SGI® InfiniteStorage 4500 RAID
User's Guide

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About This Guide

This guide provides an overview of the SGI InfiniteStorage 4500 RAID system. It covers routine operation and replacement procedures and provides troubleshooting and reference information for all customer-replaceable components.

The SGI InfiniteStorage 4500 system is a highly scalable RAID storage system designed for continuous availability. Some of the features of this system include hot-swappable components and redundant power and cooling systems.

This guide is intended for system operators and service technicians who have extensive knowledge of Fibre Channel network technology and computer system operation, maintenance, and repair.

Use this guide to learn about the following:

- The parts of your system: the rack, controller enclosures, and drive enclosures
- Operating your system
- Replacing failed components in the controller enclosures and drive enclosures

Note that users who expect to reconfigure, upgrade, or replace system components should have a good working knowledge of RAID concepts, Fibre Channel technology, and SAN hardware operations.

Important Information

Danger: Never look into the end of a fiber optic cable to confirm that light is being emitted (or for any other reason). Most fiber optic laser wavelengths (1300 nm and 1550nm) are invisible to the eye and cause permanent eye damage. Shorter wavelength lasers (for example, 780 nm) are visible and can cause significant eye damage. Use only an optical power meter to verify light output.

Danger: Never look into the end of a fiber optic cable on a powered device with any type of magnifying device, such as a microscope, eye loupe, or magnifying glass. Such activity causes cause a permanent burn on the retina of the eye. Optical signal cannot be determined by looking into the fiber end.

Chapter Descriptions

This guide contains the following chapters:

- Chapter 1, "Introduction," introduces, gives a functional overview, and describes the features of the system.

- Chapter 2, "Controller Enclosures," describes the attributes of the controller module and its internal components; the five sub-modules are sometimes referred to as "canisters." They includes the following:

    – Controller canister (two)

    – Power supply/fan canister (two)

    – Interconnect/battery canister (one)

- Chapter 3, "Operation of Controller Enclosures," describes the use, operation, and troubleshooting of the 6998 controller enclosure (module).The procedures include: turning on power, turning off power, responding to an unplanned power outage, and responding to the audible alarm.

- Chapter 4, "Troubleshooting Controller Enclosure Components," provides troubleshooting and recovery procedures for the 6998 controller enclosure (also called the controller module). This chapter also presents tables that explain the meanings of the indicator lights on the canister components.

- Chapter 5, "Replacing Controller Enclosure Components," describes the replacement of each component in the controller enclosure (module) and explains the procedures for replacing a controller canister, power supply/fan canister, interconnect/battery canister, and SFP transceiver.

- Chapter 6, "Drive Enclosures," gives a detailed overview of the drive enclosures and their components.

- Chapter 7, "Operating Drive Enclosures," describes the functions and basic operation of the drive enclosures, including power up and troubleshooting with the indicator lights.

- Chapter 8, "Replacing Drive Enclosure Components," gives detailed procedures for replacing failed drive enclosure components.

- Chapter 9, "Cabling,"describes cabling between components and between the components and the hosts.

- Appendix A, "Specifications and Requirements" describes component specifications and requirements for purposes of installation and maintenance.

- Appendix B, "SGI Field Engineering Compliance Statements" describes the regulatory and compliance information for the system.

Related Publications

This guide is part of a document set that supports the installation, operation, and service of the SGI InfiniteStorage 4500 storage system. See the following documents for more information about your system.

If a document number ends in "X," use the latest available version of that document.

- *SGI InfiniteStorage TPSSM Software Concepts Guide* (007-4749-00X)
  This guide explains the terminology and features of the TPSSM storage management software.

- *SGI InfiniteStorage TPSSM Administration Guide* (007-4748-00X)
  This guide gives complete instructions on how to install the TPSSM software for host and/or client operation.

- *SGI Storage Area Network Installation Instructions* (108-0252-00X)
  This guide is included with the Fibre Channel switch and provides information on Storage Area Network installation and topologies.

You can obtain SGI documentation, release notes, or man pages in the following ways:

- See the SGI Technical Publications Library at http://docs.sgi.com. Various formats are available. This library contains the most recent and most comprehensive set of online books, release notes, man pages, and other information.

- If it is installed on your SGI system, you can use InfoSearch, an online tool that provides a more limited set of online books, release notes, and man pages. With an IRIX system, select **Help** from the Toolchest, and then select **InfoSearch**. Or you can type infosearch on a command line.

- You can also view release notes by typing either grelnotes or relnotes on a command line.

- You can also view man pages by typing man <*title*> on a command line.

SGI systems based on IRIX include a set of IRIX man pages, formatted in the standard UNIX "man page" style. These are found online on the internal system disk (or CD-ROM) and are displayed using the man command. For example, to display the man page for the Add_disk command, type the following on a command line:

man Add_disk

Important system configuration files and commands are documented on man pages. References in the documentation to these pages include the name of the command and

the section number in which the command is found. For example, "Add_disk(1)" refers to the Add_disk command and indicates that it is found in section 1 of the IRIX reference.

For additional information about displaying reference pages using the man command, see man(1).

In addition, the apropos command locates man pages based on keywords. For example, to display a list of man pages that describe disks, type the following on a command line:

apropos disk

For information about setting up and using apropos, see apropos(1) and makewhatis(1M).

Conventions

The following conventions are used throughout this document:

Convention	Meaning
Command	This fixed-space font denotes literal items such as commands, files, routines, path names, signals, messages, and programming language structures.
variable	The italic typeface denotes variable entries and words or concepts being defined. Italic typeface also is used for book titles.
user input	This fixed-space font denotes literal items that the user enters in interactive sessions. Output is shown in nonbold, fixed-space font.
[ ]	Brackets enclose optional portions of a command or directive line.
...	Ellipses indicate that a preceding element can be repeated.
man page(*x*)	Man page section identifiers appear in parentheses after man page names.
GUI element	This font denotes the names of graphical user interface (GUI) elements such as windows, screens, dialog boxes, menus, toolbars, icons, buttons, boxes, fields, and lists.

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Introduction

This chapter gives a brief overview of the features of the SGI InfiniteStorage 4500 system and its primary components in the following sections:

- "System Features" on page 1
- "Rack Features" on page 3
- "Controller Enclosure Features" on page 3
- "Drive Enclosure Features" on page 4

System Features

SGI InfiniteStorage 4500 RAID storage systems have the following features:

- Outstanding performance, utilizing multi-channel end-to-end Fibre Channel technology.
- Continuous availability, with constant monitoring and optional redundancy of all active components.
- Dynamic scalability, making it easy to grow all subsystem resources without disruption.
- Superior connectivity allowing simultaneous connections to multiple servers directly or by way of storage area networks (SANs). Supports optical host connections.
- Vast storage capacity, maximizing storage density per square foot.
- Storage management facilities for installation, configuration, expansion, and monitoring.
- Controller enclosure(s) and drive enclosure(s) with redundant power supplies and hot-swappable components.
- Configurable to meet your performance requirements.

- Supports a large number of drives.

- RAID 0, 0+1, 3, 5 support for LUNs containing n+1 drives (n ≤ 29).

- Battery backup for cache data.

Note: JBOD is not supported.

Figure 1-1   Rack with Controller Enclosures and Drive Enclosures

Rack Features

The rack has the following features:

- 72-in. high x 22-in. wide x 36-in. deep

- 38 rack units (1 rack unit = 1.75 in.)

- Removable rear panel

- Dual power distribution units (PDUs)

- Convenient access to power and data cables through openings in the top and bottom of the rack

Controller Enclosure Features

The controller enclosure has the following features:

- Height equal to four rack units (1 rack unit = 1.75 in.)

- Dual Active RAID controller levels

- Supports RAID 0, 1, 1+ 0, 3, 5.

- Supports small form-factor pluggable (SFP) host and drive connections.

- Up to 1GB, 4 GB, and 8 GB of ECC-protected cache memory per controller

- Battery backup for cache data

- Redundant, hot-swappable power supplies

- Redundant, hot-swappable cooling fans

- Four host ports and four back-end ports per controller

- Supports point-to-point, switch, and arbitrated loop topologies.

- Four Fibre Channel drive interfaces with two sets of redundant loops

- Two Ethernet interfaces per controller enclosure for controller management

- Audible alarm (controlled with an enable/disable switch or by using TPSSM client software)

- Fault, status, and ready-to-service LEDs

For additional information on the controller enclosure, see Chapter 2, "Controller Enclosures".

Drive Enclosure Features

The drive enclosures have the following features:

- A 16-drive capacity
- Fault and activity indicators
- Redundant hot-pluggable power supplies
- Redundant hot pluggable environmental service modules (ESMs)
- Redundant cooling fans
- SFP drive enclosure interfaces

For more information about the features of the drive enclosures, see Chapter 6, "Drive Enclosures".

Controller Enclosures

The controller enclosure (module) is a high-performance unit that directs and manages the I/O activity between a host and the volumes in a storage array. The controller module has 4 host channels and can support up to 512 host ports. The enclosure has 4 dual-ported drive channels and can support up to 224 Fibre Channel drives with a maximum of 2048 addressable volumes. The controller module has 2.4 GHz control processors with 2 GB of cache RAM and port speeds of up to 4 Gb/s. Figure 2-1 shows the controller module with front cover in place.

Figure 2-1   The Controller Module

The controller module is comprised of five sub-modules, referred to as "canisters", which serve individual support functions for the unit.

The following list identifies the types of canisters and the quantity of each in the controller module:

- Controller canister (two)

- Power supply/fan canister (two)

- Interconnect/battery canister (one)

The power supply/fan canisters and interconnect/battery canister are located behind the front cover. The controller canisters are located in the rear of the controller module. All canisters are secured in the controller module by quick release latches, enabling each canister to be removed by disengaging the latch and sliding the canister from the controller module chassis. Figure 2-1 shows the positions of the canisters in the controller module.

1. Controller Canisters
2. Power Supply/Fan Canisters
3. Interconnect/Battery Canister

76021

Front

Figure 2-2   Location of the Canisters in the Controller Module

The module provides flexibility in configuring a storage array. A minimal storage array configuration would consist of one controller module and one drive module. The drive module can contain as few as two disk drives. The maximum number of disk drives a

two-controller module can support is 224 drives. The maximum number of drive enclosures is 14, with each drive module containing 16 disk drives.

Controllers

Each controller module houses two controllers. Both controllers are identical and interchangeable. The controllers are different from some previous SGI RAID units in that they install from the rear of the module. The upper controller is controller A; the lower controller is controller B. All connections to the hosts and the drives in the storage array are through the controllers. Figure 2-3 shows an example rear view of the controllers.

76012

Figure 2-3   Controllers A and B in the at the Rear of the Controller Module

Information about the condition of the controllers is conveyed by two seven-segment status LEDs on the back.

Controller Cable Connections

Each controller provides the following connections:

- Four host channels
- Two dual-ported drive channels
- Two RJ-45 Ethernets
- One RS-232 serial
- AC or DC power

Figure 2-4 identifies the connectors on the back of each controller canister.

76032

1. Host Channels
2. RS-232 Serial Port
3. Ethernet Ports
4. Dual-Ported Drive Channels
5. AC Power
6. DC Power
7. Controller Status LEDs

Figure 2-4   Controller Canister Connectors

Each controller has two drive channels; each drive channel has two ports. The drive channel ports are configured from loop switches.

Each controller has four host Fibre Channel ports. The controllers perform link speed negotiation on each host channel Fibre Channel port (also referred to as auto-negotiation). The controllers interact with the host or switch to determine the fastest compatible speed between the controllers and the host or switch. The fastest compatible speed becomes the operating speed of the link. If the host or switch on the other end of the link are fixed speed or not capable of negotiating, the controllers automatically detect the operating speed of the other host or switch and sets the controller link speed accordingly. Link speed negotiation for a given host channel is limited to link speeds supported by the small form-factor pluggable (SFP) transceiver on that channel.

The controllers will enter into auto-negotiation at these points in time:

- Start-of-Day

- Detection of a link-up event after a previous link-down event

If the auto-negotiation process fails, the controllers will consider the link to be down until negotiation is again attempted at one of these points in time.

For a 4Gb controller, the supported link speeds are 1, 2, and 4Gb.

The Ethernet connections provide for out-of-band management configurations to a host.

The RS-232 serial connection provides a diagnostic port.

Controller Memory

Each controller has up to 8 GB of memory for processor memory and data cache. The processor memory stores the controller firmware, while the data cache is a buffer used to temporarily store data during data read and write operations. A Fast Cache Write light on the controller turns on when the cache contains unwritten data. The light turns off when the cache does not contain unwritten data.

For specific information about the memory in the controller canisters, refer to Table 2-1.

Table 2-1   Memory in the Controller Canisters

Controllers (1 pair)	Processor Memory in Each Controller	Cache Memory in Each Controller
2 GB	512 GB	Two 512 GB
8 GB	512 GB	Four 1 GB
16 GB	1 GB	Four 2 GB

Table 2-2 lists the technical specifications for the controllers.

Table 2-2   Controller Specifications

Category	Criteria	Specification
Processor	Speed	2.4 GHz
Memory	Processor/cache size	1 GB

Table 2-2   Controller Specifications **(continued)**

Category	Criteria	Specification
Flash Memory	Capacity	32 MB
NVSRAM	Capacity	512 KB
Processor bus	Speed	64b 100MHz
Interface	Host port	4 fiber optic per controller 2 Ethernet per controller (for out-of-band management)
	Drive port	4 per controller
Array Support	Drive loops	2 per controller
	Maximum number of drives per loop	112 drives per loop
	Maximum number of drives supported by one controller module	224 drives (2 drive loops with 112 drives in each loop)
Data Transfer Rates	Fibre Channel host	Up to 4 Gb/sec maximum
	Fibre Channel drives	Up to 4 Gb/sec maximum (depends on drive enclosure speed)
	Primary PCI bus	64-bit 100MHz
	Ethernet	10 Base T 100 Base T

Power Supply/Fan Canisters

The controller module has two power supply/fan canisters. Each power supply/fan canister contains a power supply, a fan, and a battery charger. Each power supply provides power to the controllers by converting incoming AC voltage to the appropriate DC voltages. In addition to the AC-to-DC power supply, the command module is available with a DC-to-DC power supply. The DC-to-DC power supply is telephone company/network equipment building standards (TELCO/NEBS) compliant. If one power supply/fan canister is turned off or malfunctions, the remaining power supply/fan canister can maintain electrical power and cooling to the controller module.

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The power supply/fan canisters install from the front of the controller module. Figure 2-5 shows how a power supply/fan canister slides in or out of the controller module. The levers securing the power supply/fan canisters into the command module are shown in the released position.

1. Latches
2. Levers, Released
   Position

Front

76003

Figure 2-5   Power Supply/Fan Canister

Information about the condition of the power supplies, fans, and battery charger is conveyed by indicator lights on the front of each of the power supply/fan canisters. The front cover must be removed to see the lights.

Interconnect/Battery Canister

The interconnect/battery canister is a removable mid-plane that provides cross-coupled signal connection between the controllers. The control output from each controller is connected to the control input in the alternate controller. The interconnect/battery canister contains alternate power, power supply canister signals, inter-controller discrete lines, and redundant drive channels.

Figure 2-6 shows how the interconnect/battery canister slides into the front of the main enclosure. The levers securing the interconnect/battery canisters into the module are shown in the released position.

1. Interconnect/Battery Canister
2. Latch
3. Levers, Released Position

Front

Figure 2-6   Interconnect/Battery Canister

The interconnect/battery canister contains one or two battery packs that provide backup power to the controller cache memory. Each battery pack contains sealed, rechargeable lithium ion batteries. The battery pack voltage ranges from 9 to 13 V. For 2 GB cache, one battery pack can maintain memory for seven days. If the controller module is connected to an uninterruptable power supply (UPS), a battery pack is not required for backup power to the controller cache memory.

The battery chargers in the power supply canisters perform a battery test when the controller module is started and on a regularly scheduled interval thereafter. Data caching starts after the battery completes its startup tests.

The interconnect/battery canister is hot-swappable. You can remove the interconnect/battery canister for servicing and then reinsert it while the controllers continue to perform I/O operations without any data loss. Data access is limited to only one controller when the interconnect/battery canister is removed. One controller becomes inactive while the other performs all controller operations.

Removing the interconnect/battery canister after either a controller or a power supply canister has already been removed results in a loss of data access.

Caution: Never remove/replace the interconnect/battery canister unless directed to do so by a Customer Support representative.

Information about the condition of the interconnect/battery canister is conveyed by indicator lights on the front of interconnect/battery canister.

SFP Transceivers

The controller module supports fiber optic interface cables. These fiber optic cables require a small form-factor pluggable (SFP) transceiver that must be installed in each interface connector on the controller where a fiber optic cable is to be installed.

Figure 2-7 shows an SFP transceiver with fiber optic cable. Note that the SFP transceiver shown may look slightly different from those shipped with your unit. The differences will not affect transceiver performance.

1. ISFP Transceiver
2. Fiber Optic Cable

Figure 2-7   SFP Transceiver and Fiber Optic Cable

Note: You can use copper cables in place of the fiber optic cables for the back-end connections.

Important: Several references are made in this manual to the storage management software (TPSSM). For complete information on the operation and use of this software, see the documents titled *SGI InfiniteStorage TPSSM Software Concepts Guide* (007-4749-00X) and *SGI InfiniteStorage TPSSM Administration Guide* (007-4748-00X).

Operation of Controller Enclosures

This chapter describes the use, operation, and troubleshooting of the controller enclosure. The procedures include: turning on power, turning off power, responding to an unplanned power outage, and responding to the audible alarm. The procedures are for controller modules that are already installed and operational. Troubleshooting procedures include failure detection, recovery procedures, and explanations of status indicator LEDs on the enclosure's modules.

Removing and Replacing the Front Cover

The controller module is equipped with a front cover, which you must remove in order to access the power supply/fan canister and interconnect/battery canister, or to view the indicator lights on the front of those canisters.

Figure 3-1 illustrates the following steps used to remove and replace the front cover.

1. Remove the front cover by grasping the sides and pulling the cover toward you.

2. Install the front cover by aligning the pins on the controller module chassis with the spring-steel retainers on the cover, and then press the cover toward the chassis until the pins snap into place.

Figure 3-1   Removal and Replacement of the Controller Module Front Cover

Turning On Power

Use this procedure to turn on power to a storage array at the initial startup or after a normal shutdown. To restore power after an unplanned shut down, refer to "Restoring Power after an Unplanned Shutdown" on page 23.

Caution: Potential damage to drives and data loss – Turning off and turning on power without waiting for the disk drives to spin down can damage the drives and may cause data loss. Always let at least 30 seconds elapse from when you turn off the power until you turn on the power again.

Caution: Turn off both power switches on all modules in the storage array before connecting power cords or turning on the main circuit breakers.

1. If the main circuit breakers in the cabinet are off, turn them on.

2. Turn on both power switches on the attached drive modules.

3. You must turn on power to each attached drive module before turning on power to the controller module to ensure that the controllers acknowledge each drive module.

4. Turn on the AC power switch on the back of each controller in the controller module. Figure 3-2 shows the location of the AC power switch and power connector on the controller.

