WWN, in the Enterprise Virtual Array user documentation.

## Arbitrated Loop Physical Addresses

**IMPORTANT:** The AL\_PA and the loop ID are not the same. These are two different addresses referring to the same Fibre Channel name.

The loop IDs are a *recommendation* to assign a specific AL\_PA to a specific bay. The allocated AL\_PA is the actual, negotiated address.

The arbitrated loop physical address (AL\_PA) is a one-byte (8-bit) value that identifies a port in the arbitrated loop topology. This is the device address used by Fibre Channel loop. The AL\_PAs have a range of consecutive, but not contiguous, values between *00* and *EF* (hexadecimal notation). The valid values were chosen to improve certain types of error detection on the Fibre Channel bus.

## Loop ID

The EMU can recommend a preferred loop ID in the range is *00* through *7E* (hexadecimal notation). However, selecting, requesting, and assigning a preferred loop ID during initialization is a complex process. The drive is not obligated to honor these recommendations. When the recommended AL\_PA is already in use, the drive will negotiate for the first available AL\_PA.

Therefore, initially each drive has the loop ID *7F* to indicate that the EMU is not recommending an AL\_PA. The drive will then negotiate for the first available AL\_PA starting with bay 1 in each enclosure, based upon the sequence in which the drives spin up.

You can use the *Li* function to determine the loop ID assigned to bay 1 in each drive enclosure as described in the section titled “How to View the Loop ID.”

## How to View the Loop ID

You can determine the bay 1 loop ID of an enclosure by completing the following procedure.

**IMPORTANT:** All the examples for navigating the alphanumeric display are for En 06 and a loop ID of 18.

1. Press and release the bottom pushbutton until the alphanumeric display is *Li* (see Figure 7-1).
2. Press and release the top pushbutton to display the loop ID, *18*.
3. To exit the loop ID display, press and release the bottom pushbutton. The display will now be *Li*.

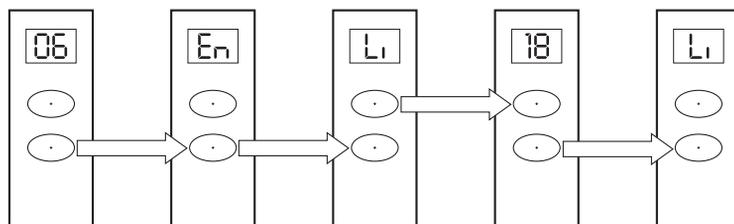
### LEGEND



Press and Release



Pushbutton LED off



CXO7700A

**Figure 7-1: Viewing the loop ID**



**CAUTION:** Although the EMU has the capability of recommending a different loop ID, Compaq does not recommend using this feature for an Enterprise Storage System.



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## Using the Reporting Group Feature

A Reporting Group (rG) is a controller pair and the associated drive enclosures. The controller pair *automatically assigns* a unique four-digit Reporting Group Number (RGN) to each EMU on an FC-AL loop. Each EMU collects environmental information from the associated enclosure and broadcasts the information to reporting group members using the enclosure address bus. Information from enclosures in other reporting groups is ignored.

The reporting group feature provides a means of segregating, identifying, categorizing, isolating, and separating controller enclosure and drive enclosure environmental information. The feature does not use the FC-AL bus—the “in-band” communications. Instead this feature uses “out-of-band” communications.

**IMPORTANT:** The EMU has the capability of requesting a different RGN for an enclosure. Implementing this option in an Enterprise Storage System may cause problems. Therefore, procedures for requesting a different RGN are not documented.

### Reporting Group Numbers

The reporting group number (RGN) range is *0000* through *4099*, decimal.

- *0000* is reserved for enclosures that are not part of any reporting group, a JBOD configuration.
- *0001* through *0015* are RGNs reserved for use by the EMU. When entered by the user, they default to *0000*.
- *0016* through *4095* are valid RGNs.
- *4096* through *4099* are invalid RGNs. When entered by the user, they default to *4095*.

The reporting group numbers are displayed on the EMU alphanumeric display as a pair of two-digit displays. These two displays are identified as *rH* and *rL*.

- Valid *rH* displays are in the range *00* through *40*, and represent the high-order (most significant) two-digits of the RGN.

- Valid *rL* displays are in the range 00 through 99, and represent the low-order (least significant) two-digits of the RGN.

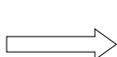
## How to View a Reporting Group Number

Complete the following procedure to view a reporting group number, such as 2553.

- Press and release the bottom pushbutton until the alphanumeric display is *rG*.

