DIGITAL StorageWorks UltraSCSI RAID Enclosure (DS–BA370–Series)

User's Guide

Part Number: EK–BA370–UG. B01

January 1998

The DIGITAL DS–BA370-series UltraSCSI RAID rack-mountable enclosure is the basic building block of the UltraSCSI RAID subsystems. This guide, and the related publications comprise the basic documentation set for these subsystems.

Digital Equipment Corporation
Maynard, Massachusetts

January 1998

Note

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules which are designed to provide reasonable protection against such radio frequency interference. Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference. Any modifications to this equipment – unless expressly approved by the manufacture – can void the user's authority to operate this equipment under part 15 of the FCC rules.

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Preface

The *DIGITAL StorageWorks UltraSCSI RAID Enclosure (DS–BA370-Series) User's Guide* describes the functions, operations, components, configurations, assembly, and specifications of this enclosure.

Intended Audience

This document is for use by personnel responsible for designing, configuring, assembling, installing, and operating UltraSCSI RAID subsystems using a DS–BA370-series enclosure mounted in either a data center cabinet or a departmental server cabinet.

Structure

The organization of this manual is as follows:

Chapter 1
This chapter describes the UltraSCSI RAID enclosure functions, uses, components, and features.

Chapter 2
This chapter describes how to configure and operate an UltraSCSI RAID enclosure.

Chapter 3
This chapter describes the environmental monitoring unit (EMU) operation, functions, uses, configuration, and replacement procedures.

Chapter 4
This chapter describes the power verification and addressing (PVA) assembly operation, functions, uses, configuration, and replacement procedures.

Chapter 5
This chapter describes the single-ended I/O module operation, functions, uses, configuration, and replacement procedures.

Chapter 6
This chapter describes the enclosure power distribution components operation, functions, uses, configuration, and replacement procedures.

Chapter 7
This chapter describes the disk drives operation, functions, uses, configuration, and replacement procedures.

Chapter 8
This chapter describes blower operation, status reporting, and replacement procedures.

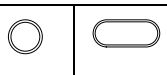
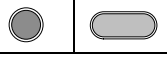
Appendix A
This appendix describes the enclosure physical, electrical, and environmental specifications.

Appendix B
This appendix describes the procedures for installing components in an enclosure to create an UltraSCSI RAID subsystem.

Glossary

Documentation Conventions

The documentation conventions used in this publication are as follows:

boldface type	Boldface type indicates the first instance of terms being defined in the text, the glossary, or both.
italic type	Italic type indicates emphasis and publication titles. Italic type in the glossary indicates a cross–reference.
A/R	As required
	LED is OFF
	LED is ON or blinking slowly
	LED is FLASHING (blinking rapidly)
	**Warning** Information essential to people's safety
	**Caution** Information the user needs to know to avoid damaging the software or hardware.
Note	Information that might be of special importance to the user.
	Single-ended SCSI bus
	Differential SCSI bus

Related Documents

The following publications contain additional information about the UltraSCSI RAID subsystem.

Publication Title	Order Number
AC Input Power Controller (DS–BA35X–HE) Installation Guide	EK–35XHE–IG
Blower (DS–BA35X–MK) Installation Guide	EK–35XMK–IG
Environmental Monitoring Unit (DS–BA35X–EB) Installation Guide	EK–35XEB–IG
HSZ70 Array Controller HSOF Version 7.0 CLI Reference Manual	EK–CLI70–RM
HSZ70 Array Controller HSOF Version 7.0 Configuration Manual	EK–HSZ70–CG
HSZ70 Array Controller HSOF Version 7.0 Service Manual	EK–HSZ70–SV
Installing a Host Bus Cable Ferrite Bead	EK–SWXES–IG
Installing an HSZ70 ECB Cable	EK–HSZ70–TE
Operating System Specific Release Notes	See system specific “Getting Started” manual
Power Verification and Addressing Assembly (DS–BA35X–EC) Installation Guide	EK–35XEC–IG
Shelf Power Supply (DS–BA35X–HH) Installation Guide	EK–35XHH–IG
Single-Ended I/O Module (DS–BA35X–MN) Installation Guide	EK–35XMN–IG
UltraSCSI RAID Data Center Cabinet (DS–SW600-Series) Installation and User’s Guide	EK–SW600–UG
UltraSCSI Subsystem Standby Power Operation	EK–POWER–IG

Manufacturer’s Declarations

Electromagnetic Compatibility

You can install this CE–Mark Class A certified product in a commercial or an office environment.

WARNING!

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

ACHTUNG!

Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkstörungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

AVERTISSEMENT!

Ceci est un produit de Classe A. Dans un environnement domestique, ce produit risque de créer des interférenences radioélectriques, il appartiendra alors à l’utilisateur de prendre les mesures spécifiques appropriées.

Acoustic Noise Declarations

DIGITAL declares that the acoustic values of this product are as follows:

Acoustics – Declared Values per ISO 9296 and ISO 7779:				
	Sound Power Level L_{WAd}, B		Sound Pressure Level L_{pAm} dBA (bystander positions)	
Product	**Idle**	**Operate**	**Idle**	**Operate**
RAID Array 7000 Subsystem (DS–SWXRE–HA) with: 2 – ac power controllers (DS–BA35X–HE) 8 – 180 W shelf power supplies (BA35X–HH) 24 – disk drives (2, 4, 9 GB)	6.1	N/A	48.4	48.4
RAID Array 7000 Subsystem (DS–SWXRE–HA) with: 2 – ac power controllers (DS–BA35X–HE) 8 – 180 W shelf power supplies (BA35X–HH) 24 – disk drives (2, 4, 9 GB)	6.1	6.3	48.4	48.4

Note

Current values for sound power levels are available from DIGITAL representatives.
1 Bel = 10 dBA.

Schallemissionswerte – Werteangaben nach ISO 9296 und ISO 7779/DIN EN27779:				
	Schalleistungspegel L_{WAd}, B		**Schalldruckpegel L_{pAm}, dBA (Zuschauerpositionen)**	
Gerät	**Leerlauf**	**Betrieb**	**Leerlauf**	**Betrieb**
RAID Array 7000 Subsystem (DS–SWXRE–HA) with: 2 – ac power controllers (DS–BA35X–HE) 8 – 180 W shelf power supplies (BA35X–HH) 24 – disk drives (2, 4, 9 GB)	6,1	N/A	48,4	48,4
RAID Array 7000 Subsystem (DS–SWXRE–HA) with: 2 – ac power controllers (DS–BA35X–HE) 8 – 180 W shelf power supplies (BA35X–HH) 24 – disk drives (2, 4, 9 GB)	6,1	6,3	48,4	48,4

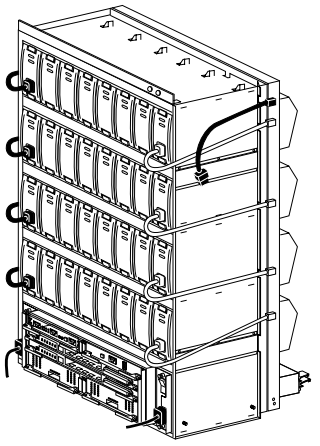
Note

Aktuelle Werter für spezielle Austüstungsstufen sind über die Digital Equipment Vertretungen erhältlich. 1 Bel = 10 dBA.

1
Introducing the UltraSCSI RAID Enclosure

The StorageWorks™ **UltraSCSI (small computer system interface) RAID (random array of independent disks)** enclosure (DS–BA370-series), see Figure 1–1, is the basic building block for DIGITAL™ **single-ended** UltraSCSI RAID subsystems.

Figure 1–1 DS–BA370 Series UltraSCSI Enclosure



CXO5797A

™ Trademark of Digital Equipment Corporation

This enclosure cannot function until:

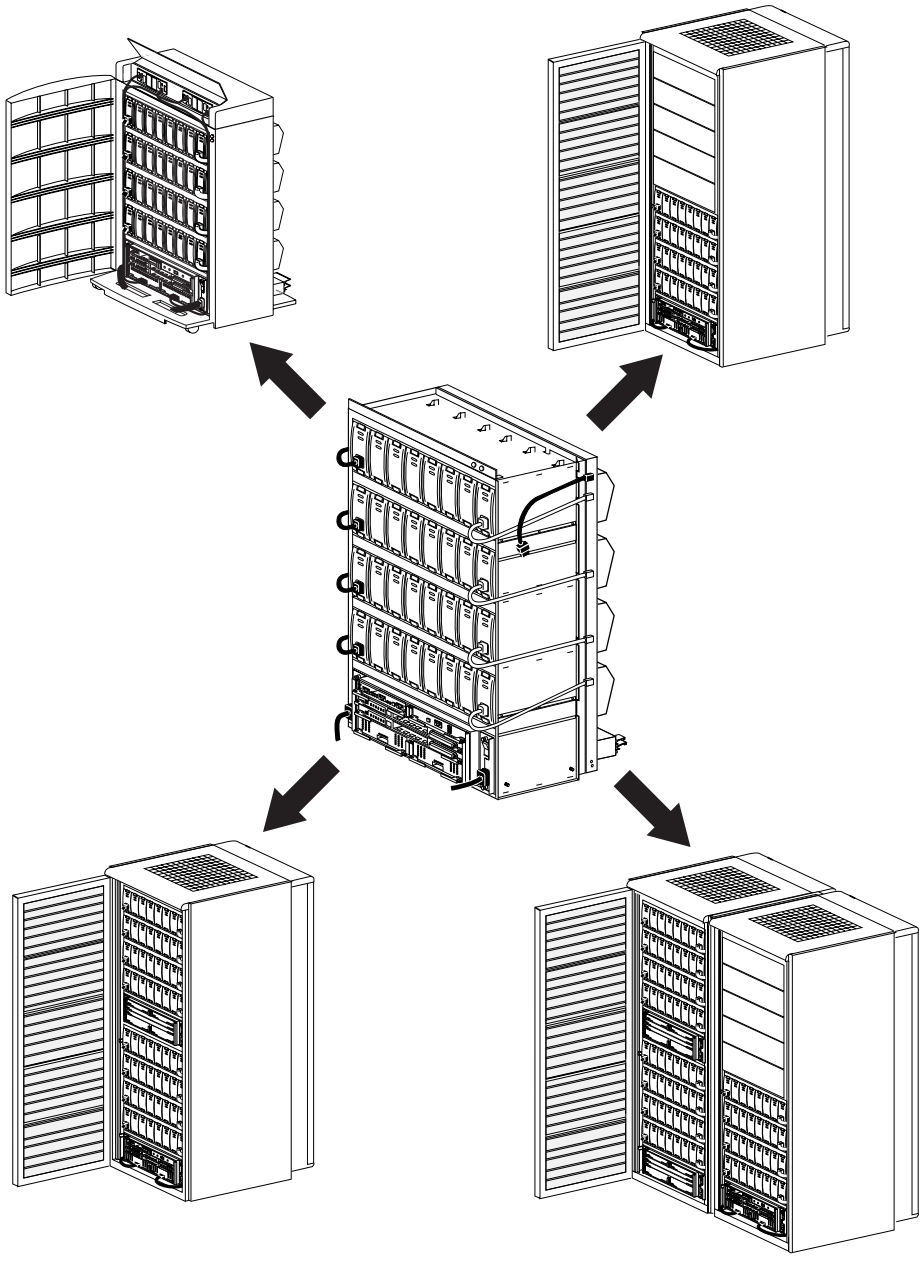
- It is installed in an UltraSCSI data center cabinet (DS–SW600-series)
- It is installed in an UltraSCSI departmental server (DS–SWXRE-series).
- 3.5-inch **StorageWorks building block** (**SBB)** disk drives are installed
- A compatible **array controller** is installed and connected to a **host computer** or **adapter**
- The enclosure and the subsystem are configured for UltraSCSI operation

Note

The "DS–" model number prefix defines *new* DIGITAL storage products. In some cases, these numbers may be similar to an existing product number. For example, the DS–BA35X–HE **ac power controller** and the *BA35X–HE ac power controller have similar model numbers but are not interchangeable. These products are not interchangeable*. Installing incompatible products in a StorageWorks subsystem could result in degraded operation or non-compliance with country-specific certifications.

See Figure 1–2 for the DIGITAL-supported enclosure applications.

Figure 1–2 Typical DS–BA370 Applications



CXO6264A

An UltraSCSI Bus Overview

Developed by the Digital Equipment Corporation and subsequently standardized by the **ANSI (American National Standards Institute)** SCSI committee as standard X3T10, UltraSCSI is a technology that incorporates several improvements over a **Fast SCSI 10** bus.

UltraSCSI increases the maximum transfer rate on a **wide** (16-bit) SCSI bus from 10 **MHz** (**mega Hertz**) to 20 MHz. This results in an increase in maximum **bus bandwidth** from 20 **MB/sec** (**mega bytes per second**) to 40 MB/sec.

UltraSCSI incorporates smaller **very high density computer interconnect** (**VHDCI**) cables and connectors. The connector is up to half the size of the Fast SCSI **HD68** (high-density 68-pin) connector and the cables are thinner.

The higher speed of the single-ended UltraSCSI signals can cause degradation of signal integrity over the same distances as single-ended Fast SCSI signals. However, the UltraSCSI bus can run over much greater distances than Fast SCSI in either single-ended or differential mode. To attain these greater distances, UltraSCSI defines, and the StorageWorks UltraSCSI implements the bus segment concept.

An UltraSCSI bus segment is as an unbroken electrical path consisting of conductors (in cables or on backplanes) and connectors. Every UltraSCSI bus segment must have two **terminators**, one at each end of the bus segment. Bus segments can either be single-ended or differential, depending on the type of terminators used in that segment. In other words, an UltraSCSI bus segment corresponds to what in Fast SCSI was an entire SCSI bus. As in Fast SCSI, a bus segment can only support devices of the same type as its terminators. You cannot, for example.
Use a differential SCSI device on a single-ended bus segment.

Note

The DIGITAL UltraSCSI RAID enclosure only supports the single-ended UltraSCSI bus.

Product Description

The UltraSCSI enclosure is a rack mountable unit that accommodates the following components:

- A minimum of one, or a maximum of two, UltraSCSI controllers with cache modules[1], such as the DS–HSZ70-series
- An **environmental monitoring unit** (DS–BA35X–EB), the **EMU**, that monitors enclosure operation, detects and reports error conditions, and can automatically initiate corrective actions
- A **power verification and addressing assembly** (DS–BA35X–EC), the **PVA**, that establishes enclosure and storage device addressing, monitors enclosure operation, and detects and reports error conditions.
- A minimum of one, or a maximum of two, ac power controller**s** (DS–BA35X–HE), the **power controllers**, to distribute ac power to the shelf power supplies
- A minimum of five, and a maximum of eight shelf power supplies (DS–BA35X–HH)
- Eight dual-speed blowers (DS–BA35X–ML) that cool the components by drawing air in through the front and exhausting it out the rear
- Six single-ended I/O modules (DS–BA35X–MN) for connecting enclosures together
- A maximum of 24 single-ended, 3.5-inch SBB disk drives
- Expansion enclosures have filler panels installed in the controller and cache module slots that improve air flow and reduce EMI radiation
- For enclosures with fewer than 24 disk devices, installing the *optional* blank bezels (DS–BA35X–PB) improve air flow and reduce EMI radiation.
- The blank panels in the controller B and cache module B locations improve air flow and control EMI in enclosures with only one controller.

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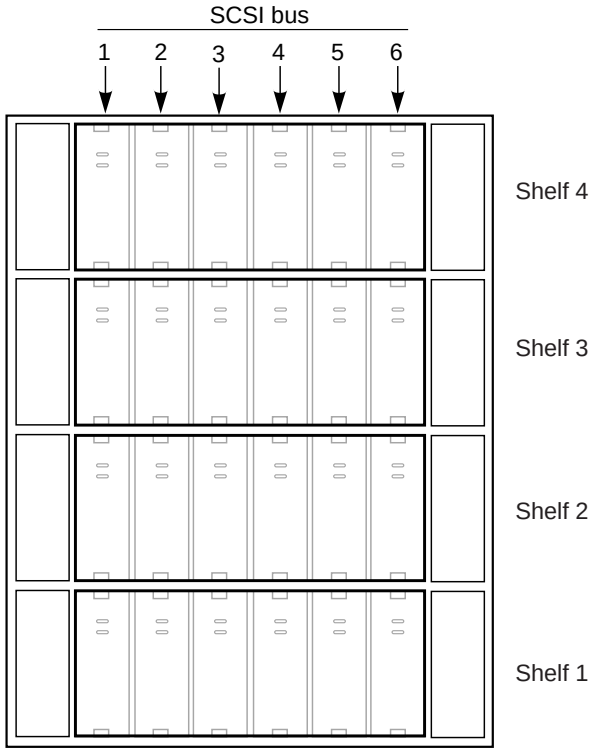
1 Each cache module requires an external cache battery (DS–BA35X–Bx series). The batteries are installed either in a data center cabinet shelf or a departmental server cabinet top cover—not in the enclosure.

The enclosure backplane eliminates the need for cables to connect the six vertical buses to the four horizontal SBB shelves. All the devices on a shelf use the same SCSI bus ID. The PVA selectable enclosure UltraSCSI ID defines the SCSI bus ID of each shelf. See Figure 1–3 for bus and shelf identifiers when viewing the enclosure from the front.

Figure 1–3 Typical Enclosure Bus and Device Addressing



The ac power controllers distribute ac power to the individual shelf power supplies through ac power cables. The backplane distributes the dc output voltages (+5 V dc and +12 V dc) over two buses to the:

- EMU
- PVA
- UltraSCSI bus controllers and cache modules
- Disk drives

- I/O modules

UltraSCSI RAID Subsystem

A subsystem is one or more departmental server cabinets or data center cabinets with enclosures. Each subsystem requires a master enclosure with an UltraSCSI controller installed. Installing one or two expansion enclosures and connecting them with cables creates an expanded subsystem. See Table 1–1 for the capacities of the various subsystems:

Note

Not all array controllers support configurations with expansion cabinets. Refer to the array controller documentation to verify that your controller can support multiple cabinets.

Table 1–1 UltraSCSI Subsystems Capacities

Enclosures	SCSI Buses	Disk Drives	Total Disk Drives
1	6	24	24
2	6	24	48
3	6	24	72

EMU

The device that monitors the status of the UltraSCSI RAID enclosure to include power, ambient (intake) air temperature, blower status, and so forth. It also detects error and fault conditions, displays these conditions, reports the conditions to the user and the array controller, and, in some cases, implements corrective actions.

PVA

The UltraSCSI RAID enclosure assembly whose primary functions are as follows:

- Allows the user to select the enclosure UltraSCSI bus ID,
- Enables the user to place the subsystem in a standby power mode condition or return it to an operational status,

- In conjunction with the associated EMU, ensures that the major components are functioning properly and notifies the user and the array controller of error or fault conditions. Each PVA functions only with its host enclosure and EMU. There is no master PVA in the UltraSCSI RAID subsystem.

Master Enclosure

Each UltraSCSI RAID subsystem, whether it has one, two, or three enclosures, is under the control of the **master enclosure**. The enclosure with the array controllers is the master enclosure. The EMU in these enclosures is the only EMU that can communicate directly with the array controllers. In a multiple enclosure, or expansion configuration, this enclosure also communicates with the other enclosures using the EMU—EMU communications bus. The master enclosure PVA SCSI bus address setting is always **0**. Using address 0 automatically assigns SCSI bus device addresses 0, 1, 2, and 3 to the four disk drive shelves.

Master EMU

The environmental monitoring unit in the master enclosure is the Master EMU. This is the only EMU that communicates directly with the array controller and the expansion enclosure EMUs over the EMU—EMU communications bus. This EMU controls the operation of the entire subsystem to include error detection, reporting, and status displays.

Expansion Enclosure

An UltraSCSI RAID enclosure connected to the master enclosure with cables is an expansion enclosure. Depending upon the array controller, a subsystem can have a maximum of two expansion enclosures. The expansion PVA SCSI bus address setting is either:

2–to establish SCSI bus device addresses 8, 9, 10, and 11.

3– to establish SCSI bus device addresses 12, 13, 14, and 15.

Caution

Not all array controllers support an UltraSCSI RAID subsystem with more than one enclosure. Read the array controller documentation to ensure the controller supports expanded configurations.

Expansion EMU

An environmental monitoring unit installed in an expansion enclosure is an Expansion EMU. This EMU communicates with the master EMU over the EMU—EMU communications bus. Upon loss of communications with the master EMU, the expansion EMU assumes control of certain expansion enclosure functions. In this state, the expansion EMU cannot communicate with the UltraSCSI controller

I/O Module

This device provides termination for the internal UltraSCSI buses and is the connection point for the cables connecting the six buses to an expansion enclosure.

SCSI Bus Controllers

A hardware–software device that manages SCSI bus communications to devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support. Other terms commonly used include array controller or controller..

Cache Module

A storage buffer required for each bus controller.

ECBs

ECBs (external cache batteries) provide backup power to the cache module to protect data integrity if there is a power failure.

Enclosure Status

When any of the multiple error detection circuits determines there is a problem, an audible alarm may sound and one or more sets of status **LEDs** (**light emitting diodes**) display an error code.

The enclosure has two *go—no go* indicators (see Figure 1–4). The green LED is the System OK LED; the amber LED is the Fault LED. When the Fault LED is on, you must check the other status LEDs to determine the cause of the error.

- For an enclosure in a pedestal these LEDs are part of the pedestal. (See Figure 1–5.)
- For an enclosure in a DS–SW600 series cabinet, LEDs on the cabinet door also displays the enclosure status.

Figure 1–4 DS–BA370 Status LEDs Locations

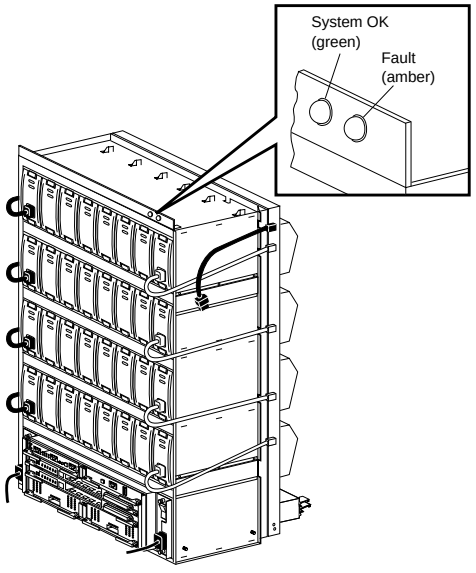
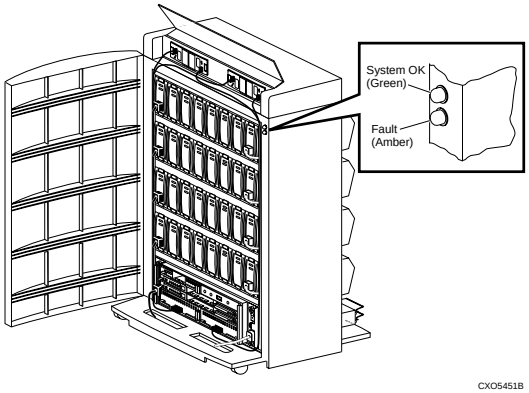


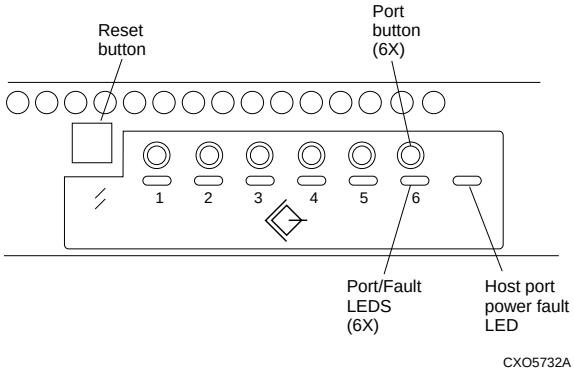
Figure 1–5 RA7000 Status LEDs Locations



Typical Controller Status LEDs

The operator control panel (OCP) status LEDs (see Figure 1–6) display the controller status. For a detailed explanation of each status code refer to the controller documentation.

Figure 1–6 Typical Array Controller OCP LEDs



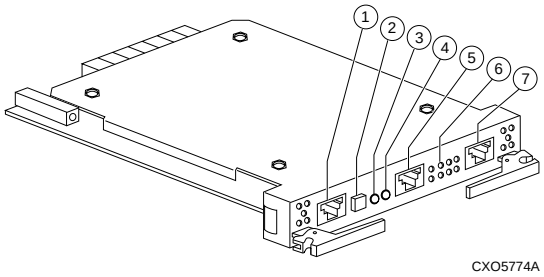
The green array controller LED in the RESET button indicates controller status. This LED flashes constantly once the controller initialization is complete and the software is functioning. Pressing this switch resets the controller.