1. AC power switch
2. AC power connector
3. DC power switch
4. DC power connector

Figure 3-2   AC Power Switch and Connector

The controller module may take up to 30 seconds to power up. The battery self test may take an additional 10 minutes. The lights will blink intermittently until the controller module powers up and completes the battery self test.

Note: Before attempting any operations, wait for the controller module to completely power up.

Determine the status of all modules and components in the storage array by completing the following steps:

1. Check all lights on each component in the drive modules. Ensure that all the lights show normal status.

2. Check all lights on each canister in the controller module. Ensure that all the lights show normal status.

3. Open the **Array Management Window** and display the **Physical View** for the storage array.

4. The status for each component will be either **Optimal** or **Needs Attention**.

5. Review the status of the storage array components shown in the **Array Management Window** by selecting the appropriate component button for each module.

6. Are the lights indicating normal operation, and is the status **Optimal** on all the storage array components?

   – Yes – End of procedure.

   – No – Go to the next steps.

Diagnose and correct any faults by completing the following steps:

1. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the **Array Management Window**.

2. Complete the recovery procedure.

   If the Recovery Guru directs you to replace a failed component, use the individual lights on the modules to locate the failed component. (For procedures to replace a failed component, refer to Chapter 5, "Replacing Controller Enclosure Components").

3. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.

4. If the problem has not been fixed, contact your applicable technical support organization.

Turning Off Power for a Planned Shutdown

Storage array modules are designed to run continuously, 24 hours a day, and should remain on except during certain upgrade and service procedures.

To turn off power for an unplanned shut down, refer to "Turning Off Power for an Unplanned Shutdown" on page 20.

Caution: Potential damage to drives and data loss – Turning off and turning on power without waiting for the disk drives to spin down can damage the drives and may cause data loss. Always let at least 30 seconds elapse from when you turn off the power until you turn on the power again.

Use the following procedures to turn off power to one or more modules and for a planned shutdown:

1. Stop all I/O activity to the modules.

2. Determine the status of all modules and components in the storage array by completing the following sub-steps.

   – Check all lights on each component in the drive modules. Ensure that all the lights show normal status.

   – Check all lights on each canister in the controller module. Ensure that all the lights show normal status. For information about light status, refer to "Troubleshooting the Controller Module" on page 47 and reference the tables in the following sections covering individual canisters.

   – Open the **Array Management Window** for the storage array and display the **Physical View** for the storage array.

   – Review the status of the storage array components shown in the **Array Management Window** by selecting the appropriate component button for each module.

   The status for each component will be either **Optimal** or **Needs Attention**.

3. Are the lights indicating normal operation, and is the status **Optimal** on all the storage array components?

   – Yes – Go to step 5.

   – No – Go to step 4.

4. To diagnose and correct any fault, complete the following steps.

   – Run the Recovery Guru by selecting the Recovery Guru toolbar button in the **Array Management Window**.

   – Complete the recovery procedure. If the Recovery Guru directs you to replace a failed component, use the individual lights on the modules to locate the failed component.

   – When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.

   – If the problem has not been fixed, contact Customer and Technical Support. Do not turn off power until all problems are corrected.

5. Check the back of the controller module, and verify that the Fast Write Cache light is off.

   If the Fast Write Cache light is on steady, the cache contains data. Wait for the data to clear from cache memory before turning off the power.

6. Check the lights on the drive modules to verify that all drive Active lights are on steady (not blinking).

   If one or more lights are blinking, data is being written to or from the drives. Wait for all Active lights to stop blinking.

7. Turn off the AC power switch on the back of each controller in the controller module. (Figure 3-2 on page 17 shows the location of the AC power switch on a controller.)

   Note: Until the power switch on each controller canister is turned off, power still remains turned on for both controllers; therefore, the seven-segment display on each controller stays on until the power switch on each controller canister is turned off.
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8. Turn off both power switches on the back of each drive module in the storage array to complete the procedure.

Turning Off Power for an Unplanned Shutdown

Storage array modules are designed to run continuously, 24 hours a day. Certain situations, however, may require that you to shut down all storage array modules

quickly. These situations might include a power failure or an emergency because of a fire, a flood, an extreme weather condition, or some other hazardous circumstance, or a power supply shutdown caused by overheating.

In the event of a power source failure, the controller module recovers automatically. When normal power is restored after a power source failure, the module performs power-up recovery procedures without operator intervention.

Caution: Potential damage to drives and data loss – Turning the power off and on without waiting for the disk drives to spin down can damage the drives and cause data loss. Always wait at least 30 seconds from when you turn off the power until you turn it on again. **Potential data corruption** – Turning off power when a fault light is on can cause data corruption. Always check for and correct all faults before turning off the power.

Use the following procedures to turn off power to all modules in a storage array during an emergency situation:

1. Stop I/O activity to the storage array.

2. Determine the status of all the modules and their components in the storage array by completing the following sub-steps.

    – Check all lights on each component in the drive module. Ensure that all the lights show normal status.

    – Check all lights on each canister in the controller module. Ensure that all the lights show normal status. For information about light status, refer to Chapter 4, "Troubleshooting Controller Enclosure Components". Check the status table covering the lights for the canister you need information on.

    – Open the **Array Management Window** for the storage array.

    – Select the appropriate component button for each module in the **Physical View** of the **Array Management Window** to view the status of all its components.

    The status for each component will be either **Optimal** or **Needs Attention**.

3. Are the lights indicating normal operation, and is the status **Optimal** on all the storage array components?

    – Yes – Go to step 5.

    – No – Go to step 4.

4. Diagnose and correct the fault by completing the following steps.

   a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the **Array Management Window**.

   b. Complete the recovery procedure.

   c. If the Recovery Guru directs you to replace a failed component, use the individual lights on the modules to locate the specific failed component.

   d. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.

   e. If the problem has not been fixed, contact Customer and Technical Support.

   Note: Do not turn off power until all problems are corrected.

5. Check the back of the controller module to verify that the Fast Write Cache light is off.

   If the Fast Write Cache light is on steadily, the cache contains data. Wait for the data to clear from cache memory before turning off the power.

6. Check the lights on the drive modules to verify that all drive Active lights are on steady (not blinking). If one or more lights are blinking, data is being written to or from the drives. Wait for all Active lights to stop blinking.

7. Turn off the AC power switch on the back of each controller in the command module. (Figure 3-2 on page 17 shows the location of the AC power switch on a controller.)

Note: Until the power switch on each controller canister is turned off, power still remains turned on for both controllers; therefore, the seven-segment display on each controller stays on until the power switch on each controller canister is turned off.

8. Turn off both power switches on the back of each drive module in the storage array to complete the procedure.

Restoring Power after an Unplanned Shutdown

Use the following procedure to restore power to the module in a storage array after an unplanned shutdown.

Warning: **Risk of severe electrical shock – Never turn on the power to any equipment if there is evidence of fire, water, or structural damage. Doing so may cause severe electrical shock.**

1. Visually check the equipment for damage. Is there evidence of damage to any of the modules, cables, or equipment attached to the modules?

    – Yes – **Do *not* continue with this procedure.** Contact Customer and Technical Support for assistance. Depending on the current service agreements, you may need to return the equipment to the factory or local service center for repair.

    – No **–** Go to step 2.

Caution: Potential data loss or corruption – Before resetting circuit breakers in the cabinet, ensure that the controller module and drive modules power switches are turned off. Resetting circuit breakers after an emergency situation while the controller module and drive module power switches are turned on can cause potential data loss or corruption.

2. Verify the main circuit breakers in the cabinet are turned off.

3. Verify that the AC power switch on each controller module is turned off. (Figure 3-2 on page 17 shows the location of the AC power switch on each controller.)

4. Verify that both power switches on all drive modules in the storage array are turned off.

5. Turn on the main circuit breakers in the cabinet.

6. Turn on both power switches on the back of each drive module.

Important: You must turn on power to each attached drive module before turning on power to the controller module to ensure that the controllers acknowledge each drive module.

7. Turn on the AC power switch on the back of each controller in the controller module. Figure 3-2 on page 17 shows the location of the AC power switch on the controller.

8. The controller module may take up to 30 seconds to power up. The battery self test may take an additional 10 minutes. The lights will blink intermittently until the controller module powers up and completes the battery self test.

9. Determine the status of all modules and their components in the storage array, by completing the following steps.

   a. Check all lights on each component in the drive modules. Ensure that all the lights show normal status.

   b. Check all lights on each canister in the controller module. Ensure that all the lights show normal status. For information about light status, refer to Chapter 4, "Troubleshooting Controller Enclosure Components" and check the table covering any canister that displays a trouble light status.

   c. Open the **Array Management Window** and display the **Physical View** for the storage array.

   d. Review the status of the storage array components shown in the **Array Management Window** by selecting the appropriate component button for each module.

   The status for each component will be either **Optimal** or **Needs Attention**.

10. Are the lights indicating normal operation, and is the status **Optimal** on all the storage array components?

    – Yes – End of procedure.

    – No – Go to step 11.

11. Diagnose and correct the fault by completing the following steps.

    a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the **Array Management Window**.

    b. Complete the recovery procedure.

    c. If the Recovery Guru directs you to replace a failed component, use the individual lights on the modules to locate the specific failed component. For more on troubleshooting the controller module, refer to Chapter 4, "Troubleshooting Controller Enclosure Components" to find additional troubleshooting information on the individual canisters within the module.

    d. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.

    e. If the problem has not been fixed, contact Technical Support.

Responding to the Audible Alarm

The alarm provides an audible warning of potentially serious problems with the controller module. Enable the alarm and leave it enabled at all times. The controller module is shipped with the alarm enabled. You can enable or disable the Audible Alarm feature using the SANtricity Storage Manager **Array Management Window** graphical user interface (GUI). Any change you make takes effect immediately.

The GUI indicates alarm status for the controller modules as follows:

- Alarm control (enabled/disabled)
- Alarm state (inactive/sounding/muted)
- The GUI provides the following alarm controls for the controller modules:
- Enable/disable alarm (error status is displayed if an attempt is made to enable an alarm that is not present)
- Mute alarm

You can configure the alarm duty cycle (the amount of time the alarm sounds) using the User Configurable Option **Audible Alarm Interval Control**. The active period when the alarm is sounding is fixed at one second. The silent period of the cycle is configurable from 1 to 60 seconds. If the interval is set to zero, the alarm will sound continuously when activated.

You cannot change the **Audible Alarm Interval Control** through the GUI.

The alarm sounds and the Needs Attention light turns on when one of the following conditions occur:

- **Hardware malfunction in a command module –** This includes an overheating condition or a component failures (controllers, power supplies, or fans).
- **Transmission failures –** This includes I/O transmission problems with the SFP transceivers or cables.

The module combines a Mute button and Needs Attention indicator on the front cover. (Figure 3-3 shows the location of the Mute button, as well as the Power-on and Locate lights.) You can mute the alarm using either the Mute button or the storage management software. In either case, the alarm will sound again if a new fault occurs.

1. Power-on Light
   (Green)
2. Mute Button and Needs
   Attention Light
   (Amber)
3. Locate Light
   (White)

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Figure 3-3   Alarm Mute Button on the Controller Enclosure Front Cover

If the alarm sounds, check the command module for faults. For troubleshooting procedures, refer to "Controller Module Attention Light Procedures" in Chapter 4.

Troubleshooting the Controller Module

The storage management software enables you to monitor the controller module, diagnose problems, and recover from failures. For best storage array operation, run the storage management software continuously, and frequently check the storage array status.

Use the following procedure to check the status of the controller module. If a problem has occurred, use the storage management software and the lights on the command module to help locate a failed component.

1. If applicable, turn off the alarm by pressing the Mute button on the front cover of the controller module.

    Note: If another fault occurs, the alarm will sound again.

2. Use the storage management software to print a storage array profile.

3. Using the **Enterprise Management Window**, view the status of the storage arrays. Are any storage arrays indicating **Needs Attention**?

   – Yes – Go to step 4.

   – No – All components are Optimal. Go to step 8.

4. Open the **Array Management Window** and display the **Physical View** for the storage array.

5. View the status of the command module by selecting the controller module button and expanding the **Overall Component Information**.

Using the **Overall Component Information** view, you can see the status of the following components:

- Interconnect canister and battery packs in the canister

- SFPs

- Support canisters, and fans and power supplies in the canisters

- Temperature sensors

- UPS (optional)

The status for each component will be either **Optimal** or **Needs Attention**.

6. Do any components have a **Needs Attention** status?

   – Yes – Go to step 7.

   – No – All components are Optimal. Go to step 8.

7. Select the Recovery Guru toolbar button. Perform the procedure in the Recovery Guru to correct the problem. The Recovery Guru may direct you to replace the failed component; if so, go to step 9, otherwise continue with step 8.

8. Check the lights on the controller module to determine if a fault has occurred in the controller module.

For the definition of the lights, refer to and reference the appropriate table for the canister affected. Are any lights indicating a fault condition?

   – Yes – Go to the next step.

   – No – You are finished with this procedure.

9. Replace the failed component, see Chapter 5, "Replacing Controller Enclosure Components" for instructions on replacing the controller canister, power supply/fan canister, interconnect/battery canister, battery pack, and SFP transceivers.

If you are still experiencing a problem with this storage array and are unable to determine the root cause, go to step 10.

10. If the problem has not been fixed contact Customer and Technical Support.

Print a storage array profile and save the storage array support data. The profile and support data will be helpful when troubleshooting storage array problems. (For information about printing a storage array profile and saving the support data, refer to the **Array Management Window** online help.)

Controller Canister Lights

Figure 3-4   Controller Canister Lights

Table 3-1   Definition of the Controller Canister Lights

Location in Figure	Light	Color	Normal Status	Problem Status	Procedure
1	Host Channel Speed – L1	Green LED	L1 L2 Definition Off Off No connection/link down On Off 1 Gb		
2	Host Channel Speed – L2	Green LED	Off On 2 Gb On On 4 Gb		
3	Drive Port Bypass (one light per port)	Amber LED	Off	On = Bypass	
4	Drive Channel Speed – L1	Green LED	L1 L2 Definition Off Off No connection/link down		
5	Drive Channel Speed – L2	Green LED	Off On 2 Gb On On 4 Gb		
6	Drive Port Bypass (one light per port)	Amber LED	Off	On = Bypass	
7	Service Action Allowed	Blue LED	Off	On = Safe to remove	Replace a controller canister
8	Needs Attention	Amber LED	Off	On = Controller needs attention	Troubleshooting chapter
9	Fast Write Cache	Green LED	On = Data in cache Off = No data in cache	Not Applicable	
10	Ethernet Link Speed	Green LED	Off = 10 base T On = 100 base T	Not Applicable	
11	Ethernet Link Activity	Green LED	Off = No link established On = Link established Blinking = Activity	Not Applicable	
12	Numeric Display (Tray ID and Diagnostic Display)	Green/yellow seven segment display	Diagnostic LED = off: Controller ID Diagnostic LED = on: Diagnostic code		

Numeric Display

The numeric display consists of two seven-segment LEDs that provide information about tray identification and diagnostics. Figure 3-5 shows the numeric display and the diagnostic LED.

1. Seven Segment Display
2. Diagnostic LED

Figure 3-5   Numeric Display

When the controller module is operating normally, the numeric display shows the tray identification (tray ID) of the controller module. The controller module tray ID is automatically set by the controller firmware and automatically adjusts during power-on to avoid conflicts with IDs used for the attached drive modules. You can, however, set the controller module tray ID through the SANtricity Storage Manager. The tray ID is an attribute of the controller module; both controllers will display the same tray ID. It is possible, however, that one controller will display the tray ID, while the other controller displays a diagnostic code.

If an error has occurred and the controller canister Needs Attention light is on, the numerical display shows diagnostic information. The numeric display indicates the information is diagnostic by illuminating an LED that appears as a decimal point between the display numbers. The diagnostic LED tuns off when the numeric display shows the controller module tray ID. The numeric display shows diagnostic codes after each power cycle or reset. After diagnostics are complete, the current controller module tray ID is displayed.

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Diagnostic codes in the form of L*x*, where *x* is a hexadecimal digit, indicate controller state information. In general, these codes are displayed only when the controller is in a non-operational state. The controller might be non-operational due to a configuration problem (such as mismatched controller types), or it might be non-operational due to hardware faults. If the controller is non-operational due to system configuration, the controller Needs Attention light will be off. If the controller is non-operational due to a hardware fault, the controller Needs Attention light will be on. The definitions for L*x* diagnostic codes are listed in tables in the section beginning with "Controller Canister Lights" in Chapter 4.

Table 3-2   Numeric Display Diagnostic Codes

Value	Controller State	Description	Storage Manager View
L0	Suspend	Mismatched controller types	Needs Attention condition for board type mismatch
L1	Suspend	Missing interconnect/battery canister	Needs Attention condition for missing interconnect/battery canister
L2	Suspend	Persistent memory errors	Needs Attention condition for offline controller
L3	Suspend	Persistent hardware errors	Needs Attention condition for offline controller
L4	Suspend	Persistent data protection errors	Needs Attention condition for offline controller
88	Reset	Controller is held in reset by alternate controller	

Power Supply/Fan Canister Lights

Figure 3-6   Power Supply/Fan Canister Lights

Table 3-3   Definition of the Power Supply/Fan Canister Lights

Location in Figure	Light	Color	Normal Status	Problem Status	Procedure
1	Power	Green LED	On = Power supply/fan canister is providing power	Off = Power supply/fan canister is not providing power	
2	Battery Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted or discharged	
3	Battery Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted or discharged	

Table 3-3   Definition of the Power Supply/Fan Canister Lights **(continued)**

Location in Figure	Light	Color	Normal Status	Problem Status	Procedure
4	Needs Attention	Amber LED	Off	On = Power supply/fan canister needs attention	Troubleshooting chapter
5	Service Action Allowed	Blue LED	Off	On = Safe to remove . May also indicate an open circuit breaker.	Resetting a circuit breaker in "Resetting the Controller Circuit Breakers" on page 37. Replacing a power supply/fan canister in Chapter 5.

Interconnect/Battery Canister Lights

Figure 3-7   Interconnect/Battery Canister Lights

Table 3-4   Definition of the Interconnect/Battery Canister Lights

Location in Figure	Light	Color	Normal Status	Problem Status	Procedure
1	Battery Needs Attention	Amber LED	Off	On = Battery missing or failed	Replace battery canister Chapter 5
2	Power	Green LED	On = Controller module is powered on	Off = Controller module is powered off	
3	Needs Attention	Amber LED	Off	On = A component in the controller module has developed a fault. Inspect the Needs Attention lights on the other canisters to isolate the fault.	Troubleshooting Chapter 4
4	Locate	White LED	Off	On = controller module locate	
5	Service Action Allowed	Blue LED	Off	On = Safe to remove	Replace interconnection /battery canister
6	Battery Needs Attention	Amber LED	Off	On = Battery missing or failed	Battery replace

The Power, Needs Attention, and Locate lights are general indicators for the entire controller module, not specifically for the interconnect/battery canister. The Needs Attention light will turn on if a fault condition is detected in any component in the controller module. The Power, Needs Attention, and Locate lights shine through the front cover.