**IMPORTANT:** All the examples for navigating the alphanumeric display are for En 06 and a bay 1 loop ID of 18.

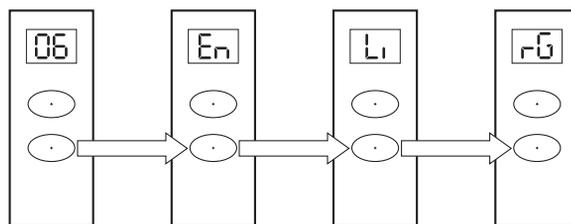
### LEGEND



Press and Release



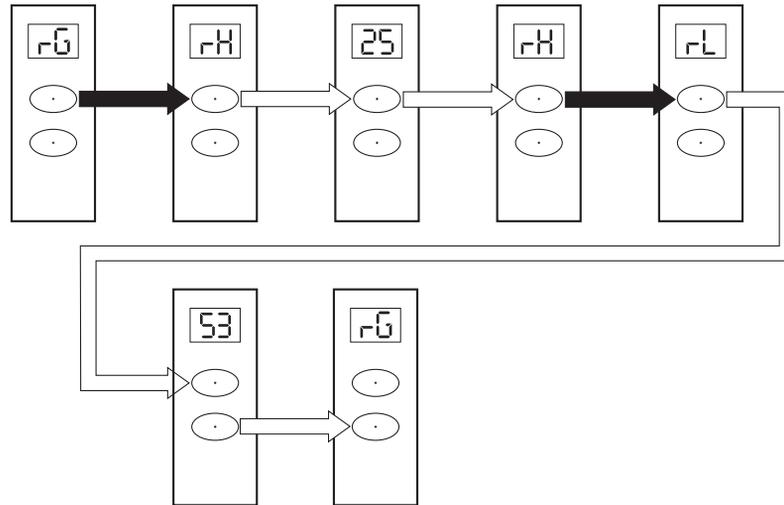
Pushbutton LED off



CXO7699A

**Figure 8–1: Selecting the display group rG.**

2. To display two most significant Reporting Group numbers press and hold the top pushbutton until the display is *rH*.



CXO7677A

### Figure 8–2: Displaying the Reporting Group

3. Press and release the top pushbutton to display the first two-digits of the RGN, 25.
4. Press and release the top pushbutton until the alphanumeric display is *rH*.
5. Press and hold the top pushbutton until the alphanumeric display is *rL*.
6. Press and release the top pushbutton to display the last two-digits of the RGN, 53.
7. To exit the display, press and release the bottom pushbutton until the alphanumeric display is *rG*.



---

## Analyzing Condition Reports

This appendix provides a description of the EMU generated condition reports that contain the following information:

- Element type (*et*), a hexadecimal number in the range *01* through *FF*.
- Element number (*en*), a decimal number in the range *00* through *99* that defines a probable cause of the problem.
- Error code (*ec*), a decimal number in the range *00* through *99*.
- The recommended corrective action.

**IMPORTANT:** The conventions used to differentiate between the elements of the condition report are:

- The element type has a period after each character.
- The element number has a period after the second character.
- The error code has no periods.

The EMU can send error messages to the controller for transmission to the HSV element manager graphical user interface (GUI). The messages displayed are HSV element manager specific and are not within the scope of this publication.

Included in this appendix are discussion of the condition report format, correcting problems, and how to identify element types. The error codes are arranged in element type sequence (that is, *0.1.*, *0.2.*, *0.3.*, and so forth).

## Condition Report Format

When the EMU alphanumeric display is Er, there are additional displays that identify the element type, the specific element, and the error code, which defines the possible cause of the problem.

- The first level display defines the type of element affected with two alphanumeric characters separated by periods such as *0.1.*, *0.2.*, *1.3.*, *FF.*, and so forth. A disk drive problem would display an element type number of *0.1.*
- The second level display defines the element affected with a two-digit, decimal number followed by a period. For example, when there is a bay 6 drive error, the element number display would be *06.*; a display of *14.* indicates a bay 14 problem.
- The third level display defines a specific problem, the error code with a two-digit, decimal number. For example, should the problem be either the installation of an incorrectly configured drive or one that cannot operate at the loop link rate, the display would be *01.*

## Correcting Errors

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

- Record the error code
- Implement the recommended corrective action.

## Element Types

Table A-1 lists the element type codes assigned to the drive enclosure elements. Elements that do not have an active condition report are shaded.

**Table A-1: Assigned Element Type Codes**

Code	Element
0.1.	Disk Drives (see Figure A-1 on page A-4)
0.2.	Power Supplies (see Figure A-2 on page A-9)
0.3.	Blowers (see Figure A-3 on page A-12)
0.4.	Temperature Sensors (see Table A-2 on page 18)
0.6.	Audible Alarm <sup>1</sup>
0.7.	EMU
0.C.	Controller OCP LCD <sup>1</sup>
0.F.	Transceivers (see Figure A-5 on page A-33)
1.0.	Language <sup>1</sup>
1.1.	Communication Port <sup>1</sup>
1.2.	Voltage Sensors (see Table A-2 on page 18)
1.3.	Current Sensors (see Table A-2 on page 18)
8.0	Drive Enclosure <sup>1</sup>
8.2.	Drive Enclosure Backplane
8.7.	I/O Modules (see Figure A-6 on page A-41)
F.F.	Host

1. A shaded element does not generate a condition report.

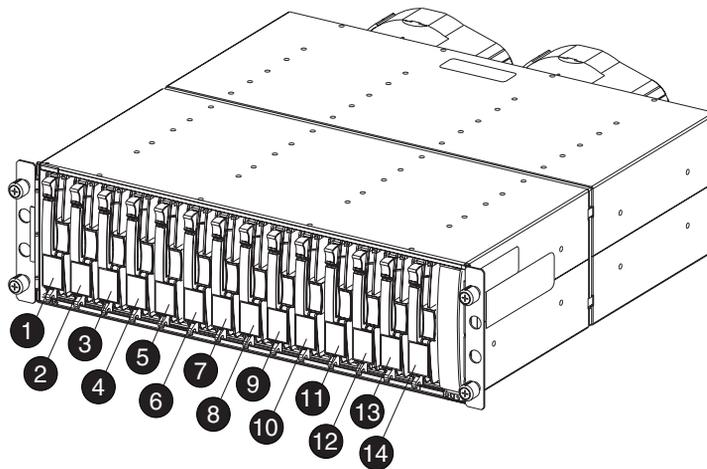
## Drive Conditions

The format of a disk drive condition report is *0.I.en.ec*, where:

- *0.I.* is the disk drive element type number
- *en.* is the two-character disk drive element (see Figure A-1)
- *ec* is the error code

**NOTE:** There is a direct correlation between the disk drive element number and the bay number.

There is no direct correlation between the disk drive bay number and the device FC-AL physical address. The FC-AL physical address is assigned by negotiation during system initialization.



CXO7375A

**Figure A-1: Drive bay and element numbering**

The following sections define the disk drive error codes.

## 0.1.en.01 CRITICAL Condition Drive Configuration, or Drive Link Rate

As each drive spins up and comes on-line, the EMU determines if the drive is Fibre Channel compatible and can operate at the link rate (1 Gbps or 2 Gbps) established by the I/O module. If either of these conditions are not met the EMU issues the condition report *0.1.en.01*.

This condition report remain active until the problem is corrected. The problem affects disk drive *en*. Therefore, correction to prevent the possible failure of other elements is not required.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the defective drive with:
  - A Fibre Channel compatible drive
  - A Fibre Channel drive capable of operating at a link rate supported by I/O modules and transceivers.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.1.en.02 INFORMATION Condition Drive Missing

The drive is improperly installed or missing. This could affect the enclosure air flow and cause an over temperature condition for another element.