The amber port LEDs are off when the bus is functioning properly. A port LED that is on or flashing indicates that a device on that bus is not functioning properly.

Environmental Monitoring Unit (EMU) Status LEDs

The EMU status LEDs (see Figure 1–7) have multiple functions (see Chapter 3, “Environmental Monitoring Unit”).

Figure 1–7 EMU Status LED Locations

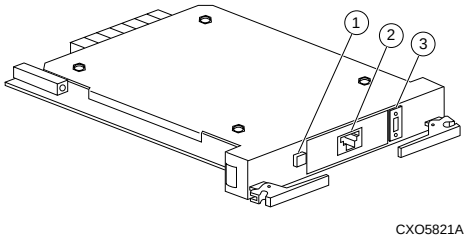


2. System fault LED (amber).
3. Temperature fault LED (amber).
4. Power status LED (green).
6. Blower fault, Error Condition, and Fault Code LEDs (amber).

Power Verification and Address (PVA) Status LEDs

The PVA (Figure 1–8) has only one status LED, the power status LED. For a detailed description of the PVA status displays and alarm see Chapter 4, “Power Verification and Addressing (PVA).”

Figure 1–8 PVA Status LED Locations

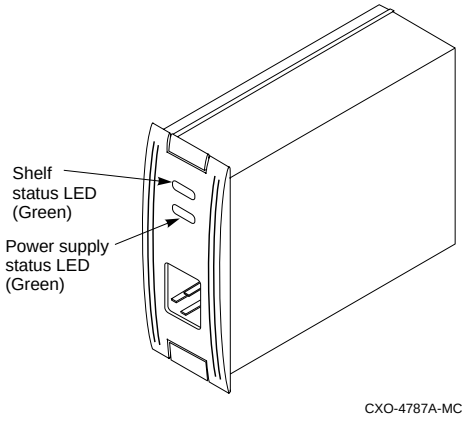


1. The green power status LED is part of the standby power switch.

Power Supply Status LEDs

Each power supply (see Figure 1–9) has two green status LEDs—the Shelf Status LED and the Power Supply Status LED. See Chapter 6, “Power Distribution” for detailed information about these LEDs.

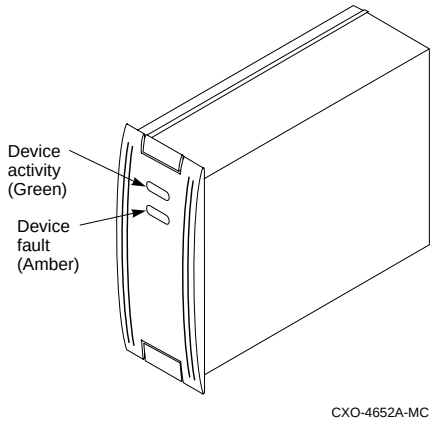
Figure 1–9 Power Supply Status LED Locations



SBB Status LEDs

Each SBB (see Figure 1–10) has two status LEDs—a green device activity LED and an amber device fault LED. See Chapter 7, “Storage Devices” for detailed information about these LEDs.

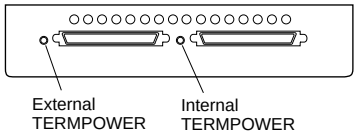
Figure 1–10 SBB Status LED Locations



I/O Module LEDs

Each I/O module (see Figure 1–11) has two green status LEDs that display the status of both the internal and the external SCSI bus terminator power (**TERMPOWER**). Whenever TERMPOWER is present, the LED is ON. See Chapter 5, "Single–Ended I/O Modules," for detailed information about these LEDs.

Figure 1–11 I/O Module TERMPOWER LEDs



Options

The following sections describe the UltraSCSI RAID subsystem user selectable options:

Power

The standard UltraSCSI enclosure power configuration consists of one ac power controller and five shelf power supplies. This configuration provides the *minimum SBB power supply* redundancy. A system power failure will occur for any of the following conditions:

- Loss of the ac power source
- Failure of the ac power controller
- Failure of two shelf power supplies

The user has the option of modifying the power configuration to eliminate single points of failure,

Redundant Power Supply Configuration

Adding three SBB shelf power supplies and a second ac power controller provides significantly more power redundancy than the standard configuration. A system power failure will occur for any of the following conditions:

- Loss of the ac power source
- Failure of *both* ac power controllers
- Failure of *five* shelf power supplies

DIGITAL suggests using this configuration to provide additional power supply redundancy.

Optimum Power Configuration

Adding *three power supplies*, a *second ac power controller*, and a *second ac power source* provides the *optimum* power redundancy. With separate ac power sources for each ac power controller there are no single points of failure.

Note

For optimum operation each ac power controller should use a different ac power source.

A system power failure will occur for any of the following conditions:

- Loss of *both* ac power sources
- Failure of *both* ac power controllers
- Failure of *five* shelf power supplies
- Failure of the power source for power B and 1 power supply on bus A
- Failure of the power controller on bus A and 1 power supply on bus B
- Failure of the power controller on bus B and 1 power supply on bus A
- Failure of the power controller on bus A and 1 power supply on bus B

DIGITAL recommends using this configuration to eliminate all single points of power failure.

Dual Controllers

Establishing a dual-redundant subsystem with two UltraSCSI controllers, two cache modules, and external cache batteries, is the most effective and efficient method of ensuring continuous subsystem operation.

UltraSCSI Bus Expansion

Some controllers support expanding the UltraSCSI bus from the master enclosure to two expansion enclosures.

2

Operating the UltraSCSI Enclosure

Setting up an UltraSCSI RAID subsystem for operation involves implementing the procedures described in the system specific “Getting Started” manual provided with each system. This chapter supplements and expands on this information.

Other chapters in this manual contain detailed information about individual component functions, operations, error conditions, and so forth.

UltraSCSI Configuration Rules

Proper operation of the subsystem requires complying with both the UltraSCSI and hardware configuration rules. In some instances operating system specific configuration rules also apply.

General

The following rules apply to the UltraSCSI bus:

1. The UltraSCSI RAID subsystems can transfer data at a higher rate (40 MB/sec versus 20 MB/sec) than do the FAST 10 subsystems.
2. UltraSCSI subsystems require 68-pin VHDCI cables and connectors. The physical difference in the contact spacing precludes using FAST 10 cables.
3. The following devices use a SCSI bus address and are SCSI bus "nodes:"
   - Adapters
   - Controllers
   - Storage devices
4. Every node on a bus must have a unique SCSI ID.
5. The SCSI ID for controller "A" is always *7*.
6. The SCSI ID for controller "B" is always *6*.
7. There are slots for six 3.5-inch SBB nodes in a shelf. The address switch on the PVA module determines node SCSI bus IDs. There is a maximum of 12 valid DS–BA370 SCSI IDs—*0 through 3* and *8 through 15*.
8. A DS–BA370 UltraSCSI bus cannot support 5.25-inch devices.
9. With only UltraSCSI devices installed the maximum transfer rate of an UltraSCSI bus is 40 MB/sec.
10. Installing a FAST 10 storage device limits the bus segment operations as follows:

a. The maximum transfer rate when using a wide (–VW suffix), FAST 10 device is 20 MB/sec.

b. The maximum transfer rate when using a narrow (–VA suffix), FAST 10 device is 10 MB/sec.

UltraSCSI RAID Controllers

Caution

Should there be a conflict in controller configuration information between this document and the controller specific documentation, use the information in the controller specific documentation.

The following *general* configuration rules apply to the UltraSCSI RAID array controllers:

1. The controller "A" SCSI bus ID is always *7*.
2. The controller "B" SCSI bus ID is always *6*.
3. Some controllers support FAST 10 (10 MB/sec) 16–bit (wide) disk drives.
4. Some controllers support FAST 20 (20 MB/sec) 16–bit (wide) disk drives.

Note

Disk drive support is controller specific. Refer to your array controller documentation to determine compatible disk drives.

UltraSCSI Nodes

A node is a SCSI device that uses a SCSI bus ID. The following rules apply to UltraSCSI nodes, such as disks, tapes, and so forth.

1. Only a controller node can use SCSI bus ID 7.
2. Only a controller node can use SCSI bus ID 6.
3. No node can use SCSI bus IDs 4, 5, 13, 14, or 15
4. An UltraSCSI bus cannot support 5.25-inch devices.
5. The maximum bus transfer rates are device dependent.
    a. A bus with all UltraSCSI devices has a maximum transfer rate of 40 MB/sec.
    b. A bus with *one* wide (16-bit), FAST 10, SCSI devices (–VW suffix) installed, has a maximum transfer rate of 20 MB/sec.
    c. A bus with one narrow (8-bit), FAST 10, SCSI devices (–VA suffix) has a maximum transfer rate of 10 MB/sec.

5. The valid device SCSI bus IDs are device type dependent.
    a. An UltraSCSI device can use device addresses 0 through 6 or 8 through 14.
    b. A wide (16-bit), FAST 10, SCSI devices (–VW suffix) can use device addresses 0 through 6 or 8 through 14.
    c. A narrow(8-bit), FAST 10, SCSI devices (–VA suffix) can use device addresses 0 through 6.

UltraSCSI Enclosures

The following configuration rules apply to the UltraSCSI RAID subsystem enclosures:

1. The only compatible power controller is the model DS–BA35X–HE.
2. The only compatible power supply is the model DS–BA35X–HH (180 W). The bezel label (see Figure 2–1) identifies these power supplies.

Figure 2–1 Power Supply Bezel Label

CXO5926A

Enclosure Addressing

The following configuration rules apply to the UltraSCSI RAID enclosure address settings when there is a controller in the master enclosure:

1. The enclosure containing the array controller is the master enclosure. The PVA SCSI ID switch setting for the master enclosure is always **0**.
2. UltraSCSI subsystem expansion enclosures use either PVA SCSI ID switch setting 2 or 3.
   - The PVA SCSI ID switch setting for the *first* expansion enclosure is always **2**.
   - The PVA SCSI ID switch setting for the *second* expansion enclosure is always **3**.

See Table 2–1 for the DIGITAL-supported enclosure address settings.

Table 2–1 DIGITAL–Supported Enclosure Address Settings

No. of Enclosures	Master	Expansion 1	Expansion 2
1	**0**	None	None
2	**0**	**2**	None
3	**0**	**2**	**3**

Starting the Subsystem

After installing the departmental server cabinet or data center cabinet and connecting the enclosures, you can apply power to start the subsystem.

Applying power to all the enclosures causes the EMU, PVA, and array controller to automatically begin system operation.

Note

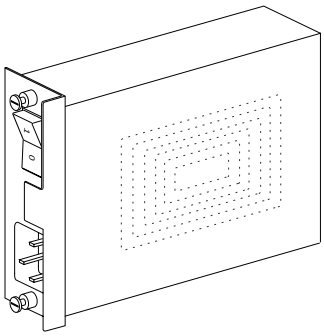
Before applying power to the subsystem, be sure to configure the entire subsystem, to include the host and the array controller, as described in the appropriate publications.

Initial power application is simply a matter turning on the ac power controllers located in the lower left and right corners of the enclosure (see Figure 2–2). Pressing 1 on the ac power switch applies ac power only to the shelf power supplies on the associated power bus (bus A or B). Apply power in the following sequence:

1. All expansion enclosures.
2. Master enclosure.

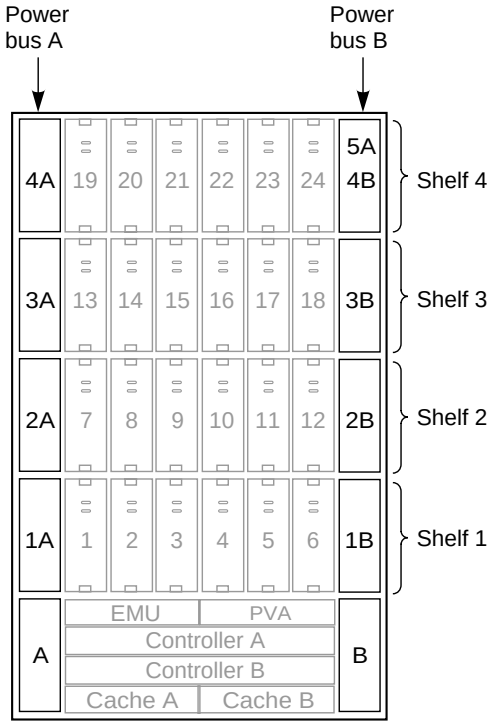
Figure 2–2 AC Power Distribution

AC Input Power Controller



CXO5113A

AC Input Power Controller and SBB Shelf Power Supply Locations



CXO5808A

Shutting Down the Subsystem

Shutting down the subsystem involves (1) Clearing the cache module and shutting down the controller. (2) Either turning OFF the dc power in an enclosure (the standby power mode) or turning OFF the ac power controllers (full power shutdown).

Placing the subsystem in the standby power mode disconnects the dc power from the backplane. The ac power is still applied to the shelf power supplies. In this mode the EMU alarm control switch now functions as a standby power switch. To restore the dc power to the backplane requires pressing the standby power switch on each EMU.

Caution

Failure to clear the cache module and shut down the array controller before removing power will disrupt data transfers. Therefore, always shut down the array controller as described in the array controller documentation.

Turning the subsystem off involves shutting down the array controller and then turning off the ac power controllers in each enclosure.

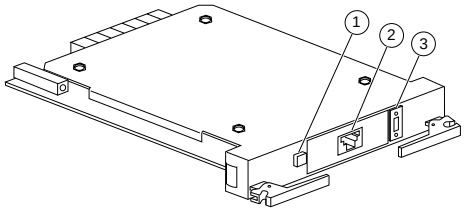
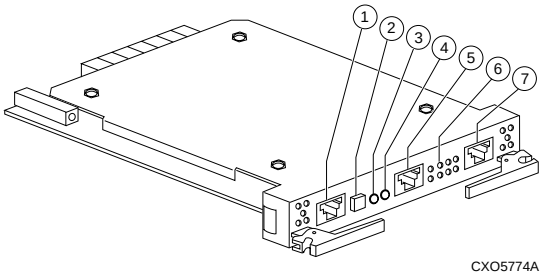
Powering down an enclosure always involves shutting down the array controller and then pressing the PVA standby power switch on an expansion enclosure.

When there are no expansion enclosures, shut down the array controller and then press the PVA standby power switch on the master enclosure.

Using the Power Standby Mode

Complete the procedure in Table 2–2 to place the subsystem in standby power mode (that is, turning off the dc power distribution)

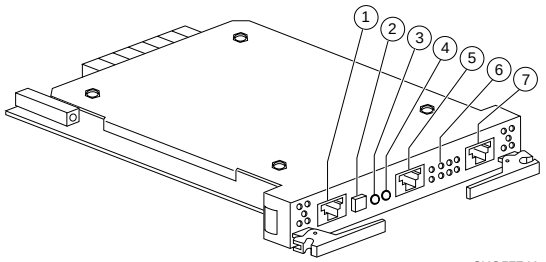
Table 2–2 Turning Off the DC Power

1.	Clear the cache module and shut down the array controller (see the array controller documentation).
2.	Shut down the array controller, press and hold the PVA standby power switch (**CALLOUT** 1) on an expansion enclosure until the master EMU initiates a power shut down on all enclosures. If there is no expansion enclosure, press and hold the PVA standby power switch (CALLOUT 1) on the master enclosure until the EMU initiates a power shut down on all enclosures.  CXO5821A
3.	The EMU alarm control switch (CALLOUT 2) on each enclosure now functions as the dc power switch.  CXO5774A

Applying DC Power

Complete the procedure in Table 2–3 to restore the dc power within each enclosure.

Table 2–3 Turning On the DC Power

1.	When there are no expansion enclosures, go to Step 3.
2.	Momentarily press the EMU alarm control switch (CALLOUT 2) on each expansion enclosure. 
3.	Momentarily press the EMU Alarm control switch (CALLOUT 2) on the master enclosure.
4.	The array controller restores the subsystem to an operational state.

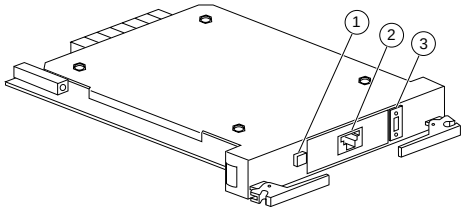
Turning Off the Subsystem

Adding enclosures or moving the subsystem may require removing all power from the subsystem. Complete the procedure in Table 2–4 to remove all power.

Table 2–4 Turning Off the Subsystem Power

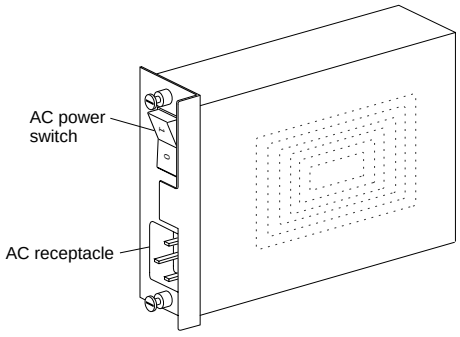
1. Shut down the array controller, press and hold the PVA standby power switch (CALLOUT 1) on an expansion enclosure until the master EMU initiates a power shut down on all enclosures.

   When there is no expansion enclosure, press and hold the PVA standby power switch (CALLOUT 1) on the master enclosure until the master EMU initiates a power shut down on all enclosures.



CXO5821A

2. Turn OFF all the power controllers by pressing O on each power switch.



CXO5488A

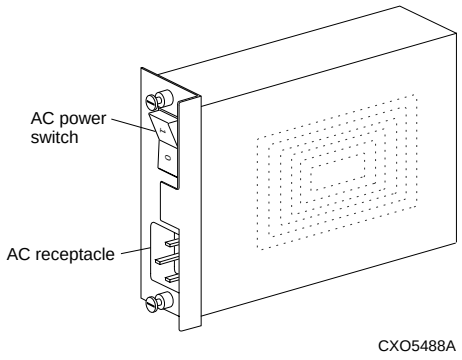
Note

When there is no expansion EMU, press the PVA standby power switch on the master enclosure.

Turning On the Subsystem Power

After completing subsystem expansion or moving the subsystem, complete the procedure in Table 2–5:

Table 2–5 Turning On the Subsystem Power

1.	When there are no expansion enclosures, go to Step 4.
2.	Starting with an expansion enclosure, turn ON all the power controllers by pressing **1** on each power switch. 
3.	Repeat Step 1 for the other expansion enclosure.
4.	Turn on all the ac power controllers in the master enclosure.
5.	The array controller restores the subsystem to an operational state.

Error Detection, Reporting, Analysis

The EMU and PVA constantly monitor the operational status of the enclosure and its components. In some instances, automatic corrective action implementation occurs. Status changes can be reported to the user using a combination of LEDs, the EMU audible alarm, and an optional maintenance terminal connected to the array controller. Table 2–6 lists the major enclosure components and the status monitored.

Table 2–6 Enclosure Status Monitoring

Component	Status Monitored
Enclosure	• Intake air temperature • Exhaust temperature • AC input power. • Number of operational 180 W power supplies. • Enclosure address
Power	• Output of dc power supplies • DC bus voltages • Termination I/O module dc voltage
Storage devices (SBBs)	• Control signal response • Controller detected fault condition. • Removal • Installation
Blowers	• Operation • Operating speed • Installation
EMU	• Installation
PVA	• Installation

For a detailed description of status LEDs, and specific error conditions, see the chapter for each component.

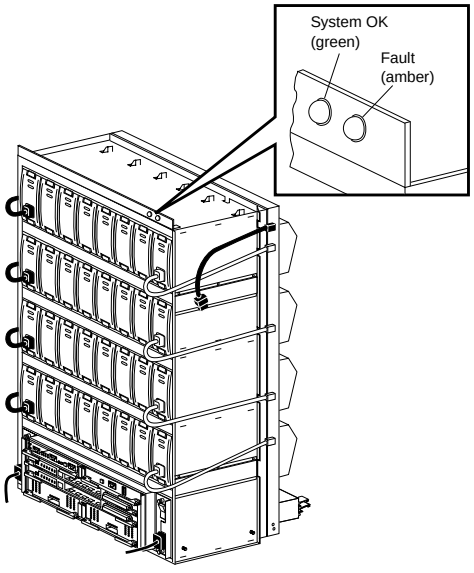
Enclosure Status

Note

HSZ70-series controllers can process the enclosure status signals. Other adapters and controllers may not have this capability.

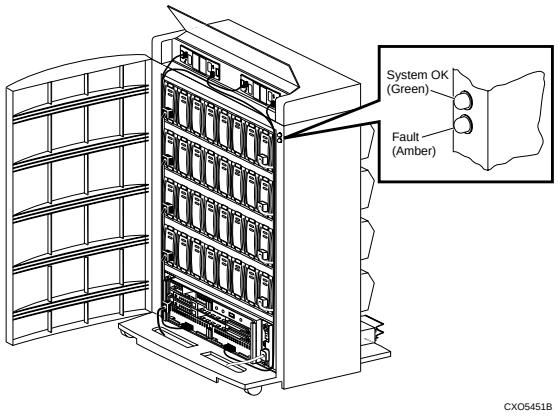
The primary elements of the enclosure status are the enclosure power and the blowers. Loss of either a dc voltage or a blower is an error condition. The enclosure notifies the user of the problem by sounding an audible alarm and changing the status LED displays (see Table 2–7). When the enclosure is mounted in a data center cabinet or a departmental server cabinet, the two status LEDs may be connected to LEDs on the front door.

Figure 2–3 Enclosure Status LEDs



The status LEDs (see Figure 2–4) are in the upper right corner of the pedestal.

Figure 2–4 Pedestal Status LEDs

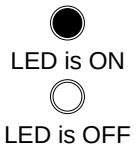


The green LED is the System OK LED and the amber LED is the system fault LED.

The green LED indicates the enclosure is operational. This LED can be ON as long as at a minimum number of redundant components, such as blowers, or power supplies, are functioning correctly.

When the amber system fault LED is ON, it indicates one or more components have an error or fault condition. To isolate an error condition requires you to observe LEDs on the EMU, PVA, power supplies, SBBs, and array controllers (see Table 2–7.

Table 2–7 Enclosure Status LED Displays



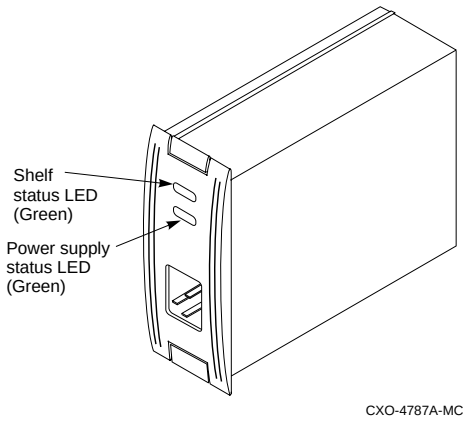
When the LED display is		
Data Center Cabinet	**Dept. Server Cabinet**	**The enclosure status is…**
● ○	● ○	The enclosure is operating normally. There are no detected errors.
● ●	● ●	There are one or more failed components. 1. Observe the EMU front panel to see if there is an overtemperature condition, a blower problem, or a power problem. Replace the defective blower or power components. 2. Observe individual SBBs for error condition. 3. Check the array controller optional system maintenance terminal for error messages.
○ ○	○ ○	Either there is no power applied to the enclosure or the enclosure is in a reset state. 1. Ensure that ac power is present at the power controllers and that the array controllers are on. 2. Ensure that there are at least four operational power supplies. 3. Check the array controller optional system maintenance terminal for error messages.

SBB Shelf Status

The two green LEDs on each power supply (see Figure 2–5) display the blower, the power bus, and the individual power supply status. Normally, both these LEDs are ON.

The shelf status LED is ON when all the power supplies and all the blowers are operational. When any blower or power supply fails, this LED is OFF.

Figure 2–5 Shelf Status LEDs



The power supply status LED is ON when the power supply is operating properly

For detailed information about the power supply status LEDs, see Chapter 6, “Power Distribution.”

SBB Configuration

Part of the initial configuration procedure for the subsystem involves configuring the disk drives so that the array controllers know the device type, physical location, and logical location. This information is the basis for the array controller transferring data blocks to specific disks to create storage sets. Once the configuration process is complete, the system cannot function properly unless all the disks remain in the same physical and logical location.

The enclosure automatically notifies the array controller of the removal of a device. This ensures that the array controller can implement the following actions.