Important: If you see a Needs Attention light, refer to the storage management software to determine the problem with the controller module. Also, inspect the Needs Attention lights on the other canisters in the controller module to help isolate the fault to a specific canister.

Recovering from an Overheated Power Supply

The controller module has two power supply/fan canisters. Each power supply/fan canister contains a power supply, a cooling fan, a battery charger, and a built-in temperature sensor designed to prevent the power supplies from overheating. Under normal operating conditions, with an ambient air temperature range of 5° C to 40° C, (40° F to 104° F), the cooling fans maintain a proper operating temperature inside the module.

Several factors can cause the power supplies to overheat. These factors include:

- Unusually high room temperature

- Fan failure

- Defective circuitry in the power supply

- Blocked air vent

- Failure in other devices installed in the cabinet

If the internal temperature rises above 70° C (158° F), one or both power supplies automatically shut down. If *one* power supply shuts down, the storage management software displays a **Needs Attention** status in the **Array Management Window,** the alarm sounds, and the Needs Attention light on the front cover of the command module turns on.

If a common environmental stress causes *both* power supplies to shut down, the controller module shuts down, and the storage management software displays a **Not Responding** status in the **Array Management Window**.

If event monitoring is enabled and event notification is configured, the software also issues critical event notifications.

- **Nominal temperature exceeded** – The controller module temperature exceeds the normal operating range.

- **Maximum temperature exceeded** – The controller module temperature exceeds 70° C (158° F).

Use the following procedure to resume normal operation after a power supply shutdown.

Caution: Risk of damage from overheating – Power supplies automatically shut down when air temperature inside the cabinet reaches 70° C (158° F) or above. If the power supplies have shut down, immediately remove all cabinet panels to help cool the cabinet air temperature and prevent damage to the command module.

---

1. If applicable, turn off the alarm by pressing the Mute button on the front cover of the controller module.

2. Use the storage management software to print a storage array profile.

3. Did you use the procedure "Troubleshooting the Controller Module" in Chapter 4 to identify an overheating problem?

    –   Yes – Go to step 4.

    –   No – Perform the appropriate procedures under "Troubleshooting the Controller Module" on page 47 to verify that the power supplies have shutdown because of an overheating problem.

4. Try alleviating the overheating problem by:

    –   Removing all panels from the cabinet

    –   Cooling the area using external fans

    –   Shutting down the power to the controller modules or drive modules

5. Stop all I/O activity to the controller module and to all attached drive modules.

6. Wait until the ambient air temperature around the controller module cools.

The controller module is capable of power-up recovery without operator intervention after the temperature inside the power supply/fan canister cools to below 70° C (158° F). After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers reset and return to normal operation.

7. Did the power supplies restart automatically?

    –   Yes – Go to step 9.

    –   No – Got to step 8.

8. Turn off the power switch on each controller in the controller module. Wait 10 seconds, and then turn on the controller module power. If the power supplies go into operation, go to step 9. If not, call Customer and Technical Support.

9. Check the status lights on the front and back of the controller module.

For information about controller module and canister lights, refer to Chapter 4, "Troubleshooting Controller Enclosure Components".

10. Are the lights on the controller module indicating normal status?

   – Yes – Go to next step.

   – No – Got to step 12 and diagnose the fault.

11. Use the storage management software to check the status of all modules in the storage array. Is the status Optimal for each module?

   – Yes – End of procedure. Resume normal operation.

   – No – Go to step 12.

12. Diagnose and correct the fault by completing the following steps.

   a. Select the Recovery Guru toolbar button in the **Array Management Window** to run the Recovery Guru.

   b. Complete the recovery procedure.

   c. If the Recovery Guru directs you to replace a failed component, use the individual lights on the modules to locate the specific failed component.

   d. When the procedure is completed, select **Recheck** in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.

   e. If the problem has not been fixed contact Customer and Technical Support.

Print a storage array profile and save the storage array support data. The profile and support data will be helpful when troubleshooting storage array problems. (For information about printing a storage array profile and saving the support data, refer to the **Array Management Window** online help.)

Resetting the Controller Circuit Breakers

Each controller module controller has two circuit breakers that provide over current protection to the power supply in a power supply/fan canister. One circuit breaker provides protection for AC input, the second circuit breaker provides protection for DC input. The circuit breakers are mounted inside the controller canister, in line with the internal power cable.

The internal power cable runs from the AC connector and DC connector on a controller canister to the power supply in a power supply/fan canister. Power to the left power supply/fan canister (as viewed from the front of the command module) is routed through the top controller canister; power to the right power supply/fan canister is routed through the bottom controller canister.

If a circuit breaker has tripped, the condition might appear as if a power supply/fan canister has failed. The power supply is no longer providing power to the command module. An tripped circuit breaker is indicated when all of the following conditions are present:

- Alarm is sounding.

- Needs Attention light on the command module front cover is turned on.

- The controller canister Needs Attention lights are not turned on.

- The power supply/fan canister Needs Attention lights are not turned on.

- The Service Action Allowed light is turned on for the power supply/fan canister connected to the controller canister with the open circuit breaker.

- The **Array Manager Window** shows the failed controller canister as present, but not responding.

Use the following procedure to ensure that a circuit breaker has opened, and then to reset the circuit breaker.

Tools and Equipment

- Antistatic protection
- Non-conducting stylus

Procedure

Caution: Electrostatic discharge can damage sensitive component. – Touching the command module or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the controller module. You can also control the alarm using the TPSSM client software.

1. Mute Button and Needs
Attention Light
(Amber)

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Figure 3-8   Mute Button/Needs Attention Light—Front Cover

2. Check to ensure that the external power cables are completely plugged into the controller canisters and into the power source.

3. Put on antistatic protection.

4. Remove the front cover by grasping the sides and pulling the cover toward you.

5. Check the Needs Attention light on each power supply/fan canister. (Figure 3-9 shows the location of the Needs Attention light.)

1. Needs Attention (Amber)
2. Service Action Allowed (Blue)

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Figure 3-9   Power Supply/Fan Canister Needs Attention Light

a. Is a power supply/fan canister Needs Attention light on?

– Yes – A power supply/fan canister has failed. To replace the failed power supply/fan canister, refer to Chapter 5.

– No – Go to sub-step (b).

b. Is a power supply/fan canister Service Action Allowed light on?

– Yes – If the Service Action Allowed light on the left power supply/fan canister is turned on, then the circuit breakers in the upper controller canister have tripped. If the Service Action Allowed light on the right power supply/fan canister is turned on, then the circuit breakers in the lower controller canister have tripped. (Left and right are determined by facing the front of the controller module.) Go on to step 6.

– No – Contact Customer and Technical Support.

Caution: Potential damage to fiber optic cables – Fiber optic cables are fragile. Bending, twisting, folding, or pinching fiber optic cables can cause damage to the cables, degraded performance, or data loss. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables in less than a two-inch radius.

Note: You do not need to remove the interface cables from the controller canisters to reset the circuit breakers; however, removing the cables can make this procedure easier. If you choose to remove the interface cables ensure that you label each cable so that you can reconnect them correctly to the controller canister. Figure 3-10 identifies all of the connectors on the back of the controller canister.

---

1. Host Channels
2. RS-232 Serial Port
3. Ethernet Ports
4. Dual-Ported Drive
   Channels
5. AC Power
6. DC Power
7. Status LEDs

Figure 3-10   Controller Canister Connectors

6. Use the storage management software to take the controller offline. After the controller is offline, the Service Action Allowed light turns on and you can safely remove the controller.

7. Slide the controller canister with the open circuit breaker from the controller module. You do not need to completely remove the controller canister, only slide it out far enough to reveal the holes over the circuit breakers.

    a. Using your index fingers, simultaneously push the latches to release the levers, and rotate the levers to disengage them from the locking pins.

    b. Use the levers to slide the controller canister from the controller module chassis. (Figure 3-11 shows the controller canister sliding from the controller module chassis.)

1. Levers, Released Position
2. Latches
3. Controller Canisters

76005

Figure 3-11   Removing a Controller Canister from the Controller Module

Circuit Breaker Access
Holes In The Controller
Cover

76047

1. DC Circuit Breaker
2. AC Circuit Breaker

Figure 3-12   Circuit Breaker Access Holes Locations

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8. Insert a non-conducting stylus through the appropriate hole in the cover of the controller canister. One hole is over the AC circuit breaker a second hole is over the DC circuit breaker. Figure 3-12 shows the location of the circuit breaker access holes in the controller canister cover and Figure 3-13 shows the location of the circuit breakers in the controller canister.

9. Reset the circuit breaker that tripped by pressing down on the rocker switch.

Circuit Breaker Location In
The Controller Canister
(Cover Removed)

76039

Figure 3-13   Controller Circuit Breakers

10. Slide the controller canister into the controller module chassis, and push it firmly until the levers snaps into place.

11. If you removed the interface cables, reconnect all host interface cables and drive interface cables, including the SFP transceivers.

12. Wait approximately 60 seconds for the storage management software to recognize the controller canister.

13. Complete any remaining Recovery Guru procedures for controller canister replacement, if needed.

14. Based on the Host Channel Speed, Drive Channel Speed, and Needs Attention light status, proceed to one of the following steps:

    • **All channel speed lights are on** *and* **the Needs Attention light is off –** Go to step 16.

    • **All channel speed lights are off** *or* **the Needs Attention light is on –** Verify the controller has been installed correctly. Reinstall the controller canister. Go to step 15.

Note: If a host channel or drive channel does not have a cable connected, the channel speed LEDs will not be illuminated.

---

15. Did this correct the problem?

    – Yes – Go to step 16.

    – No – If the problem has not been fixed, contact Customer and Technical Support.

16. Remove the antistatic protection.

17. Install the front cover by aligning the pins on the command module chassis with the spring-steel retainers on the cover, and then pressing the cover toward the chassis until the pins snap into place.

18. Using the **Enterprise Management Window**, view the status of the storage arrays. Are any storage arrays indicating **Needs Attention**?

    – Yes – Go to step 19.

    – No – All components are Optimal. You are finished with this procedure.

19. Use the **Array Management Window** to check the status of all modules in the storage array.

20. Do any storage array modules have a **Needs Attention** status?

   – Yes – Select the Recovery Guru toolbar button in the **Array Management Window** and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

   – No – contact Customer and Technical Support.

Print a storage array profile and save the storage array support data. The profile and support data will be helpful when troubleshooting storage array problems. (For information about printing a storage array profile and saving the support data, refer to the **Array Management Window** online help.)

Troubleshooting Controller Enclosure Components

This chapter provides troubleshooting and recovery procedures for the controller enclosure (also called the controller module). This chapter also presents tables that explain the meanings of the indicator lights on the canister components in the module.

Troubleshooting the Controller Module

The storage management software enables you to monitor the controller module canister functionality, diagnose problems, and recover from failures. For best storage array operation, run the storage management software continuously, and frequently check the storage array status.

Use the following procedures to check the status of the controller module. If a problem has occurred, use the storage management software and the lights on the controller module to help locate a failed component.

1. If applicable, turn off the alarm by pressing the Mute button on the front cover of the controller module. You can also control the alarm using the TPSSM client software.

    Note: If another fault occurs, the alarm will sound again.

    ---

2. Use the storage management software to print a storage array profile.

3. Using the **Enterprise Management Window**, view the status of the storage arrays. Are any storage arrays indicating **Needs Attention**?

    –   Yes – Go to step 4.

    –   No – All components are **Optimal**. Go to step 5.

4. Open the **Array Management Window** and display the **Physical View** for the storage array.

5. View the status of the module by selecting the controller module button and expanding the **Overall Component Information**.

   Using the **Overall Component Information** view, you can see the status of the following components:

   – Interconnect canister and battery packs in the canister

   – SFPs

   – Support canisters, and fans and power supplies in the canisters

Temperature sensors

The status for each component in the module will be either **Optimal** or **Needs Attention**.Use the following information to identify any component needing service:

1. Do any components have a **Needs Attention** status?

   – Yes – Go to step 2.

   – No – All components are Optimal. Go to step 3 to check for any additional problems.

2. Select the Recovery Guru toolbar button. Perform the procedure in the Recovery Guru to correct the problem. The Recovery Guru may direct you to replace the failed component; if so, go to step 5, otherwise continue to the next step.

3. Check the lights on the command module to determine if a fault has occurred in the command module.

   For the definition of the lights, refer to Table 4-1 on page 49, Are any lights indicating a fault condition?

   – **Yes** – Go to the next step.

   – **No** – You are finished with this procedure.

If you are still experiencing a problem with this storage array, go to the next step.

4. Replace the failed component.

For instruction on replacing the controller canister, power supply/fan canister, interconnect/battery canister, battery pack, and SFP transceivers, refer to

5. If the problem has not been fixed, contact your technical support organization.

Print a storage array profile and save the storage array support data. The profile and support data will be helpful when troubleshooting storage array problems. (For information about printing a storage array profile and saving the support data, refer to the **Array Management Window** online help.)

Controller Canister Lights

Figure 4-1   Controller Canister Lights

Table 4-1   Definition of Controller Canister Lights

Location in Figure 7-1	Light	Color	Normal Status	Problem Status	Procedure
1	Host Channel Speed – L1	Green LED	L1 L2 Definition Off Off No connection/link down On Off 1 Gb		
2	Host Channel Speed – L2	Green LED	Off On 2 Gb On On 4 Gb		
3	Drive Port Bypass (one light per port)	Amber LED	Off	On = Bypass	

Table 4-1   Definition of Controller Canister Lights **(continued)**

Location in Figure 7-1	Light	Color	Normal Status	Problem Status	Procedure
4	Drive Channel Speed – L1	Green LED	L1 L2 Definition Off Off No connection/link down Off On 2 Gb On On 4 Gb		
5	Drive Channel Speed – L2	Green LED			
6	Drive Port Bypass (one light per port)	Amber LED	Off	On = Bypass	
7	Service Action Allowed	Blue LED	Off	On = Safe to remove	Replace controller canister
8	Needs Attention	Amber LED	Off	On = Controller needs attention	"Controller Module Attention Light Procedures" on page 60
9	Fast Write Cache	Green LED	On = Data in cache Off = No data in cache	Not Applicable	
10	Ethernet Link Speed	Green LED	Off = 10 base T On = 100 base T	Not Applicable	
11	Ethernet Link Activity	Green LED	Off = No link established On = Link established Blinking = Activity	Not Applicable	
12	Numeric Display (Tray ID and Diagnostic Display)	Green/yellow seven segment display	Diagnostic LED = off: Controller ID Diagnostic LED = on: Diagnostic code		

Numeric Display

The numeric display consists of two seven-segment LEDs that provide information about tray identification and diagnostics. Figure 4-2 shows the numeric display and the diagnostic LED.

1. Seven Segment Display
2. Diagnostic LED

Figure 4-2   Numeric Display

When the controller module is operating normally, the numeric display shows the tray identification (tray ID) of the controller module. The controller module tray ID is automatically set by the controller firmware and automatically adjusts during power-on to avoid conflicts with IDs used for the attached drive modules. You can, however, set the controller module tray ID through the SANtricity Storage Manager. The tray ID is an attribute of the controller module; both controllers will display the same tray ID. It is possible, however, that one controller will display the tray ID, while the other controller displays a diagnostic code.

If an error has occurred and the controller canister Needs Attention light is on, the numerical display shows diagnostic information. The numeric display indicates the information is diagnostic by illuminating an LED that appears as a decimal point between the display numbers. The diagnostic LED tuns off when the numeric display shows the controller module tray ID. The numeric display shows diagnostic codes after each power cycle or reset. After diagnostics are complete, the current controller module tray ID is displayed.

Diagnostic codes in the form of L*x*, where *x* is a hexadecimal digit, indicate controller state information. In general, these codes are displayed only when the controller is in a non-operational state. The controller might be non-operational due to a configuration problem (such as mismatched controller types), or it might be non-operational due to hardware faults. If the controller is non-operational due to system configuration, the

controller Needs Attention light will be off. If the controller is non-operational due to a hardware fault, the controller Needs Attention light will be on. The definitions for L*x* diagnostic codes are listed in Table 4-2.

Table 4-2   Numeric Display Diagnostic Codes

Value	Controller State	Description	SANtricity Storage Manager View
L0	Suspend	Mismatched controller types	Needs Attention condition for board type mismatch
L1	Suspend	Missing interconnect/battery canister	Needs Attention condition for missing interconnect/battery canister
L2	Suspend	Persistent memory errors	Needs Attention condition for offline controller
L3	Suspend	Persistent hardware errors	Needs Attention condition for offline controller
L4	Suspend	Persistent data protection errors	Needs Attention condition for offline controller
88	Reset	Controller is held in reset by alternate controller	

007-4843-001

Power Supply/Fan Canister Lights

Figure 4-3   Power Supply/Fan Canister Lights

Table 4-3   Definition of the Power Supply/Fan Canister Lights

Location in Figure 7-3	Light	Color	Normal Status	Problem Status	Procedure
1	Power	Green LED	On = Power supply/fan canister is providing power	Off = Power supply/fan canister is not providing power	
2	Battery Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted or discharged	

Table 4-3   Definition of the Power Supply/Fan Canister Lights **(continued)**

Location in Figure 7-3	Light	Color	Normal Status	Problem Status	Procedure
3	Battery Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted or discharged	
4	Needs Attention	Amber LED	Off	On = Power supply/fan canister needs attention	"Power Supply/Fan Canister Lights" on page 53
5	Service Action Allowed	Blue LED	Off	On = Safe to remove. May also indicate an open circuit breaker.	"Resetting the Controller Circuit Breakers" on page 59, Chapter 5, "Replacing Controller Enclosure Components"

Interconnect/Battery Canister Lights

Figure 4-4   Interconnect/Battery Canister Lights

Table 4-4   Definition of the Interconnect/Battery Canister Lights

Location in Figure 4-4	Light	Color	Normal Status	Problem Status	Procedure
1	Battery Needs Attention	Amber LED	Off	On = Battery missing or failed	Replace battery, see: "Replacing a Backup Battery Pack" in Chapter 5
2	Power	Green LED	On = Command Module is powered on	Off = Command Module is powered off	

Table 4-4   Definition of the Interconnect/Battery Canister Lights **(continued)**

Location in Figure 4-4	Light	Color	Normal Status	Problem Status	Procedure
3	Needs Attention	Amber LED	Off	On = A component in the controller module has developed a fault. Inspect the Needs Attention lights on the other canisters to isolate the fault.	"Troubleshooting the Controller Module" on page 47
4	Locate	White LED	Off	On = Controller module locate	
5	Service Action Allowed	Blue LED	Off	On = Safe to remove	
6	Battery Needs Attention	Amber LED	Off	On = Battery missing or failed	Replace battery, see Chapter 5

The Power, Needs Attention, and Locate lights are general indicators for the entire controller module, not specifically for the interconnect/battery canister. The Needs Attention light will turn on if a fault condition is detected in any component in the controller module (enclosure). The Power, Needs Attention, and Locate lights shine through the front cover.

Note: If you see a Needs Attention light, refer to the storage management software to determine the problem with the command module. Also, inspect the Needs Attention lights on the other canisters in the controller module to help isolate the fault to a specific canister.