- This error remains active for 1 minute, or until the problem is corrected, *whichever occurs first*.
- Immediate correction is not required. However, correction cannot be delayed indefinitely.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Remove and installing the drive to ensure that it is properly installed.
3. Observe the EMU to ensure the error is corrected.
4. If removing and installing the drive did not correct the problem, install a replacement drive or a drive blank.
5. Observe the EMU to ensure the error is corrected.
6. If unable to correct the problem, contact your Compaq Authorized Service Provider.

### **0.1.en.03 INFORMATION Condition Drive Software Lock Active**

Some enclosures have a software-activated lock that prevents physically removing a drive while this feature is active. This feature can be activated even when an enclosure does not have a physical lock. Removing a drive when this feature is active generates a condition report. This error remains active for 15 seconds.

There is no action required to correct this condition.

### **0.1.en.04 CRITICAL Condition Loop A Drive Link Rate Incorrect**

The drive is capable of operating at the loop link rate, but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Remove and replace the drive in the enclosure.
3. Observe the drive status LEDs to ensure the drive is operational.
4. Observe the EMU to ensure the error is corrected.
5. If removing and replacing the drive did not correct the problem, replace the drive.
6. Observe the drive status LEDs to ensure the drive is operational.
7. Observe the EMU to ensure the error is corrected.
8. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **0.1.en.05 CRITICAL Condition Loop B Drive Link Rate Incorrect**

The drive is capable of operating at the loop link rate but is running at a different rate. For example, the drive is operation at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem.

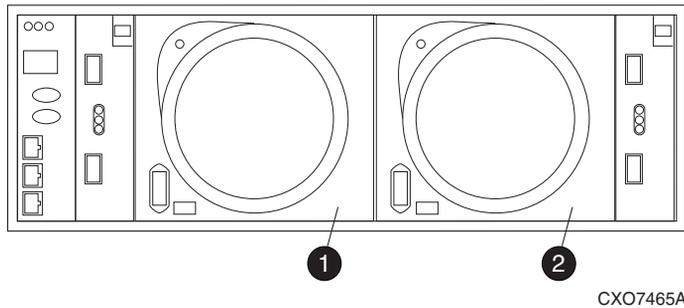
1. Record all six characters of the condition report.
2. Remove and replace the drive in the enclosure.
3. Observe the drive status LEDs to ensure the drive is operational.
4. Observe the EMU to ensure the error is corrected.
5. If removing and replacing the drive did not correct the problem, replace the drive.
6. Observe the drive status LEDs to ensure the drive is operational.
7. Observe the EMU to ensure the error is corrected.
8. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## Power Supply Conditions

The format of a power supply condition report is *0.2.en.ec*, where:

- *0.2.* is the power supply element type number
- *en.* is the two-character power supply element number
- *ec* is the error code

As shown in Figure A–2, power supply 1 is in location ❶, and power supply 2 is in location ❷.



**Figure A–2: Power supply element numbering**

The following sections define the power supply condition reports.

## **0.2.en.01 NONCRITICAL Condition Power Supply AC Input Missing**

The loss of the AC input to a power supply makes the remaining supply a single point of failure.

This condition report remains active until the AC power is applied to the power supply.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that there is AC power to the rack PDU, and from the PDU to the PDMs and that the PDU and PDM circuit breakers are not reset.  
If there is no AC power to the PDU, contact building facilities management.  
Verify that the power supply AC power cord is properly connected.
3. If AC is present, and the rack power distribution circuitry is functioning properly, the power supply LED should be on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.2.en.02 UNRECOVERABLE Condition

### Power Supply Missing

This condition report indicates a power supply is not installed or installed incorrectly. Both of these conditions affect air flow within the enclosure and can cause an over temperature condition. *Enclosure shutdown is imminent!*

The operational power supply will automatically shut down after 7 minutes, thereby disabling the enclosure. This condition report remains active until either the problem is corrected, or the operational power supply shuts down, *whichever occurs first*.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that the power supply is properly installed.
3. If the power supply is properly installed, replace the supply.
4. Verify that the power supply status LED is on.
5. Observe the EMU to ensure the error is corrected.
6. If unable to correct the problem, contact your Compaq Authorized Service Provider.



**CAUTION:** Removing power from an enclosure may cause the loss or corruption of data. To avoid this condition it may be necessary to shut down the system using either the HSV element manager GUI, or the controller shutdown procedure described in the *Enterprise Array HSV Controller User Guide*.

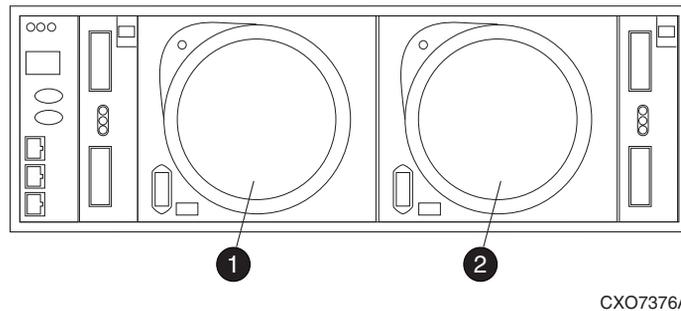
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## Blower Conditions

The format of a blower condition report is *0.3.en.ec*, where:

- *0.3.* is the blower element type number
- *en.* is the two-character blower element number
- *ec* is the error code

As shown in Figure A–3, blower 1 is in location ❶ and blower 2 is in location ❷.



**Figure A–3: Blower element numbering**



**CAUTION:** A single blower operating at high speed can provide sufficient air flow to cool an enclosure and the elements for up to 100 hours. However, operating an enclosure at temperatures approaching an overheating threshold can damage elements and may reduce the MTBF of a specific element. Immediate replacement of the defective blower is required.

---

The following sections define the power supply condition reports.

### **0.3.en.01 NONCRITICAL Condition Blower Speed**

A blower is operating a speed outside of the EMU specified range, possibly because of a bearing problem. This can affect enclosure cooling and cause an element to fail. This condition report remains active until the problem is corrected.