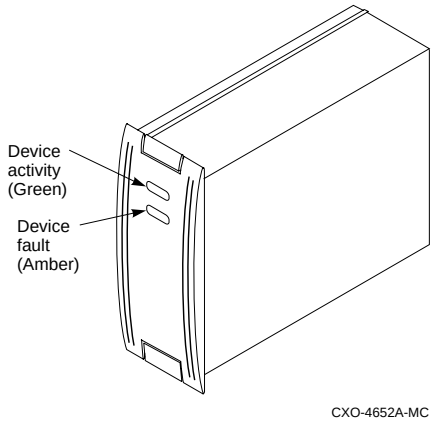
- When data is not being transferred, there is no array controller response to SBB removal.
- When data is being transferred, the array controller responds to SBB removal by verifying the data validity.

When you install a replacement device in a configured subsystem, the array controller ensures that the replacement device type is identical to the one removed. Only after establishing complete compatibility can the array controller start configuring the SBB. As part of the configuration process the array controller will restore all data that was on the original disk.

SBB Failure

The LEDs on the SBBs (Figure 2–6) display the status of the individual devices. The SBB green device activity LED flashes whenever the SBB is active.

Figure 2–6 SBB Status LEDs



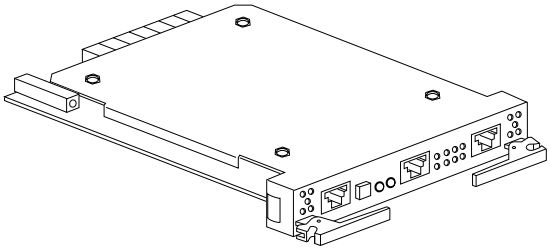
Whenever the array controller detects a device error condition it causes the amber device fault LED to flash. This LED is only ON or FLASHING when there is a device malfunction.

For detailed information about the SBB status LEDs, see Chapter 7, “Storage Devices.”

3
Environmental Monitoring Unit (EMU)

The primary function of the EMU (Figure 3–1) is to monitor, process, report, and display power distribution, temperature, blower, configuration, SCSI addressing, I/O module, communications, and microcode status information. The EMU and the array controller can exchange and process some of this information.

Figure 3–1 EMU



CXO-5497A-MC

Caution

Proper operation of an UltraSCSI subsystem requires an operational EMU and PVA in each enclosure. You must also establish communications links between the EMUs to ensure proper subsystem operation and error reporting.

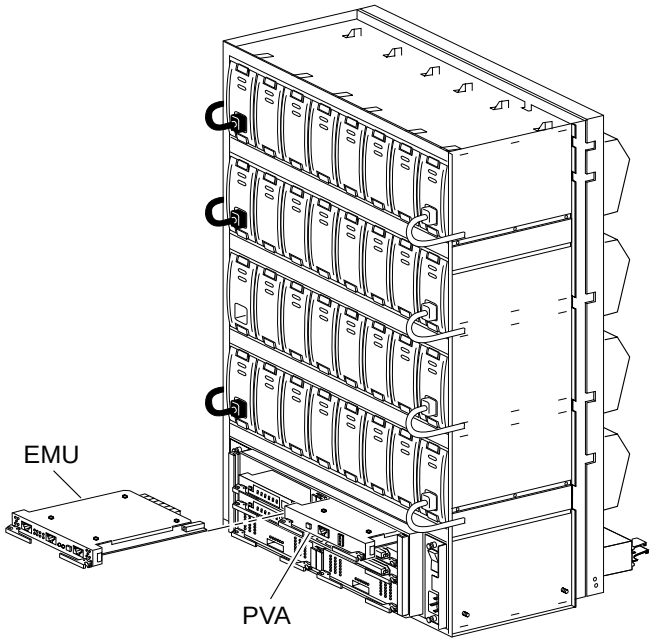
Product Description

The EMU identifies enclosure error conditions and configuration faults, and notifies the user of existing or impending failures, using one or more of the following error reporting systems:

- EMU LEDs
- EMU audible alarm
- Error messages on the host interface
- Enclosure LEDs

The EMU mounts directly above controller "A" (upper) bus controller (see Figure 3–2).

Figure 3–2 EMU Location



In some instances, such as a blower failure, a high intake air temperature, or a high internal enclosure (exhaust) temperature, the EMU can automatically initiate a corrective action. For example, operating the blowers at high speed. When there is the possibility of component damage due to overheating, the EMU can turn off the enclosure power.

Note

Unless the array controller is shut down, the EMU cannot place the enclosure into the standby power mode due to an overtemperature.

When the array controller is operational, an overtemperature condition causes the EMU to turn the enclosure power OFF. When the master enclosure has an overtemperature condition, clearing the cache module prior to turning off the power does not occur.

Controller Status

The master EMU monitors the state of both array controllers. Should the EMU detect a controller fault it can implement the following actions:

- Sound the audible alarm
- Cause the EMU system fault status LED to flash
- Display a controller fault code on the blower LEDs *after* you momentarily press the alarm control switch

Note

An error on the EMU–array controller communications path can also cause a controller fault.

I/O Module Status

The EMU also ensures that the six I/O modules are present, properly installed, and communicating with the backplane, and that TERMPOWER is at the correct level. The EMU reports an error condition whenever any of these conditions occurs. The EMU also reports the I/O module type to the array controller. Should the controller determine that the all modules are not the same type, it can display this information on the *optional* maintenance terminal.

An integrated circuit on each I/O module functions as a **bus expander**. The EMU and the array controller can enable or disable this circuit on an individual I/O module, thereby controlling individual external SCSI buses.

Enclosure Configuration Information

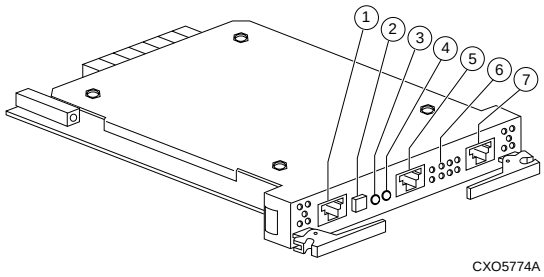
The EMU maintains the following configuration information:

- Enclosure number (the PVA SCSI ID setting)
- EMU microcode revision
- EMU message protocol revision
- Temperature sensor set points
- The number of installed power supplies by location
- The number of installed SBBs by location
- The number of operational blowers in each bank

EMU Front Panel

The EMU user interface controls, connectors, and LED displays are on the front panel. Use Figure 3–3 and the following sections to identify, and determine the function of each component.

Figure 3–3 EMU Major Component Locations



1. EMU communications connector
2. System fault LED (amber) and alarm control switch
3. Temperature fault LED (amber).
4. Power status LED (green)
5. RS232 Connector
6. Blower fault LEDs (amber)
7. EMU communications connector

EMU Communications Connectors

A connector (CALLOUTS 1 and 7) for EMU—EMU communications.

System Fault LED and Alarm Control Switch

The amber system fault LED in the alarm control switch (CALLOUT 2) is ON whenever an error condition exists.

- This LED is FLASHING whenever the EMU has one or more fault codes to display.
- When the alarm control LED is FLASHING, momentarily pressing the EMU alarm control switch turns OFF the audible alarm and starts the fault code LED display.
- Pressing the alarm control switch for at least 5 seconds clears all the active fault codes. Detection and the display of new faults continue.
- When in the standby power mode, momentarily pressing this switch will restore power to the enclosure.

Temperature Fault LED

Whenever either the intake or the exhaust air temperature exceeds the user-defined temperature setpoints, this amber LED (CALLOUT 3) is ON until the overtemperature condition is corrected.

Power Supply Status LED

This green LED (CALLOUT 4) is ON whenever *ALL* the following conditions exist:

- +5 V dc is greater than +4.7 V dc.
- +12 V dc is greater than +11.4 V dc.
- At least four power supplies are operational.
- TERMPOWER is present on all six I/O modules.

This LED is OFF whenever any *ONE* of the following conditions exists:

- +5 V dc is less than +4.7 V dc.
- +12 V dc is less than +11.4 V dc.
- Fewer than four power supplies are operational.
- One or more I/O modules are missing TERMPOWER

RS232 Connector

You can connect a maintenance terminal console or PC to connector (CALLOUT 5) to display EMU:

- Error messages.
- Information messages.

A PC can also load the microcode updates into the EMU memory through this connector.

Blower Fault LEDs

One or more of these eight, amber blower fault LEDs (CALLOUT 6) are ON whenever one of the following conditions exists:

- One or more blowers are not operating.
- One or more blowers are not operating at the correct speed.
- Removal of a blower

The blower LEDs are also on when there is a configuration fault.

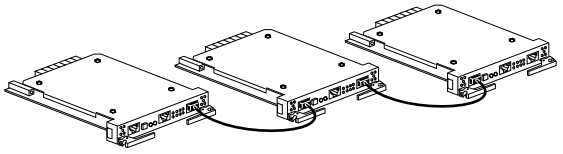
Configuring the EMU

Configuring the EMU requires connecting the EMU—EMU communications bus and then using the **CLI** (**command line interpreter**) `set emu` command to establish the temperature set points and the blower speed operating mode.

Connecting the EMU Communication Bus

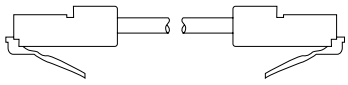
In an expansion configuration you must establish communications between the master EMU and each expansion EMU. To establish communications you must connect a communication port on each EMU to a communication port on another EMU (see Figure 3–4). By establishing an EMU—EMU communication bus you ensure that the master EMU can monitor and control all the enclosures in the UltraSCSI subsystem.

Figure 3–4 EMU Communication Connections



DIGITAL recommends that use a BN26M cable (see Table 3–1) no longer than 4 m (13.1 ft) to connect the EMUs.

Table 3–1 EMU Communication Cables

Description	Length		Part
	Meters	Feet	Number
8-conductor 24 AWG, PVC, round cable assembly with: 2–8 position (8MP). locking, plug connectors  CXO5747A	0.2 0.5 1.0 3.0 4.0	0.7 1.0 1.6 9.8 13.1	BN26M–0B BN26M–0E BN26M–01 BN26M–03 BN26M–04

EMU Firmware

The EMU firmware enables you to use CLI commands to establish limits for EMU functions such as temperature and blower speed control. The different versions determine the specific commands or functions available. The EMU compares the temperature sensor readings and the blower speed readings against the limits you entered.

When the EMU controls blower speed, it will automatically place the blowers into the high-speed mode when the any sensor reports a temperature that is within 4°C (7°F) of the sensor setpoint. For example, if a temperature set point is 41°C (106°F), the EMU would cause the blowers to operate at high speed when the temperature reaches 37°C (99°F). The blowers operating at high-speed should prevent an overtemperature condition occurring and shutting down the enclosure.

You *must* use the following CLI commands to set the temperature set point for each EMU:

```
set emu sensor_1_setpoint=48
set emu sensor_2_setpoint=48
set emu sensor_3_setpoint=41
```

Where: 1 = backplane sensor 1 (exhaust)
2 = backplane sensor 2 (exhaust)
3 = EMU sensor (intake)

DIGITAL recommends that use these set points.

Caution

For EMU firmware versions 1.0 and 1.1 you cannot use the command: `set emu sensor_n_setpoint=default`. This command will establish a temperature set point that is too low for proper operation. This can result in an erroneous subsystem alarm.
Removing and replacing the master EMU automatically changes the temperature set points to the default setting. You must then set all the temperature set points using the CLI commands.

Setting the Temperature Sensors

There are three temperature sensors in each UltraSCSI enclosure

- Two on the rear of the backplane in the top middle
- One mounted on the EMU module

You have the option of setting the temperature at which an individual sensor reports an overtemperature condition. You enter the desired temperature in degrees Celsius (°C) within the range of 0°C (32°F) through 49°C (120°F). See Table 3–2 for the relationship between °C and °F (Fahrenheit). Always use the rules in Table 3–3 when setting the temperature set points.

The EMU sensor monitors the EMU air temperature, while the two enclosure sensors monitor the exhaust air temperature. The exhaust air temperature is higher than the EMU air temperature.

In an expansion configuration you can only set the master EMU temperatures. The temperature set points for the other UltraSCSI enclosures automatically change to match the master EMU setting.

Note

For detailed instructions about using the `set emu` commands, refer to the array controller CLI documentation.

Table 3–2 EMU Set Point Temperature Conversions

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
32	0	50	10	68	20	86	30	104	40
34	1	52	11	70	21	88	31	106	41
36	2	54	12	72	22	90	32	108	42
37	3	55	13	73	23	91	33	109	43
39	4	57	14	75	24	93	34	111	44
41	5	59	15	77	25	95	35	113	45
43	6	61	16	79	26	97	36	115	46
45	7	63	17	81	27	99	37	117	47
46	8	64	18	82	28	100	38	118	48
48	9	66	19	84	29	102	39	120	49

Table 3–3 Temperature Set Point Rules

1.	Enter all temperatures in degrees Centigrade (°C). You cannot enter temperatures as fractions, decimals, or degrees Fahrenheit (°F).
2.	The EMU set point (sensor_3) temperature must be a minimum of 6°C (11°F) greater than the highest expected ambient (intake) temperature.
3.	The backplane set points (sensor_1 and sensor_2) must be a minimum of 13°C (23°F) greater than the highest expected ambient temperature. (7°C [13°F] greater the EMU set point).
4.	The backplane set points (sensor_1 and sensor_2) must be the same temperature.
5.	When operating with EMU firmware versions 1.0 or 1.2, you *cannot use* the command: `set emu sensor_`*`n`*`_setpoint=default.`
6.	When operating with EMU firmware versions 1.0 or 1.2, you *must use* the commands `set emu sensor_`*`n`*`_setpoint=`*`nn`*`,` where nn is the temperature in °C.

Setting the Blower Speed Control

The UltraSCSI enclosure blowers normally operate at low speed and provide sufficient air flow to cool the enclosure components and ensure proper operation. Use the CLI `set emu fanspeed` command to change the operating speed of the blowers.

- When you enter `set emu fanspeed=high`, all blowers in all enclosures operate at high speed.
- When you enter `set emu fanspeed=automatic`, the local EMU controls the blower speed in each enclosure.

Note

For detailed instructions about using the `set emu` commands, refer to the array controller documentation.

DIGITAL recommends using the `set emu fanspeed=automatic` so that each EMU can implement corrective action whenever one of the following error conditions occurs:

- A blower fails
- You remove a blower
- A blower is rotating too slowly to provide sufficient air flow
- The intake air temperature exceeds the user defined temperature
- Either backplane temperature exceeds the user defined temperature

DIGITAL suggests using `set emu fanspeed=high` whenever the following conditions exist:

- The intake temperature is more than 38°C (100°F)
- There is no air conditioning
- Both conditions exist

When the EMU detects a blower or temperature error condition it can automatically switch all the operational blowers to high speed. This thereby increases the air flow through the enclosure and reduces the possibility of component failure. Simultaneously, the EMU can initiate the following actions:

- Enable the audible alarm on the EMU

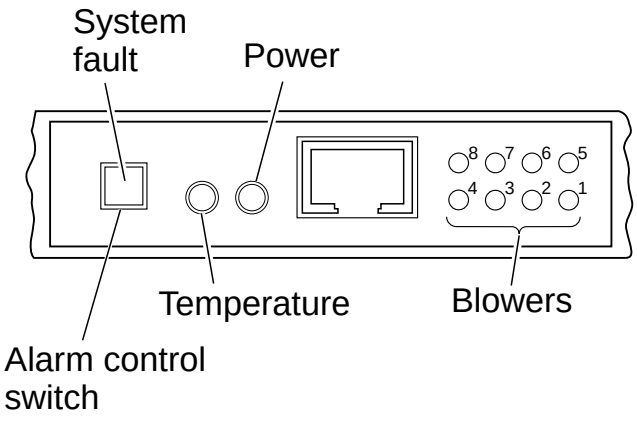
- Turn on the amber system fault LED whenever the temperature exceeds a set point
- Turn on the amber temperature fault LED
- Notify the array controller of the error condition
- Start the EMU timer when (1) all blowers in a bank are defective, or (2) a blower is removed
- Eight minutes after the EMU timer begins operating, turn off the dc power in the enclosure to prevent component overheating

When you momentarily depress the alarm control switch the EMU audible alarm will turn OFF and the fault status LEDs remain ON. At this time the blower LEDs will display the system fault codes ("Configuration Fault Code Reporting").

EMU Status Reporting

The EMU processes subsystem status reports and notifies the user of problems using the EMU audible alarm and the status LEDs (system, temperature, power, blower). See Figure 3–5.

Figure 3–5 EMU Status LEDs



The EMU processes two types of problems:

- An **error condition** involving the failure of a component or conditions outside the predetermined environment, such as an overtemperature condition.

  When there is an error condition the system fault LED is ON. For detailed information about system fault LEDs, see "Error Condition Reporting," on page 3–17.

- A **fault condition** involves a subsystem configuration problem, such as a Boot ROM checksum failure.

  When there is a fault condition the system fault LED is FLASHING. For detailed information about the system fault LED, see "Configuration Fault Code Reporting."

Whenever the audible alarm sounds, the user should check the EMU status LEDs to determine the problem.

Caution

Should the audible alarm sound but the status LEDs not indicate an error condition, it is possible that the error condition no longer exists. However, you should always check the error log on the maintenance terminal to ensure that the error no longer exists.

The EMU reports the system status, to include error conditions, to the array controller that records *some* of this information in the error log and displays it on the controller console.

Alarm Control Switch

Whenever a power, environment, blower error, or fault condition occurs the EMU turns on the local audible alarm. At the same time the alarm sounds, an amber LED in the alarm control switch turns ON. The alarm remains on until one of the following conditions occurs:

- Correction of the error condition
- The user momentarily presses the alarm control switch

When you *momentarily* press the switch you turn off the audible alarm for all current fault conditions in the local subsystem. The alarm remains OFF until one of the following conditions occur:

- A different fault occurs
- An existing fault clears and reoccurs
- An error condition still exists after 1 hour. This causes he audible alarm to sound for approximately 5 seconds once every hour.

When you press and hold the switch for at least 5 seconds you clear all the fault codes displays.

Note

The alarm control switch does not affect either the error condition or the error condition code *stored* by the EMU. The only way to clear this stored error condition code is to correct the problem.

The alarm control switch functions as an enclosure power switch when the standby power mode is active. You must press the alarm control switch to restore dc power to the enclosure.

Subsystem Status LEDs

Table 3–4 shows the possible EMU status LED displays. When the LED blinking or flashing interval is more than 1 second, the LED is ON.

Table 3–4 Subsystem Status LEDs Displays

Symbol		Condition
		LED is ON or blinking slowly
		LED is OFF.
		LED is FLASHING (blinking rapidly)

Monitoring Power Supply Operation

Even when there are four operational power supplies, it is possible that a power supply problem will cause one or both of the dc voltages to be too low. Both the PVA and the EMU monitor power supply operations to ensure that the dc voltages are within the ranges specified in Table 3–5.

Table 3–5 DC Voltage Ranges

Nominal Voltage	+ 5 V dc	+ 12 V dc
Minimum Voltage	+4.7 V dc	+ 11.4 V dc

When there are at least four operational power supplies both the minimum voltages, which are sufficient to run the system, are present. Fewer than four operational power supplies cannot maintain the minimum voltages. Should this occur, the EMU will notify the array controller. The EMU can automatically initiate the standby power mode when controller directs or the PVA .

Note

Only the EMU monitors the I/O module +5 V dc TERMPOWER. The PVA does not monitor these voltages.

Error Condition Reporting

The EMU LEDs (see Table 3–6) display the enclosure, the temperature status, error conditions, individual blowers status, and blower bank status (When the enclosure is functioning properly only the Power LED is on.) The figures describe:

- The EMU LED display
- The enclosure status associated with each display
- The probable cause of the error condition
- The actions recommended to correct the problem

Note

It is not practical to display all the possible LED display combinations. For example, there are eight displays for the failure of an individual blower. Therefore, Table 3–6 lists only a representative sampling of the possible displays.

Table 3–6 EMU Status Displays

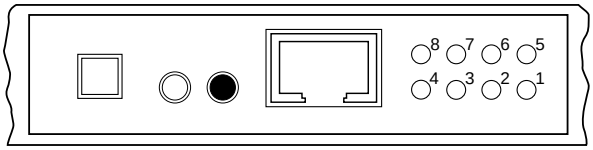
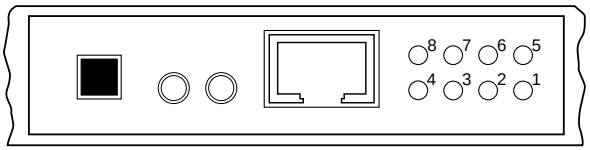
EMU Status	EMU LED Display
Operational Enclosure The subsystem is fully operational. The power supplies and the blowers are functioning properly. The intake and exhaust air temperatures are within the user specified limits.	 CXO5778A
Non-Operational Enclosure	 CXO5780A
Probable Cause 1—Either +5 V dc or 12 V dc out of range. Observe the power supply status LEDs to determine the defective power supply and replace it. **Probable Cause 2**—TERMPOWER less than +4.5 V dc on one or more I/O modules. Replace the I/O modules with a TERMPOWER LED OFF	

Table 3–6 EMU Status Displays (Continued)

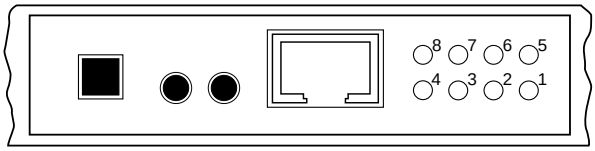
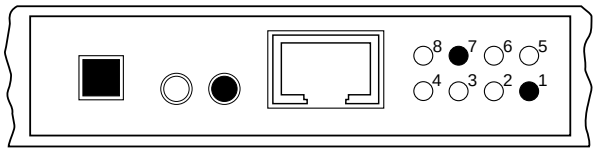
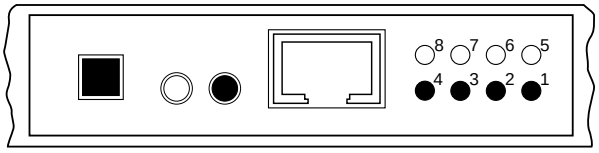
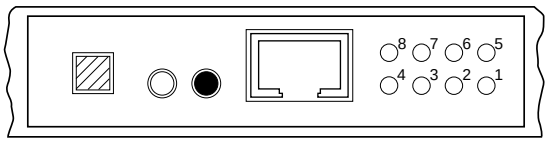
EMU Status	EMU LED Display
Overtemperature Condition	 CXO5779A **Probable Cause 1**—A temperature in one or more enclosures is above the user specified limit. Determine and correct the cause of this condition quickly prevent the overtemperature condition from causing a subsystem RESET or failure. **Probable Cause 2**—A temperature set point is too low for environment. Change temperature set point.
Single Blower Fault Operational blowers are running at high speed.	 CXO5781A **Probable Cause**—A blower in *either bank, or both banks*, is not operating properly. Replace the defective blowers. **Comment**—In this example blower 1 and 7 are not operating.

Table 3–6 EMU Status Displays (Continued)

EMU Status	EMU LED Display
Missing Blower Fault or Multiple Blower Faults Operational blowers are running at high speed.	 CXO5782A
Probable Cause 1—A blower is removed. Replace the missing blower. **Probable Cause 2**—All blowers in one bank are not operating. Remove and install blowers correctly within 8 minutes. **Probable Cause 3**—Multiple blowers are installed incorrectly. Remove and install blowers correctly within 8 minutes. **Comment**—In this example, one of the following conditions exists in Bank 1: • A blower is removed. or • Two or more blowers are not operating. Failure to replace the missing blower within 8 minutes can result in the enclosure entering the standby power mode.	
Configuration Error	 CXO5783A
Probable Cause 1—Configuration error. See “Configuration Fault Code Reporting” for the specific error condition. **Probable Cause 2**—Slave EMU cannot communicate with Master EMU. See “Configuration Fault Code Reporting” for the specific error condition. **Probable Cause 3**—External SHELF_OK signal indicates error. See “Configuration Fault Code Reporting” for the specific error condition.	

Configuration Fault Code Reporting

The system fault, temperature, power, and blower LEDs, cannot display all the possible system faults. Therefore, a FLASHING system fault LED indicates that there are system faults. To determine what the system fault is you must observer the hexadecimal code displayed on the blower LEDs in binary format. The upper LEDs (8 through 5) display the first digit (the most significant digit); the lower LEDs (4 through 1) display the second digit (the least significant digit).

Note

Until you momentarily press the FLASHING alarm control switch, the blower LEDs cannot display the fault codes.

Each time you momentarily press the alarm control switch, the EMU initiates the following actions:

1. Displays the first *reported* hexadecimal fault code on the blower LEDs three times in succession.
   - The LEDs display the first reported fault code the first time for one second and then go OFF.
   - The LEDs display the first reported fault code the second time for one second and then go OFF.
   - The LEDs display the first reported fault code the third time for one second and then go OFF.
2. The LEDs now display the next reported fault code three times.
3. Steps 1 and 2 repeat for all fault codes.