Recovering from an Overheated Power Supply

The controller module has two power supply/fan canisters. Each power supply/fan canister contains a power supply, a cooling fan, a battery charger, and a built-in temperature sensor designed to prevent the power supplies from overheating. Under normal operating conditions, with an ambient air temperature range of 5° C to 40° C, (40° F to 104° F), the cooling fans maintain a proper operating temperature inside the module.

Several factors can cause the power supplies to overheat. These factors include:

- Unusually high room temperature
- Fan failure
- Defective circuitry in the power supply
- Blocked air vent
- Failure in other devices installed in the cabinet

If the internal temperature rises above 70° C (158° F), one or both power supplies automatically shut down. If *one* power supply shuts down, the storage management software displays a **Needs Attention** status in the **Array Management Window**, the alarm sounds, and the Needs Attention light on the front cover of the controller module turns on.

If a common environmental stress causes *both* power supplies to shut down, the controller module shuts down, and the storage management software displays a **Not Responding** status in the **Array Management Window**.

If event monitoring is enabled and event notification is configured, the software also issues critical event notifications.

- **Nominal temperature exceeded** – The controller module temperature exceeds the normal operating range.
- **Maximum temperature exceeded** – The controller module temperature exceeds 70° C (158° F).

Use the following procedures to resume normal operation after a power supply shutdown.

Caution: Risk of damage from overheating – Power supplies automatically shut down when air temperature inside the cabinet reaches 70° C (158° F) or above. If the power supplies have shut down, immediately remove all cabinet panels to help cool the cabinet air temperature and prevent damage to the controller module.

---

1. If applicable, turn off the alarm by pressing the Mute button on the front cover of the controller module.
2. Use the storage management software to print a storage array profile.

3. Did you use the procedure "Troubleshooting the Controller Module" on page 47 to identify an overheating problem?

   - Yes – Go to step 4.

   - No – Perform the procedure "Troubleshooting the Controller Module" on page 47 to verify that the power supplies have shutdown because of an overheating problem.

4. Try alleviating the overheating problem by:

   - Removing all panels from the cabinet

   - Cooling the area using external fans

   - Shutting down the power to the controller modules or drive modules

5. Stop all I/O activity to the command module and to all attached drive modules.

6. Wait until the ambient air temperature around the controller module cools.

Note: The controller module is capable of power-up recovery without operator intervention after the temperature inside the power supply/fan canister cools to below 70° C (158° F). After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers reset and return to normal operation.

---

7. Did the power supplies restart automatically?

   - Yes – Go on to step 10.

   - No – Got to step 9.

8. Turn off the power switch on each controller in the controller module. Wait 10 seconds, and then turn on the controller module power. If the power supplies go into operation, go to the next step. If not, call Customer and Technical Support.

9. Check the status lights on the front and back of the controller module.

   For information about controller module lights, refer to Table 4-1 on page 49, Table 4-2 on page 52, Table 4-3 on page 53 and Table 4-4 on page 55. Are the lights on the controller module indicating normal status?

   - Yes – Go to next step.

   - No – Got to step 12.

10. Use the storage management software to check the status of all modules in the storage array. Is the status **Optimal** for each module?

- Yes – End of procedure. Resume normal operation.

- No – Go to next step.

11. Diagnose and correct the fault by completing the following steps.

    – Select the Recovery Guru toolbar button in the **Array Management Window** to run the Recovery Guru.

    – Complete the recovery procedure.

If the Recovery Guru directs you to replace a failed component, use the individual lights on the modules to locate the specific failed component.

    – When the procedure is completed, select Recheck in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.

    – If the problem has not been fixed contact Customer and Technical Support.

Print a storage array profile and save the storage array support data. The profile and support data will be helpful when troubleshooting storage array problems. (For information about printing a storage array profile and saving the support data, refer to the **Array Management Window** online help.)

Resetting the Controller Circuit Breakers

Each controller module controller has two circuit breakers that provide over current protection to the power supply in a power supply/fan canister. One circuit breaker provides protection for AC input, the second circuit breaker provides protection for DC input. The circuit breakers are mounted inside the controller canister, in line with the internal power cable.

The internal power cable runs from the AC connector and DC connector on a controller canister to the power supply in a power supply/fan canister. Power to the left power supply/fan canister (as viewed from the front of the command module) is routed through the top controller canister; power to the right power supply/fan canister is routed through the bottom controller canister.

If a circuit breaker has tripped, the condition might appear as if a power supply/fan canister has failed. The power supply is no longer providing power to the controller

module. An tripped circuit breaker is indicated when all of the following conditions are present:

- Alarm is sounding.

- Needs Attention light on the controller module front cover is turned on.

- The controller canister Needs Attention lights are not turned on.

- The power supply/fan canister Needs Attention lights are not turned on.

- The Service Action Allowed light is turned on for the power supply/fan canister connected to the controller canister with the open circuit breaker.

- The **Array Manager Window** shows the failed controller canister as present, but not responding.

Use the following procedure to ensure that a circuit breaker has opened, and then to reset the circuit breaker.

Tools and Equipment

- Antistatic protection
- Non-conducting stylus

Controller Module Attention Light Procedures

Caution: Electrostatic discharge can damage sensitive component. – Touching the controller module or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the controller module.

1. Mute Button and Needs
   Attention Light
   (Amber)

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Figure 4-5   Mute Button/Needs Attention Light—Front Cover

2. Check to ensure that the external power cables are completely plugged into the controller canisters and into the power source.

3. Put on antistatic protection.

4. Remove the front cover by grasping the sides and pulling the cover toward you.

5. Check the Needs Attention light on each power supply/fan canister. (Figure 4-5 shows the location of the Needs Attention light.)

1. Needs Attention
   (Amber)
2. Service Action Allowed
   (Blue)

Figure 4-6   Power Supply/Fan Canister Needs Attention Light

a.   Is a power supply/fan canister Needs Attention light on?

–   Yes – A power supply/fan canister has failed. To replace the failed power supply/fan canister, refer to Chapter 5, "Replacing Controller Enclosure Components".

   •   No – Go to sub-step b.

b.   Is a power supply/fan canister Service Action Allowed light on?

–   Yes – If the Service Action Allowed light on the left power supply/fan canister is turned on, then the circuit breakers in the upper controller canister have tripped. If the Service Action Allowed light on the right power supply/fan canister is turned on, then the circuit breakers in the lower controller canister have tripped. (Left and right are determined by facing the front of the command module.) Go on to step 6.

–   No – Contact Customer and Technical Support.

Caution: Potential damage to fiber optic cables – Fiber optic cables are fragile. Bending, twisting, folding, or pinching fiber optic cables can cause damage to the cables, degraded performance, or data loss. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables in less than a two-inch radius.

Note: You do not need to remove the interface cables from the controller canisters to reset the circuit breakers; however, removing the cables can make this procedure easier. If you choose to remove the interface cables ensure that you label each cable so that you can reconnect them correctly to the controller canister. Figure 4-7 identifies all of the connectors on the back of the controller canister.

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1. Host Channels
2. RS-232 Serial Port
3. Ethernet Ports
4. Dual-Ported Drive Channels
5. AC Power
6. DC Power
7. Status LEDs

Figure 4-7   Controller Canister Connectors

6. Use the storage management software to take the controller offline. After the controller is offline, the Service Action Allowed light turns on and you can safely remove the controller.

7. Slide the controller canister with the open circuit breaker from the controller module. You do not need to completely remove the controller canister, only slide it out far enough to reveal the holes over the circuit breakers.

   a. Using your index fingers, simultaneously push the latches to release the levers, and rotate the levers to disengage them from the locking pins.

   a. Use the levers to slide the controller canister from the controller module chassis. (Figure 4-8 shows the controller canister sliding from the controller module chassis.)

1. Levers, Released Position
2. Latches
3. Controller Canisters

Figure 4-8   Removing a Controller Canister from the Module

Insert a non-conducting stylus through the appropriate hole in the cover of the controller canister. One hole is over the AC circuit breaker a second hole is over the DC circuit breaker. Figure 4-9 shows the location of the circuit breaker access holes in the controller canister cover.

Figure 4-10 on page 66 shows the location of the circuit breakers in the controller canister.

Hole 1 is the DC circuit breaker.

Hole 2 is the AC circuit breaker.

Figure 4-9   Circuit Breaker Access Holes in the Controller

Figure 4-10   Controller Circuit Breakers

8. Reset the circuit breaker that tripped by pressing down on the rocker switch.

9. Slide the controller canister into the controller module chassis, and push it firmly until the levers snaps into place.

10. If you removed the interface cables, reconnect all host interface cables and drive interface cables, including the SFP transceivers.

11. Wait approximately 60 seconds for the storage management software to recognize the controller canister.

12. Complete any remaining Recovery Guru procedures for controller canister replacement, if needed.

13. Based on the Host Channel Speed, Drive Channel Speed, and Needs Attention light status, proceed to one of the following steps:

- **All channel speed lights are on** *and* **the Needs Attention light is off** – Go to step 16.

- **All channel speed lights are off** *or* **the Needs Attention light is on** – Verify the controller has been installed correctly. Reinstall the controller canister. Go to step 14.

Note: If a host channel or drive channel does not have a cable connected, the channel speed LEDs will not be illuminated.

---

14. Did this correct the problem?

    – Yes – Go to step 15.

    – No – If the problem has not been fixed, contact Customer and Technical Support.

15. Remove the antistatic protection.

16. Install the front cover by aligning the pins on the controller module chassis with the spring-steel retainers on the cover, and then pressing the cover toward the chassis until the pins snap into place.

17. Using the **Enterprise Management Window**, view the status of the storage arrays. Are any storage arrays indicating **Needs Attention**?

    – Yes – Go to step 18.

    – No – All components are **Optimal**. You are finished with this procedure.

18. Use the Array Management Window to check the status of all modules in the storage array.

19. Do any storage array modules have a Needs Attention status?

    – Yes – Select the Recovery Guru toolbar button in the **Array Management Window** and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

    – No – contact Customer and Technical Support.

Print a storage array profile and save the storage array support data. The profile and support data will be helpful when troubleshooting storage array problems. (For information about printing a storage array profile and saving the support data, refer to the **Array Management Window** online help.)

Replacing Controller Enclosure Components

This chapter describes the replacement of each component in the controller enclosure (module) and explains the procedures for replacing a controller canister, power supply/fan canister, interconnect/battery canister, and SFP transceiver. Before using the procedures in this chapter, perform the appropriate troubleshooting steps described in Chapter 4, "Troubleshooting Controller Enclosure Components" and in the Recovery Guru.

Replacement Parts

The following list has the components that you can replace on site. To order parts, contact your local service center or Customer and Technical Support.

- Controller canister

- Power supply/fan canisters (containing power supplies, fans, and battery chargers)

- Interconnect/battery canister (containing the mid-lane and batteries for the cache backup)

- SFP transceivers

- Interface cables

- Ethernet cables

Important: Never remove the interconnect/battery canister unless directed to do so by a Customer and Technical Support representative.

Hot Swap

Hot swap refers to the ability to remove and replace a component "canister" while the controller module (enclosure) is under power and processing data. The controller module has three major components you can replace on site: the controller canister, power supply/fan canister, and interconnect/battery canister. In a fully-configured module, the controller canisters and power supply/fan canisters are redundant. If any one of these redundant canisters fails, the canister can be replaced without powering off the enclosure, and without interrupting data processing. While you can replace the interconnect/battery canister while the module is under power and processing data, never replace it unless instructed to by a Customer and Technical Support representative.

You can perform all replacement procedures in this chapter as hot swap procedures.

Service Action Allowed Status Light

Each controller, power supply/fan, and interconnect/battery canister has a Service Action Allowed status light. This light is a blue LED. The purpose of the Service Action Allowed status light is to help ensure that a canister is not removed before it is safe to do so.

Caution: Potential loss of data – Never remove a controller, power supply/fan, or interconnect/battery canister unless the Service Action Allowed status light is turned on.

If a controller or power supply/fan canister fails and needs to be replaced, the amber Needs Attention status light on that canister turns on to indicate that service action is required. If there are no data availability dependencies or other conditions that dictate the canister should not be removed, the blue Service Action Allowed status light turns on. The Service Action Allowed status light automatically turns on or off as conditions change. In most cases, the Service Action Allowed status light will turn on steadily when the Needs Attention status light is turned on for the canister.

If the interconnect/battery canister needs to be replaced, the Service Action Allowed status light does not automatically turn on. Before the interconnect/battery canister Service Action Allowed status light can turn on, you must place controller B into Service mode. The reason for this is to route all control and I/O activity through one controller

to help ensure that data availability is maintained while the interconnect/battery canister is removed.

The ability to remove a canister depends on the data availability dependencies of the controller module. The Service Action Allowed status light will not turn on if removing a canister will jeopardize data on the drive modules or current I/O activity. An example of limiting when you can remove a canister is when one controller has a Needs Attention status light turned on; you cannot remove the other controller (the Service Action Allowed status light will not turn on), because doing so would jeopardize the data either on the drive modules or transitioning through the controllers. A less obvious example is when the power supply for the controller in slot A has failed, and the controller in slot B has failed. Removing the controller in slot B before replacing the failed power supply/fan canister will cause controller A to lose power, resulting in a loss of data availability. This occurs because power distribution from each power supply/fan canister is through the controller physically connected to that power supply/fan canister.

Table 5-1 shows when the Service Action Allowed status light will not turn on (the light is suppressed) for each canister. An "X" in a table cell indicates the Service Action Allowed status light will not turn on. For example, if the power supply in the power supply/fan – slot A canister has failed, then the Service Action Allowed status light will not turn on for controller B, interconnect/battery, and power supply/fan - slot B canisters.

Table 5-1   Availability Dependencies

	Service Action Allowed Suppressed				
	Controller A	Controller B	Interconnect/ Battery Canister	Power Supply/ Fan Canister – Slot A	Power Supply/ Fan Canister – Slot B
Failure Description					
Controller A Failed or Locked Down		X	X		
Controller B Failed or Locked Down	X				

Table 5-1   Availability Dependencies **(continued)**

Failure Description	Controller A	Controller B	Interconnect/ Battery Canister	Power Supply/ Fan Canister – Slot A	Power Supply/ Fan Canister – Slot B
	Service Action Allowed Suppressed				
Controller A Drive Path Unavailable		X	X		
Controller B Drive Path Unavailable	X		X		
Power Supply/Fan – Slot A Canister Power Supply Failure		X	X		X
Power Supply/Fan – Slot A Canister Fan Failure					
Power Supply/Fan – Slot B CanisterPower Supply Failure	X		X	X	
Power Supply/Fan – Slot B Canister Fan Failure					
Interconnect/Battery Canister Removed	X			X	
Controller A Removed		X	X		X
Controller B Removed	X			X	
Power Supply/Fan Canister A Removed		X	X		X
Power Supply/Fan Canister B Removed	X		X	X	
Battery Pack Failed					
Battery Pack Removed					

Releasing a Canister Lever

Each canister is secured into the controller module chassis by two cam lock levers
mounted to the canister. The lever engages with a pin on the controller module chassis
to pull the canister securely into the chassis. The levers are locked in place by
spring-loaded latches. The control canisters have the levers on the same side. The power
supply/fan canisters and the interconnect/battery canister have the one lever mounted
to the top of the canister and one lever mounted to the bottom of the canister. Figure 5-1

shows a canister lever and the latch that secures the lever. The top view shows the lever in the closed and latched position. The bottom view shows the lever in the released position.

1. Latch
2. Lever
3. Pin

Figure 5-1   Canister Lever and Latch

The lever and latch are designed to be released with one hand. Using your index finger, simultaneously push the latch to one side until the tab on the latch is past the end of the lever, then rotate the lever, releasing it from the pin. Ensure that the lever is completely free of the pin. Use the both levers to pull the canister from the controller module chassis.

When re-installing a canister, ensure that the lever engages the pin so the canister is completely pulled into the controller module chassis. This ensures all electrical connections make full contact.

Replacing a Controller

Use the following procedure to replace a controller in a controller module.

Important: To provide full functionality, the two controller canisters should have the same memory capacity. Although two controller canisters of different memories can be paired in an controller module, the mismatch will cause some functions to be disabled (for example, the cache mirroring function). Fail over is disabled during the controller replacement procedure.

Tools and Equipment

- Antistatic protection
- Replacement controller

Procedure

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the controller module.

2. Did you perform the "Troubleshooting the Controller Module" in Chapter 4 procedure and did the procedure direct you to replace a failed controller?

   – Yes – Go on to step 3.

   – No – To identify the failed component, perform the "Troubleshooting the Controller Module" in Chapter 4 procedures. Perform the maintenance indicated in the procedure.

3. Locate the failed controller by checking the Needs Attention status lights on the controllers in the controller module. (Figure 5-2 shows the location of the Needs Attention light on the back of a controller.)

1. Needs Attention (Amber)

Figure 5-2   Controller Canister Needs Attention Light

4.   Use the storage management software to do the following:

   a.   Print a storage array profile.

   b.   Move volume ownership to the other controller.

   c.   Move the failed controller to an Offline state.

   Caution: Potential loss of data – Never remove a controller unless the Service Action Allowed status light is turned on.

   ---

5.   Is the Service Action Allowed status light turned on. (Figure 5-2 shows the location of the Service Action Allowed status light on the back of a controller.)

   –   Yes – Go to step 6.

   –   No – Another component requires attention before you can remove the controller. Run the Recovery Guru to determine, what other components might require attention. If the Recovery Guru does not indicate any other component problems, contact Customer and Technical Support.

   Caution: Electrostatic discharge can damage sensitive components – Touching the controller module or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

   ---

6.   Put on antistatic protection.

7.   Unpack the new controller.

   Save all packing materials in the event you need to return the new controller.

Caution: Potential damage to fiber optic cables – Fiber optic cables are fragile. Bending, twisting, folding, or pinching fiber optic cables can cause damage to the cables, degraded performance, or data loss. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables in less than a two-inch radius.

---

8. Disconnect all attached interface cables from the failed controller including the SFP transceivers. Ensure that you label each cable so that you can reconnect them correctly to the new controller. Figure 5-3 shows the location of the connectors on the back of a controller canister.

1. Host Channel
2. RS-232 Serial Port
3. Ethernet Ports
4. Dual-Ported Drive Channels
5. AC Power
6. DC Power
7. Status LEDs

Figure 5-3   Connectors on the Back of Each Controller

9. Remove the failed controller. Figure 5-4 on page 77 shows the controller sliding from the controller module chassis.

1. Levers, Released Position
2. Latches
3. Controller Canisters

Figure 5-4   Removing a Controller from the Enclosure

10. Install the new controller.

   a. Carefully position the controller in the module chassis. Ensure that the controller will slide correctly into the module chassis.

   b. Slide the controller into the module chassis, and push it firmly until the latches snap into place.

11. Reconnect all host interface cables and drive interface cables, including the SFP transceivers.

12. Wait approximately 60 seconds for the storage management software to recognize the new controller.

13. Complete any remaining Recovery Guru procedures for controller replacement, if needed.

14. Based on the Host Channel Speed, Drive Channel Speed, and Needs Attention light status, proceed to one of the following steps:

   • **All channel speed lights are on** *and* **the Needs Attention light is off –** Go to go to step 16.