This error does not normally require immediate correction. However, an error of this type could contribute to an element overheating.

Compaq recommends replacing the blower as soon as possible.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that the blower is properly installed.
3. If the blower is properly installed, replace the supply.
4. Verify that the power supply status LED is on.
5. Observe the EMU to ensure the error is corrected.
6. If unable to correct the problem, contact your Compaq Authorized Service Provider.

### **0.3.en.02 CRITICAL Condition Blower Speed**

A blower is operating at a speed that is significantly outside the EMU specified range, possibly because of a bearing problem. This can cause the loss of cooling and cause an element to fail. The error remains active until the problem is corrected.

Compaq recommends replacing the blower as soon as possible.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the defective blower.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.3.en.03 UNRECOVERABLE Condition Blower Failure

A blower has stopped. The operational blower now operates a high speed and is a single point of failure. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the defective blower.



**CAUTION:** Removing a blower automatically closes flaps over the power supply blower opening. However, the air flow within the enclosure changes and can cause an over temperature condition.

Therefore, do not remove a defective blower until a replacement blower is available.

---

3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

### 0.3.en.04 NONCRITICAL Condition Blower Internal

A power supply reported an internal blower error which could affect enclosure cooling and cause an element to fail. Compaq recommends correcting the problem before the blower fails. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the defective blower.



**CAUTION:** Removing a blower automatically closes flaps over the power supply blower opening. However, the air flow within the enclosure changes and can cause an over temperature condition.

Therefore, do not remove a defective blower until a replacement blower is available.

---

3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.3.en.05 NONCRITICAL Condition Blower Missing

A blower has been removed or is improperly installed. Even though the blower flaps close to maintain the proper air flow, the reduced cooling capability can cause overheating, causing an element to fail. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that the blower is properly installed.
3. If the blower is properly installed, and not rotating, replace the blower, as described in *Enterprise Virtual Array Drive Enclosure User Guide*.



**CAUTION:** Removing a blower automatically closes flaps over the power supply blower opening. However, the air flow within the enclosure changes and can cause an over temperature condition.

Compaq recommends not removing defective blower until a replacement blower is available.

---

4. Verify that the power supply status LED is on.
5. Observe the EMU to ensure the error is corrected.
6. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.3.en.06 UNRECOVERABLE Condition

### No Blowers Installed

**IMPORTANT:** When this condition exists there will be two error messages.

The first message will be *0.3.en.05* and will identify the first blower.

The second message will be *0.3.en.06* and will identify the second blower.

The EMU cannot detect any installed blowers. *Shutdown is imminent!* The EMU will shut down the enclosure in *7 minutes* unless you correct the problem. This condition report remains active until you correct the problem or the EMU shuts down the power supplies, whichever occurs first.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace one blower *NOW!* Replace the other blower as soon as possible.
3. If no blower is available proceed to step 6.
4. Verify that the power supply status LED is on.
5. Observe the EMU to ensure the error is corrected.
6. If unable to correct the problem it may be necessary to use the controller shutdown procedure to:
  - Flush data from the controllers.
  - Issue a command to the EMUs to shut down after a 10–30 second delay.
  - Shut down the controllers.



**CAUTION:** Using the controller shutdown command is a drastic measure that will stop all Enterprise Virtual Array operations.

Compaq recommends using this procedure only when necessary to protect an enclosure from overheating.

---

7. Contact your Compaq Authorized Service Representative.

## Temperature Conditions

The format of a temperature condition report is *0.4.en.ec*, where:

- *0.4.* is temperature sensor element type
- *en.* is the two-character temperature sensor element
- *ec* is the error code

Refer to Table A–2 to determine the location of each temperature sensor.

**Table A–2: Temperature Sensor Element Numbering**

Sensor	Sensor Location	Sensor	Sensor Location
01.	Power Supply 1 Exhaust	10.	Drive Bay 7
02.	Power Supply 2 Exhaust	11.	Drive Bay 8
03.	EMU	12.	Drive Bay 9
04.	Drive Bay 1	13.	Drive Bay 10
05.	Drive Bay 2	14.	Drive Bay 11
06.	Drive Bay 3	15.	drive Bay 12
07.	Drive Bay 4	16.	Drive Bay 13
08.	Drive Bay 5	17.	Drive Bay 14
09.	Drive Bay 6		

The following sections list the temperature condition reports and the default temperature thresholds. Table A–3 defines the temperature sensor ranges for the disk drives, EMU, and power supplies.

**Table A–3: Element Temperature Sensor Thresholds**

	Disk Drive	EMU	Power Supply
<b>High Temperature Thresholds</b>			
<b>Limit</b>			
<b>CRITICAL</b>	60°C (140°F)	43°C (109°F)	60°C (140°F)
<b>NONCRITICAL</b>	55°C (131°F)	39°C (102°F)	50°C (122°F)
<b>Low Temperature Thresholds</b>			
<b>Limit</b>			
<b>CRITICAL</b>	5°C (41°F)		
<b>NONCRITICAL</b>	9°C (48°F)		

## 0.4.en.01 NONCRITICAL Condition High Temperature

This condition report indicates that an element temperature is approaching, but has not reached, the high temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that all elements are properly installed to maintain proper air flow.
3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.
4. Ensure that both blowers are operating properly (the LEDs are on) and neither blower is operating at high speed. Replace a defective blower.
5. Verify that the ambient temperature range is +10°C to +35°C (+50°F to +95°F). Adjust as necessary.
6. Observe the EMU to ensure the error is corrected.
7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **0.4.en.02 CRITICAL Condition High Temperature**

This condition report indicates that an element temperature is above the high temperature CRITICAL threshold. Continued operation under these conditions may result in element failure and may reduce an element MTBF. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Ensure that all elements are properly installed to maintain proper air flow.
3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.
4. Ensure that both blowers are operating properly (the LEDs are on) and neither blower is operating at high speed. Replace a defective blower
5. Verify that the ambient temperature range is +10°C to +35°C (+50°F to +95°F). Adjust as necessary.
6. Observe the EMU to ensure the error is corrected.
7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **0.4.en.03 NONCRITICAL Condition Low Temperature**

This condition report indicates that an element temperature is approaching, but has not reached, the low temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Verify that the ambient temperature range is +10°C to +35°C (+50°F to +95°F). Adjust as necessary.
3. Observe the EMU to ensure the error is corrected.
4. If the ambient temperature is correct and the problem persists, contact your Compaq Authorized Service Provider.