For a detailed explanation of the fault codes see Table 3–7.

Table 3–7 EMU Fault Code Displays

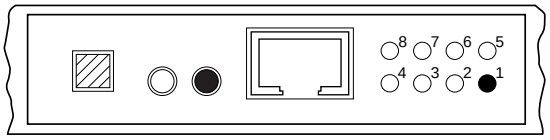
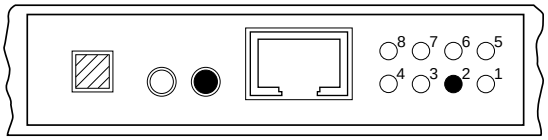
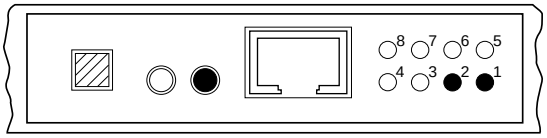
Fault Code, Cause, Corrective Action	EMU LED Display
Fault Code 01 One of the following Boot ROM error conditions exist: 1. A Boot ROM Signature failure. Replace the EMU. 2. A Boot ROM Checksum failure. Replace the EMU.	 CXO5760A
Fault Code 02 Both microcode images are bad. 1. Load microcode image to the EMU from the PC. 2. Replace the EMU.	 CXO5761A
Fault Code 03 Either a PVA SCSI ID switch setting is invalid (1, 4, 5, 6, or 7) or there is no master enclosure (SCSI ID 0). 1. Ensure PVA SCSI ID switches settings are as follows: • Master enclosure–0. • First expansion enclosure–2. • Second expansion enclosure–3. 2. If you change any PVA SCSI ID switch setting, turn the system OFF, and then turn the system ON. 3. Replace each of the PVAs in sequence until the fault condition clears.	 CXO5762A

Table 3–7 EMU Fault Code Displays (Continued)

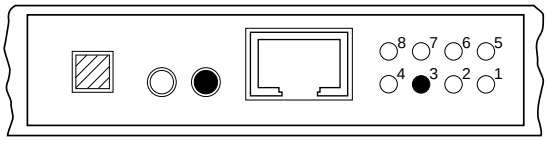
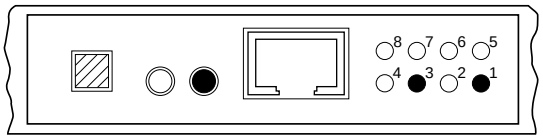
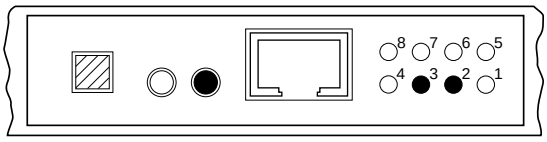
Fault Code, Cause, Corrective Action	EMU LED Display
Fault Code 04 Master EMU cannot communicate with expansion EMU. 1. Ensure PVA SCSI ID switches settings are as follows: • Master enclosure–0. • First expansion enclosure–2. • Second expansion enclosure–3. 2. If you change any PVA SCSI ID switch setting, turn the system OFF, and then turn the system ON. 3. Ensure the EMU cables are properly connected. 4. Disconnect each EMU cable and connect them one at a time. Replace the defective cable. 5. Replace the EMU.	 CXO5763A
Fault Code 05 Master EMU cannot communicate with array controller. 1. Replace the EMU. 2. Replace the array controller	 CXO5764A
Fault Code 06 1. One or more temperature sensors indicating an “invalid” temperature–one that is greater than 49°C (120°F). 2. Replace the EMU. 3. Have field service replace temperature sensor.	 CXO5765A

Table 3–7 EMU Fault Code Displays (Continued)

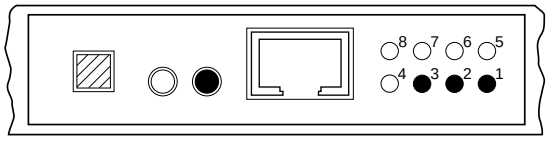
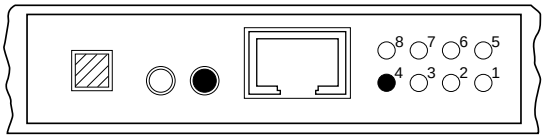
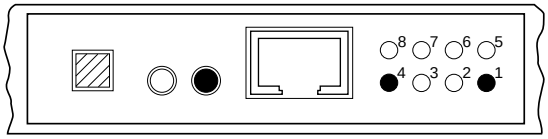
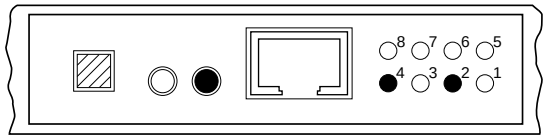
Fault Code, Cause, Corrective Action	EMU LED Display
Fault Code 07 Invalid configuration. Requires an array controller specific action.	 CXO5766A
Fault Code 08 Two PVA SCSI ID switch settings are the same.	 CXO5767A
1. Ensure the PVA SCSI ID switch settings are as follows: • Master enclosure–0. • First expansion enclosure–2. • Second expansion enclosure–3. 2. If you change any PVA SCSI ID switch setting, turn the system OFF, and then turn the system ON. 3. Replace each of the PVAs in sequence until the fault condition clears.	
Fault Code 09 EMU installed in PVA slot. Install the EMU in the slot on the left using the procedure in Table 3–9.	 CXO5768A
Fault Code 0A No PVA installed. Install the PVA using the procedure in Table 4–7	 CXO5769A

Table 3–7 EMU Fault Code Displays (Continued)

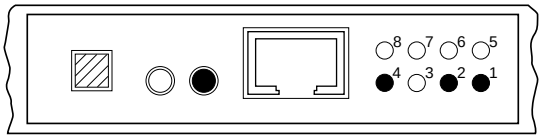
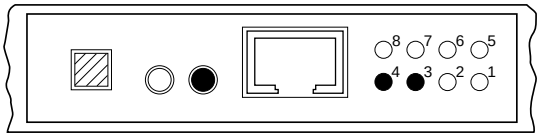
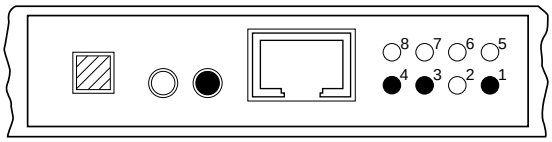
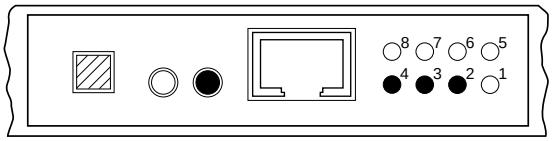
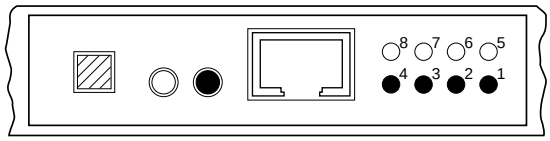
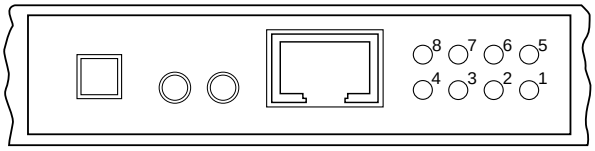
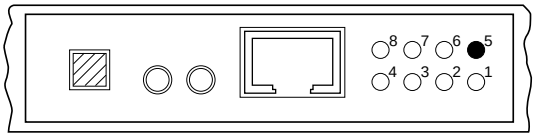
Fault Code, Cause, Corrective Action	EMU LED Display
Fault Code 0B Controller fault. Requires an array controller specific action (see the array controller documentation).	 CXO5770A
Fault Code 0C One or more defective power supplies. Observe all power supply status LEDs. Replace any power supply with the lower LED OFF	 CXO5771A
Fault Code 0D Master enclosure SCSI ID address incorrect or array controller installed in expansion enclosure. 1. Change the master enclosure SCSI ID to 0 and turn the system OFF, and then turn the system ON. 2. Install the array controller in the master enclosure.	 CXO5772A
Fault Code 0E EMU memory test failed. Replace the EMU	 CXO5773A

Table 3–7 EMU Fault Code Displays (Continued)

Fault Code, Cause, Corrective Action	EMU LED Display
Fault Code 0F Less than four operational power supplies. Replace the defective power supplies. Comment—The EMU places the system in the standby power mode	**Initial Display**  CXO5784A **Standby Power Mode Display**  CXO5815A
Fault Code 10 EMU diagnostic program loaded. The audible alarm is on continuously and you cannot clear it by pressing the alarm control switch. 1. Load new microcode, turn the system OFF, and then turn the system ON. 2. Replace the EMU with one with proper microcode, turn the system OFF, and then turn the system ON.	 CXO5814A

Replacing an EMU

To remove an EMU complete the procedure in Table 3–8. To install an EMU complete the procedure in Table 3–9.

Table 3–8 Removing an EMU

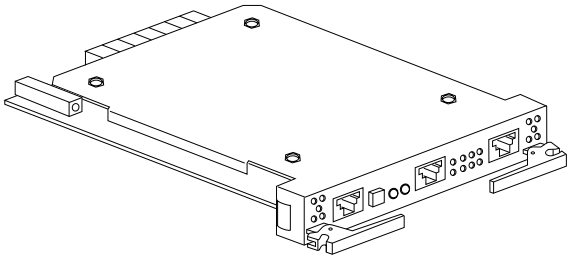
1. Shut down the system by clearing the cache module and shutting down the controller.
2. Turn Off the enclosure power.
3. Pull the extractor latches forward and remove the EMU.  CXO-5497A-MC

Table 3–9 Installing an EMU

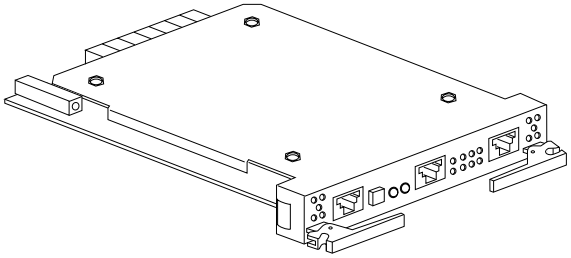
1. Remove the EMU from the shipping container and ensure that it is a model DS–BA35X–EB.  CXO-5497A-MC

Table 3–9 Installing an EMU (Continued)

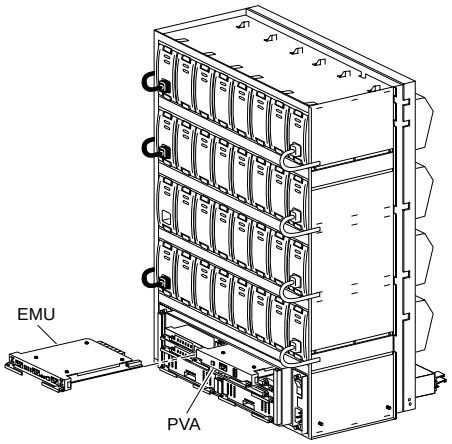
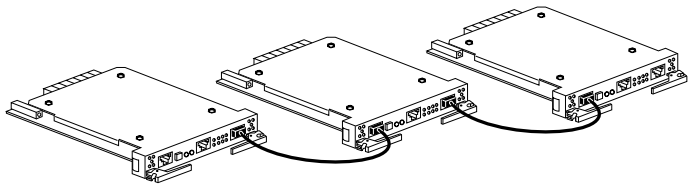
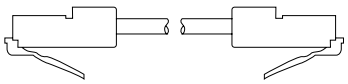
2. Align the EMU with left hand slot.    CXO5754A
3. Insert the EMU into the slot and push it in until the extractor latches engage the enclosure.
4. For an expansion configuration use a BN26M-series cable (see Table 3–10) to connect the EMU—EMU communications bus.  CXO5820A
5. After installing all components, apply power to the expansion enclosures.
6. Apply power to the master enclosure and after the controller is operational, verify that the subsystem is functioning properly.

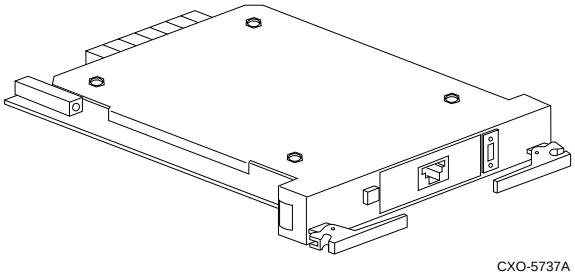
Table 3–10 EMU Communications Cables

Description	Length		Part Number
	Meters	Feet	
8-conductor 24 AWG, PVC, round cable assembly with: 2 each, 8 position (8MP) locking, plug connectors  CXO5747A	0.5 1.0 3.0 4.0 7.0	1.0 1.6 9.8 13.0 23	BN26M–0E BN26M–01 BN26M–03 BN26M–04 BN26M–07

4
Power Verification and Addressing (PVA)

The PVA (power verification and addressing) assembly (Figure 4–1) and the associated EMU monitors the status of the major UltraSCSI enclosure components to verify proper operation. When an error or fault condition occurs, these modules notify the user, and, in some instances, the array controller, that a problem exists. The array controller can identify and display information about some problems. The PVA and EMU LED displays identify possible problem causes.

Figure 4–1 PVA

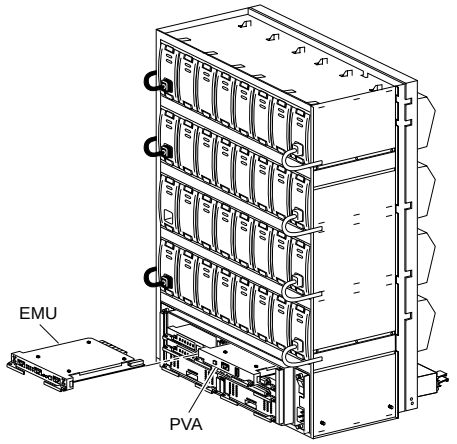


Caution

Proper operation of an UltraSCSI subsystem requires an operational EMU (model DS–BA35X–EB) and PVA (model DS–BA35X–EC) in each enclosure. You must also establish communications links between the EMUs to ensure proper subsystem operation and error reporting.

The PVA and EMU mount next to each other in the enclosure—the EMU on the left and the PVA on the right (see Figure 4–2).

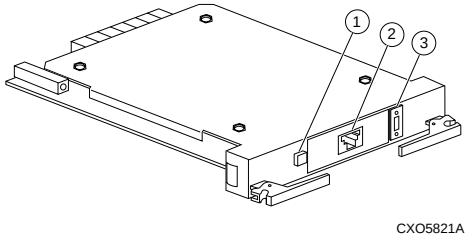
Figure 4–2 PVA Location



Product Description

Figure 4–3 identifies the major PVA components.

Figure 4–3 PVA Major Components



1. Standby power switch.
2. Communications port (unused)
3. Enclosure SCSI address switch

The PVA has two status indicators:

- A green power status LED in the power switch ⏻ This LED is ON whenever both there at least four operational power supplies. When an error condition occurs, the LED is OFF.

  This switch can initiate the standby power mode when the array controller is inactive. In this mode, ac power is applied to the power controllers and the power supplies. However, the shelf power supplies dc outputs are not distributed.

- An audible alarm that beeps slowly when the PVA detects removal of the EMU. This beep reminds the user to install an operational EMU to restore the subsystem to an operational status.

Functions

The primary functions of the PVA include the following:

- Ensuring there are at least four operational power supplies in the enclosure
- Notifying the array controller when there are less than four operational power supplies in the master enclosure. The array controller may then initiate a RESET

  This duplicates an EMU function and ensures optimum subsystem performance and integrity.

- Allowing the user to select a DIGITAL supported device SCSI bus address (device ID) for each enclosure
- Monitoring the enclosure EMU status and notifying the user when the EMU is missing

PVA Operation

Most PVA operations occur automatically and do not require any user intervention. The following sections define major PVA operations.

EMU Installation Monitoring

Should you remove the EMU, or install it incorrectly (for example, not seating it fully), the PVA detects this condition and sounds the PVA audible alarm. This alarm will beep slowly until the PVA senses the presence of an operational EMU.

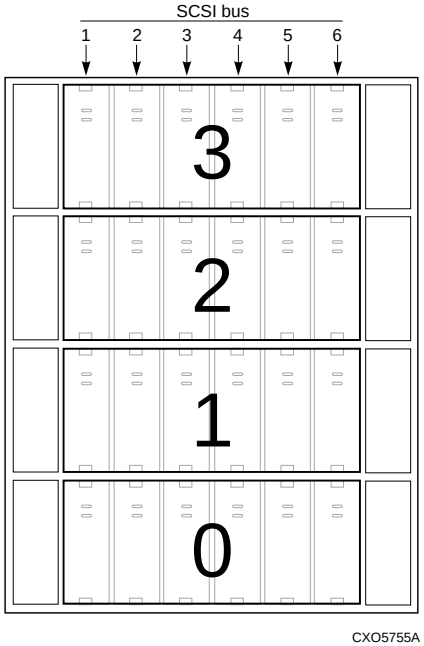
Caution

Removing both the EMU and PVA at the same time will cause the system to RESET.

SBB Device IDs

The 24 disk drives in each enclosure are arranged on six vertical buses in four horizontal shelves. All six devices on the same horizontal shelf use the same device address or ID. See Figure 4–4 for the master enclosure SBB device IDs.

Figure 4–4 Master Enclosure Device IDs



Caution

To preclude SCSI bus addressing conflicts, DIGITAL only supports enclosure address settings 0, 2, and 3.

Use the PVA address switch to establish SCSI bus IDs for all the devices on the same shelf. This switch has eight (0 through 7) positions.

Always set the master enclosure switch is to *0*.

Monitoring Power Supply Operation

Even when there are four operational power supplies, it is possible that a power supply problem will cause one or both of the dc voltages to be too low. Both the PVA and the EMU monitor power supply operations to ensure that the dc voltages are within the ranges specified in Table 4–1

Table 4–1 DC Voltage Ranges

Nominal Voltage	+ 5 V dc	+ 12 V dc
Minimum Voltage	+4.7 V dc	+ 11.4 V dc

When there are at least four operational power supplies both the minimum voltages, which are sufficient to run the system, will be present. Fewer than four operational power supplies cannot maintain the minimum voltages. Should this occur, the EMU will notify the array controller. The EMU can automatically initiate the standby power mode.

Note

Only the EMU monitors the system dc voltages and the I/O module +5 V dc TERMPOWER. The PVA only monitors the system dc voltages.

Setting the Enclosure Address

Use the procedure in Table 4–2 to identify the enclosure as either a master or an expansion enclosure. This switch also establishes the SCSI bus address (device ID) for the disk drives (SBBs) in the enclosure. The following restrictions apply to establishing the enclosure address:

1. The master enclosure address is *always* **0**.
2. There is only one master enclosure in any subsystem.
3. No two enclosures can have the same address.

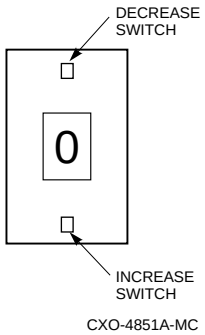
See Table 4–3 for the DIGITAL-supported enclosure addresses.

Caution

DIGITAL does not support any combination of enclosure address settings that assign the same SCSI bus device address to more than one device on a SCSI bus

To preclude SCSI bus addressing conflicts, DIGITAL only supports enclosure address settings 0, 2, and 3.

Table 4–2 Setting the Enclosure Configuration



To decrease the configuration number:
Press the upper switch to step the address down one address at a time (decrement).

To increase the configuration number:
Press the lower switch to step the address up one address at a time (increment).

Caution

To implement an address setting change you must turn the enclosure OFF and then turn it ON.

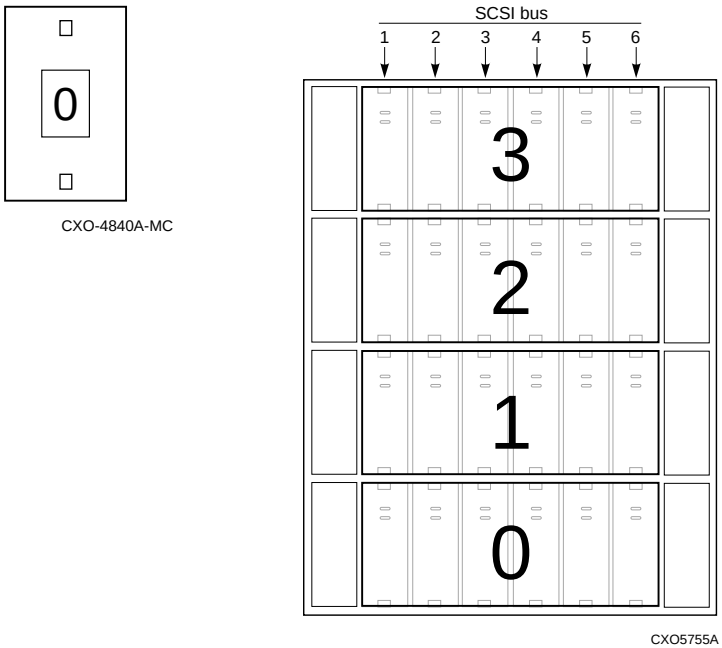
Table 4–3 DIGITAL Supported Enclosure Addresses

No. of Enclosures	Master	Expansion 1	Expansion 2
1	**0**	None	None
2	**0**	**2**	None
3	**0**	**2**	**3**

Master Enclosure Address

The master enclosure address is always 0 that establishes the SBB SCSI bus IDs shown in Figure 4–5.

Figure 4–5 Master Enclosure SCSI Bus IDs



Expansion Enclosure Addresses

DIGITAL supports *only* expansion enclosure address settings 2 (see Figure 4–6) and 3 (see Figure 4–7).

Caution

To preclude SCSI bus addressing conflicts, DIGITAL *does not support* enclosure address settings 1, 4, 5, 6, or 7 for systems with HSZ70-series controllers.

Figure 4–6 Enclosure Address 2 SCSI Bus IDs

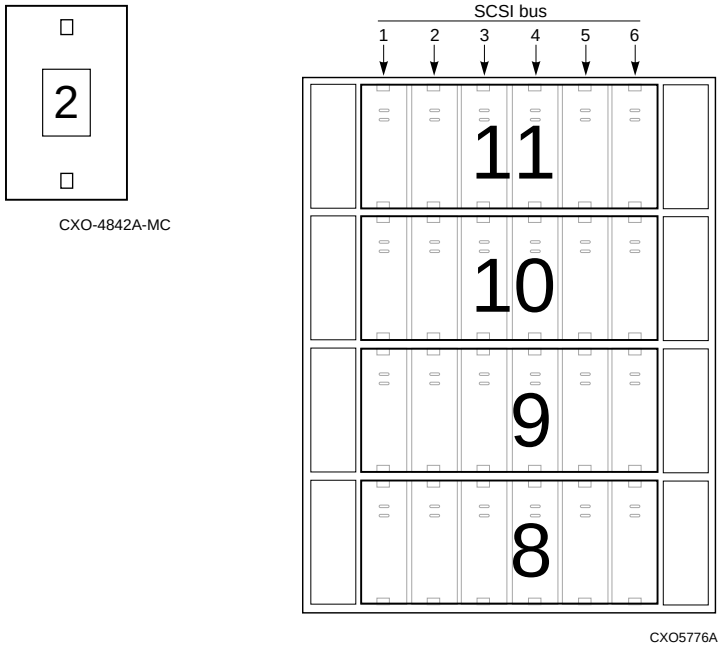
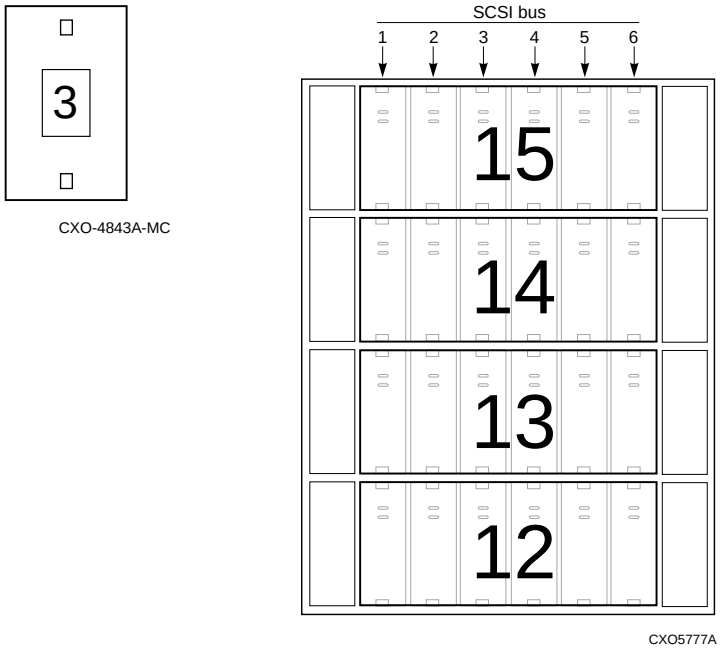


Figure 4–7 Enclosure Address 3 SCSI Bus IDs



Implementing the Standby Power Mode

A major function of the PVA is implementing the standby power mode. This mode removes dc power from all components except the EMU alarm control switch. In the standby power mode the EMU alarm control switch now functions as a dc power switch. Complete the procedure in Table 4–4 to place the subsystem in the standby power mode. Complete the procedure in Table 4–5 to restore dc power to each enclosure.