- **All channel speed lights are off** *or* **the Needs Attention light is on** – Verify the controller has been installed correctly. Reinstall the controller canister. Go to step 15.

Note: If a host channel or drive channel does not have a cable connected, the channel speed LEDs will not be illuminated.

---

15. Did this correct the problem?

    – Yes – Go to step 16.

    – No – If the problem has not been fixed, contact Customer and Technical Support.

16. Remove the antistatic protection.

17. Use the **Array Management Window** to check the status of all modules in the storage array.

18. Do any storage array modules have a fault (**Needs Attention**) status?

    – Yes – Select the Recovery Guru toolbar button in the **Array Management Window** and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

    – No – Go to the next step.

19. Use the storage management software to print a new storage array profile.

Replacing a Power Supply/Fan Canister

Use the following procedure to replace a power supply/fan canister. Each power supply/fan canister contains a power supply, cooling fan, battery charger, and temperature sensor. If any of these components fail, the power supply/fan canister must be replaced. The power supply, fan, battery charger, and temperature sensor are not replaceable components.

Tools and Equipment

- Antistatic protection
- Replacement support canister

Procedure

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the command module.

2. Did you perform the "Troubleshooting the Controller Module" in Chapter 4 procedures and did the procedure direct you to replace a failed power supply/fan canister?

   – Yes – Go on to step 3.

   – No – To identify the failed component, go through the "Troubleshooting the Controller Module" in Chapter 4 procedures, then perform the maintenance indicated by the procedure.

3. Use the storage management software to print a storage array profile.

4. Locate the module that contains the failed power supply/fan canister by checking the Needs Attention light on the front cover of the module. (Figure 5-5 shows the location of the Needs Attention light on the front cover.)

1. Mute Button and Needs Attention Light (Amber)

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Figure 5-5   Needs Attention Light on the Module Front Cover

5. Remove the front cover by grasping the sides and pulling the cover toward you.

6. Locate the failed power supply/fan canister by checking for the power supply/fan canister Needs Attention light that is turned on. (Figure 5-6 shows the lights on the power supply/fan canister.)

1. Needs Attention
   (Amber)
2. Service Action Allowed
   (Blue)

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Figure 5-6   Power Supply/Fan Canister Lights

Caution: Potential loss of data – Never remove a power supply/fan canister unless the Service Action Allowed status light is turned on.

---

7. Is the Service Action Allowed status light turned on. (Figure 5-6 shows the location of the Service Action Allowed status light on the power supply/fan canister.)

   – Yes – Go to step 8.

   – No – Another component requires attention before you can remove the power supply/fan canister. Run the Recovery Guru to determine, what other components might require attention. If the Recovery Guru does not indicate any other component problems, contact Customer and Technical Support.

Caution: Electrostatic discharge can damage sensitive components – Touching the controller module or its components without using a proper ground may damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

8. Put on antistatic protection.

9. Unpack the new power supply/fan canister.

10. Save all packing materials in the event you need to return the new power supply/fan canister.

11. Remove the failed power supply/fan canister. (Figure 5-7 shows a power supply/fan canister sliding from the controller module chassis.)

1. Latches
2. Levers, Released Position
3. Power Supply/Fan Canisters

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Figure 5-7   Removing Power Supply/Fan Canister from Controller Module

12. Install the new power supply/fan canister.

    a. Carefully position the power supply/fan canister in the controller module chassis.

       Note that the power supply/fan canister has a relief formed along one long edge of the canister. The canister relief fits onto a rail cast into the controller module chassis. Ensure that the canister relief fits onto the rail before attempting to slide the controller into the command module chassis.

b. Slide the power supply/fan canister into the into the controller module chassis, and push it firmly until the latches snaps into place.

13. Wait approximately 60 seconds for the storage management software to recognize the new power supply/fan canister.

14. Complete any remaining Recovery Guru procedures for power supply/fan canister replacement, if needed.

15. Did this correct the problem?

    – Yes – Go to step 16.

    – No – Contact Customer and Technical Support.

16. Remove the antistatic protection.

17. Install the front cover by aligning the pins on the controller module chassis with the spring-steel retainers on the cover, and then press the cover toward the chassis until the pins snap into place.

18. Use the **Array Management Window** to check the status of modules in the storage array.

19. Do any storage array modules have a fault (**Needs Attention**) status?

    – Yes – Select the Recovery Guru toolbar button in the
    Array Management Window and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

    – No – Go to step 20.

20. Use the storage management software to print a new storage array profile.

Replacing the Interconnect/Battery Canister

Use the following procedure to replace the interconnect/battery canister.

Important: Never remove the interconnect/battery canister unless directed to do so by a Customer and Technical Support representative.

Tools and Equipment

- Antistatic protection
- Replacement interconnect/battery canister

Procedure

Caution: Electrostatic discharge can damage sensitive component. – Touching the controller module or its components without using a proper ground may damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

---

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the controller module.

2. Did you perform the "Troubleshooting the Controller Module" in Chapter 4 procedures and did the procedure direct you to replace a failed interconnect/battery canister?

   – Yes – Go to step 3.

   – No – To identify the failed component, perform the "Troubleshooting the Controller Module" in Chapter 4 procedures and then perform the maintenance indicated.

3. Use the storage management software to print a storage array profile.

4. Locate the failed interconnect/battery canister by checking the Needs Attention light on the front cover of the controller module. (Figure 5-8 on page 84 shows the location of the Needs Attention light on the front cover.)

1. Mute Button and Needs Attention Light (Amber)

Figure 5-8   Needs Attention Light on the Enclosure's Front Cover

5. Remove the front cover by grasping the sides and pulling the cover toward you.

Caution: Potential loss of data – Never remove a power supply/fan canister unless the Service Action Allowed status light is turned on, see Figure 5-9.

---

6. Is the Service Action Allowed status light turned on. (Figure 5-9 shows the location of the Service Action Allowed status light on the interconnect/battery canister.)

   – Yes – Go to step 7.

   – No – Another component requires attention before you can remove the interconnect/battery canister. Run the Recovery Guru to determine, what other components might require attention. If the Recovery Guru does not indicate any other component problems, contact Customer and Technical Support.

1. Needs Attention Light (Amber)
2. Service Action Allowed (Blue)

76080

Figure 5-9   Interconnect/Battery Canister Needs Attention and Service Action Allowed Lights

7. Put on antistatic protection.

8. Unpack the interconnect/battery canister.

    Save all packing materials in the event you need to return the new interconnect/battery canister.

9. Remove the failed interconnect/battery canister. (Figure 5-10 on page 86 shows the interconnect/battery canister sliding from the command module chassis.)

1. Interconnect Canister
2. Latches
3. Levers, Released Position

Figure 5-10   Removing an Interconnect/Battery Canister from the Enclosure

10. Install the new interconnect/battery canister.

a. Carefully position the interconnect/battery canister in the controller module chassis.

The interconnect/battery canister has a pin on the connector end of the canister. The pin fits onto a relief cast into the controller module chassis. (You can see the relief by peering into the slot for the interconnect canister.) Ensure that the interconnect canister pin is aligned with the relief in the command module chassis before attempting to slide the interconnect canister into the controller module chassis.

b. Slide the interconnect/battery canister into the slot, and push it firmly until the latches snap into place.

11. Wait approximately 60 seconds for the storage management software to recognize the new interconnect canister.

12. Complete any remaining Recovery Guru procedures for interconnect/battery canister replacement, if needed.

13. Did this correct the problem?

    – Yes – Go to step 14.

    – No – If the problem has not been fixed, contact Customer and Technical Support.

14. Remove the antistatic protection.

15. Install the front cover by aligning the pins on the controller module chassis with the spring-steel retainers on the cover, then press the cover toward the chassis until the pins snap into place.

16. Use the **Array Management Window** to check the status of all modules in the storage array.

17. Do any storage array modules have a fault (**Needs Attention**) status?

    – Yes – Select the Recovery Guru toolbar button in the **Array Management Window** and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

    – No – Go to step 18.

18. Use the storage management software to print a new storage array profile.

Replacing a Backup Battery Pack

Use the following procedure to replace a backup battery pack in the interconnect/battery canister.

Tools and Equipment

- Antistatic protection

Replacement Battery Pack Procedure

Caution: Electrostatic discharge damage to sensitive components – To prevent electrostatic discharge damage to the module, use proper antistatic protection when handling the module components.

---

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the controller module.

2. Did you perform the "Troubleshooting the Controller Module" in Chapter 4 procedures and did the procedure direct you to replace a failed backup battery pack?

    –   Yes – Go to step 3.

    –   No – To identify the failed component, perform the procedures in "Troubleshooting the Controller Module" in Chapter 4.

3. Use the storage management software to print a storage array profile.

4. Locate the controller module that contains the interconnect/battery canister with the failed battery by checking the Needs Attention light on the front cover of the controller modules in the storage array. (Figure 5-11 shows the location of the Needs Attention light on the front cover.)

1. Mute Button and Needs Attention Light (Amber)

76081

Figure 5-11   Needs Attention Light on the Enclosure Front Cover

5. Remove the front cover by grasping the sides and pulling the cover toward you.

6. Put on antistatic protection.

7. Unpack the new battery pack.

   Save all packing materials in the event you need to return the new battery pack.

8. Remove the battery access cover from the front of the interconnect/battery canister by removing the thumb screws that secure the cover to the canister. Figure 5-12 shows the access cover and mounting screws on the interconnect/battery canister.

1. Access Cover

76045

Figure 5-12   Battery Access Cover on the Interconnect/Battery Canister

9. Remove the battery pack by sliding it out of the interconnect/battery canister.

10. The battery pack is mounted to a sheet metal bracket. The sheet metal bracket has a flange formed on the end of the bracket closest to the access in the interconnect/battery canister. Grasp the flange to slide the battery pack from the interconnect/battery canister.

11. Install the replacement battery pack.

    a. Carefully position the battery pack to ensure that the battery pack will slide correctly into the interconnect/battery canister.

    b. Slide the battery pack into the interconnect/battery canister. Push the battery pack firmly into the interconnect/battery canister to ensure that the battery

pack completely engages with the connectors in the interconnect/battery canister.

12. Reinstall the battery access cover onto the front of the interconnect/battery canister.

13. Remove the antistatic protection.

14. Install the front cover by aligning the pins on the controller module chassis with the spring-steel retainers on the cover, then press the cover toward the chassis until the pins snap into place.

15. Use the **Array Management Window** to check the status of all modules in the storage array.

16. Do any storage array modules still have a fault (**Needs Attention**) status?

    – Yes – Select the Recovery Guru toolbar button in the **Array Management Window** and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

    – No – Go on to step 17.

17. Use the storage management software to print a new storage array profile.

Warning: **Potentially hazardous material – The battery pack contains sealed lithium ion batteries that may be considered hazardous material. Use proper facilities to recycle the used battery. You must handle the battery pack in accordance to all applicable local and federal regulations.**

Warning: **Potentially hazardous material – If the used battery pack is physically damaged and is leaking, DO NOT ship it to a recycling center. Doing so exposes you and others to potentially hazardous material. You must dispose of damaged batteries according to local regulations, which may include procedures for handling batteries as a hazardous waste.**

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18. Dispose of the used battery pack according to local and federal regulations, which may include hazardous material handling procedures. Figure 5-13 shows the warning label on the battery.

Figure 5-13   Battery Warning Label

19. After 24 hours, check the Needs Attention and Battery lights to ensure that the battery is working properly.

If the battery is indicating a fault, use the storage management software to check the command module status and obtain the recovery procedure.

Replacing an SFP Transceiver

Use the following procedure to replace an SFP transceiver in a controller canister.

The SFP transceiver shown in this procedure may look different from those you are using, but the difference will not affect transceiver performance.

Tools and Equipment

- Antistatic protection
- Replacement SFP transceiver

Procedure

Caution: Electrostatic discharge damage to sensitive components – To prevent electrostatic discharge damage to the command module, use proper antistatic protection when handling the module components.

1. If the alarm is sounding, turn off the alarm by pressing the Mute button on the front cover of the controller module.

2. Did you perform the "Troubleshooting the Controller Module" in Chapter 4 procedures and did the procedure direct you to replace a failed SFP transceiver?

    – Yes – Go to step 3.

    – No – To identify the failed component, perform the procedures in "Troubleshooting the Controller Module" on page 47. Perform the maintenance indicated by the procedure.

3. Use the storage management software to print a new storage array profile.

4. Locate the controller module that has the failed SFP transceiver by checking the Needs Attention light on the front cover of the controller module. (Figure 5-14 shows the location of the Needs Attention light on the front cover.)

1. Mute Button and Needs
   Attention Light
   (Amber)

76081

Figure 5-14   Needs Attention Light on the Enclosure Front Cover

5. Locate the failed SFP transceiver by checking the SFP Bypass light and Needs
    Attention light on the controller canisters. If a fault is detected, the lights will be on.
    Figure 5-15 shows the location of the controller canister SFP Bypass light and Needs
    Attention light on the controller canister.

1. Needs Attention Light
2. SFP Bypass Light

76040

Figure 5-15   SFP Transceiver Bypass Lights

6. Put on antistatic protection.

7. Unpack the new SFP transceiver. Verify that it is the same type of transceiver you
    are replacing.

    Save all packing materials in the event you might need to return the new SFP
    transceiver.

Caution: **Potential damage to fiber optic cables** – Fiber optic cables are fragile. Bending, twisting, folding, or pinching fiber optic cables can cause damage to the cables, degraded performance, or data loss. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables in less than a two-inch radius.

Caution: **Potential data loss** – Removing an SFP transceiver that has not failed can cause data loss. To prevent data loss, remove only the SFP that has a Bypass light on or a failed status in the storage management software.

8. Disconnect the interface cable from the SFP transceiver. (Figure 5-16 shows the SFP transceiver, interface cable, and the rear of a controller canister.)

Figure 5-16   Replacing an SFP Transceiver

9. Remove the failed SFP transceiver from the controller canister.

10. Install the new SFP transceiver into the controller canister.

11. Reconnect the interface cable.

12. Check the Bypass and Needs Attention lights for the new SFP transceiver.

    Based on the status of the Bypass and Needs Attention lights, choose one of the following steps.

    - **Bypass light** *or* **Needs Attention light is illuminated** –The SFP transceiver and cables may be installed incorrectly, or the cable may not be securely connected. Reinstall the SFP transceiver and cable, check the cable connection, and then go to step 13.

    - **Bypass light** *and* **Needs Attention light are off –** Go to step 14.

13. Is the problem corrected?

    – Yes – Go to step 14.

    – No **–** Contact Customer and Technical Support.

14. Remove the antistatic protection.

15. Use the **Array Management Window** to check the status of all modules in the storage array.

16. Do any storage array modules have a fault (**Needs Attention**) status?

    – Yes – Select the Recovery Guru toolbar button in the **Array Management Window** and complete the recovery procedure. If the problem persists, contact Customer and Technical Support.

    – No – Go to step 17.

17. Use the storage management software to print a new storage array profile.

Drive Enclosures

This chapter describes the components in drive enclosures in the following sections:

A Quick Glance at the Drive Enclosure Hardware

- The top-left ESM is inverted from the bottom-right ESM.

- The top-right power-fan unit is inverted from the bottom-left power-fan unit.

- The drive tray is in the correct (top) orientation when the lights of the drives are at the bottom.

- Four fans pull air through the enclosure from front to back across the drives.

1. Drive Unit
2. Alarm Mute Button
3. Link (Data) Rate Switch (4/2 Gb/s)
4. ESM CRU
5. Power-Fan CRU
6. Power Connector
7. Power Switch
8. In/Out Ports
9. Serial Port
10. In/Out Ports (Reserved for future use)
11. Tray ID/Diagnostic Display (Set automatically)

Figure 6-1   Front and Back View of the Drive Enclosure

Overview

> **Important:** Several references are made in this chapter to the storage management software (TPSSM). For complete information on the operation and use of this software, see the *SGI InfiniteStorage TPSSM Software Concepts Guide* (007-4749-00*x*).

Figure 6-2 shows a front view of the drive enclosure. The front of the enclosure contains the following components:

- **Front bezel:** The bezel is a removable decorative cover with holes for viewing the status LEDs and openings for the drive bays.

- **Disk drives:** Up to 16 sled-mounted drives can be installed in the bays on the front of the enclosure.

- **LEDs:** There are three LEDs for each of the (up to) 16 drives that indicate the status of the drive: the (green) drive active LED, the (amber) service action required LED, and the (blue) service action allowed LED. There are also three LEDs that indicate the overall status of the enclosure: the (amber) service action required LED, the (green) power LED, and the (blue/white) locate LED.

- **Alarm mute button:** The drive enclosure alarm button is not used. The storage array has been programmed through the global NVSRAM to only sound the alarm on the RAID controller enclosure.

The rear of each enclosure may contain the following components:

- **Environmental status modules (ESMs):** Drive enclosures have two ESM modules.

- **Link rate/ enclosure ID switches:** These switches indicate the connection speed and set the ID number of the enclosure.

- **Power supply/fan modules:** Two fan/power supply modules provide redundant power and cooling for the enclosure.

Callout 1 in Figure 6-2 shows the location of the first drive unit, callout 2 shows the location of the mute button and callout 3 the location of the data rate select switch (2Gb/4Gb per second). Figure 6-3 shows a rear view of a drive enclosure. Callout 4 shows the location of an environmental status module (ESM) unit and callout 5 the location of a power supply/fan unit. Both are customer replaceable units (CRUs).

Figure 6-2   Drive Enclosure and Bezel (Front View)

Figure 6-3   Drive Enclosure Components (Rear View)

The Disk Drives

Each drive enclosure can contain up to 16 low-profile Fibre Channel disk drives. Controller enclosures can be cabled to as many as six drive enclosures for a total capacity of 112 disks in one storage system. Each disk is mounted in a sled for ease of installation and removal. These drive sleds have a lever and latch mechanism that allows you to cam the drive in and out of the enclosure.

Each drive has three status LEDs (see Figure 6-4) as follows:

- **LED 1 is the drive service action allowed indicator:** This LED is normally off showing it is OK to remove the drive. It illuminates green when a problem status indicates the drive should not be removed.

- **LED 2 is the Drive fault indicator:** The normal status of this LED is off, although it will blink during drive volume or storage array locate functions. If this LED illuminates solid amber, then there is a problem with the drive.

- **LED 3 is the drive active indicator:** It blinks when data is being processed and stays on steadily when the drive is on but no data is processing. If it is off, there is no power to the drive, or, the drive is not seated properly in the slot.

Figure 6-4   Disk Drive Locations and Status LEDs

Environmental Status Modules (ESMs)

The drive enclosures contain environmental status modules (ESMs) instead of RAID controllers (see Figure 6-5). Each environmental status module contains an environmental services monitor board and two slots for SFPs (small form-factor pluggables). The environmental services monitor board is the interface between the

controller enclosure and the drive enclosure, and it monitors drive enclosure status. If there are internal problems in the drive enclosure, the environmental services monitor board lights the appropriate fault LED. For more information about this LED, see "Checking the Indicator Lights" on page 114.