## **0.4.en.04 CRITICAL Condition Low Temperature**

This condition report indicates that an element temperature has reached the low temperature CRITICAL threshold. Compaq recommends correcting this error to prevent affecting other elements. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Verify that the ambient temperature range is +10°C to +35°C (+50°F to +95°F). Adjust as necessary.
3. Observe the EMU to ensure the error is corrected.
4. If the ambient temperature is correct and the problem persists, contact your Compaq Authorized Service Provider.

## 0.4.en.05 UNRECOVERABLE Condition High Temperature

This condition report indicates that the EMU has evaluated the temperature of the three temperature groups (EMU, disk drives, and power supplies), and determined that the average temperature of two of the three groups exceeds the critical level (see Table A-3). Under these conditions the EMU starts a timer that will automatically shut down the enclosure in 7 minutes unless you correct the problem.  
*Enclosure shutdown is imminent!*

Complete the following procedure to correct this problem.

1. Ensure that all disk drive, I/O module, and power supply elements are fully seated.
2. Ensure that all blowers are operating properly.
3. Verify that the ambient temperature range is +10°C to +35°C (+50°F to +95°F).  
Adjust as necessary.
4. If neither Steps 1, 2 or 3 revealed a problem, use the HSV element manager to request the HSV controller to shut down the drive enclosure. Completing this action will halt the drive enclosure data transfers.
5. Contact your Compaq Authorized Service Provider and request assistance.

## EMU Conditions

The format of an EMU condition report is *0.7.01.ec*, where:

- *0.7.* is the EMU element type number
- *01.* is the two-character EMU element number
- *ec* is the error code

**IMPORTANT:** There is only one EMU in a drive enclosure. Therefore, the element number is always 01.

## Resetting the EMU

In some cases, the only corrective action for an EMU error is to replace the EMU, as described in *Enterprise Virtual Array Drive Enclosure User Guide*. Another option is to reset the EMU using the following procedure.

1. Firmly grasp the EMU mounting handle and pull the EMU partially out of the enclosure.

**IMPORTANT:** You do not need to remove the EMU from the enclosure, nor to disconnect the cables. You must avoid putting any strain on the cables or connectors.

2. Wait 30 seconds, and then push the EMU in and fully seat the element in the backplane. The EMU should display any enclosure condition report within two minutes.

## **07.01.01 CRITICAL Condition EMU Internal Clock**

There is an internal EMU clock error that will remain active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. If resetting the EMU did not correct the problem, replace the EMU:
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **07.01.02 UNRECOVERABLE Condition EMU Communications Interrupted**

The Inter-IC (I2C) bus is not processing data and the EMU is unable to monitor or report the status of the elements or enclosures. *IMMEDIATE* corrective action is required to ensure proper enclosure operation. This condition report remains active until the problem is corrected.

Complete the following procedure *NOW* to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, replace the EMU
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

### **0.7.01.03 UNRECOVERABLE Condition Power Supply Shutdown**

This message only appears on the HSV element manager GUI to report a power supply has already shut down. This message can be the result of the controller shutdown command or an EMU or power supply initiated power shutdown.

This message cannot be displayed until after restoration of power. Therefore, there is no corrective action required.

### **0.7.01.04 INFORMATION Condition EMU Internal Data**

The EMU is unable to collect data for the SCSI-3 Engineering Services (SES) page. This condition report remains active for 15 seconds. The condition report affects only internal EMU operations. There is no degradation of enclosure operations.

The EMU initiates automatic recovery procedures.

If the problem is not automatically corrected after one minute, replace the EMU.

### **0.7.01.05 UNRECOVERABLE Condition Backplane NVRAM**

**IMPORTANT:** Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

When a backplane NVRAM is not programmed or cannot be read by the EMU, there is no communication with the disk drives. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, replace the EMU.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.7.01.10 NONCRITICAL Condition NVRAM Invalid Read Data

The data read from the EMU NVRAM is invalid. This error initiates an automatic recovery process. This condition report remains active until the problem is corrected.

If the automatic recovery process does not correct the problem, complete the following procedure.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, initialize the enclosure by:
  - a. Removing power from the enclosure.
  - b. Applying power to the enclosure.
5. Observe the EMU to ensure the error is corrected.
6. If initializing the enclosure did not correct the problem, replace the EMU, as described in *Enterprise Virtual Array Drive Enclosure User Guide*.
7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **0.7.01.11 NONCRITICAL Condition EMU NVRAM Write Failure**

The EMU cannot write data to the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, initialize the enclosure by:
  - a. Removing power from the enclosure.
  - b. Applying power to the enclosure.
5. Observe the EMU to ensure the error is corrected.
6. If initializing the enclosure did not correct the problem, replace the EMU,
7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.7.01.12 NONCRITICAL Condition EMU Cannot Read NVRAM Data

The EMU is unable to read data from the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, initialize the enclosure by:
  - a. Removing power from the enclosure.
  - b. Applying power to the enclosure.
5. Observe the EMU to ensure the error is corrected.
6. If initializing the enclosure did not correct the problem, replace the EMU, as described in *Enterprise Virtual Array Drive Enclosure User Guide*.
7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.7.01.13 UNRECOVERABLE Condition EMU Load Failure

The EMU Field Programmable Gate Array (FPGA) that controls the ESI bus failed to load information required for EMU operation. This condition report remains active until the problem is corrected.

Complete the following procedure *NOW* to correct this problem.

1. Record all six characters of the condition report.
2. Reset the EMU.
3. Observe the EMU to ensure the error is corrected.
4. If resetting the EMU did not correct the problem, initialize the enclosure by:
  - a. Removing power from the enclosure.
  - b. Applying power to the enclosure.
5. Observe the EMU to ensure the error is corrected.
6. If initializing the enclosure did not correct the problem, replace the EMU, as described in *Enterprise Virtual Array Drive Enclosure User Guide*.
7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 0.7.01.14 NONCRITICAL Condition EMU Enclosure Address

Either the enclosure address is incorrect or the enclosure has no address. Possible causes include a defective enclosure address bus cable, an incorrectly connected cable, or a defective enclosure address bus JB. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Remove and reconnect the cable between the address bus JB and the EMU.