Table 4–4 Turning Off the DC Power Distribution

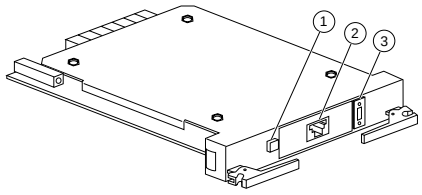
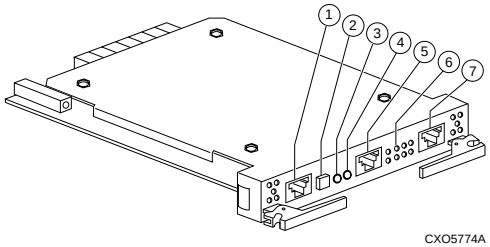
1. Clear the cache module and shut down the array controller as described in the array controller documentation.
2. Shut down the array controller, press and hold the PVA standby power switch (CALLOUT 1) on an expansion enclosure until the master EMU initiates a power shut down on all enclosures. If there is no expansion enclosure, press and hold the PVA standby power switch (CALLOUT 1) on the master enclosure until the EMU initiates a power shut down.    CXO5821A
3. The enclosure EMU alarm control switches now function as the subsystem power switch.

Table 4–5 Turning On the DC Power Distribution

1. Momentarily press the EMU alarm control switch (CALLOUT 2) on each expansion enclosure.    CXO5774A
2. Momentarily press the EMU Alarm control switch (CALLOUT 2) on the master enclosure.
3. The array controller restores the subsystem to an operational state.

Replacing a PVA

Complete the procedures in Table 4–6 and Table 4–7 to replace a defective PVA. Complete the procedure in Table 4–7 when assembling an UltraSCSI RAID enclosure.

Table 4–6 Removing a PVA

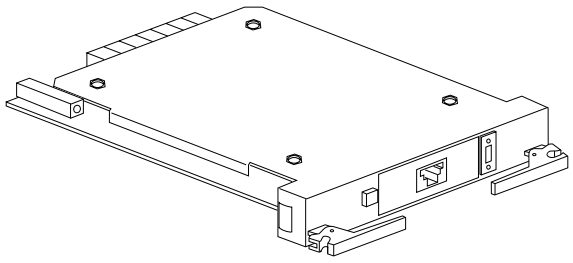
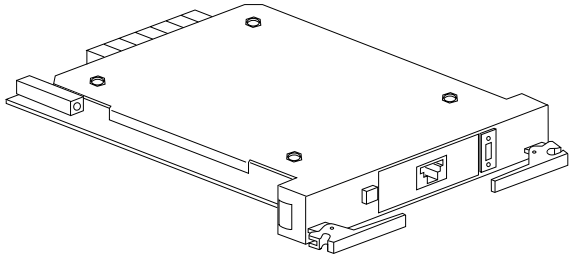
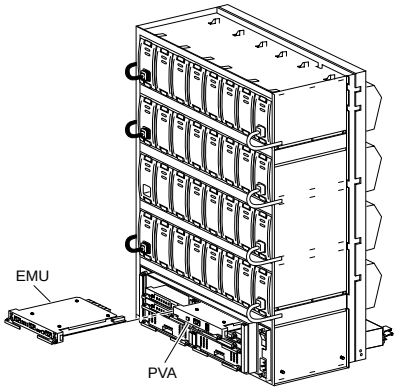
1. Shut down the array controller and turn off power in the enclosure.
2. Note the enclosure address setting on the thumbwheel switch.  CXO5737A
3. Pull both extractor latches forward and remove the PVA.

Table 4–7 Installing a PVA

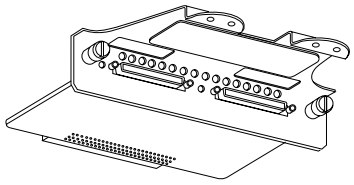
1. Remove the PVA from the shipping container and verify that it is a model DS–BA35X–EC.  CXO5737A
2. Align the PVA with the *right hand* slot.  CXO5754A
3. Insert the PVA into the slot and push it in until the extractor latches engage the enclosure.
4. Push in on the extractor latches to firmly seat the PVA.
5. Ensure that the enclosure address setting on the thumbwheel switch is valid for the enclosure.
6. After installing all the components, apply power to the enclosure and start the subsystem.

5
Single-Ended I/O Modules

The single-ended I/O modules (see Figure 5–1) have two functions:

- Providing termination for both the internal and external SCSI buses
- Establishing SCSI bus communications between

Figure 5–1 Single-Ended I/O Module



CXO5816A

Caution

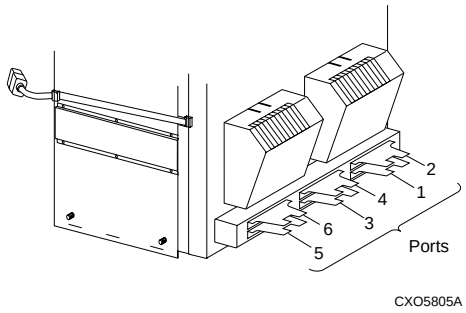
Not all array controllers support an UltraSCSI RAID subsystem with more than one enclosure. Read the array controller documentation to ensure the controller supports expanded configurations.

Caution

I/O modules provide termination for both the internal and the external SCSI buses. Therefore, you must install the same type, operational I/O modules on each of the six enclosure connectors.

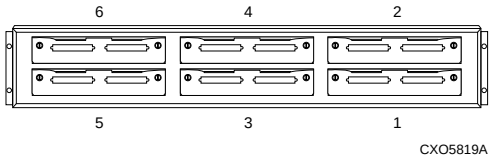
The six I/O modules mount on the bottom rear (see Figure 5–2) of the enclosure. These modules are the interconnection point between the array controller in the master enclosure and the devices in the expansion enclosures. In an UltraSCSI RAID subsystem, the I/O modules, the internal SCSI buses, and the array controller ports all have the same number. For example, array controller port 2, SCSI bus 2, and I/O module 2 are different elements of the same logical bus.

Figure 5–2 I/O Module Location



The odd numbered ports are in the bottom row and the even number ports are in the top row (see Figure 5–3). Port 1 is in the lower right corner and Port 6 is in the upper left corner.

Figure 5–3 I/O Module Numbering



Replacing I/O Modules and Cables

Replacing an I/O module or a cable without first shutting down the controller can adversely affect data integrity. Removal of the I/O module causes the EMU to report the following error conditions to the controller: (1) Installation of different I/O modules. (2) Loss of TERMPOWER. Either of these error conditions can cause the controller to cease operating without implementing procedures to protect the data.

Before you remove an I/O module or an expansion cable, completion of the of the following procedures is *mandatory* (1) Shut down the array controller, and (2) Turn off the enclosure power. Failure to do so can induce a controller error condition.

Expanding the UltraSCSI Bus

Each I/O module has a UltraSCSI single-ended bus expansion integrated circuit that isolates the internal and external SCSI bus, enhances SCSI signals, and extends the length of the UltraSCSI bus.

The two, 68-pin, VHDCI receptacle connectors are the connection points for expanding the SCSI buses between enclosures. These connectors are wired in parallel and can act as a trilink connector. In an expansion configuration, DIGITAL recommends a *maximum cable length* of 2 m (6.3 ft) between enclosures.

Note

Connecting a cable to the *right* I/O module connector removes the external SCSI bus termination from the module.

Controlling the Internal SCSI Bus

The I/O module controls the internal SCSI bus in the following manner:

- Isolates the internal SCSI bus from the external SCSI bus
- Provides single-ended SCSI bus termination for each internal bus
- Disconnects the internal SCSI bus from the external SCSI bus when the EMU so directs
- Distributes TERMPOWER (+5 V dc) to the internal SCSI bus
- Turns ON the green internal TERMPOWER LED when internal TERMPOWER is present
- Turns OFF the green internal TERMPOWER LED when there is either an internal TERMPOWER overcurrent condition or no TERMPOWER

Controlling the External SCSI Bus

The I/O module controls the external SCSI bus in the following manner:

- Provides single-ended SCSI bus termination for the external bus
- Distributes TERMPOWER (+5 V dc) to the external SCSI bus
- Turns ON the green external TERMPOWER LED when external TERMPOWER is present
- Turns OFF the green external TERMPOWER LED when there is either an external TERMPOWER overcurrent condition or no TERMPOWER
- Disables the external bus termination when a cable is connected to the right VHDCI connector

Controlling the Fault Bus

The I/O module controls fault bus operation in the following manner:

- Provides a fault bus driver for improved signal transmission
- Distributes the FAULT_CLK and FAULT_DATA signals from the master enclosure to the expansion enclosures
- Distributes the SHELF_OK and SWAP_L signals from the expansion enclosures to the master enclosure

Error Reporting

The EMU monitors the status of the I/O modules for the following error conditions:

- The installation of incompatible I/O modules
- A TERMPOWER problem

Incompatible I/O Modules

An I/O module error condition exists whenever any of the following conditions exists:

- Fewer than six operational I/O modules are installed
- The I/O modules are not the same type

When the EMU detects an error conditions it automatically reports the problem to the controller. An operational controller will automatically turn off without implementing procedures to clear the cache module. The result is that the controller will cease to operate and be in an error state; a state that can adversely affect the integrity of the data.

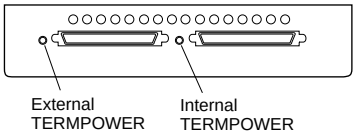
Only when all I/O modules are the same type can an UltraSCSI RAID subsystem function properly. The DIGITAL UltraSCSI controller only supports single-ended buses. Therefore, you can only use single-ended I/O modules (DS–BA35X MN). The enclosure does not support the following conditions:

- Installing a single-ended I/O module improperly
- Installing fewer than six single-ended I/O modules.
- Installing a termination I/O module
- Installing a differential I/O module

TERMPOWER Errors

The I/O module displays the TERMPOWER status for both the internal and the external bus (see Figure 5–4).

Figure 5–4 I/O Module TERMPOWER LEDs



The nominal TERMPOWER for both buses is +5 V dc.

- The green internal and external TERMPOWER LEDs are ON during normal operation.
- Whenever there is a TERMPOWER overcurrent condition or there is no TERMPOWER, the associated LED is OFF.

See Table 5–1 for possible causes of TERMPOWER problems.

Table 5–1 TERMPOWER Problems

TERMPOWER Error	Possible Causes
Internal	I/O module Power supply
External	I/O module Power supply External SCSI bus cable

Removing an I/O module disconnects the SCSI bus termination. The result is there is no TERMPOWER available to the internal SCSI bus and the bus cannot function correctly.

Rules for Expanding an UltraSCSI Bus

By connecting the master enclosure to one or two expansion enclosures, you can expand the SCSI bus from a 4-device bus to an 8-device or 12–device bus. See Chapter 4, “Power Verification and Addressing Assembly,” for a discussion of the valid enclosure SCSI bus addresses and the associated array controller and storage device SCSI bus IDs.

Caution

The UltraSCSI bus can support a maximum of 16 devices (2 array controllers and 14 disk drives), However, DIGITAL does not support any configuration with more than 12 disk devices. This precludes creating device ID conflicts between the array controllers and the disk drives, or between disk drives.

To expand a SCSI bus, use the 68-pin VHDCI receptacle connectors on the I/O module and a BN37A–series cable. See Table 5–2 for a list of the rules for expanding and UltraSCSI bus.

Caution

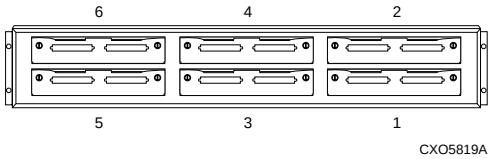
The DIGITAL UltraSCSI controller does not support connecting or disconnecting a SCSI bus when both data and power are present on the connector, a "hot swap." You can only connect or disconnect SCSI bus cables using the cold swap method.

To replace a cable, (1) Clear the cache module. (2) Shut down the array controller, and (3) turn off the enclosure power before removing an I/O module.

Note

Connecting a cable to the *right* I/O module connector removes the external SCSI bus termination from the module.

Table 5–2 UltraSCSI Bus Expansion Rules

1. The I/O module numbers (1–6) match the enclosure SCSI bus numbers and the array controller port numbers. 
2. Always connect the cables between the I/O modules in the same location on the same bus. That is, connect I/O module 1 on the master enclosure to I/O module 1 on an expansion enclosure.
3. The *first cable* on any I/O module always connects to the *left connector*.
4. The *second cable* on any I/O module always connects to the *right connector*.

Cabling an UltraSCSI Subsystem

Caution

Not all array controllers support an UltraSCSI RAID subsystem with more than one enclosure. Read the array controller documentation to ensure the controller supports expanded configurations.

Caution

The DIGITAL UltraSCSI controller does not support connecting or disconnecting a SCSI bus when both data and power are present on the connector, a "hot swap." You can only connect or disconnect SCSI bus cables using the cold swap method.

To replace a cable, (1) Shut down the array controller, and (2) Turn off the enclosure power before removing an I/O module.

Before beginning the installation, you must complete the preliminary procedures, select the UltraSCSI VHDCI cables, and shut down the subsystem.

Preliminary Procedures

Complete the procedure in Table 5–3 before installing the cables.

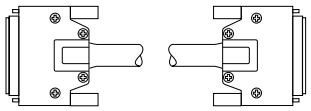
Table 5–3 Preliminary Cabling Procedures

1.	Select the UltraSCSI cables for each segment based upon the distances between the enclosures.
2.	Determine the optimum route for each set of cables.
3.	Shut down the array controllers.
4.	Complete the installation procedure for either a two or three enclosure subsystem.

Selecting an UltraSCSI VHDCI Cable

You can use the cables listed in Table 5–4 to connect devices or cables with 68-pin VHDCI receptacle connectors.

Table 5–4 UltraSCSI Bus Cables

Description	Length		Order
	Meters	Feet	Number
68-conductor SCSI cable with: 2–VHDCI straight plug connectors with jack screws.  CXO5702A	0.3 0.5 1.0 1.5 2.0	1.0 1.6 3.3 4.9 6.6	BN37A–0C BN37A–0E BN37A–01 BN37A–1E BN37A–02

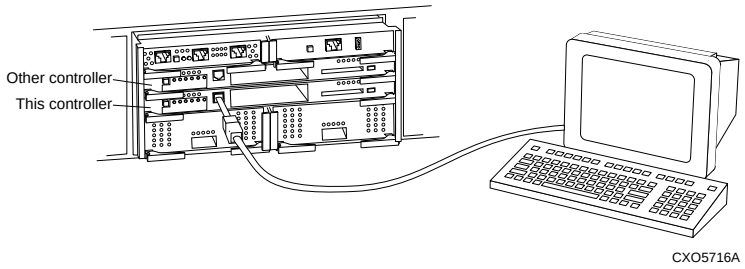
Caution

To ensure proper UltraSCSI bus operation, DIGITAL recommends a maximum cable length of 2 m (6.3 ft).

Shutting Down the Subsystem

To protect data and the devices you must complete the procedures in Table 5–5 before you begin installing the cables.

Table 5–5 Shutting Down the UltraSCSI Subsystem

1.	On the host dismount the UltraSCSI RAID subsystem disk drives.
2.	Connect a maintenance terminal to an array controller. 
3.	Shut down the other array controller by entering the command— `shutdown other_controller.`
4.	Shut down the array controller by entering the command— `shutdown this_controller.`
5.	Shut down both array controllers.
6.	Turn off all the ac power controllers in all the enclosures.

Cabling a Three–Enclosure Subsystem

Caution

Not all array controllers support an UltraSCSI RAID subsystem with more than one enclosure. Read the array controller documentation to ensure the controller supports expanded configurations.

Note

Each bus requires two BN37A cables, a total of 12 cables.

Complete the procedure Table 5–6 for the I/O modules on each SCSI bus starting with SCSI bus 1.

Caution

Overtightening the I/O module spring-loaded mounting screws can damage the threads.

Table 5–6 Installing Three Enclosure Subsystem Cables

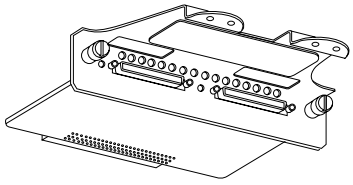
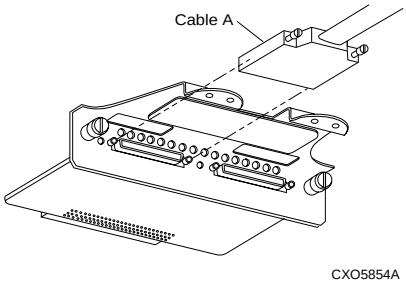
1.	Shut down the array controller (see Table 5–5). Use a screwdriver to loosen the two, spring-loaded mounting screws on the I/O module.
2.	Grasp the module by the cable support bracket and pull it directly to the rear and remove it from the enclosure shroud.  CXO5816A
3.	Repeat Steps 1 and 2 for all the I/O modules.
4.	On the first (master) I/O module, align the Cable A connector with the left connector.  CXO5854A Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
5.	Align the module with the *Port 1* backplane connector in the master enclosure shroud. Gently insert the module and fully seat it. Use a screwdriver to tighten the spring-loaded mounting screws.

Table 5–6 Installing Three Enclosure System Cables (Continued)

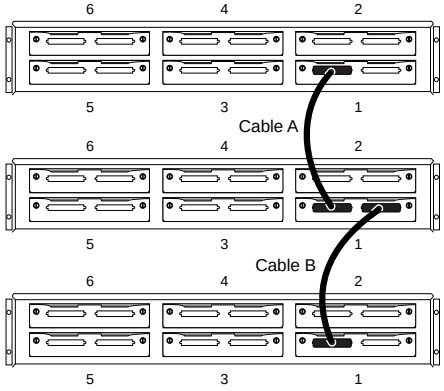
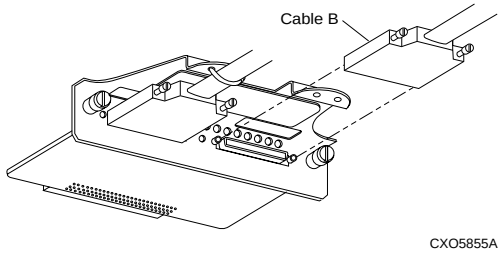
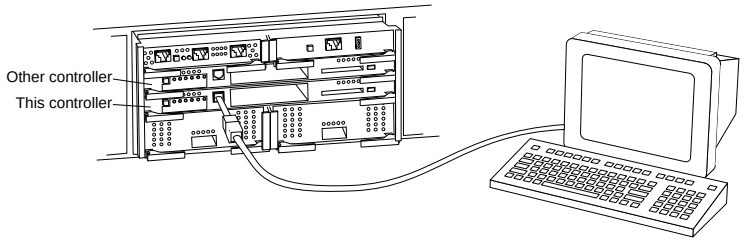
6. On an expansion I/O module, align the Cable *A* with the *left* connector. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie. 
7. Align the Cable *B* connector with the *right* connector. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie. 
8. Align the *Cable B* connector with the *left* connector on the other I/O module. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.

Table 5–6 Installing Three Enclosure System Cables (Continued)

9. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
10. Align the I/O module with the *Port 1* backplane connector in the *second* expansion enclosure shroud. Gently insert the module and fully seat it. Use a screwdriver to tighten the spring-loaded mounting screws.
11. Repeat steps 1 through 10 for the remaining SCSI buses.
12. Turn the subsystem on (see Table 5–7) and verify that it is functioning properly.

Table 5–7 Turning On the UltraSCSI Subsystem

1. Restore power to each enclosure by turning ON the ac power controllers.
2. Connect a maintenance terminal to the array controller.
3. On controller “A”, press and hold the reset switch for at least 3 seconds.
4. On controller “B”, press and hold the reset switch for at least 3 seconds.    CXO5716A
5. Verify that the other array controller is functioning by entering the command—`show other controller`
6. Verify that this array controller is functioning by entering the command—`show this controller`

Cabling a Two–Enclosure Subsystem

Caution

Not all array controllers support an UltraSCSI RAID subsystem with more than one enclosure. Read the array controller documentation to ensure the controller supports expanded configurations.

Complete the procedures in Table 5–8 to connect the master enclosure to one expansion enclosure. Perform this procedure for the I/O modules on each SCSI bus starting with SCSI bus 1. Each SCSI bus requires one BN37A cable for a total of 6 cables.

Caution

Overtightening the I/O module spring-loaded mounting screws can damage the threads.

Table 5–8 Installing Two Enclosure Subsystem Cables

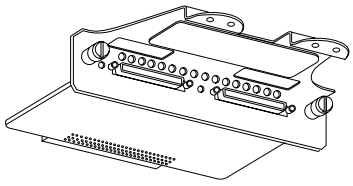
1. Shut down the array controller (see Table 5–5). Use a screwdriver to loosen the two, spring-loaded mounting screws on the I/O module.
2. Grasp the module by the cable support bracket and pull it directly to the rear and remove it from the enclosure shroud.  CXO5816A
3. Repeat Steps 1 and 2 for all the I/O modules.

Table 5–8 Installing Two Enclosure System Cables (Continued)

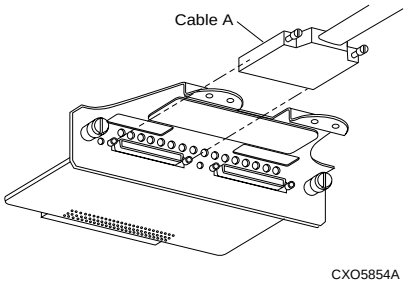
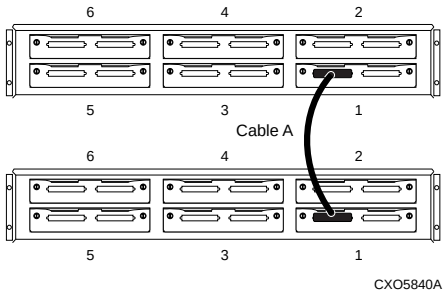
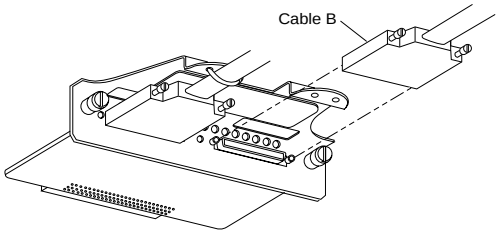
4. On the first (master) I/O module, align the Cable A connector with the left connector.    Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
5. Align the module with the *Port 1* backplane connector in the master enclosure shroud. Gently insert the module and fully seat it. Use a screwdriver to tighten the spring-loaded mounting screws.
6. On an expansion I/O module, align the Cable *A* with the *left* connector. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.    Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.

Table 5–8 Installing Two Enclosure System Cables (Continued)

7. Align the Cable *B* connector with the *right* connector. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie. 
8. Align the *Cable B* connector with the *left* connector on the other I/O module. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.
9. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
10. Align the I/O module with the *Port 1* backplane connector in the *second* expansion enclosure shroud. Gently insert the module and fully seat it. Use a screwdriver to tighten the spring-loaded mounting screws.
11. Repeat steps 1 through 10 for the remaining SCSI buses.
12. Turn the subsystem on (see Table 5–7) and verify that it is functioning properly.

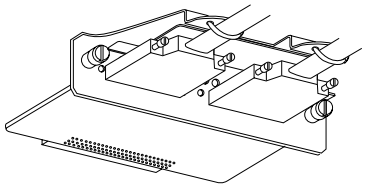
Replacing an I/O Module

Complete the procedure in Table 5–9 to remove I/O modules. Complete the procedure in Table 5–10 to install I/O modules when assembling an enclosure or replacing an individual module.

Caution

To prevent interrupting a data transfer or losing data, shut down the subsystem before removing an I/O module.