Disk expansion enclosure rear panel ESMs

Figure 6-5   Environmental Status Modules

Power Supply and Fan Modules

The drive enclosures each have two combined function power/fan units. These units are mounted in the rear of the enclosure (see Figure 6-6). They pull air through the front bezel to cool the internal components of the enclosure. The air is exhausted out the rear of the fan units. For more information on the power/fan units, see "Wiring and Power" on page 181.

The power/fan units provide power to the other components in the enclosure by converting incoming AC voltage to DC voltage. The power supplies are redundant: if one supply fails, the other power supply can keep the enclosure running until the failed unit can be replaced. Each power/fan unit has the following components on its rear panel (see Figure 6-6 on page 103):

*   Locking lever
*   AC power input connector
*   Power switch
*   Power light
*   Fault light

During normal operation, the power light is illuminated. If there is a problem with the power/fan supply, the fault light comes on.

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The fans provide redundant cooling of the enclosure. If one fan unit fails, the other fan unit runs at a higher speed to compensate for the loss. Each power/fan unit has a fault light that illuminates if there is a problem with the units. Callout 1 shows the latching mechanism used to remove or secure the power/fan unit in the drive enclosure.

Figure 6-6   Power/Fan Units

Tray ID Selection

The tray ID number is set through the graphical user interface (GUI) or command-line interface (CLI) that comes with the InfiniteStorage system. During initial power-up of the RAID system, the controller and ESM enclosures are automatically assigned tray IDs. If required, the user can assign a specific unique identifier to every enclosure in the system.

Note: Each enclosure in a storage system must have a unique ID. If you are installing multiple systems in one rack, there may be enclosures with the same ID numbers because the systems are independent.

Link Rate Switch

The link rate switch is located on the same panel as the enclosure ID switch, between the power supplies on the rear of the enclosure (see Figure 6-7). The link rate switch controls the speed of the Fibre Channel connections to the enclosure. This switch can be set to 2 Gbit/s or 4 Gbit/s. When there is a 4 Gbit/s link present, the link rate LED illuminates green. Callout 1 in Figure 6-7 shows the location of the link rate switch. See the section "Rear Indicator Lights" on page 116 for more information on the link rate switch.

Figure 6-7   Link Rate Switch Location

Note: The link rate switches on all enclosures in a system should be set to the same transfer rate.

SFP Transceivers

An SFP (small form-factor pluggable) transceiver is a module that fits into the interface connectors on the RAID controllers and the ESM modules (see Figure 6-8). Every Fibre Channel cable that connects to a RAID controller or ESM module requires an SFP transceiver. As shown in Figure 6-8, the SFP assembly consists of an active SFP transceiver unit (callout 1), and the fibre optic cable assembly (callout 2) that connects with it. Or, the SFP may have a passive SFP transceiver (callout 3) that is integrated with a copper cable assembly (callout 4).

Figure 6-8   SFP Transceiver

You can hot-swap a failed SFP transceiver, which means you can replace it while the enclosure is in operation. If you replace the SFP transceiver and continue to experience problems, the enclosure may have defective components or connections. Check the storage management software (TPSSM) for indications of other component failures.

Operating Drive Enclosures

This chapter describes the operation of the drive enclosures in the following sections:

Turning the Power On

If the drive enclosure was turned off due to an unexpected shutdown or a power failure, follow the instructions in "Turning the Power On after an Unexpected Shutdown" on page 109.

Danger: **Severe electrical shock can occur. Never turn on the power to any equipment when there is evidence of fire, water, or structural damage. If there is evidence of damage, call the factory or appropriate service organization for assistance. Depending on the current service agreements, you may need to send the unit back to the factory for repair/replacement.**

To turn on the enclosure after a normal shutdown (as described in "Turning the Power Off" on page 112), turn on both power switches on the rear of the enclosure (see Figure 7-1) or the main circuit breaker, whichever is applicable. You must turn on both power supply switches to take advantage of the redundant power supplies.

Note: Always wait at least 30 seconds between the time you turn a power switch off and the time you turn it back on again.

Note: To speed drive spin-up, it is recommended that you start the drive enclosures before or at the same time as the controller enclosure.

Power switch

Power switch

Figure 7-1   Turning the Power On and Off

Note: The activity and fault indicators above the drive bays may flash intermittently as the drives spin up. Wait until the enclosure has finished powering on before checking the indicator lights on the front of the enclosure. All indicators should be green. If they are not, use the storage management software (TPSSM) to diagnose the problem.

Turning the Power On after an Unexpected Shutdown

The enclosure (and the entire storage array) may shut down unexpectedly under the following conditions:

- If the internal temperature of the enclosure exceeds the maximum operating temperature (an overtemp condition). See the "Troubleshooting an Overtemp Condition" section for more information on overtemp conditions.

- If there is a general power failure or a loss of power to the storage array.

- If you are forced to shut down the storage array without performing the normal shutdown procedures (in "Turning the Power Off" on page 112) due to an emergency situation.

Note that in each of these cases, some data may be lost.

Warning: **To avoid damage to the hardware, take special care when restarting the enclosure after an unexpected shutdown.**

If the enclosure shuts down unexpectedly, but there is still power to the site, use TPSSM to determine if the enclosure has overheated.

- If an overtemp condition is indicated, follow the steps in "Turning the Power On after an Overtemp Shutdown" on page 110 to restart the drive enclosure.

- If the enclosure has shut down due to a power failure or an emergency shutdown, follow the steps in "Turning the Power On after an Emergency Shutdown" on page 111 to restart the enclosure.

Troubleshooting an Overtemp Condition

If both fan units fail or are unable to maintain an internal temperature below 70 $^{\circ}$C (158 $^{\circ}$F), one or both of the power supplies in the enclosure will shut down. If both power supplies shut down, the enclosure is inoperable.

TPSSM warns you if the temperature of the enclosure is rising (before it has risen sufficiently to shut down the power supplies). The first warning comes when the enclosure temperature exceeds 40 $^{\circ}$C (104 $^{\circ}$F). The enclosure shuts down if the temperature rises above 70 $^{\circ}$C (158 $^{\circ}$F).

In the drive enclosures, the overtemp indicator on the environmental status module illuminates if the temperature reaches 40 °C (104 °F). If both power supplies shut down, the overtemp indicator cannot come on. See Figure 7-3 on page 116 for the location of the overtemp indicators on drive enclosures.

Turning the Power On after an Overtemp Shutdown

To restart the enclosure after an unexpected shutdown due to an overtemp condition, follow these steps:

1. Turn off both power switches (see Figure 7-1 on page 108).

2. Do whatever is necessary to cool the enclosure (replace the fans, use external fans to cool the room, and so on).

Danger: Severe electrical shock can occur. Never turn on the power to any equipment when there is evidence of fire, water, or structural damage. If there is evidence of damage, call the factory or appropriate service organization for assistance. Depending on the current service agreements, you may need to send the unit back to the factory for repair/replacement.

3. Check all components and cables for visible damage. Do not power on the enclosure if you find evidence of damage.

Note: To speed drive spin-up, it is recommended that you start the drive enclosures before or at the same time as the controller enclosure.

4. Once the internal temperature is below 40 °C (104 °F), turn on the power switches and wait for the enclosure to power on.

5. Use TPSSM and the drive fault indicators (see "Checking the Indicator Lights" on page 114) to check the overall status of the enclosure and its components. Repair any faults found.

Turning the Power On after an Emergency Shutdown

To restart the enclosure after a power failure or emergency shutdown, follow these steps:

1. After the emergency situation is over or power is restored to the site, turn off all power switches (see Figure 7-1 on page 108).

Danger: **Severe electrical shock can occur. Never turn on the power to any equipment when there is evidence of fire, water, or structural damage. If there is evidence of damage, call the factory or appropriate service organization for assistance. Depending on the current service agreements, you may need to send the unit back to the factory for repair/replacement.**

2. Check all components and cables for visible damage. Do not power on the enclosure if you find evidence of damage.

Note: To speed drive spin-up, it is recommended that you start the drive enclosures before or at the same time as the controller enclosure.

3. Turn on the power to the enclosures (see Figure 7-1 on page 108).

4. Use TPSSM and the drive fault indicators (see "Checking the Indicator Lights" on page 114) to check the overall status of the enclosure and its components. Repair any faults found.

Turning the Power Off

The enclosure is designed to run continuously, 24 hours a day. However, you may need to turn the power off for maintenance, such as upgrading the drives or replacing certain modules.To turn the power off, follow these steps:

1. Use TPSSM to determine the status of your system components and any special instructions before proceeding. The operating system software may require you to perform other procedures before turning off the power.

2. Stop all I/O activity to the enclosure.

    If applicable, use TPSSM to logically disconnect the enclosure from the host. Make sure that all the drive activity indicators on the front of the enclosure are not blinking (indicating I/O activity) and that the fast write cache indicator light on the applicable RAID controller is off (not blinking).

3. Make sure that all the enclosure fault indicators are off (see Figure 7-2 on page 115 and Figure 7-3 on page 116).

    If a fault indicator is on, correct the problem before turning off the power. Use TPSSM to diagnose and fix the problem.

Warning: **To shut off all power to an enclosure, you must turn off both power switches and disconnect both power cords. An enclosure has two power switches and two power cords. The enclosure continues to operate if both switches are not turned off and both cords are not disconnected.**

4. Turn off both power switches on the rear of the enclosure or the main circuit breaker, whichever is applicable (see Figure 7-1 on page 108).

    Important: Once the power is off, you must wait at least 30 seconds before you turn it back on again.

5. After you have performed the necessary maintenance procedure, power on the enclosure using the procedure in "Turning the Power On" on page 107.

Monitoring Status with Software

Use storage management software (TPSSM) to monitor enclosure status. You should run the software constantly and check it frequently.

TPSSM provides the best method to diagnose and repair failures. This software helps you do the following:

- Determine the nature of the failure.

- Locate the failed component.

- Provide recovery procedures to repair the failure.

Although the enclosure has fault indicators, these lights do not necessarily indicate which component has failed or needs to be replaced, or which type of recovery procedure you must perform. In some cases (such as loss of redundancy in various components), the fault light does not even come on. Only TPSSM can detect the failure.

For example, the recovery procedure for an impending drive failure (a predictive failure analysis, or PFA, flag on a drive) varies depending on the drive status (hot spare, unassigned, RAID level, current volume status, and so on). Depending on the circumstances, a PFA flag on a drive can indicate a high risk of data loss (if the drive is in a RAID 0 volume) or a minimal risk (if the drive is unassigned). Only TPSSM can identify the risk level and provide the necessary recovery procedures. Note also that in the case of PFA flags, the global fault and drive fault indicators do *not* come on, so just checking the indicators will not notify you of the failure, even if the risk of data loss is high.

In addition, recovering from a failure may require you to perform procedures other than replacing the component (such as backing up the volume or failing a drive before removing it). TPSSM provides these procedures.

Caution: If the software recovery procedures are not followed, data loss can result.

Note: For more information on the storage management software (TPSSM), see the *SGI TPSSM Administration Guide* (007-4306-00*x*), and the *SGI InfiniteStorage TPSSM Software Concepts Guide* (007-4749-00*x*).

Checking the Indicator Lights

The enclosure's indicator lights display the status of the enclosure and its components. Green indicators mean a normal operating status; amber indicators mean a possible failure.

It is important that you check all the indicators on the front and rear of the enclosure when you turn on the power. Besides checking for faults, you can use the indicators on the front of the enclosure to determine if the drives are responding to I/O transmissions from the host.

Important: Except as described in the notes following Figure 7-2 and Figure 7-3, an amber light indicates a component failure. If you see an amber indicator, run TPSSM to diagnose and repair the problem.

To check the enclosure indicators and operating status, follow the guidelines in Table 7-1 on page 115 (front indicators) and Table 7-2 on page 116 (rear indicators). If any indicators show anything other than a "normal" status, run TPSSM to diagnose and repair the problem.

Front Indicator Lights

This section describes the front indicator lights for the drive enclosures. Figure 7-2 shows the front indicators for the drive enclosures. The numbered callouts (1 through 6) show the disk system status as defined in Table 7-1 on page 115.

Note: The normal operating state of all indicators on the front panel is green. If an amber indicator is on, or a green indicator is off, use TPSSM to determine the nature of the fault and the recovery procedure. **Exception:** If the drive fault indicators are blinking, it means that TPSSM is locating a component. It does not indicate a failure.

Table 7-1   Enclosure Front Panel Status LEDs

LED location #	Component LED	Normal status	Problem status
1	Drive service action allowed (OK to remove)	Off	On
2	Drive fault	Off If blinking – drive, volume, or storage array locate function	On (not blinking) drive failure
3	Drive active	Blinking – data being processed On (steady) – no data processing	Off - no power to drive or drive not seated
4	Global locate	On	Not applicable
5	Global summary fault	Off	On - enclosure component failure
6	Global power	On	Off - no power

Figure 7-2   Drive Enclosure Front Indicator Lights

Rear Indicator Lights

This section describes the rear indicator lights for the drive enclosure. Figure 7-3 shows the rear indicators on the drive enclosure.

Figure 7-3   Drive Enclosure Rear Indicator Lights

Table 7-2 describes the rear indicators on the enclosure.

Table 7-2   Drive Enclosure Rear LED Status Information

Callout location	Component Light	Normal Status	Problem Status
1	ESM service action allowed (OK to remove)	Off	On
2	ESM Fault	Off	On
3	ESM Power	On	Off
4	Power-Fan CRU Power	On	Off
5	Power-Fan CRU Service Action Allowed (OK to Remove)	Off	On
6	Power-Fan CRU Fault	Off	On
7	Power-Fan CRU Direct Current Enabled	On	Off
8	ESM Port 1 In Bypass	Off - (Also off if no SFP connected)	On – No valid device detected and port is bypassed

Table 7-2 (continued)   Drive Enclosure Rear LED Status Information

Callout location	Component Light	Normal Status	Problem Status
9	ESM Ports 1 and 2 Data Rate	On with light 10 on if 4 Gb	Not applicable
10	ESM Ports 1 and 2 Data Rate	On and light 9 off if 2 Gb On with light 9 on if 4 Gb	Not applicable
11	ESM Port 2 In Bypass	Off - (Also off if no SFP connected)	On – No valid device detected and port is bypassed
12	ESM Port 3 In Bypass	Off	Blinking if SFP is installed in port 3
13	ESM Ports 3 and 4 Data Rate	Ports 3 and 4 reserved for future use	
14	ESM Ports 3 and 4 Data Rate	Ports 3 and 4 reserved for future use	
15	ESM Port 4 In Bypass	Off	Blinking if SFP is installed in port 4

The normal operating state of all indicators on the rear panel is green. If an amber indicator is on, or a green indicator is off, use TPSSM to determine the nature of the fault and the recovery procedure.

There is a link rate switch to the right of the front indicator lights and alarm mute button. The link rate lights are located on the back of the drive tray. The link rate switch (see Figure 7-4) enables you to select the data transfer rate between the ESMs and the drives to either 2 Gb/s or 4 Gb/s. The link rate switch is only read when power to the drive tray is turned on. Callout 1 in Figure 7-4 shows the location of the switch.

Callout 1 in Figure 7-5 shows a blowup of the location of the link rate LEDs (on the back of the enclosure). When the drive enclosure is operating at 2 Gb per second only one of the LEDs is on. When it is operating at 4 Gb per second both LEDs are lit.

Figure 7-4   Link Rate Switch Location (Front of Enclosure)

Figure 7-5   Link Rate Rear Indicator Lights (Rear of Enclosure)

Service Action Allowed Light

A Service Action Allowed light lets you know when you can remove a customer replaceable unit (CRU) with another component safely. Each drive CRU, power-fan CRU, and ESM CRU has a Service Action Allowed light.

Caution: Potential loss of data access – Never remove a drive CRU, a power-fan CRU, or an ESM CRU unless the Service Action Allowed light is turned on.

If a drive CRU, a power-fan CRU, or an ESM CRU fails and must be replaced, the amber Fault light on that CRU turns on to indicate that service action is required. If there are no data availability dependencies, or other conditions that dictate that a CRU should not be removed, the Service Action Allowed light turns on. The Service Action Allowed light automatically turns on or off as conditions change. In most cases, the Service Action Allowed light turns on steadily when the Fault light is turned on for a CRU.

Moving the Enclosure

Before moving the enclosure to a new location or before removing the enclosure from its rack, it is highly recommended that you first remove all drive sleds from the enclosure. Doing so helps safeguard the equipment and ensures a smoother transition to the new location. Before removing the drive sleds, label each one so that you can reinstall them in the correct order.

Instructions for depopulating the enclosure are provided in Chapter 8, "Replacing Drive Enclosure Components".

If you are removing a drive enclosure so that you can connect it to a different InfiniteStorage 4500 controller enclosure:

- Check with your service organization for appropriate software procedures that allow moving the volume to the new RAID.

- Delete all volumes and hot spares from the drives before removing the unit.

- If you are moving the enclosure a significant distance (such as to another building or city), it is recommended that you pack it in its original shipping container.

Removing the Enclosure

To remove the enclosure from the rack, follow these steps:

1. Unsnap the side brackets from the front of the enclosure (see Figure 7-6).

2. Unscrew the front bezel from the mounting pins.

3. Using a flat-blade screwdriver, carefully remove the bezel from the front of the drive enclosure. You must remove the bezel before you can remove the enclosure from the rack.

Figure 7-6   Removing the Front Bezel and Front Retention Screws

4. It is highly recommended that you remove all of the modules and disks from the enclosure to make it lighter and easier to remove. See Chapter 8, "Replacing Drive Enclosure Components" for information about depopulating an enclosure.

5. Remove the front mounting screws (see Figure 7-6 on page 120). There are also two mounting screws at the rear, one for each support rail.

6. Slide the enclosure out of the front of the rack.

7. Repeat steps 1 through 6 for any other enclosures to be moved.

Reinstalling the Enclosure

If you are installing the enclosure in another location in the rack, (or in another rack) use the following mounting rail tips as applicable:

- Attach the support rails to the new location in a rack. For more information, refer to the installation instructions included with your support rails.

- If you are installing the rails above an existing module, position the rails directly above the module.

- If you are installing the rails below an existing module, allow 13.3-cm (5.25-in.) clearance for a drive module or RAID controller module.

To reinstall the enclosure into a rack, follow these steps:

1. Install the support rails in the rack.

2. From the front of the rack, slide the enclosure into the rack along the support rails.

3. Fasten the rear and front mounting screws (see Figure 7-6 on page 120).

4. Wearing antistatic protection, reinstall the components into the enclosure. See Chapter 8, "Replacing Drive Enclosure Components" for more information.

5. Slide the top of the front bezel over the indicator lights and snap into place. If your enclosure comes with an air filter installed in the bezel, check it using the information in "Front Bezel Air Filter" on page 123.

Front Bezel Air Filter

Use the following procedures to check, replace, or clean an air filter installed in the bezel of your disk drive enclosure.

Under certain conditions you may need to clean or replace the air filter in your RAID enclosure (callout 3 in Figure 7-7) as often as every three months.

Removing and Replacing the Filter

Use the following steps to replace the bezel filter:

1. If the enclosure's bezel (callout 1 in Figure 7-7) has not already been removed, grip the ends and remove it from the front of the unit.