**NOTE:** The EMU display may not display a change in condition for up to 30 seconds.

3. Observe the EMU to ensure the error is corrected.
4. If the problem is not corrected, remove and reinstall the bottom and top terminators, and all the JB-to-JB cables.
5. Observe the EMU to ensure the error is corrected.
6. Reset the EMU.
7. Observe the EMU to ensure the error is corrected.
8. If resetting the EMU did not correct the problem, replace the EMU, as described in *Enterprise Virtual Array Drive Enclosure User Guide*.
9. If unable to correct the problem, contact your Compaq Authorized Service Provider.

### **0.7.01.15 UNRECOVERABLE Condition EMU Hardware Failure**

The EMU is inoperative and must be replaced *NOW!* This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the EMU, as described in *Enterprise Virtual Array Drive Enclosure User Guide*.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

### **0.7.01.16 INFORMATION Condition EMU Internal ESI Data Corrupted**

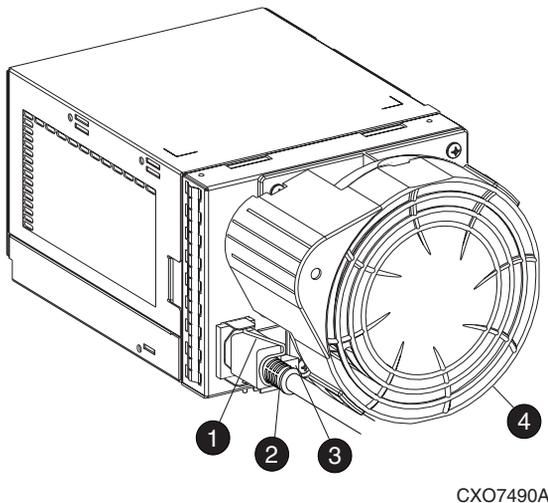
The EMU ESI data is corrupted. This does not affect any other element and there is no action required.

## 0.7.01.17 UNRECOVERABLE Condition Power Supply Shutdown Failure

The power supply did not respond to a controller, EMU, or power supply shut down command. Shutting down the supply is required to prevent overheating.

Complete the following procedure to correct the problem.

1. Record all six characters of the condition report.
2. Move the power cord bail lock ❶, Figure A-4, to the left.
3. Disconnect the AC power cord ❷ from the supply.



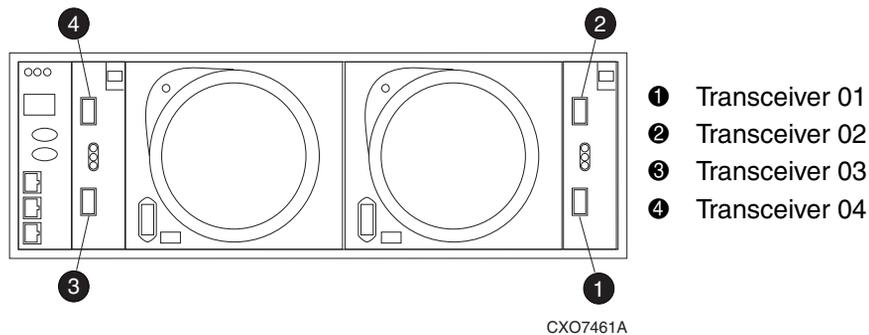
CXO7490A

**Figure A-4: Disconnecting AC power**

## Transceiver Conditions

The format of a transceiver condition report is *0.F.en.ec*, where:

- *0.F.* is the transceiver element type number
- *en.* is the two-character transceiver element number (see Figure A–5)
- *ec* is the error code



**Figure A–5: Transceiver element numbering**

### 0.F.en.01 CRITICAL Condition Transceiver Incompatibility

The transceiver on this link are not the same type or they are incompatible with the I/O module. This error prevents the controller from establishing a link with the enclosure drives and eliminates the enclosure dual-loop capability. This error remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Check all the transceivers on the loop to ensure they are I/O module compatible.
3. Replace any incompatible transceivers.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **0.F.en.02 CRITICAL Condition Transceiver Data Signal Lost**

The transceiver can no longer detect a data signal. This error prevent the controller from transferring data on a loop and eliminates the enclosure dual-loop capability. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the transceiver cable.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **0.F.en.03 CRITICAL Condition Transceiver FC-AL Bus Fault**

The system has detected an FC-AL bus fault involving a transceiver. This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Check all the transceivers and cables to ensure they are properly connected.
3. Check all the transceivers on the loop to ensure they are I/O module compatible.
4. Replace any incompatible transceivers.
5. Observe the EMU to ensure the error is corrected.
6. Replace the input cable.
7. If replacing the cable did not correct the problem, replace both transceivers attached to the cable.
8. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## Voltage Sensor and Current Sensor Conditions

The format of these sensor condition reports is *1.2.en.ec* for a voltage sensor, and *1.3.en.ec* for a current sensor, where:

- *1.2.* is the voltage sensor element type
- *1.3.* is the current sensor element type number
- *en.* is the sensor element number
- *ec* is the error code

Table A–4 lists the location of the power supply voltage and current sensors.

**Table A–4: Voltage and Current Sensor Locations**

Sensor	Sensor Element Location
01.	Power Supply 1 +5 VDC
02.	Power Supply 1 +12 VDC
03.	Power Supply 2 +5 VDC
04.	Power Supply 2 +12 VDC

Table A–5 list the voltage and current error thresholds for both +5 VDC and +12 VDC power supplies.