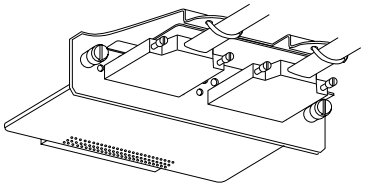
Table 5–9 Removing an I/O Module

1.	Shut down the array controller (see Table 5–10). Use a screwdriver to loosen the two, spring-loaded mounting screws on the I/O module.
2.	Grasp the module by the cable support bracket and pull it directly to the rear and remove it from the enclosure shroud.  CXO5940A
3.	Cut the wire tie on the left cable. Loosen the thumb screws and remove the cable.
4.	Label the cable connector.
5.	Cut the wire tie on the right cable. Loosen the thumb screws and remove the cable.
6.	Label the cable connector.

Caution

Overtightening the I/O module spring-loaded mounting screws can damage the threads.

Table 5–10 Installing an I/O Module

1. Remove the I/O module from the shipping container and verify that it is a model DS–BA35X–MN.
2. Align the left cable with the I/O module connector.
3. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.  CXO5940A
4. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
5. Align the right cable with the I/O module connector.
6. Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.
7. Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
8. Align the I/O module with the backplane connector in the enclosure shroud. Gently insert the module and fully seat it. Use a screwdriver to tighten the spring-loaded mounting screws.
9. Turn on the subsystem and verify that it is operating properly.

Replacing a Cable

Caution

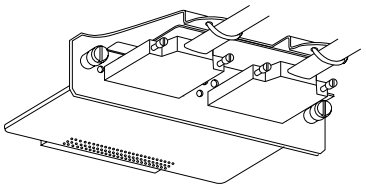
Not all array controllers support an UltraSCSI RAID subsystem with more than one enclosure. Read the array controller documentation to ensure the controller supports expanded configurations.

Complete the procedure in Table 5–11 to remove expansion cable. Complete the procedure in Table 5–12 to install cables when assembling an enclosure or replacing an individual cable.

Caution

To prevent interrupting a data transfer or losing data, shut down the subsystem before removing an I/O module.

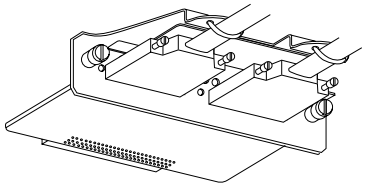
Table 5–11 Removing an Expansion Cable

1.	Shut down the array controller (Table 5–5). Use a screwdriver to loosen the two, spring-loaded mounting screws on the I/O module.
2.	Grasp the module by the cable support bracket and pull it directly to the rear and remove it from the enclosure shroud.
3.	Repeat Steps 1 and 2 for the other I/O module.
4.	Cut the wire tie on the left cable. Loosen the thumb screws and remove the cable.  CXO5940A
5.	Label the cable connector.
6.	Cut the wire tie on the right cable. Loosen the thumb screws and remove the cable.
7.	Label the cable connector.

Caution

Overtightening the I/O module spring-loaded mounting screws can damage the threads.

Table 5–12 Installing an Expansion Cable

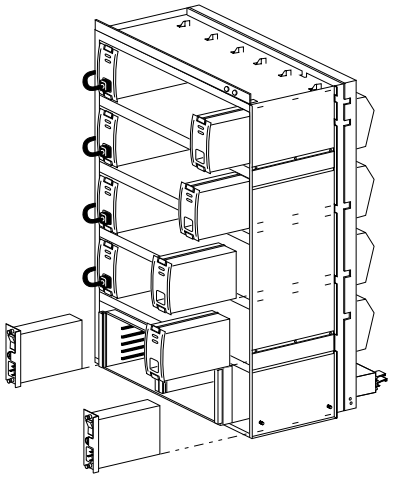
1.	Remove the expansion cable from the shipping container and verify that it is proper type and length.
2.	Align the left cable with the I/O module connector.
3.	Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.  CXO5940A
4.	Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
5.	Align the right cable with the I/O module connector.
6.	Gently insert the cable connector into module connector. Tighten both cable connector thumb screws to fully seat the connector.
7.	Install a wire tie through the holes on the cable support bracket and around the cable. Tighten the wire tie.
8.	Align the I/O module with the backplane connector in the enclosure shroud. Gently insert the module and fully seat it. Use a screwdriver to tighten the spring-loaded mounting screws.
9.	Turn on the subsystem and verify that it is operating properly.

6
Power Distribution

This chapter describes the UltraSCSI RAID enclosure power distribution to include the following:

- The enclosure power system and components (see Figure 6–1)
- Power distribution configurations (standard, redundant, optimum)
- Configuring the power distribution
- Error detection and reporting
- Replacement procedures

Figure 6–1 Enclosure Power System



CXO5800A

Note

Proper operation of the controller cache modules requires external cache batteries (ECBs). The array controller documentation discusses how to use the ECBs.

Power System Overview

In any RAID subsystem a consideration is the elimination of single points of failure. Designing systems with redundant power capabilities is one way to accomplish this.

The following are the major components of the power system:

- AC power sources
- Power controllers
- Power cords
- Shelf power supplies

Note

The power controller power cords are integral to the data center cabinets. For the departmental server cabinets the *user–supplied* power cords are country–specific.

The SBB shelf ac power cords are integral parts of the UltraSCSI enclosures.

Power Configurations

For all StorageWorks products with the capability of using redundant power, the power configurations definitions are in the format ***n+x***. In this format, ***n*** is the minimum number of supplies required for operation, and ***x*** is the number of redundant supplies. The UltraSCSI enclosures require a minimum of four (***n***) supplies.

Standard (n+1)

This configuration has one redundant power supply for a total of *five power supplies*. A *single power controller* distributes ac power to the five supplies on power bus A. This configuration requires only *one ac power source*.

n+4 (Redundant)

This configuration has four redundant power supplies for a total *of eight power supplies*. *Two power controllers* distribute ac power to four supplies on power bus A and power bus B. This configuration requires only *one ac power source*.

n+4 (Optimum)

This configuration has four redundant power supplies for a total *of eight power supplies*. *Two power controllers* distribute ac power to four supplies on power bus A and power bus B. This configuration requires *two* ac power sources.

AC Power Source

The power controller requires one of the following ac power sources:

100–120 V ac, 60 Hz, single-phase, 12A.

or

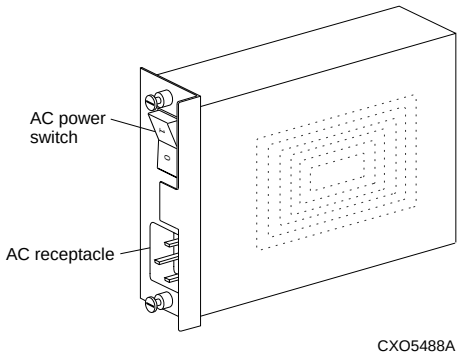
220–240 V ac, 50 Hz, single-phase, 6A.

The optimum power configuration requires *two separate ac power sources*; one for each power controller. The ac power sources cannot be on the same distribution leg, use the same circuit breaker, nor the same ac wall receptacle. They must have common ground.

AC Input Power Controller

The ac power distribution is through the power controller (see Figure 6–2) to the shelf power supplies. The ON–OFF switch on each power controller controls the ac distribution to the associated power bus (A or B). These power controllers are completely interchangeable and there are no physical or electrical differences between them. These units do not have any error indicators nor do they generate any error signals. In a standard or redundant power supply configuration without an optional second power controller, a power controller failure disables the enclosure.

Figure 6–2 AC Power Input Controller



Caution

The only compatible power controller is the model DS–BA35X–HE.

You cannot use the model BA35X–HE ac power controller in an UltraSCSI RAID enclosure.

The ON–OFF switch on each power controller controls the ac distribution to the shelf power supplies on the same power bus (A or B). These power controllers are completely interchangeable and there are no physical or electrical differences between them. These units do not have any error indicators nor do they generate error signals. A power controller failure can disable the enclosure.

Shelf Power Supplies

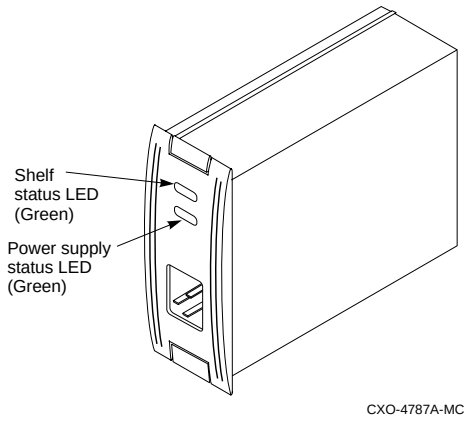
Caution

The UltraSCSI RAID enclosure *requires* shelf power supplies rated for at least 180 W, such as the model DS–BA35X–HH shelf power supplies. Other supplies, such as the 150 W power supply, model BA35X–HF, *can not be used.*

The shelf power supply converts the ac voltage to +5 V dc and +12 V dc and distributes these voltages throughout the RAID enclosure.

- The maximum capacity of the UltraSCSI RAID enclosure is eight power supplies and has four redundant power supplies.
- The standard power supply configuration has one redundant supply.

Figure 6–3 Shelf Power Supply



AC Power Buses

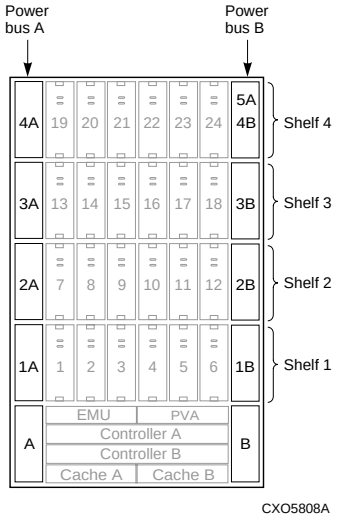
AC power distribution to the UltraSCSI shelf power supplies is over two buses–bus **A** and bus **B** (see Figure 6–4). Each bus has an ac power source, a separate power controller, power supplies, and power cords.

Although bus **A**, the **n+1** configuration, can operate the system, DIGITAL recommends using both buses, the *optimum* power configuration (n+4) with two ac power sources.

Power bus A uses black power cords. The grey power cords are for power bus B.

- AC power controller **A** controls the black power cords—positions **1A** through **5A**
- AC power controller **B** controls the grey power cords—positions **1B** through **4B**

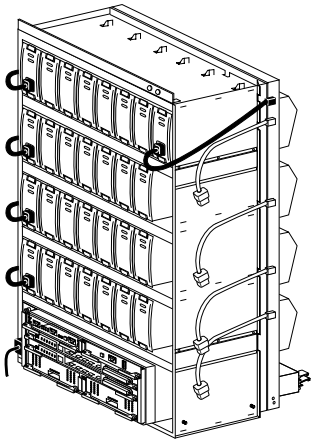
Figure 6–4 Enclosure AC Power Buses



Standard (n+1) Power Configuration

This power configuration distributes ac power over power bus A to five power supplies located in positions 1A through 5A. Power bus A uses the black power cords on the left side of the enclosure and on the upper right corner (see Figure 6–5).

Figure 6–5 Standard Power Configuration



The standard power configuration has the following components:

1 – ac power source.

5 – shelf power supplies (Locations 1A through 5A).

1 – ac power controller (Location A).

Any one of the following power related error conditions *will* cause the UltraSCSI RAID enclosure to cease operation:

- Loss of the ac power source
- Failure of *two* shelf power supplies
- Failure of the power controller

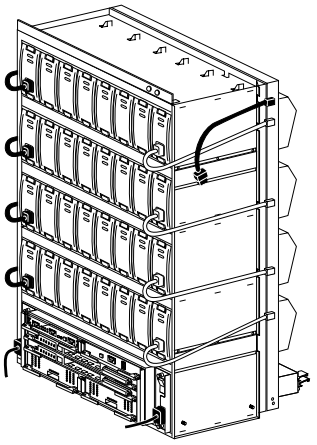
Redundant (n+4) Power Supply Configurations

This power configuration distributes ac power over both the power buses (A and B). See Figure 6–6. Each bus has four power supplies.

To implement this configuration from an n+1 configuration requires the user to order the following additional components:

- 3 – power supplies (DS–BA35X–HH)
- 1 – ac power controller (DS–BA35X–HE)

Figure 6–6 Redundant Power Configuration



CXO5797A

DIGITAL *recommends* this power configuration for complete data protection with maximum redundancy of all enclosure power system components. Any *one* of the following *multiple* error conditions can comprise data integrity *before* you can take corrective actions:

- Loss of the ac power source
- Failure of *five* shelf power supplies
- Failure of *both* power controllers

Power controller **A** distributes the ac power through the *four black* cords at the *left end* of the device shelves. Power controller **B** distributes the ac power through the *four grey* cords at the *right end* of the device shelves.

Optimum (n+4) Power Supply Configurations

The only difference between this configuration and the redundant (n+4) configuration is the use of separate ac power sources.

To implement this configuration from a standard n+1 configuration requires the user to order the following additional components:

- 3 – power supplies (DS–BA35X–HH)
- 1 – ac power controller (DS–BA35X–HE)

To implement this configuration from n+1 or an n+4 configuration requires a second ac power source.

DIGITAL *recommends* this power configuration for complete data protection with maximum redundancy of all enclosure power system components. Any *one* of the following *multiple* error conditions can comprise data integrity *before* you can take corrective actions:

- Loss of the ac power sources
- Failure of *five* shelf power supplies
- Failure of *both* power controllers

Power Supply Error Condition Reporting

Each shelf power supply has two green LEDs that display the power supply status (see Figure 6–7). Table 6–1 describes the following:

- The LED state
- The status being reported
- The recommended corrective action

Figure 6–7 Power Supply Status LEDs

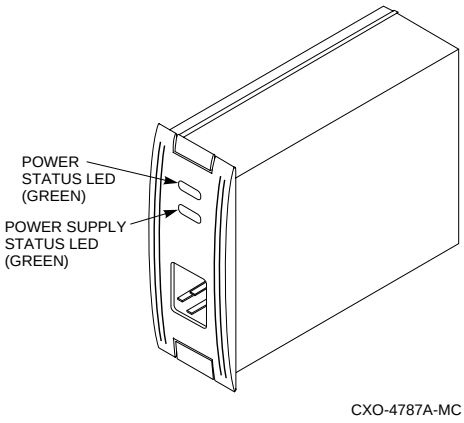


Table 6–1 Shelf Power Status LED Displays

If the LED display is…	the Blower and Power Supply status is
LED is ON. LED is OFF LED is FLASHING	The power supply is functioning properly.
	1. There is no ac power Check ac power source. 2. The shelf power supply has failed. Replace the shelf power supply

Replacing a Power Supply

Caution

To protect this sensitive electronic device from electrostatic discharge (ESD) use the following precautions—(1) Wear an ESD wrist strap. (2) Do not touch the printed circuit board or the backplane connector. (3) Do not lay the device on a work surface but place it on an electrostatic mat. (4) Place the device in an electrostatic bag for shipment.

The basic procedure for removing and replacing shelf power supplies is the same as for replacing disk drives. Normally you can replace one shelf power supply without removing power from the enclosure.

There are two methods for replacing shelf power supplies—the hot swap method and the cold swap method. Use the LEDs on the front of the SBB that indicate the status, either operational or non-operational, to determine the swap method to use.

- Normally use the hot swap method
- The cold swap method is normally used only during initial installation. This requires removing the power from the UltraSCSI RAID enclosure and all devices are inactive.

Complete the procedures in Table 6–2 and Table 6–3 to replace a shelf power supply:

Caution

To prevent ESD (electrostatic discharge) damage to an SBB, do not touch the SBB connector.

Table 6–2 Removing a Power Supply

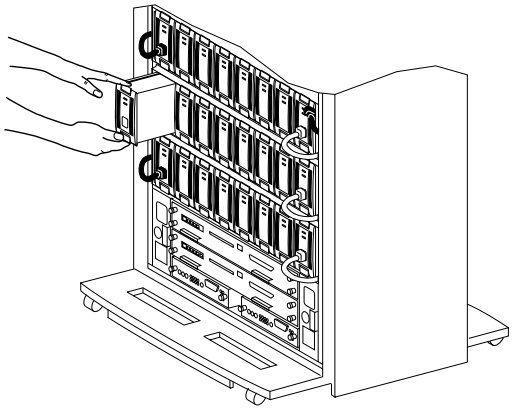
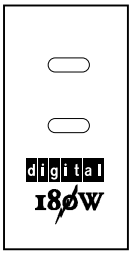
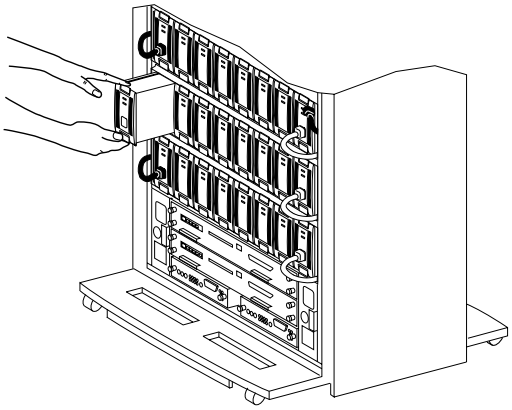
1.	To perform a hot swap go to Step 3.
2.	To perform a cold swap, turn off the ac power controller.
3.	Disconnect the power cord from the front of the SBB.
4.	Press the two mounting tabs together to release the power supply from the shelf.  CXO-4314A-MC
5.	Use both hands and pull the power supply out of the shelf.
6.	Insert the power supply into an electrostatic shipping container.
7.	Lay the supply on a flat surface.
8.	Insert the shelf power supply into the guide slots and push it in to fully seat it and the bezel mounting tabs engage the shelf.
9.	Connect the power cord to the shelf power supply.
10.	Both status LEDs should be ON.

Table 6–3 Installing a Shelf Power Supply

1. Remove the supply from the electrostatic shipping container and verify that it is a 180 W power supply by checking the bezel label. 
2. Lay the supply on a flat surface.  CXO-4314A-MC
3. Insert the shelf power supply into the guide slots and push it in to fully seat it and the bezel mounting tabs engage the shelf.
4. Connect the power cord to the shelf power supply.
5. Both status LEDs should be ON.

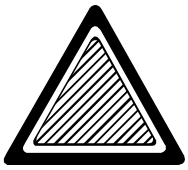
Power Controller Error Condition Reporting

There are no power controller status indicators. A possible indication of a power controller failure is that both status LEDs on *all* the associated shelf power supplies are OFF. This could also indicate an ac power failure.

Replacing a Power Controller

Complete the procedure in Table 6–4 to remove a power controller. Complete the procedure in Table 6–5 when assembling the UltraSCSI enclosure or replacing a single power controller.

WARNING



Only qualified service personnel can replace an ac power controller.
To prevent the possibility of injury or death as a result of electrical shock—(1) Always disconnect the ac power cord before removing a power controller. (2) Never touch the backplane connector or circuit board. (3) Always install the power controller before connecting the ac power cord.

Complete the procedure in Table 6–4 to remove an ac power controller.

Table 6–4 Removing an AC Input Power Controller

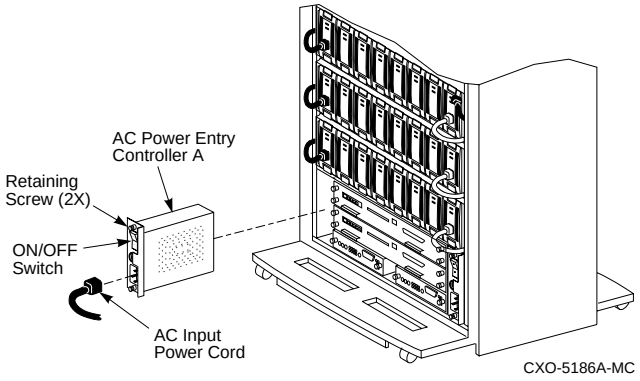
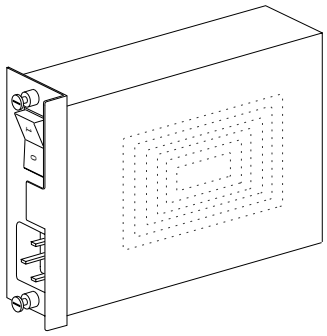
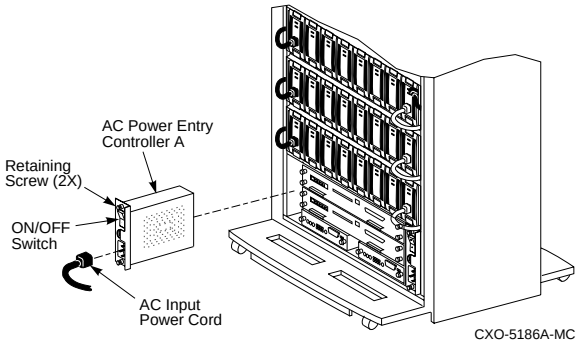
1.	Press **O** on the ON/OFF switch.
2.	Disconnect the ac power cord.
3.	Loosen the two retaining screws. 
4.	Remove the power controller from the UltraSCSI RAID enclosure and either place in on an electrostatic mat or place it in an electrostatic bag.

Table 6–5 Installing an AC Power Controller

1. Remove the power controller from the shipping container and verify that it is a model DS–BA35X–HE.  CXO5113A
2. Press **O** on the ON/OFF switch to turn the power controller OFF.
3. Align the first power controller with either slot A or slot B in the lower *left corner* of the RAID enclosure.  CXO-5186A-MC
4. Push in on the power controller to fully seat it.
5. Tighten the two retaining screws.
6. Install the power cord from the ac power source to the ac power controller.
7. Complete Steps 1 through 6 for the other power controller.

7
Storage Devices

This chapter describes the procedures for handling, addressing, identifying, and replacing StorageWorks building block (SBB) disk drives in an UltraSCSI RAID enclosure. Also described are error conditions and the associated LED displays.

Caution

The DIGITAL UltraSCSI RAID enclosure supports 3.5-inch disk drive SBBs. This enclosure does not support tape drives, solid state disks, optical disk drives, CD–ROMs, or 5.25-inch devices.

For a list of supported devices refer to the operating system-specific release notes.

Handling an SBB

Figure 7–1 defines the proper methods for handling an SBB to prevent damage.

Figure 7–1 SBB Handling Rules

SBB Device Address

Determining the SBB device address is a function of the following:

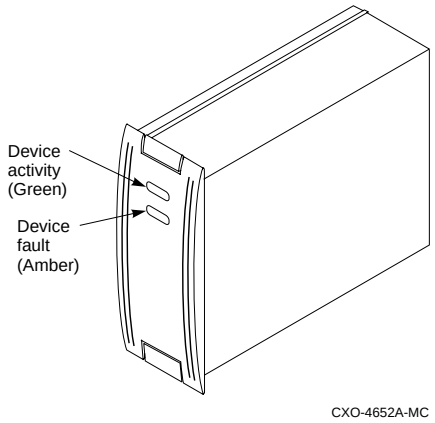
- The PVA–determined enclosure address (0, 2, or 3)
- The SBB enclosure shelf location

SBB Status Reporting

StorageWorks shelves monitor the status of the storage SBBs. When a fault occurs, the fault and the SBB device address (SCSI target ID) are reported to the array controller or host for processing The SBB LEDs define the status of the individual SBBs.

Each storage SBB has two LED indicators (see Figure 7–2) that display the SBBs status. These LEDs have three states: on, off, and flashing.

Figure 7–2 SBB Status LEDs



- The green LED is the device activity LED and is on or flashing when the SBB is active.

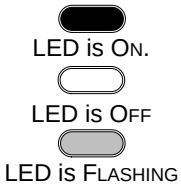
Caution

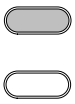
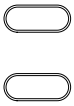
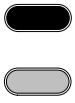
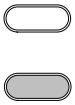
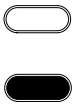
Removing a storage SBB when the upper LED is on or flashing can comprise data integrity.

- The amber LED is the storage SBB fault status LED and indicates an error condition when it is either on or flashing. The SCSI bus controller controls this LED.

See Table 7–1 for definitions of the LED displays.

Table 7–1 SBB Status LED Displays

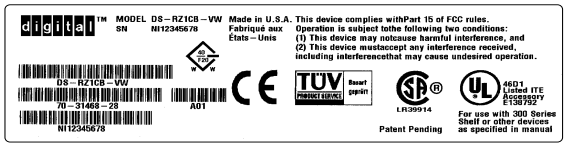


When the LED display is…	the SBB Status is
	The SBB is operating normally.
	The SBB is operating normally. The SBB is inactive, and there is no fault.
	The SBB is probably not responding to control signals. DIGITAL recommends that you replace the SBB.
	The SBB is active and is spinning down because of the fault. DIGITAL recommends that you replace the SBB after the device has spun down.
	In response to a fault bus message, the array controller is spinning down the device. DIGITAL recommends that you replace the SBB after the device has spun down.
	The SBB is inactive and spun down. You can replace the SBB.