2. Before removing the filter (callout 2 in Figure 7-7) note the position of the bezel's screen frame and how the filter sits in the frame.

Figure 7-7   Bezel Air Filter Replacement

3. Remove the screen frame (callout 1 in Figure 7-8) and filter from the back side of the enclosure's front bezel.

4. Disengage the air filter (callout 3 in Figure 7-8) from the screen frame's retaining clips (callout 2).

Figure 7-8   Remove or Replace an Air Filter in the Bezel's Screen Frame

5. Insert the new air filter (or clean filter) into the screen frame and secure it within the screen frame by pressing it underneath the retaining clips on the sides of the frame.

6. Replace the screen frame in the back of the front bezel.

7. Reinstall the front bezel onto the drive module.

Cleaning an Existing Air Filter

If replacement of an air filter is necessary and there is not a spare immediately available, you can clean and reuse an existing filter using the following information:

1. Remove the front bezel and filter from the enclosure using the steps in "Removing and Replacing the Filter" on page 123.

2. Immerse the air filter in a solution of warm water and mild detergent and rinse with clean water.

3. Allow the air filter to **dry completely** before you reinstall it into the screen frame.

Caution: Placing a wet filter in the front bezel and installing it on the enclosure could result in damage to the drive mechanisms or connectors in the enclosure.

Replacing Drive Enclosure Components

This chapter describes how to replace each component in the drive enclosure in the following sections:

- "Replacing a Failed Disk Drive" on page 125
- "Replacing a Failed Power/Fan Module" on page 128
- "Replacing a Failed Environmental Status Module" on page 134
- "Upgrading Drives" on page 136
- "Adding Drive Enclosures" on page 140

Replacing a Failed Disk Drive

When the storage management software (TPSSM) instructs you to replace a failed drive module, read "The Disk Drives" on page 101, and then follow the steps in this section.

To prevent loss of access to data, remove only a failed drive that has a drive Fault light on and the drive Service Action Allowed light on, or has a Failed status in the storage management software.

Warning: **Electrostatic discharge can damage sensitive components. Use a grounded wrist strap or other antistatic precautions before handling enclosure components.**

1. Check TPSSM for instructions on drive failure recovery procedures. Follow any instructions provided by the software before proceeding.

⚠ **Caution:** Removing the wrong drive can cause data loss. Ensure that you remove only the failed drive. The drive fault indicator of the failed drive module illuminates amber. Removing a drive module while its green activity indicator is blinking can cause data loss and may cause the host controller to mark the drive as failed. If you remove an active drive accidentally, wait at least 30 seconds and then reinstall it. See TPSSM for further recovery instructions.

2. Locate the failed drive module (its fault light should be on).

3. Wearing antistatic protection, lift (open) the lever of the failed drive module (see callout 1 in Figure 8-1).

4. Pull out the drive module (see Figure 8-1).

5. Wait at least 30 seconds for the management software to recognize the drive's removal, then go on to the next steps and install the replacement drive in the enclosure.

Figure 8-1   Removing and Installing a Drive Module

6. Unpack the new drive module if you have not already done so. Save all packing materials in case you need to return the module.

7. Review all documentation shipped with the new drive module for any updated replacement procedures and other information. If necessary, modify the remaining steps to meet the system requirements. Kits often contain the most current servicing information. If the kit instructions conflict with those in this procedure, follow the kit instructions.

> ⚠ **Caution:** If the temperature of the shipping or storage environment differs significantly from the temperature of the environment in which the drive module will be installed, acclimate the drive module before you install it.

8. Wearing antistatic protection, slide the new drive module fully into the slot.

> ⚠ **Caution:** Partial insertion of a drive may cause the controller to mark other drives on the same bus as failed. Install a drive in one complete motion. Make sure that you insert it all the way into the slot and lock it into place.

9. Lower (close) the lever. Wait for the new drive to spin up.

10. Check the drive service, drive fault and drive activity indicators on the new drive module. The activity indicator (right LED) should be on (either blinking or steady) and the drive service and fault (left and middle LEDs) should be off.

> **Note:** The fault indicator may flash intermittently while the drive spins up. The activity indicator blinks when data is being written to the new drive module.

11. Based on the status of the drive Active and drive Fault lights, choose one of the following actions.

    • **The drive service action LED is off –** go to the next step.

    • **The drive Active light is on** *and* **the drive Fault light is off –** Go to the next step.

    • **The drive Active light is off** – The drive might be installed incorrectly. Remove the drive, wait 30 seconds, and then reinstall it. When finished, go to the next step.

    • **The drive Fault light is on** – The new drive might be defective. Replace the defective drive with a new drive, and then go to the next step.

12. See the applicable software procedures (for TPSSM or other system software) for instructions on bringing the drive module back online.

13. Complete any remaining Recovery Guru procedures, if needed.

14. Check the status of each enclosure in the storage array.

15. Does any component have a Needs Attention status?

- **Yes** – Click the Recovery Guru toolbar button in the Array Management Window, and complete the recovery procedure. If a problem is still indicated, contact your Technical Support organization.

- **No** – Go to the next step.

16. Create, save, and print a new storage array profile.

Important: Depending on your storage array configuration, the storage array may automatically reconstruct data to the new drive module. If the array uses hot spares, it may have to complete reconstruction on the hot spare before it copies the data to the replaced drive. This increases the time required to complete this procedure. Use TPSSM to determine the current status of the new drive and the progress of any reconstruction or copyback.

Replacing a Failed Power/Fan Module

The InfiniteStorage 4500 drive enclosure uses a combined power supply and cooling fan module. When TPSSM instructs you to replace a failed power/fan module, read "Power Supply and Fan Modules" on page 102, and then follow these steps:

Caution: Electrostatic discharge can damage sensitive components. Use a grounded wrist strap or other antistatic precautions before handling enclosure components.

---

1. Check TPSSM for instructions on power/fan module failure recovery procedures. Follow any instructions provided before proceeding.

2. If applicable, turn off the audible alarm by pressing the **Alarm Mute** button on the front of the drive enclosure.

3. Unpack the new power/fan module. Set the new power/fan module on a dry, level surface near the enclosure. Save all packing materials in case you need to return the module.

4. Review all documentation shipped with the new power/fan module for any updated replacement procedures and other information. If necessary, modify the remaining steps to meet the system requirements. Kits often contain the most current servicing information. If the kit instructions conflict with those in this procedure, follow the kit instructions.

5. If TPSSM instructs you to do so, turn off the power to the enclosure. Otherwise, leave the power on.

⚠ **Caution:** To prevent the enclosure from overheating while in use, complete the power/fan module replacement procedure within 15 minutes from the time you remove the failed module to the time you install the new module. Both power/fan modules must be installed in the enclosure to provide continuous power and air circulation within the enclosure.

---

6. Locate the failed power/fan module (its fault light should be on).

7. Turn off the power switch, and unplug the power cord from the failed power/fan module.

8. Wearing antistatic protection, pull the latch handle outward to unlock the module (see callout 1 in Figure 8-2). The latch handle is at the top of the left-side power/fan module, and at the bottom of the right-side power/fan module.

Figure 8-2   Removing and Installing a Power/Fan Module

9. With the module fully unlatched pull the unit gently outward to remove the power/fan module from the enclosure.

10. Determine the correct orientation for the new power/fan module. If replacing the module on the left, orient the unit so the latch is at the top. If replacing the right-side module, orient the unit so the latch is at the bottom.

11. Slide the new module into the slot and push firmly until the latch snaps into place.

12. Plug the power cord back into the power/fan module and turn the power on.

13. Check the fault indicators as follows (see Figure 8-3):

   • If the fan fault indicator is on or the fans are not spinning, the module might be installed incorrectly. Remove the fan module and reinstall it.

   • If any of the other fault indicators shown in Figure 8-3 are on, use TPSSM to determine the problem.

Figure 8-3   Fault Lights for Power/Fan Module Replacement

Replacing an SFP Transceiver

Use the following procedure to replace a small form-factor pluggable (SFP) transceiver on the drive tray. The SFP transceiver shown in this procedure might look different from those you are using, but the difference does not affect transceiver performance. You need antistatic protection and a replacement SFP transceiver for this procedure.

Caution: Electrostatic discharge can damage sensitive components – Touching the tray or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection.

---

1. If needed, use the storage management software to create, save, and print a new storage array profile.

2. Did the Recovery Guru direct you to replace a failed SFP transceiver?

- **Yes** – Go to the next step.

- **No** – Run the Recovery Guru to confirm the identity of the failed component, and then go to the next step.

3. Put on antistatic protection.

4. If applicable, turn off the audible alarm by pressing the Alarm Mute button on the front of the drive tray.

5. Unpack the new SFP transceiver. Verify that it is the same type of transceiver you are replacing, reference. If it is not, contact your Customer Support Organization.

6. Check the controller module Fault lights to locate the failed SFP transceiver. If a fault is detected, the amber Fault light is on.

Important: Potential degraded performance – To prevent degraded performance, do not twist, fold, pinch, or step on fiber-optic cables. Do not bend the fiber-optic cables tighter than a 2-inch radius.

Caution: Potential loss of data access – To prevent loss of access to data, remove only the SFP transceiver that has a failed status as shown in the storage management software.

---

7. Disconnect the fiber-optic interface cables from the SFP transceiver.

8. Based on the status of the ESM Port In Bypass and the ESM Fault lights, choose one of the following actions:

– **The ESM Port In Bypass light *or* the ESM Fault light is on** – Reinstall the SFP transceiver and the fiber-optic cables, and verify that the SFP transceiver and fiber-optic cables are securely connected. When finished, go on to the next step.

– **The ESM Port In Bypass light *and* the ESM Fault light are off** – Go to step 11.

9. Remove the failed SFP transceiver from the controller.

10. Install the new SFP transceiver into the controller.

11. Reconnect the fiber-optic cable.

12. Check the bypass indicator next to the new SFP transceiver as follows:

– If the bypass indicator is on, the SFP transceiver might be installed incorrectly. Remove the SFP transceiver and reinsert it.

– If the bypass indicator stays on, or a fault indicator on the environmental status module comes on, use TPSSM to determine the problem.

1. Fiber-optic Cable
2. SFP Transceiver
3. ESM In Bypass Light
4. Host Interface Connector
5. ESM Fault Light
6. ESM CRU

Figure 8-4   Replacing an SFP Transceiver

13. Check the ESM Port In Bypass and the ESM Fault lights for the new SFP transceiver.

14. Is the problem corrected?

    – **Yes** – Go to the next step.

    – **No –** Contact Customer and Technical Support.

15. Complete any remaining Recovery Guru procedures, if needed.

16. Check the status of each tray in the storage array.

17. Does any component have a Needs Attention status?

    – **Yes** – Click the Recovery Guru toolbar button in the Array Management Window, and complete the recovery procedure. If a problem is still indicated, contact Customer and Technical Support.

    – **No** – Go to the next step.

18. Create, save, and print a new storage array profile.

    As shown in Figure 8-5, the SFP assembly consists of an active SFP transceiver unit (callout 1), and the fibre optic cable assembly (callout 2) that connects with it. Or, the SFP may have a passive SFP transceiver (callout 3) that is integrated with a copper cable assembly (callout 4).

Figure 8-5   SFPs and Cable Used

Replacing a Failed Environmental Status Module

When TPSSM instructs you to replace a failed environmental status module, read "Environmental Status Modules (ESMs)" on page 101, and then follow the steps in this section.

⚠ **Caution:** Electrostatic discharge can damage sensitive components. Use a grounded wrist strap or other antistatic precautions before handling enclosure components.

1. Check TPSSM for instructions on environmental status module failure recovery procedures. Follow any instructions provided before you proceed.

2. Unpack the new environmental status module. Set the new module on a dry, level surface near the enclosure. Save all packing materials in case you need to return the module.

3. Review all documentation shipped with the new environmental status module for updated replacement procedures and other information. If necessary, modify the remaining steps to meet the system requirements. Kits often contain the most current servicing information. If the kit instructions conflict with those in this procedure, follow the kit instructions.

4. Locate the failed environmental status module (its fault indicator should be on).

5. Disconnect the Fibre Channel cables from the SFP transceivers in the failed module, and then remove the SFP transceivers (see "Replacing an SFP Transceiver" on page 131). Label each cable to ensure that all cables are properly reconnected to the new module.

⚠ **Caution:** Bending or damaging Fibre Channel cables can result in degraded performance or data loss. Fibre Channel cables are fragile. Do not pinch the cables with tie wraps, step on them, or bend at them at sharp angles.

6. Wearing antistatic protection, push down on the latch centered above the environmental status module. The levers will pop out of the locked position (see Figure 8-6).

7. Grasp the pull-rings and pull on the levers to remove the failed module.

8. Wearing antistatic protection, slide the new environmental status module all the way into the empty slot.

9. Close both levers until the latch locks into place.

10. Install the SFP transceivers and Fibre Channel interface cables in their original locations.

11. Check the power and fault indicators on the new module.

    • If the power indicator is off, the module may not have been inserted correctly. Remove the module and reinsert it.

    • If the fault indicator is on, the power indicator stays off, or any other fault indicator is on, use TPSSM to determine the problem.

12. See TPSSM for instructions on bringing the environmental status module online.

Figure 8-6   Removing and Installing an Environmental Status Module

Upgrading Drives

You can upgrade drives in the following two ways:

- Add drives to empty slots in the enclosure (see "Adding a Drive to an Empty Slot" on page 136).

- Replace existing drives with drives of larger capacity (see "Adding Drives of Larger Capacity" on page 138).

Adding a Drive to an Empty Slot

Follow these instructions to install an additional drive into an empty slot in the enclosure. You can install additional drives while the enclosure is powered on and running.

Warning: **Electrostatic discharge can damage sensitive components. Use a grounded wrist strap or other antistatic precautions before handling enclosure components.**

1. Read the pertinent information in the software manuals supplied with your system regarding drive upgrades and installation.

2. Check TPSSM and repair all reported problems.

3. Locate the blank drive module that you will replace with a drive, as follows:

   - Because a blank drive module contains no drive, its activity indicator (on the front bezel above the drive module) will not be on.

   - Verify the drive position is blank using TPSSM.

Caution: Removing the wrong drive can cause data loss. Make sure you remove only a blank drive module. If you remove an active drive accidentally, wait at least 30 seconds and then reinstall it. Check TPSSM for further recovery instructions.

4. Wearing antistatic protection, lift (open) the lever of the blank drive module.

5. Pull out the blank drive module (see Figure 8-1 on page 126).

6. Unpack the new drive module. Save all packing materials in case you need to return the module.

7. Review all documentation shipped with the new drive module for updated replacement procedures and other information.

⚠️ **Caution:** If the temperature of the shipping or storage environment differs significantly from the temperature of the environment in which the drive module will be installed, acclimate the drive module before you install it.

8. Slide the new drive module fully into the slot.

9. Lower (close) the lever.

10. Check to be sure that the drive activity indicators are on and that the fault indicators above the new drive module are off.

Note: The fault indicator may flash intermittently while the drive spins up.

- If the activity indicator is off, the drive module may not be installed correctly. Remove the drive module, wait 30 seconds, and then reinstall it.

- If the fault indicator stays on, or the activity indicator stays off, the new drive may be bad. Use TPSSM to determine the problem.

11. Configure the new drive using TPSSM.

If you need to install more than one drive module, repeat the steps in this section.

Adding Drives of Larger Capacity

This section provides guidelines for upgrading the disk drives in a storage array. Carefully read your software documentation and this entire section to determine if you should follow this procedure, a modified version of this procedure, or use a different procedure provided by your operating system. Instructions provided with your software should supersede the instructions in the section.

Warning: **Electrostatic discharge can damage sensitive components. Use a grounded wrist strap or other antistatic precautions before handling enclosure components.**

The only method for upgrading disk drives is to replace them all at the same time. This method requires you to back up the enclosure and shut down the storage array before replacing the drives. After replacing all the drives, you must reconfigure the enclosure and restore the data from backup media. This is the safest way to exchange drives without losing data. However, this method may take a long time to complete because of the backup, reconfiguration, and restoration processes. In addition, other users will not be able to use the enclosure until you finish the procedure. You must use this method on RAID 0 logical units (LUNs).

Follow these instructions to replace all drives at the same time. All the data currently on the drives will be lost when you replace the drives. You must use this method if you are upgrading drives containing RAID 0 volumes.

1. Read the following:

    • "Upgrading Drives" on page 136.

    • Information in your software documentation.

    • Documentation shipped with the new drives.

    Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.

2. Check TPSSM and repair all reported problems.

3. Perform a complete backup of the drives that you are replacing. You need the backup to restore data on the drives later in this procedure.

4. Shut down all I/O activity on the enclosure. Make sure the drive activity indicators on the front are not blinking.

5. Turn off both power switches on the rear of the enclosure.

6. Wearing antistatic protection, lift (open) the lever of a drive module and pull out the drive module (see Figure 8-1 on page 126).

7. Repeat step 6 for all of the drive modules in the enclosure.

8. Unpack a new drive. Save the packing material and documentation in case you need to return the drive.

9. Slide the new drive module fully into a slot.

10. Lower (close) the lever.

11. Repeat steps 8 through 10 until you have installed all the new drives.

12. Turn on both power switches on the enclosure.

13. Check to be sure that the drive activity indicators are on and that the fault indicators above the new drive modules are off.

Note: The fault indicator may flash intermittently while the drive spins up.

- If the activity indicator is off, the drive module may not be installed correctly. Remove the drive module, wait 30 seconds, and then reinstall it.

- If the fault indicator stays on, or the activity indicator stays off, the new drive may be bad. Use TPSSM to determine the problem.

14. Use TPSSM to configure the new drives. See your software documentation for detailed instructions.

15. Restore the data from backup to all the drives.

Adding Drive Enclosures

You can add new drive enclosures to an existing storage array without turning off the array or interrupting data flow. "Drive Cabling Topologies for the Controller Module" in Chapter 9 provides additional information on connecting multiple enclosures together into a larger RAID array.

Caution: You can add only new drive enclosures to the storage array. This means that there must be no existing information on the drives in the drive enclosure you want to install. If the enclosure you want to install currently contains volumes or configured hot spare drives, you must delete them before adding the enclosure to a new configuration.

You may need to refer to the installation manual accompanying your controller and drive enclosures to complete this procedure. Add the additional enclosure in a location within the cabinet that keeps the drive enclosures evenly distributed around the controller enclosure or storage system. In addition, you want to keep the majority of the weight in the bottom half of the rack. This procedure may be accomplished by your service provider or by trained in-house technicians.

To install one or more new drive enclosures into an existing loop, follow these steps:

1. Follow the instructions in the RAID installation documentation as applicable to set up and mount the new drive enclosure(s) and to connect them.

2. Using the information in "Drive Cabling Topologies for the Controller Module" on page 158, connect the cables from the controller enclosure to the new drive enclosure(s). Then, if applicable, connect the cables from the existing drive enclosure(s) to the new drive enclosure(s). Figure 8-7 shows an example of a drive enclosure connected to the RAID controller enclosure.