**Table A–5: Voltage and Current Sensor Thresholds**

	+5 VDC	+12 VDC
<b>High Voltage Thresholds</b>		
<b>Nominal Voltage</b>	+5.40 VDC	+12.50 VDC
<b>Limit</b>	+5.73 VDC	+13.25 VDC
<b>CRITICAL</b>		
<b>NONCRITICAL</b>	+5.67 VDC	+13.13 VDC
<b>Low Voltage Thresholds</b>		
<b>Nominal Voltage</b>	+5.40 VDC	+12.50 VDC
<b>Limit</b>	+5.08 VDC	+11.75 VDC
<b>CRITICAL</b>		
<b>NONCRITICAL</b>	+5.13 VDC	+11.88 VDC

**Table A-5: Voltage and Current Sensor Thresholds (Continued)**

	+5 VDC	+12 VDC
<b>Current Thresholds</b>		
<b>Nominal Current</b>	16 A	20A
<b>Limit</b>	24A	26.5A
<b>CRITICAL</b>		
<b>NONCRITICAL</b>	20A	22.5A

## 1.2.en.01 NONCRITICAL Condition High Voltage

This condition report indicates that an element voltage is approaching, but has not reached, the high voltage **CRITICAL** threshold. Continued operation under these conditions may result in a **CRITICAL** condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the supply.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **1.2.en.02 CRITICAL Condition High Voltage**

This condition report indicates that an element voltage has reached the high voltage CRITICAL threshold. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the supply.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **1.2.en.03 NONCRITICAL Condition Low Voltage**

This condition report indicates that an element voltage is approaching, but has not reached, the low voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the supply.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **1.2.en.04 CRITICAL Condition Low Voltage**

This condition report indicates that an element voltage has reached the high voltage CRITICAL threshold. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the supply.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **1.3.en.01 NONCRITICAL Condition High Current**

This condition report indicates that an element current is approaching, but has not reached, the high current CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the supply.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **1.3.en.02 CRITICAL Condition High Current**

This condition report indicates that an element current has reached the high current CRITICAL threshold. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the supply.
3. Verify that the power supply status LED is on.
4. Observe the EMU to ensure the error is corrected.
5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## Backplane Conditions

**IMPORTANT:** Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

The format of a backplane condition report is *8.2.01.ec*, where:

- *8.2.* is the backplane element type number
- *01.* is the two-character backplane element number
- *ec* is the error code

The only corrective action available for this type error is to replace the drive enclosure.

### 8.2.01.10 NONCRITICAL Condition Backplane NVRAM Read

An invalid NVRAM read occurred and an automatic recovery process has begun. This condition report is active for 15 seconds.

If the automatic recovery process does not correct the problem, complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Contact your Compaq Authorized Service Provider.

### 8.2.01.11 NONCRITICAL Condition Backplane NVRAM Write Failure

The system is unable to write data to the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Contact your Compaq Authorized Service Provider.

## 8.2.01.12 NONCRITICAL Condition

### Backplane NVRAM Read Failure

The system is unable to read data from the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

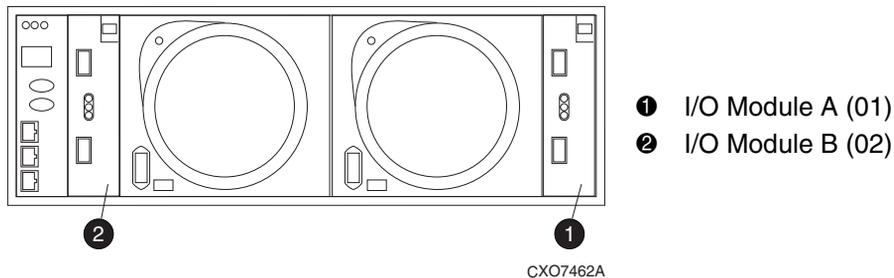
Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Contact your Compaq Authorized Service Provider.

## I/O Module Conditions

The format of an I/O module condition report is *8.7.en.ec*, where:

- *8.7.* is the I/O module element type number
- *en.* is the two-character I/O module element number (see Figure A-6)
- *ec* is the error code



**Figure A-6: I/O module element numbering**

Correction of an I/O module problem normally requires replacing the module. The following sections define the I/O module problem by I/O module location.

## 8.7.en.01 CRITICAL Condition I/O Module Unsupported

The I/O module Fibre Channel link speed is not supported by the backplane. This error prevents the controller from establishing a link with enclosure drives and eliminates the enclosure dual-loop capability. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Install a backplane Fibre Channel link speed compatible I/O module.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 8.7.en.02 CRITICAL Condition I/O Module Communication

The I/O module is unable to communicate with the EMU.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Remove and reinsert the I/O module.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

**IMPORTANT:** Multiple erroneous error messages indicating I2C bus errors, such as NVRAM errors, blowers missing, and so forth, could indicate an EMU problem.

Replace the EMU when there are multiple erroneous error messages.

## **8.7.en.10 NONCRITICAL Condition I/O Module NVRAM Read**

An invalid NVRAM read occurred and automatic recover was initiated.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Observe the I/O module status LEDs for a an operational display.  
Replace the I/O module when there is an error status.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## **8.7.en.11 NONCRITICAL Condition I/O Module NVRAM Write Failure**

The system is unable to write data to the I/O module NVRAM.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Observe the I/O module status LEDs for a an operational display.  
Replace the I/O module when there is an error status.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## 8.7.en.12 NONCRITICAL Condition I/O Module NVRAM Read Failure

The system is unable to read data from the I/O module NVRAM.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.
2. Replace the I/O module.
3. Observe the EMU to ensure the error is corrected.
4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

## Host Conditions

The EMU has the capability of displaying host controller defined condition reports on the EMU alphanumeric display.

The format of a host condition report is *F.F.en.ec*, where:

- *F.F.* is the host element type number
- *en.* is the two-character host element number
- *ec* is the error code

The host controller can display host controller defined error codes on the EMU alphanumeric display

## F.F.en.01 INFORMATION Condition Host Generated

The host controller (HSV) defines the error type and the affected elements. These messages may be displays on the HSV element manager GUI. The proper corrective action is element and error dependent.

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# Glossary

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

## **µm**

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

## **3U**

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

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

## **active virtual disk**

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

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

## **adapter**

*See* **controller**.