Identifying a Storage Device

To determine the model number of a device see the regulatory label (see Figure 7–3) on the side of the SBB or the SBB identification label (see Figure 7–4) on the bezel.

Figure 7–3 Typical SBB Regulatory Label



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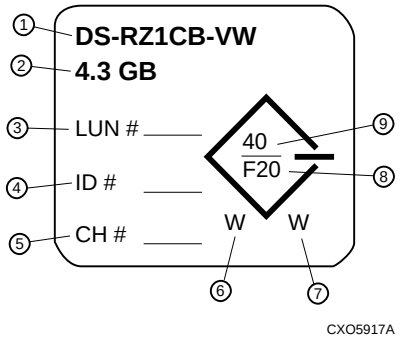
The SBB bezel label includes the following device information:

- Device type
- SCSI bus type
- User-defined information, such as:
  - — LUN # (logical unit number)
  - — ID # (device ID)
  - — CH # (channel number)

Figure 7–4 Typical SBB Bezel Label



1. The device model number.
2. The device storage capacity.
3. The user-assigned SCSI logical unit number (LUN).
4. The user-assigned SCSI identification number (target ID).
5. The user-assigned array controller channel number, that is the array controller port or SCSI bus.
6. The SCSI bus device width where–
   - **N–**an 8-bit device
   - **W–**a 16-bit device
7. The StorageWorks shelf type (Wide or Narrow) in which you can install the device where–
   - **N**—the device is 8-bit shelf compatible.
     W—the device is 16-bit shelf compatible.
   - **N/W**—the device is compatible with either an 8- or 16-bit shelf.
8. The bus speed expressed in *megabits* (Mb) per second where–
   - **S**—Slow device. For example:
     S5 = 5 Mb/s
   - **F**—Fast device. For example:
     F10 = 10 Mb/s
     F20 = 20 Mb/s
9. The rate at which a *16-bit device* can transfer data in *megabytes* (MB) per second.

Guidelines for Replacing SBBs

This section describes the items to consider when replacing SBBs.

Prerequisites for Replacing an SBB

Replacing an SBB is a relatively simple procedure. However, there are several things you must consider.

When an array controller initializes a device, it establishes the device's physical location, the device address, and the logical unit number (LUN). Physically moving the device, changing the bus, or changing the device address will cause the bus to become erratic.

You can use the SBB identification label to identify the device model, logical unit number (LUN), device address, array controller bus, and other device specific characteristics.

Caution

To protect this sensitive electronic device from electrostatic discharge (ESD) use the following precautions—(1) Wear an ESD wrist strap. (2) Do not touch the printed circuit board or the backplane connector. (3) Do not lay the device on a work surface but place it on an electrostatic mat. (4) Place the device in an electrostatic bag for shipment.

SBB Replacement Methods

There are three methods for replacing StorageWorks storage SBBs: hot swap, warm swap, and cold swap. You must determine the appropriate replacement method based on the capabilities of the array controller before replacing a device.

Caution

The methods for replacing DIGITAL array controllers and cache modules are device dependent. Refer to the array user's guide or release notes for detailed instructions.

Hot Swap

When you perform a hot swap, power and data are present on the SBB enclosure connector.

Caution

Although the HSZ70-series controllers support hot swap, other controllers do not. If you are not *positive* that your SCSI controller supports hot swap, DIGITAL recommends using warm swap to protect the integrity of your data.

Read the array controller documentation to determine which array controller-supported swap method to use.

You can use hot swap to remove and replace SBBs from a system that is on line and active.

Warm Swap

When you perform a warm swap, power is present on the SBB enclosure connector and there is no data on the bus. *Before* you perform a warm swap you must quiesce the bus at the array controller and observe the amber status LED on the SBB and ensure that *it is not flashing.*

Caution

You can perform a warm swap only when the green device activity LED is OFF.

Cold Swap

When you perform a cold swap, neither power nor data is present on the SBB enclosure connector. This requires turning OFF the enclosure power in all the UltraSCSI RAID subsystem enclosures.

The SBB Connector

The StorageWorks SBB connectors ensure that the SBBs will operate reliably even when replaced many times.

The SBB has a 96-pin receptacle DIN connector that provides positive mating with the SBB enclosure plug connectors. The connector design ensures that:

1. *DC power is present until after* the SCSI bus connection is broken.
2. *DC power is present before the SCSI bus connection* is made.

This feature protects the integrity of the SCSI data bus and avoids introducing noise on the bus that could either distort data or cause the bus to "hang."

The SBB connector is a simple, highly reliable mechanism that can support 200 SBB replacement cycles. A replacement cycle consists of removing and replacing an SBB. Over the active product life of 5 years, this is the equivalent of 40 replacement cycles per year, or approximately 1 cycle every 9 days. The replacement cycle limit applies equally to enclosure connectors and device connectors.

Replacing the SBB more often than the recommended cycle, the gold contact coating will wear away and destroy the integrity of the connection. This product does not support environments that require a greater number of replacement cycles and this is considered improper treatment or use (paragraph 9.4b of U.S. Standard Terms and Conditions). Products or connectors damaged because of a higher number of replacement cycles are not eligible for return under warranty and standard service plans. DIGITAL Equipment Corporation markets a specific family of removable storage elements for higher replacement cycle environments. Contact your DIGITAL Account Representative for more information.

Replacing an SBB

Complete the procedure in Table 7–2 to remove an SBB. When initially installing SBBs in an enclosure or installing a single SBB, complete the procedure in Table 7–3.

Table 7–2 Removing an SBB

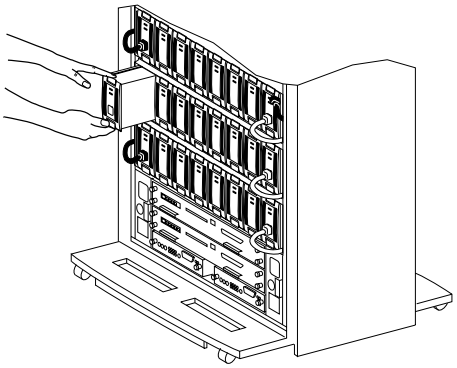
1. To perform a hot swap go to Step 4.
2. To perform a warm swap, quiesce the SCSI bus.
3. To perform a cold swap, turn off the ac power controller.
4. Press the mounting tabs together to release the SBB.
5. Use both hands and pull the defective SBB out of the shelf.  CXO-4314A-MC
6. Insert the SBB into an electrostatic shipping container.

Table 7–3 Installing an SBB

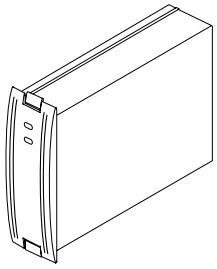
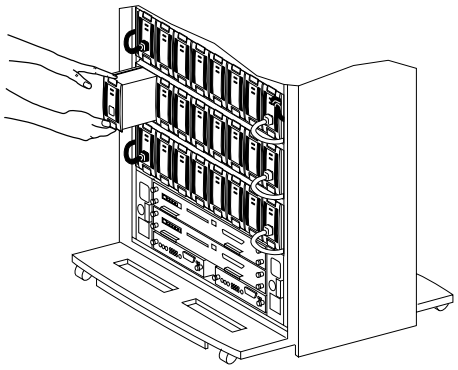
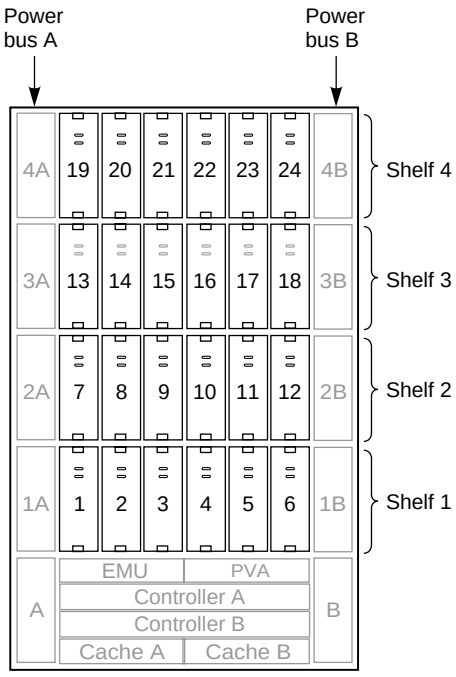
1. Remove the SBB from the shipping container and ensure it is the correct model.  CXO-4562A-MC
2. When assembling an UltraSCSI enclosure go to Step 3. To install a single SBB, insert each SBB into the guide slots and push it in until it seats fully and the mounting tabs engage the shelf.  CXO-4314A-MC After installing the SBB, go to Step 7.

Table 7–3 Installing an SBB (Continued)

3. When assembling an UltraSCSI enclosure, install all the devices in starting in the lower left corner (shelf 1, SCSI bus 1—devices 1 through 6).
4. Starting at the left end, install all the devices in shelf 2 (devices 7 through 12).
5. Starting at the left end, install all the devices in shelf 3 (devices 13 through 18).
6. Starting at the left end, install all the devices in shelf 4 (devices 19 through 24).
7. When the SCSI bus is active and the SBB has power, the green device activity LED is either ON, FLASHING, or OFF. The amber device fault LED is OFF.

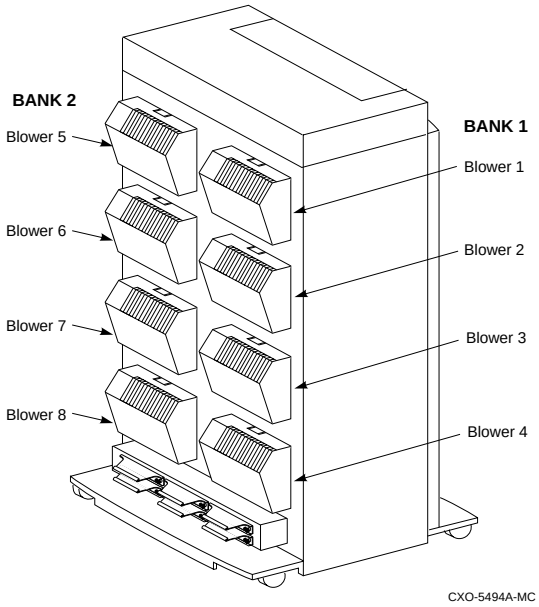


8
Enclosure Blowers

Ensuring proper UltraSCSI RAID enclosure operation requires establishing and maintaining the proper operating environment. Meeting the temperature and humidity ranges specified in Appendix A, “UltraSCSI Enclosure Specifications,” involves using air conditioning to establish and maintain the proper *external,* that is the *ambient,* environment. Failure to achieve these goals could cause components to malfunction thereby causing the comprising data integrity.

The eight blowers on the rear of the enclosure (see Figure 8–1) are an integral part of the enclosure and ensure that the components remain cool. These blowers are arranged in two banks of four blowers each. Air flow provided by these blowers is sufficient to ensure proper operation of the UltraSCSI subsystem.

Figure 8–1 Enclosure Blower Assemblies Locations



The temperature sensors in the enclosure (see Chapter 3, “Environmental Monitoring Unit”) detect overtemperature conditions or blower malfunctions and alert the user to the problem. Simultaneously, the EMU causes all the operational blowers to operate at high speed thereby increasing air flow through the enclosure to increase cooling.

- When the overtemperature condition is caused either by the intake temperature or the exhaust temperatures (backplane) being too high, the EMU initiates routines that can cause a power shut down to occur after 8 minutes.
- Removing a blower significantly changes the air flow pattern within the enclosure. The EMU initiates a routine that causes a power shut down to occur after 8 minutes.
- When there are two or more non-operating blowers (that is, not operating or rotating too slowly*) in the same blower bank* the EMU initiates a routine that causes a power shut down to occur after 8 minutes.
- When the error condition is caused by *no more than one defective blower in a blower bank* the EMU does not initiate a power shut down.

Function and Operation

Cooling the components is accomplished by pulling in air through the front of each component, over the internal circuitry, through the backplane, and exhausting it out the rear of the enclosure. The +12 V dc for blower operation is available on each of the backplane blower connectors. The blower status and speed control signals are also on these connectors and are routed to the EMU and the PVA. The blower guide pin ensures you can align the connectors when installing a blower. The combination of the connectors and the blower mounting tabs provide positive mating of the blower with blower plenum.

When an error condition involving the blowers, the intake temperature, or the exhaust temperature exists, the EMU can cause all blowers to switch to high speed to increase air flow through the enclosure. The conditions that can cause this change in blower speed include:

- Removing a blower
- A blower operating too slowly
- A stalled blower

Caution

The only StorageWorks dual speed blower that is compatible with the UltraSCSI RAID enclosures is the model DS–BA35X–MK. You cannot use the BA35X–MD dual-speed blower as a replacement.

Error Condition Reporting

The EMU LEDs display both blower and overtemperature error conditions. See Table 3–6 for the blower error conditions and the recommended corrective action.

Replacing a Blower

When there is a malfunctioning blower the other blowers operating at high speed increases air flow through the components enough to permit continued operation without corrupting or losing data. However, DIGITAL recommends that you replace a defective blower immediately. If you remove a blower and do not replace it within 8 minutes, the EMU can implement the standby power mode, thereby protecting the components.

Complete the procedures in Table 8–1 and Table 8–2 to replace a blower.

Caution

Operating an UltraSCSI enclosure with a blower removed significantly changes the air flow pattern and reduces air flow through the components, If you remove a blower and do not replace it within 8 minutes, the EMU will automatically turn off the dc power distribution.

Table 8–1 Removing a Blower

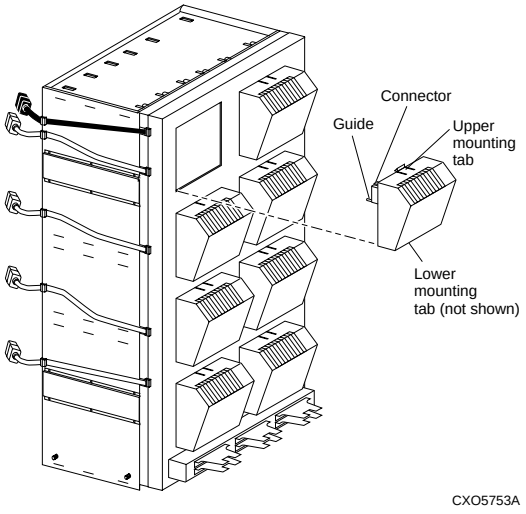
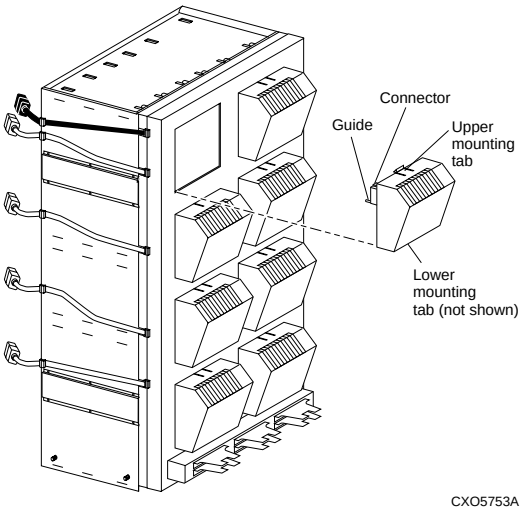
1. Use both hands to firmly press the upper and lower blower mounting tabs together to release the blower. 
2. Pull the defective blower straight out.
3. Insert the blower into an electrostatic shipping container.

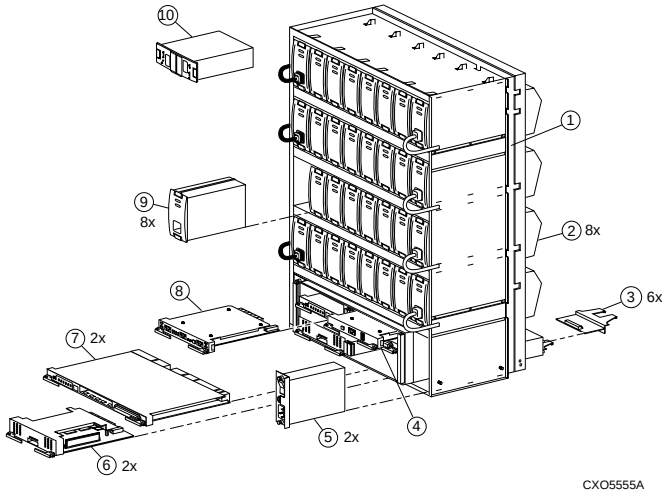
Table 8–2 Installing a Blower Assembly

1. Remove the blower from the electrostatic shipping container and verify that it is a model DS–BA35X–MK.
2. Orient the replacement blower so that the connector and guide pin align with the backplane blower connector. 
3. Push the blower straight in, until the upper and lower mounting tabs snap into place.
4. The blower should start operating when shelf power is present.

A

UltraSCSI Enclosure Specifications

This appendix defines the physical, electrical, and environmental specifications for the DIGITAL StorageWorks UltraSCSI enclosure with 24 disk drives (SBBs) and the following major electronic components:



1. DS–BA370 Enclosure
2. Blowers (8 each)
3. I/O Modules (6 each)
4. PVA (1 each)
5. Power Controller (2 each)
6. Cache Module (2 each)
7. Controller (2 each)
8. EMU (1 each)
9. 180 W Power Supply (8 each)
10. External Cache Battery

Note

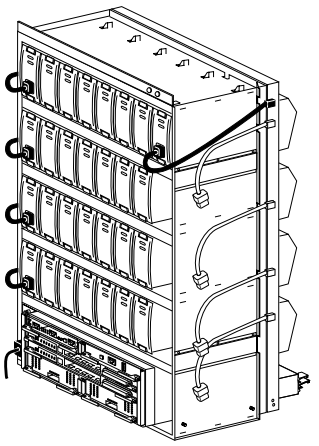
The operating and servicing physical specifications as well as the electrical specifications of the UltraSCSI RAID enclosure are cabinet and configuration specific.

Physical and Electrical Specifications

The following specifications apply to a single, Ultra SCSI enclosure *with all the components installed:*

Shipping Dimensions

Height	1156 mm (45.5 in)
Width	978 mm (38.5 in)
Depth	737 mm (29 in)
Weight	135 kg (298 lb)



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Installed Dimensions

Height	749 mm (29.5 in)
Width	435 mm (17.125 in)
Depth	432 mm (17 in)
Weight	102 kg (225 lb)

Heat Dissipation

3070 BTUs/hr

Power

110–240 V ac, 50-/60-Hz, Single Phase, 12 A/6 A

Operating Environments

DIGITAL recommends maintaining the following environments to ensure proper operation of this product.

Condition	Specification
Optimum Operating Environment (**Suggested** for optimum operation)	
Temperature	18°C to +24°C (+64°F to +75°F) with an average rate of change of 3°C/hour maximum and a step change of 3°C or less
Relative humidity	40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Altitude	Up to 2400 m (8000 ft)
Air quality	Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Nominal airflow	50 cubic ft/minute
Heat Dissipation	3070 BTUs/hr
Minimum Operating Environment (**Required** for proper operation)	
Temperature	+10°C to +40°C (+50°F to +104°F) Reduce rating by 1.8°C for each 1000 m altitude (1.0°F for each 1000 ft altitude)
Relative humidity	10 to 85% at maximum wet bulb temperature of +32°C (+90°F) and a minimum dew point of +2°C (+36°F)
Altitude	Up to 2400 m (8000 ft)
Air quality	Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Nominal airflow	40 cubic ft/minute
Heat Dissipation	3070 BTUs/hr
Non-Operating Operating Environment (Shipping or short term storage)	
Temperature	–40°C to +66°C (–40°F to +150°F)
Relative humidity	10% to 80% noncondensing
Altitude	4900 m (16,000 ft)

SBB Thermal Stabilization

For proper operation upon *initial power application*, the DIGITAL SBB storage device temperature should be within the range of 18-29°C (65-85°F).

Caution

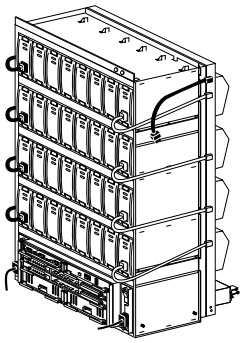
Always stabilize disk drives in the operating environment before installation or operation. Otherwise, applying power can damage the media or associated.

Condition			Then You Must ...		
When there *is condensation* on the outside of the SBB			Stabilize the device and the SBB in the operating environment for 6 hours or until the condensation is no longer visible, whichever is longer. Do not install a storage device until it stabilizes.		
When there *is no condensation* on the outside of the SBB			Thermally stabilize the device for the amount of time specified		
Storage Temperature Range			**Storage Temperature Range**		
°C	**°F**	**Stabilize for**	**°C**	**°F**	**Stabilize for**
60 to 66	140 to 151	3 hours	0 to 9	32 to 48	1 hour
50 to 59	122 to 138	2 hours	-10 to -1	14 to 30	2 hours
40 to 49	104 to 120	1 hour	-20 to -11	-4 to 12	3 hours
30 to 39	86 to 102	30 minutes	-30 to -21	-22 to -6	4 hours
18 to 29	64 to 84	None	-40 to -31	-40 to -24	5 hours
10 to 17	50 to 63	30 minutes			

B

Assembling an UltraSCSI RAID Subsystem

Assembling an UltraSCSI RAID subsystem requires sequentially installing the components in a DS–BA370–series rack-mountable enclosure. You can mount these enclosures in either a departmental cabinet, a “pedestal,” or a data center cabinet (SW600–series), and then testing the subsystem for proper operation.



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WARNING

With all the components installed, a RAID enclosure with the packing material weighs approximately 135 kgs (298 lbs). To prevent personal injury always mount the enclosure in the data center cabinet or departmental cabinet before installing any components. The empty enclosure weighs more than 102 kgs (225 lbs).

Installation Sequence

The basic installation sequence is the same for all UltraSCSI RAID subsystems, whether they use one, two, or three DS–BA370 enclosures. To reduce the possibility of multiple, interacting problems the preferred assembly sequence is as follows:

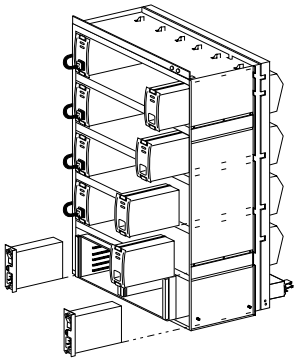
1. Assemble and test the master enclosure.
2. Assemble the first expansion enclosure.
3. Connect the first expansion enclosure to the master enclosure and test the subsystem operation.
4. Assemble the second expansion enclosure.
5. Connect the second expansion enclosure to the master enclosure and test the subsystem operation.

The assembly procedures for an enclosure are almost identical to those described elsewhere in this publication. Therefore, rather than repeating the procedures, the following sections primarily address special assembly considerations. The recommended sequence for assembling an UltraSCSI RAID enclosure is as follows:

1. Mount UltraSCSI RAID enclosure in the data center cabinet or the departmental server cabinet.
2. Install the power system.
3. Install the EMU.
4. Install the PVA.
5. Install the disk drive SBBs.
6. Cable and install the I/O modules.
7. Install the array controllers and cache modules.
8. Install the ECBs.
9. Configure the subsystem as described in Chapter 2, “Configuring an UltraSCSI RAID Subsystem.”

Installing the Power System

The ac power controllers and shelf power supplies comprise the enclosure power system.



Caution

To prevent ESD (electrostatic discharge), do not touch the connector.

Note

The ac power controller has no user serviceable components. Should a power controller fail you must replace the entire assembly.

The sequence for installing the power system is as follows:

1. Install the ac power controllers (Table 6–5).
2. Install the shelf power supplies (Table 6–3).

Installing the EMU

Each UltraSCSI enclosure requires an EMU for proper operation. In an expansion configuration you must also connect the EMU—EMU communications ports between the master EMU and all the expansion EMUs. Complete the following procedure to install an EMU.

There are two steps to installing an EMU:

1. Install the EMU in each enclosure (see Table 3–9).
2. When there are multiple EMUs, install the EMU-EMU bus cables listed in Table 3–10.

Installing the PVA

Each UltraSCSI enclosure requires a PVA for proper operation.

Complete the procedure in Table 4–7 to install a PVA in each enclosure:

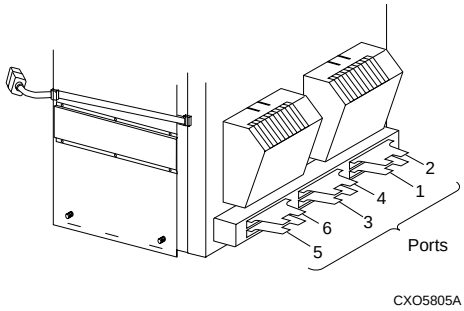
Installing the Disk Drives

Install the SBBs sequentially in the UltraSCSI enclosure using the procedure in Table 7–3.