## **AL\_PA**

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

### **allocation policy**

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

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

### **ambient temperature**

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

### **ANSI**

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

### **arbitrated loop**

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

### **arbitrated loop physical address**

*See* **AL\_PA**.

### **arbitrated loop topology**

*See* **arbitrated loop**.

### **array**

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

### **array controller**

*See* **controller**.

**asynchronous**

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

**audible alarm**

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

**backplane**

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

**bad block**

A data block that contains a physical defect.

**bad block replacement**

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

**bail lock**

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

**baud**

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

**bay**

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

### **bidirectional**

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

### **block**

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

### **blower**

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

### **cabinet**

An alternate term used for a rack.

### **cable assembly**

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

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

### **CAC**

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

### **cache**

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

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

**cache battery**

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

**cache battery LED**

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

**carrier**

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

**client**

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

**communication logical unit number (LUN)**

See console LUN.

**Compaq SANWorks™ HSV Element Manager**

See HSV Element Manager.

**Compaq StorageWorks**

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

**condition report**

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

### **console LUN**

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

### **console LUN ID**

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

*See also* **console LUN**.

### **controller**

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

### **controller enclosure**

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

### **controller event**

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

### **controller fault LED**



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

### **controller heartbeat LED**



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

### **controller pair**

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

**corrective action code**

*See CAC.*

**CRITICAL Condition**

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

**CRU**

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

**customer replaceable unit**

*See CRU.*

**data entry mode**

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

**default disk group**

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

*See also disk group.*

**Detailed Fault View**

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

**device channel**

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

**device ports**

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

**device-side ports**

*See* **device ports**.

**DIMM**

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

**dirty data**

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

**disk drive**

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

**disk drive blank**

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

**disk drive enclosure**

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

**disk drive enclosure event**

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

**disk failure protection**

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

**disk group**

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

**disk migration state**

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

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

**disk replacement delay**

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

**drive blank**

*See* **disk drive blank**.

**drive enclosure**

*See* **disk drive enclosure**.

**dual-loop**

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

**dual power supply configuration**

*See* **redundant power configuration**.

**EIA**

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

## **EIP**

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

## **electromagnetic interference**

See **EMI**.

## **electrostatic discharge**

See **ESD**.

## **element**

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

## **Element Manager GUI**

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

## **EMI**

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

## **EMU**

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

## **enclosure**

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

**enclosure address bus**

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

**enclosure services**

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

**Enclosure Services Interface**

See **ESI**.

**Enclosure Services Processor**

See **ESP**.

**Enterprise Virtual Array**

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

**Enterprise Virtual Array rack**

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

See *also* **rack**.

**environmental monitoring unit**

See **EMU**.

**error code**

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

**ESD**

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

**ESI**

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

**ESP**

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

**event**

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

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

**Event Information Packet**

*See EIP.*

**Event Number**

*See Evt No.*

**Evt No.**

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

**exabyte**

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

**fabric**

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

**fabric port**

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

**failover**

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

**fan**

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

*See also blower.*

**Fault Management Code**

*See FMC.*

**FC-AL**

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

**FC HBA**

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

*See also FCA.*

**FCA**

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

*See also FC HBA*

**FCC**

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

**FCP**

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

**fiber**

The optical media used to implement Fibre Channel.

**fiber optics**

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

**fiber optic cable**

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

**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**

Megabyte. A term defining either:

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

**Mbps**

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

**MBps**

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

**mean time between failures**

*See MTBF.*

**Mega**

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

**metadata**

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

**micro meter**

See  $\mu\text{m}$ .

**mirrored caching**

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

**mirroring**

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

**MTBF**

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

**multi-mode fiber**

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

**Network Storage Controller**

See NSC.

**NONCRITICAL Condition**

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

**node port**

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

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

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

**NSC**

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

**NVRAM**

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

**occupancy alarm level**

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

**OCP**

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

### **operator control panel**

See **OCP**.

### **OSM**

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

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

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

See also **in-band communication**.

### **param**

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

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

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

### **parity**

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

### **parity bit**

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

### **parity check**

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

**password**

A security interlock whose purpose is to allow:

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

**PDM**

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

**PDU**

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

**petabyte**

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

**physical disk**

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

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

**physical disk array**

*See array.*

**port**

A Fibre Channel connector on a Fibre Channel device.

**port\_name**

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

**port-wine colored**

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

**power distribution module**

See **PDM**.

**power distribution unit**

See **PDU**.

**power supply**

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

**preferred address**

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

**preferred path**

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

**protocol**

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

**pushbutton**

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

**quiesce**

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

**rack**

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

**rack-mounting unit**

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

**read caching**

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

**read ahead caching**

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

**reconstruction**

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

**redundancy**

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

### **redundant power configuration**

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

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

### **reporting group**

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

### **room temperature**

*See* **ambient temperature**.

### **SCSI**

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

### **SCSI-3**

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

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

*See* **SES**.

**selective presentation**

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

**serial transmission**

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

**SES**

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

**short wave**

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

**small computer system interface**

*See* SCSI.

**SMART**

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

**snapshot**

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

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

**solutions rack**

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

*See also* **rack**.

**spin down**

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

**spin up**

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

**SSN**

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

**storage carrier**

*See* **carrier**.

**storage pool**

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

**storage system**

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

**Storage System Name**

*See* **SSN**.

**switch**

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

**TB**

Terabyte. A term defining either:

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

**TBps**

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

**TC**

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

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

**Termination Code**

*See* **TC**.

**termination event**

Occurrences that cause the storage system to cease operation.

**terminator**

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

**topology**

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

**transceiver**

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

### **uninitialized system**

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

*See also* **initialization**.

### **units**

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

### **UNRECOVERABLE Condition**

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

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

### **unwritten cached data**

*Also* called unflushed data.

*See also* **dirty data**.

### **UPS**

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

### **VD**

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

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

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

**virtual disk**

*See* **VD**.

**virtual disk copy**

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

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

**virtual disk family**

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

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

**virtual disk snapshot**

*See* **snapshot**.

**Vraid0**

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

**Vraid1**

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

### **Vraid5**

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

### **World Wide Name**

*See* **WWN**.

### **write back caching**

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

### **write caching**

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

### **WWN**

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

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