1. Install six SBBs in shelf 1, starting with SCSI bus 1 (devices 0 through 6).
2. Install six SBBs in shelf 2, starting with SCSI bus 1 (devices 7 through 12).
3. Install six SBBs in shelf 3, starting with SCSI bus 1 (devices 13 through 18).
4. Install six SBBs in shelf 4, starting with SCSI bus 1 (devices 19 through 24).

Installing the I/O Modules

The six single-ended I/O modules (DS–BA35X–MN) mount on the lower rear of the enclosure.



In an expanded subsystem, connect the cables to the I/O modules (see Table 5–12) and then install the I/O modules in the enclosures (see Table 5–10). For a single enclosure subsystem, install the I/O modules in the enclosures (see Table 5–10).

Installing Expansion Cables

Caution

Not all array controllers support more than one enclosure. Read the controller documentation to verify that it does support more than one enclosure.

The UltraSCSI bus expansion cables connect to the six single-ended I/O modules (DS–BA35X–MN) mounted on the lower rear of the enclosure. Complete the procedure in Table 5–12 to install the expansion cables.

Caution

Overtightening the I/O module spring-loaded mounting screws can damage the threads

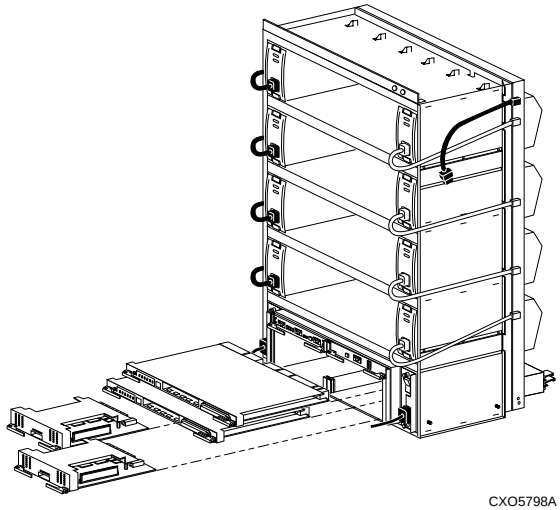
Installing Controller “A”

The UltraSCSI master enclosure contains the array controllers and cache modules. You cannot install the ECBs (external cache batteries) in the enclosure. In a departmental cabinet, you install the ECBs in the top cover. In a data center cabinet, you install the ECBs in a shelf mounted in the cabinet.

Caution

You can install only one set of array controllers and cache modules in an UltraSCSI RAID subsystem. By default, this enclosure becomes the master enclosure and always has address 0.

For complete, detailed array controller, cache module, and ECB installation procedures, to include cabling, refer to the array controller documentation.



CXO5798A

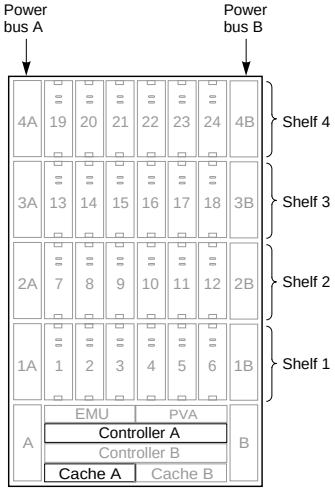
The following procedure describes the mechanical procedures for installing an array controller and a cache module. You must configure the subsystem using the procedures in the following publications:

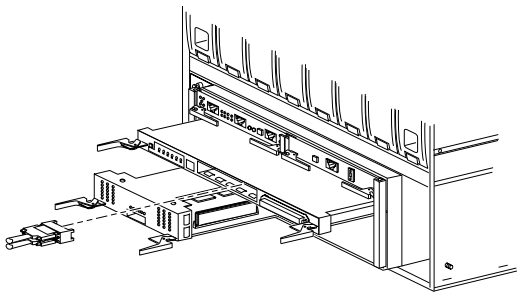
- The array controller documentation
- The operating system-specific release notes

Controller A Installation

1. Complete the sequential installation of the following UltraSCSI enclosure components:
   a) Power controllers and power supplies
   b) EMU
   c) PVA
   d) Disk Drives
   e) I/O Modules
   f) UltraSCSI expansion cables

2. Align controller “A” with the top controller slot (device address 7).



Controller A Installation (Continued)
3. Insert the array controller into the slot and push it in until the extractor latches engage the enclosure.  CXO5602A
4. Push in on the extractor latches to firmly seat the array controller.
5. Align controller “A” cache module with the cache module A slot in the enclosure.
6. Insert the cache module into the slot and push it in until the extractor latches engage the enclosure.
7. Push in on the extractor latches to firmly seat the cache module.

Installing Controller “B”

The following procedure describes the mechanical procedures for installing an array controller and a cache module. You must configure the subsystem using the procedures in the following publications:

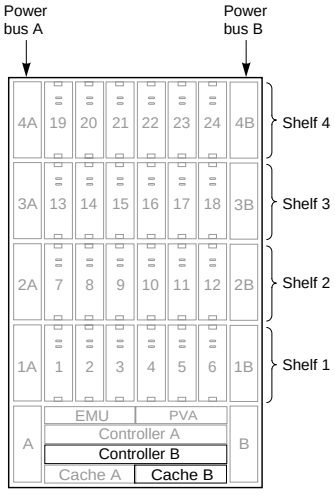
- the array controller documentation
- The operating system-specific release notes.

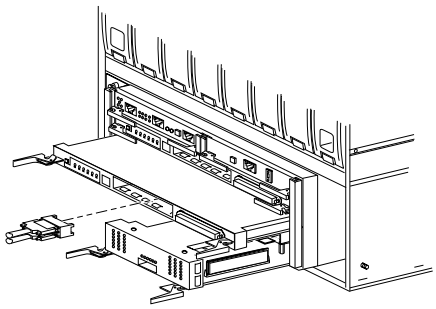
Controller B Installation

1. Complete the sequential installation of the following UltraSCSI enclosure components:
   a) Power controllers and power supplies
   b) EMU
   c) PVA
   d) Disk Drives
   e) I/O Modules
   f) UltraSCSI expansion cables
   g) Controller “B”

2. Remove the blank panels from the controller B and cache module B positions.

   Align controller “B” with the lower controller slot (device address 6).



Controller B Installation (Continued)
3. Insert the array controller into the slot and push it in until the extractor latches engage the enclosure.  CXO5603A
4. Push in on the extractor latches to firmly seat the array controller.
5. Align controller “A” cache module with the cache module A slot in the enclosure.
6. Insert the cache module into the slot and push it in until the extractor latches engage the enclosure.
7. Push in on the extractor latches to firmly seat the cache module.

Internal Cables

All internal cables are cabinet–specific. The cabinet user documentation describes the cable routing, location and function. The cables involved may include:

- Controller–to–controller
- Controller-to–host
- ECB–to–cache module cables

For a detailed description of the cable connection procedures and cable routing refer to following publications:

- The array controller documentation.
- *DIGITAL StorageWorks UltraSCSI RAID Cabinet Subsystem (SW600-Series) Installation and User’s Guide.*

Glossary

ac distribution

The method of distributing ac power within a StorageWorks shelf, enclosure, or cabinet.

ac power supply

See **shelf power supply**.

adapter

See **SCSI signal bus converter**.

ambient air temperature

The temperature of the air surrounding the cabinet, enclosure, shelf, or SBB that dissipates the heat generated by the device. Also referred to as the intake air temperature.

array controller

See **controller**.

backplane

The electronic printed circuit board mounted in the rear of the shelf. This board contains the SBB, power supply, and terminator connectors.

blower assembly

An airflow device mounted in a StorageWorks shelf.

bus expander

Devices that couple bus segments together without any impact on the SCSI protocol, or the software. These devices include both single-ended to differential and single-ended to single-ended bus extenders. The term extender is a general term that includes “extender,” “repeater” and “isolator.”

bus extender

See **bus expander**.

bus segment

A SCSI bus segment consists of all the conductors and connectors required to attain signal line continuity between every driver, receiver, and two terminators for each signal. It is not necessary that a SCSI bus segment contain any initiators or targets, but it must have at least two devices attached. (Drivers and receivers may be part of extenders as well as part initiators and targets.)

Bus segments can be either single-ended (SE) or differential (DF). The terminator properties determine the bus segment type.

Caution

The device transceiver type (single-ended or differential) must match the bus segment type. Devices that do not meet this condition cannot operate.

The allowed length of a bus segment depends on the electrical loading, transmission media type, and data transfer rate. In many cases, heavier loading, smaller wires, and higher speeds demand shorter lengths. Increasing the number of devices in a given length of the bus, by using longer stubs, or higher capacitance devices produces loading.

bus segment types

The following are the SCSI bus segments types:

- Single-ended (SE)
- High voltage differential (HVD)

The terminator properties (single-ended or differential) determine the bus segment type. Devices that do not have the same transceiver type as the terminators cannot operate in the segment defined by the terminators.

cabinet

See **data center cabinet** and **departmental server cabinet**

cable connector

Any connector that is physically part of a cable assembly attached to backplanes or other non–device connectors.

cache module

A fast storage buffer.

Callout *n*

A textual reference to a numbered callout in a figure.

carrier

See **modular carrier**.

CE–Mark

A European Economic Community (EEC) certification label that identifies electronic devices authorized for sale within member nations.

CE–Mark Class A

Similar to, but more stringent than the FCC Class A certification, this certification label appears on electronic devices that are for use in a commercial environment. You can also use a CE–Mark certified device in the United States.

CE–Mark Class B

Similar to, but more stringent than the FCC Class B certification, this certification label appears on electronic devices that are for use in either a home or a commercial environment. You can also use a CE–Mark certified device in the United States.

certified device

A storage device tested in a specific configuration and found to be in compliance with either an FCC or a CE certification standard. DIGITAL certifies these devices to operate in a specific shelf, enclosure, or cabinet.

channel

Another term for a SCSI bus.

CLI

Command line interpreter. The operator interface to HSx-series array controller software.

cold swap

A method of device replacement that requires that power be removed from one or more shelves in a cabinet thereby affecting other devices. Use this method during initial installation or StorageWorks subsystem upgrades, or when conditions preclude using either the "warm swap" or "hot swap" method
See also **warm swap** and **hot swap**.

command line interpreter

See **CLI**.

controller

(1) A hardware–software device that manages communications on behalf of host systems over the SCSI bus to devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support. (2) A standalone device that connects a host adapter to the storage SCSI bus. This device provides RAID functionality, typically has multiple SCSI bus ports, performs the lower layers of the SCSI protocol, and normally operates in the initiator role.
Also referred to as array control or SCSI bus controller.

converter

See **SCSI signal bus converter**.

data center cabinet

The largest of the StorageWorks cabinet, such as the SW800-series that can contain as many as 24 SBB shelves. These cabinets include either a 50 Hz or 60 Hz cable distribution unit (CDU), internal ac power cords, and cooling fans.

departmental server cabinet

The series of smaller StorageWorks cabinets for mounting shelves, controllers, storage device, and power control devices to form subsystems.

device

The targets, initiators, hubs, converters, and bus expanders, and similar device interconnected to form a SCSI bus. Connectors, expanders, and hubs do not use a SCSI bus ID.

See also **nodes**.

device connector

Any connector physically part of a SCSI device.

differential SCSI bus

A bus in which the potential difference between two wires determines the signal level.

disk

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

disk array controller

See **controller**.

dual power configuration

See **redundant power supply configuration**.

dual redundant configuration

An array controller configuration consisting of controller “A” and controller “B” mounted in the same controller shelf. When controller “A” fails, controller “B” assumes control over the devices.

dual bus

Configuring a single SBB shelf SCSI bus as two individual buses (a four device bus and a three device bus) creates a bus known as a dual or split bus.

ECB

External cache battery.

electromagnetic interference

See **EMI**.

electrostatic discharge

See **ESD**.

EMI

Electromagnetic interference is the impairment of a signal by an electromagnetic disturbance.

EMU

Environmental Monitoring Unit. The device that monitors the status of the UltraSCSI RAID enclosure to include power, intake air temperature, blower status, and so forth, detects error and fault conditions, displays these conditions, reports the conditions to the user and the array controller, and, in some cases, implements corrective actions.

enclosure connector

Any connector that is physically part of an enclosure (for example, pedestal, deskside enclosure, cabinet, and so forth).

end–bus position

See **SCSI end–bus position**.

Environmental Monitoring Unit

See **EMU.**

ESD

Electrostatic discharge is the discharge of a potentially harmful static electric voltage as a result of improper grounding.

expansion enclosure

An UltraSCSI RAID enclosure connected to the master enclosure with UltraSCSI bus cables. Each subsystem can have a maximum of two expansion enclosures. Set the expansion PVA SCSI bus address switch to either:

2–to establish SCSI bus device addresses 8, 9, 10, and 11.

3–to establish SCSI bus device addresses 12, 13, 14, and 15.

external cache battery

See **ECB.**

Fast 20

See **UltraSCSI**.

FCC

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

FCC Class A

This certification label appears on electronic devices for use only in a commercial environment within the United States. A CE-Mark certified device can be used in the United States in the same environment as the equivalent FCC certification.

FCC Class B

This certification label appears on electronic for use in either a home or a commercial environment within the United States. A CE–Mark certified device can be used in the United States in the same environment as the equivalent FCC certification.

Federal Communications Commission

See **FCC.**

filler panel

A panel used to cover open unused areas in cabinets or shelves for either EMI suppression, air flow control, or cosmetic purposes.

host

The primary or controlling computer (in a multiple computer network) to which storage is attached.

host adapter

A device that connects the host system I/O bus (for example, a PCI bus) to the storage SCSI bus. A host adapter performs the lower layers of the SCSI protocol and normally operates in the initiator role.

host computer

See **host**.

host controller

A device that connects the host system I/O bus (for example, a PCI bus) to the storage SCSI bus. A host controller provides RAID functionality, typically has multiple SCSI bus ports, performs the lower layers of the SCSI protocol, and normally operates in the initiator role.

host port adapter

A host controller device that adapts the host system I/O bus to the array controller SCSI bus configuration.

hot swap

A method of device replacement whereby the complete system remains on-line and active during device removal or insertion. The device being removed or inserted is the only device that cannot perform operations during this process.
See also **cold swap** and **warm swap**.

HSOF

Hierarchical Storage Operating Firmware. HS-family controller software contained on a removable ROM card (PCMCIA).

I/O module

A SCSI enclosure or SBB shelf device that integrates a single-ended SCSI bus with either an 8–bit single-ended, 16–bit single-ended, or 16–bit differential SCSI bus. This module is also a SCSI bus extender,

See also **shelf I/O Module**.

initiator

A SCSI device (usually a host system) that requests another SCSI device (a target) to complete an operation.

Input/Output module

See **I/O module.**

isolator

See **bus** extender.

Intake air temperature

The temperature of the air entering the cabinet, enclosure, shelf, or SBB. Also referred to as the ambient temperature.

logical bus

A single-ended, physical bus connected to a differential physical bus by a SCSI bus signal converter.

logical units

A group of devices addressable as a virtual unit.

maintenance terminal

The operator terminal used to identify an HS-family controller, to enable its host paths, to define its subsystem configuration, and to check its status. The HS-family maintenance terminal accepts any terminal conforming to EIA–423. Use the maintenance terminal to configure a storage subsystem.

master enclosure

The UltraSCSI RAID enclosure that includes the HSZ-series controllers and cache modules. There is only one master enclosure in each UltraSCSI RAID subsystem. The SCSI bus address switch setting is always 0. Using address 0 automatically assigns SCSI bus device addresses 0, 1, 2, and 3 to the devices.

MB/s

See **MB/sec**.

MB/sec

The bus width (8- or 16-bit), the number of bytes per word (1 or 2, respectively), and the bus clock frequency determines the transfer rate in megabytes per second (MB/sec).

megabytes per second

See **MB/sec.**

modular carrier

The StorageWorks compatible plastic container in which storage devices or power supplies are mounted to form SBBs. Modular carriers are available in both 3.5-inch and 5.25-inch form-factors.

node

A SCSI bus target or initiator that uses a SCSI bus ID. For example, disk drives, tape drives, array controllers, and adapters all have a SCSI bus ID and are nodes. Hubs, expanders, and converters are devices and do not have a SCSI bus ID.
An UltraSCSI bus can have a maximum of 16 nodes (SCSI bus addresses 0 through 15).
A narrow bus can have a maximum of eight nodes, SCSI bus addresses 0 through 7.

Overtemperature

A condition where a temperature is above a specified limit and can cause equipment failure if not corrected.

pedestal

The common name for a deskside expansion unit. *Also see* **departmental server cabinet.**

physical bus

Two SCSI terminators separated by cables, connectors, and backplane circuitry.

port

(1) A logical route for data in and out of an array controller. A port can contain one or more channels, all of which contain the same type data. (2) The hardware and software that connects a host controller to a CI, SCSI, or SDI bus.

power verification and addressing assembly

See **PVA.**

PVA

Power Verification and Addressing assembly. The module whose primary functions are (1) allow the user to select the enclosure UltraSCSI bus ID, (2) enable the user to place the subsystem in a standby power mode and return it to an operational status. (3) in conjunction with the associated EMU ensures that critical power functions are monitored.

qualified device

See **supported device**.

quiesce

To make a bus inactive or dormant. For example, you must quiesce SCSI bus operations when warm swapping an SBB.

quiescent

A bus that is inactive, still, or dormant.

radio frequency interference

See **RFI**.

RAID

Redundant array of independent disks. A set of storage techniques devised to increase the performance and availability of a storage subsystem.

redundant power supply configuration

A capability of StorageWorks cabinet and shelves to ensure there is no single point of power failure. (1) For a cabinet two ac power sources and two distribution units or power controllers distribute primary and redundant ac power to shelf power supplies. (2) For a shelf, the primary and redundant shelf SBB power supplies ensure the dc power is available even when there is a failure of one supply, one ac source, or one distribution unit or power controller.

repeater

See **bus** extender.

RFI

Radio frequency interference. The impairment of a signal by an unwanted radio signal or radio disturbance.

SBB

StorageWorks building block is basic building block of the product line. Any device conforming to shelf mechanical and electrical standards installed in either a 3.5-inch or 5.25-inch carrier is considered to be an SBB, whether it be a storage device, a power supply, or other device.

SCSI

Small computer system interface. This ANSI interface defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of seven devices.

SCSI bus signal converter

(1) A connecting device that permits the attachment of accessories or provides the capability to mount or link units. (2) The device that connects a differential SCSI bus to a single-ended SCSI bus. (3) The device that connects a differential SCSI bus operating to a single-ended SCSI bus. (4) The device that extends the length of a differential or single-ended SCSI bus.
See also **shelf I/O module**.

SCSI busing connection

A connection on the SCSI bus between two terminators, such as the SBB shelf SCSI input connector.

SCSI device

A host computer adapter, a peripheral array controller or an intelligent peripheral that can be attached to the SCSI bus.

SCSI device–side device address

The 8-bit narrow (0 through 7) or 16-bit wide (0 through 15) device addresses (target IDs) assigned to the SCSI controller and the devices it controls.

See also **SCSI host–side device address**.

SCSI device ID

The bit-significant representation of the SCSI addressing referring to one of the signal lines numbered 0 through 7 for an 8-bit bus or 0 through 15 for a 16-bit bus. Also known as “target ID”.

SCSI domain

A SCSI domain is a logical bus consisting of at least one bus segment, at least one initiator, and at least one target. Domains with multiple bus segments are enabled through the use of bus extenders. Domains are limited by device addressability. Domains are limited to a maximum of 16 initiators and targets without the use of LUN bridges.

SCSI host-side device address

The eight device addresses (target IDs) assigned to the host device and the SCSI controllers and the devices it controls.
See also **SCSI device-side device address**.

SCSI ID

See **SCSI device ID**.

SCSI port

(1) Software. The channel that controls communications to and from a specific SCSI bus in the system. (2) Hardware. The name of the logical socket at the back of the system unit to which a SCSI device is connected.

shelf power supply

The power supply that provides +5 V dc and +12 V dc to the StorageWorks shelves. These supplies can be either ac input (120 V ac) or dc (48 V dc).

single-ended SCSI bus

A bus in which the voltage of a single wire in relation to ground determines each signal’s logic level.

single-power configuration

A power configuration in which there is only one ac power source and CDU, PDU, or power controller to condition the input ac power.

Small Computer System Interface

See **SCSI**.

spin-down

The process that begins when power is removed from a storage device and data transfer halts, and ends when the device is stopped and can be moved. In the case of disk drives, the heads are retracted and the media is stopped.

spin-up

The process that begins when power is applied to a storage device, and ends when the device is determined to be operational and ready for data transfer operations.

split bus

See **dual bus.**

STERMPOWER

Terminator power on a single-ended SCSI bus.

See **TERMPOWER**.

storage array

An integrated set of storage devices.

storage array subsystem

See **storage subsystem**.

storage sets

A grouping of disk drives that make up a new distinct container.

storage subsystem

The array controllers, storage devices, shelves, cables, and power supplies that form a mass storage subsystem.

StorageWorks

The DIGITAL set of enclosure products that allows customers to design and configure their storage subsystem. Components include power, packaging, and interconnections in a StorageWorks shelf. SBBs and array controllers are integrated therein to form storage subsystems. System-level enclosures to house the shelves and standard mounting devices for SBBs are also included.

StorageWorks building block

See **SBB**.

subsystem array strategy

A strategy, including packaging, devices, and array controllers, that provides an integrated storage subsystem solution.

supported device

(1) A device that has been fully evaluated in an "approved" StorageWorks configuration (that is, shelf, cabinet, power supply, cabling, and so forth) and is in complete compliance with country-specific standards (for example, FCC, CE-Mark, CSA, TÜV, VDE, and so forth) and with all DIGITAL standards. (2) A device supported by an array controller or host operating system.

target

A SCSI device that performs an operation requested by an initiator.

target ID

See **SCSI device ID**.

terminators

The interconnect components that form the ends of the transmission lines in bus segments. A SCSI domain must have at least one segment and therefore at least two terminators. The terminators ensure that inactive SCSI bus signals are in a known state.

There are two basic types of terminators–active and passive.

- Single-ended bus segments use active, linear terminators
- Differential bus segments use a passive (linear totem pole) terminators *except* for special cases where the electrical transmission lines are very short and only one termination or pull–up is required.

terminator connector

Any connectors physically part of a terminator. It is not uncommon for terminators to have both stub and bus–path connectors.

TERMPOWER

The electrical current power required for SCSI bus terminators. This power may be supplied by an external SCSI bus, the shelf power supply or an ac–dc power converter.

topology

The physical arrangement and relationship of interconnected nodes and SCSI buses in a network. A legal topology must satisfy all the requirements of the associated SCSI bus (Fast 10, UltraSCSI, and so forth).

transmission medium

An electrical conductor has bus termination on each end and possibly stubs. Common examples of media are cables, printed wiring boards, flex circuits, and connectors that create electrical connections between various combinations SCSI devices, bus extenders, and terminators.

UL

Underwriters Laboratories. An organization that tests and certifies electrical devices.

UltraSCSI

An improvement in SCSI technology invented in 1993 by the Digital Equipment Corporation StorageWorks Engineering Group. Subsequently the ANSI SCSI standards committee issued standard X3T10 for UltraSCSI.

The UltraSCSI improvements over Fast SCSI include the following:

- Maximum transfer rate increases from 10 MHz to 20 MHz
- Maximum wide bus bandwidth increases from 20 MB/s to 40 MB/s
- VHDCI (very high density cable interconnect) cables and connectors are significantly thinner and smaller

UltraSCSI domain

A single, logical UltraSCSI bus composed of multiple diverse bus segments.

See also **bus segment**.

UltraSCSI RAID enclosure

A 24-SBB RAID shelf, such as the DS–BA370.

UltraSCSI RAID subsystem

One or more UltraSCSI RAID enclosures mounted in either a pedestal or a cabinet. Each subsystem requires a master enclosure. Installing one or two expansion enclosures and interconnecting all the enclosures with UltraSCSI bus cables creates an expanded subsystem.

Underwriters Laboratories

See **UL**.

universal ac input power supply

See **shelf power supply**.

VHDCI

Very High Density Cable Interface. A 68–pin interface with connectors on 0.8 mm centers. Required for UltraSCSI.

warm swap

A method of device replacement whereby the complete system remains on-line during device removal or insertion. During device insertion or removal the bus may halt for a brief period of time. Until the replacement System booting or code loading cannot occur until insertion of the replacement device. There is no noticeable impact on user applications that are not dependent upon the devices on the “affected” SCSI bus.
See also **cold swap and hot swap**.