Warning: **Electrostatic discharge can damage sensitive components. Use a grounded wrist strap or other antistatic precautions before handling enclosure components.**

3. After you have connected the cables to the new drive enclosure, the controllers will locate the new disk drives.

Important: Depending on how long it takes you to complete step 2, TPSSM may report a loss of redundancy error on the drive enclosures in the loop. This error will not interfere with data flow, and will disappear after you finish installing the drive enclosure(s).

---

4. Use TPSSM to check the status of the new drives and correct any errors found.

5. Use TPSSM to configure the new drives.

Figure 8-7   Adding a New Drive Enclosure to an Existing RAID Enclosure

Cabling

This chapter describes the cabling between the controller enclosure and the front-end host, the drive enclosure and the back-end drive side, Ethernet, serial port, and power connections. Direct topologies, fabric topologies, and mixed topologies are addressed. You are not limited to using only these topologies; the examples are included to provide basic concepts to help you define a maximal host-cabling topology.

The following sections describe the cabling:

Host Cabling Topologies

Note: The maximum number of hosts that can be connected to a single controller module or array module is 512.

A controller module supports both direct and fabric topologies for host I/O cabling. This section describes each type of topology.

The term "failover" describes the automatic transfer of I/O requests from a primary controller to another controller.

Failover occurs when a component failure or other error occurs either in the primary controller or in the data path to the primary controller.

Direct Topologies

In a direct topology, one or more hosts are directly connected to the host minihubs on the controller module without the use of a switch. A direct topology might not support failover. Fiber-optic cable must be used in a direct topology. Figure 9-1 shows a direct connection to four hosts with failover capability.

1. Host 1
2. Host 2
3. Host 3
4. Host 4
5. Host Minihubs 1 and 3 (Controller A)
6. Host Minihubs 2 and 4 (Controller B)

Figure 9-1   Controller Module – Direct Topology

The following host-to-controller module/array module topologies do not use switches.

One Single-HBA Host to a Single-Controller Controller Module or Array Module

Figure 9-2 shows an example of a direct topology with one host and a single-controller controller module or array module.

Note: The InfiniteStorage 4500 system has four host ports per controller. In the following illustrated examples however, we are using/showing only two host ports.

Figure 9-2   Direct Topology – One Host and Single-Controller/Array Module

Table 9-1 defines which of the components in this topology are non-redundant and present the risk of a single point of failure.

Table 9-1   Redundant and Non-Redundant Components in a Single-HBA Host to a Single-Controller/Array Module

Component	Redundant	Non-Redundant
Host/server		Y
HBA		Y

Table 9-1   Redundant and Non-Redundant Components in a Single-HBA Host to a
            Single-Controller/Array Module **(continued)**

Component	Redundant	Non-Redundant
Host-to-controller cable		Y
Controller		Y

One Dual-HBA Host to a Dual-Controller Command Module or Array Module

Figure 9-3 shows an example of a direct topology with one host and a dual-controller
module or array module. Table 9-2 defines which of the components in this topology are
non-redundant and present the risk of a single point of failure.

Caution: Risk of loss of access to data – Alternate path software or an alternate path
(failover) driver must be installed on the host to support failover in the event of an HBA
or host channel failure.

Figure 9-3   Direct Topology – One Host and Dual-Controller/Array Module

Table 9-2   Redundant and Non-Redundant Components in a Dual-HBA Host to
Single-Controller/Array Module

Component	Redundant	Non-Redundant
Host/server		Y
HBA	Y	
Host-to-controller cable	Y	
Controller	Y	

Two Dual-HBA Hosts to a Dual-Controller Module or Array Module

Figure 9-4 shows an example of a direct topology with two hosts and a dual-controller command module or array module. Table 9-3 defines which of the components in this topology are non-redundant and present the risk of a single point of failure.

Caution: Risk of loss of access to data – Alternate path software or an alternate path (failover) driver must be installed on the host to support failover in the event of an HBA or host channel failure.

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Figure 9-4   Direct Topology – Two Hosts and Dual-Controller/Array Module

Table 9-3   Redundant and Non-Redundant Components in Two Dual-HBA Hosts to a
Dual-Controller Controller/Array Module

Component	Redundant	Non-Redundant
Host/server	Y	
HBA	Y	
Host-to-controller cable	Y	
Controller	Y	

Fabric Topologies

A fabric topology uses one or more switches to connect fiber-optic cables from the host
to the command module.

A fabric topology typically supports failover but might also be used for non-failover
scenarios. Depending on your host operating system, you might have a choice of failover
methods for a storage array. For operating system-specific failover options, refer to the
post-installation tasks in the *SANtricity*® Storage Manager installation guide for your
operating system.

Figure 9-5 shows a fabric topology using two hosts and two switches.

1. Host 1
2. Host 2
3. Switch 1
4. Switch 2
5. Controller A
6. Controller B

Figure 9-5   Controller Module – Fabric Topology

The following host-to-controller module/array module topologies include one or more switches. Note that the InfiniteStorage 4500 system has four host ports per controller. In the following illustrated examples however, we are using only two host ports.

One Dual-HBA Host to a Dual-Controller Module or Array Module

Figure 9-6 shows an example of a fabric topology with one host, a dual-controller module or array module, and a zoned switch. Table 9-4 defines which of the components in this topology are non-redundant and present the risk of a single point of failure.

Figure 9-6   Fabric Topology – One Host and Dual-Controller/Array Module with a Switch

Caution: Risk of loss of access to data – Alternate path software or an alternate path (failover) driver must be installed on the host to support failover in the event of an HBA or host channel failure.

Table 9-4   Redundant and Non-Redundant Components in a Dual-HBA Host to Dual-Controller/Array Module with a Switch

Component	Redundant	Non-Redundant
Host/server		Y
HBA	Y	
Host-to-controller cable	Y	
Switch		Y
Controller	Y	

Two Dual-HBA Hosts to a Dual-Controller Module or Array Module

Figure 9-7 shows an example of a fabric topology with two hosts, a dual-controller command module or array module, and a zoned switch. Table 9-5 defines which of the components in this topology are non-redundant and present the risk of a single point of failure.

Figure 9-7   Fabric Topology – Two Hosts and Dual-Controller/Array Module with a Zoned Switch

Table 9-5   Redundant and Non-Redundant Components in Two Dual-HBA Host to Dual-Controller/Array Module with a Zoned Switch

Component	Redundant	Non-Redundant
Host/server	Y	
HBA	Y	
Host-to-controller cable	Y	
Switch		Y
Controller	Y	

Caution: Risk of loss of access to data – Alternate path software or an alternate path (failover) driver must be installed on the host to support failover in the event of an HBA or host channel failure.

Four Dual-HBA Hosts to a Dual-Controller Module or Array Module

Figure 9-8 shows an example of a fabric topology with four hosts, a dual-controller controller module or array module, and two zoned switches. Table 9-6 defines which of the components in this topology are non-redundant and present the risk of a single point of failure.

Caution: Risk of loss of access to data – Alternate path software or an alternate path (failover) driver must be installed on the host to support failover in the event of an HBA or host channel failure.

Figure 9-8   Fabric Topology – Four Hosts and Dual-Controller/Array Module with Two Zoned Switches

Table 9-6   Redundant and Non-Redundant Components in Four Dual-HBA Hosts to Dual-Controller/Array Module with Two Zoned Switches

Component	Redundant	Non-Redundant
Host/server	Y	
HBA	Y	
Host-to-controller cable	Y	
Switch	Y	
Controller	Y	

Mixed Topologies

Figure 9-9 shows an example of a mixed topology, that is, a topology that combines both fabric and direct topologies. The example shows three hosts, a dual-controller controller module or array module, and two switches. Table 9-7 defines which of the components in this topology are non-redundant and present the risk of a single point of failure.

Figure 9-9   Mixed Topology – Three Hosts and Dual-Controller/Array Module

Caution: Risk of loss of access to data – Alternate path software or an alternate path (failover) driver must be installed on the host to support failover in the event of an HBA or host channel failure.

Table 9-7   Redundant and Non-Redundant Components in Three Dual-HBA Hosts to Dual-Controller/Array Module with Two Switches

Component	Redundant	Non-Redundant
Host/server	Y	
HBA	Y	
Host-to-controller cable	Y	
Switch	Y	
Controller	Y	

Preparing the Controller Module and Drive Modules for Cabling

Use the following procedure to prepare the modules for cabling.

Caution: Electrostatic discharge damage to components – To prevent electrostatic discharge damage to the controller module, use proper antistatic protection when handling controller module components.

Important: Ensure that each drive module has a unique tray ID. Refer to the installation guide for each type of module for information on setting the tray ID.

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1. Figure 9-10 and Figure 9-11 show the two types of drive interface cables. Compare your cables with those in the figures, and then choose one of the following options, based on your interface cable type. The SFP transceiver shown in Figure 9-10 might look slightly different than the ones shipped with your command module. The difference does not affect performance.

    a. **Fiber-optic cable** – An SFP transceiver is required for each connection. Go to step 2.

    b. **Copper cable** – An SFP transceiver is not required for connection. Go to step 4.

1. SFP Transceiver
2. Fiber-Optic Cable

Figure 9-10   SFP Transceiver with Fiber-Optic Cable

1. Copper Cable
2. Passive Copper FC SFP

Figure 9-11   Copper Cable with Passive Copper FC SFP

Warning: **Risk of exposure to laser radiation – To prevent exposure to hazardous laser radiation, do not disassemble or remove any part of an SFP transceiver.**

2. If you are using fiber-optic cables, insert an SFP transceiver into the drive ports on the controller module. Figure 9-12 shows inserting an SFP transceiver.

Figure 9-12   Controller Module – Installing an SFP Transceiver

3. Insert an SFP transceiver into the ESM ports of each drive module to be used in your cabling topology. Figure 9-13 shows inserting an SFP transceiver.

1. Fiber-optic Cable
2. SFP Transceiver
3. ESM In Bypass Light
4. Host Interface Connector
5. ESM Fault Light
6. ESM CRU

77034-01

Figure 9-13   Drive Module – Installing an SFP Transceiver

4. Cable your drives according to the schemes shown in section "Drive Cabling Topologies for the Controller Module" on page 158.

Drive Cabling Topologies for the Controller Module

This section provides four cabling examples for the controller module. Each example provides redundant paths to the drives. If one of these examples is suitable for your hardware and application, complete the cabling connections as described by the tables. If you have hardware other than what is shown in these examples to include in your topology, use these examples as a starting point for creating your specific topology.

If you are using fiber-optic cables, install SFP transceivers into the ports that will receive the cables before installing the cables.

Two Controllers and One Drive Module

If you are cabling two controllers to one drive module, use the cabling topology described inFigure 9-14 and Table 9-8.

Figure 9-14   Two Controllers and One Drive Module

Table 9-8   Two Controllers and One Drive Module

	Connection Point		Connection Point	
Drive Channel	Module/Component	Port Number/Location	Module/Component	Port Number/Location
1	Controller A	4	Drive Module 1	1A/ESM A
3	Controller B	1	Drive Module 1	1B/ESM B

Two Controllers and Two Drive Modules

If you are cabling two controllers to two drive modules, use the cabling topology described in Figure 9-15 and Table 9-9.

Figure 9-15   Two Controllers with Two Drive Modules

Table 9-9   Two Controllers and Two Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/Component	Port Number/Location	Module/Component	Port Number/Location
1	Controller A	4	Drive Module 1	1A/ESM A
3	Controller B	1	Drive Module 1	1B/ESM B
2	Controller A	2	Drive Module 2	1A/ESM A
4	Controller B	3	Drive Module 2	1B/ESM B

Two Controllers and Four Drive Modules

If you are cabling two controllers to four drive modules, use Figure 9-16.

Figure 9-16   Two Controllers and Four Drive Modules

The cabling topology for connecting two controllers (one enclosure) to four drive modules is also described in Table 9-10.

Table 9-10   Two Controllers and Four Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/Component	Port Number/Location	Module/Component	Port Number/Location
1	Controller A	4	Drive Module 1	1A/ESM A
3	Controller B	1	Drive Module 1	1B/ESM B
2	Controller A	2	Drive Module 2	1A/ESM A
4	Controller B	3	Drive Module 2	1B/ESM B
1	Controller A	3	Drive Module 3	1A/ESM A
3	Controller B	2	Drive Module 3	1B/ESM B
2	Controller A	1	Drive Module 4	1A/ESM A
4	Controller B	4	Drive Module 4	1B/ESM B

Two Controllers and Eight Drive Modules

If you are cabling two controllers to eight drive modules, use the cabling topology described in Table 9-11 and Figure 9-17.

Figure 9-17 Two Controllers and Eight Drive Modules

Table 9-11   Two Controllers and Eight Drive Modules

Drive Channel	Connection Point		Connection Point	
	Module/Component	Port Number/Location	Module/Component	Port Number/Location
1	Controller A	4	Drive Module 1	1A/ESM A
	Drive Module 1	1B/ESM A	Drive Module 2	1A/ESM A
	Controller B	1	Drive Module 2	1B/ESM B
	Drive Module 2	1A/ESM B	Drive Module 1	1B/ESM B
2	Controller A	3	Drive Module 5	1A/ESM A
	Drive Module 5	1B/ESM A	Drive Module 6	1A/ESM A
	Controller B	2	Drive Module 6	1B/ESM B
	Drive Module 6	1A/ESM B	Drive Module 5	1B/ESM B
3	Controller A	2	Drive Module 3	1A/ESM A
	Drive Module 3	1B/ESM A	Drive Module 4	1A/ESM A
	Controller B	3	Drive Module 4	1B/ESM B
	Drive Module 3	1B/ESM B	Drive Module 4	1A/ESM B
4	Controller A	1	Drive Module 7	1A/ESM A
	Drive Module 7	1B/ESM A	Drive Module 8	1A/ESM A
	Controller B	4	Drive Module 8	1B/ESM B
	Drive Module 8	1A/ESM B	Drive Module 7	1B/ESM B

Ethernet Cabling for Out-of-Band Management

This section provides examples of how to connect your storage array to an Ethernet network for out-of-band storage array management. If you plan to use in-band storage array management, Ethernet cabling is unnecessary.

Caution: Risk of interruption of access to data – If out-of-band management is used, connect the controller module or array module Ethernet ports to a private network segment behind a firewall. If the Ethernet connection is not protected by a firewall, it is possible for data to become unavailable for a prolonged period of time and data may be at risk of being accessed from outside your network.

Figure 9-18 shows a single connection from the controller module or array module to the Ethernet. In this topology, a network interface card (NIC) must be installed in the storage management station where the client software resides

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Important: If the controller module or array module is connected directly to the storage management station NIC, and an Ethernet cross-over cable must be used to cable the storage management station to the Ethernet port. An Ethernet cross-over cable is a special cable that reverses the pin contacts between the two ends of the cable.

Figure 9-18   Direct Non-Redundant Out-of-Band Ethernet Topology

Figure 9-19 shows two connections from the controller module or array module to two ports on an Ethernet switch. In this topology, a network interface card must be installed in the storage management station where the client software resides, and an Ethernet switch and Ethernet cables must be used for all cabling.

Figure 9-19   Redundant Out-of-Band Ethernet Topology

If you have a total of four available Ethernet ports on your module or array module (two per controller), reserve one port on each controller for Customer Technical Support access to the storage array.

Specifications and Requirements

This appendix describes the technical specifications and requirements of the system rack and components in the following sections:

- "Rack Specifications" on page 169
- "Controller Enclosure Specifications" on page 179
- "Drive Enclosure Specifications" on page 185

Rack Specifications

The system is housed in a 22-inch wide rack that contains two AC distribution boxes. Standard EIA rails provide mounting holes for installing 19-inch wide devices. There are roller casters and stability feet on the bottom of the rack for moving and leveling during installation and relocation.

Figure A-1 shows a fully populated rack that contains ten drive enclosures and two controller enclosures mounted in a 72-inch high rack.

Figure A-1   Rack Controller Enclosures and Drive Enclosures

For more information on installation and cabling schemes, see the following documents:

- *SGI InfiniteStorage TPSSM Software Concepts Guide* (007-4749-00X)
  This guide explains the terminology and features of the TPSSM storage
  management software.

- *SGI InfiniteStorage TPSSM Administration Guide* (007-4748-00X)
  This guide gives complete instructions on how to install the TPSSM software for
  host and/or client operation.

Dimensions

Figure A-2 shows the system rack and its dimensions.

183 cm
(72 in.)

48221

56 cm
(22 in.)

91 cm
(36 in.)

Figure A-2   Dimensions of the System Rack

Weight

The total weight of the system depends on the type and quantity of enclosures installed. Table A-1 lists the overall weight of the rack, plus the maximum weights for the controller enclosures and drive enclosures. You can use these weights to estimate the total weight of your system, based on the number of devices installed in the rack.

Table A-1   Rack, Crate, and Enclosure Weights

Rack (Empty)	Crate (Empty)	Controller Enclosure (Maximum)	Drive Enclosures (Maximum)	Drive Enclosures (Maximum)
121.0 kg (270.0 lb)	97.0 kg (215.0 lb)	44.0 kg (97.0 lb)	73-GB drives 146-GB drives 300-GB drives	40.4 kg (89.0 lb) 42.1 kg (93.0 lb)

Area Requirements

The floor area at the installation site must provide the following:

- Enough stability to support the weight of the system and installed devices (see Table A-2).

- Sufficient space to install and service the rack and components (see Figure A-3).

Figure A-3   System Area Requirements

Table A-2   System Weights with Typical Configurations

Configuration	Number of Enclosures per Configuration	Weight of Each Enclosure	Total Weight (Including Rack)
Configuration A	1 controller enclosure and 5 drive enclosures with 73-GB drives	44.0 kg (97.0 lb) 40.4 kg (89.0 lb)	368.0 kg (807 lb)
Configuration B	2 controller enclosures and 10 drive enclosures with 73-GB drives	44.0 kg (76.0 lb) 40.4 kg (89.0 lb)	619.0 kb (1347 lb)

Wiring and Power

The rack's AC distribution boxes use common industrial wiring. Consider the following site wiring and power source requirements:

- **AC power source:** The AC power source must provide the correct voltage, current, and frequency specified on the manufacturer's name plate.

- **Earth ground:** You must have an earth grounding conductor to the rack's power receptacles.

- **Circuit overloading:** Make sure the power circuits and associated circuit breakers provide sufficient power and overload protection. To prevent possible damage to the AC distribution boxes and other components in the rack, isolate its power source from large switching loads (such as air conditioning motors, elevator motors, and factory loads).

- **Enclosure power distribution:** There are two accessory outlets inside the rack for enclosure power distribution. All units attached to these outlets must be auto-ranging between 180-257 VAC, 50-60 Hz.

- **Power interruptions:** The system and its enclosures will withstand the following applied voltage interruptions (with or without an integrated UPS):

  - **Input transient:** 50% of nominal voltage

  - **Duration**: One half cycle

  - **Maximum frequency:** Once every ten seconds

007-4843-001

- **Power failures:** After total power failure, the SGI InfiniteStorage 4500 enclosures will automatically perform a power-up recovery without operator intervention, once power is restored.

Power Requirements

Table A-3 and Table A-4 lists the power requirements for the rack.

Table A-3   AC Power Requirements (Domestic and International)

Unit of Measure	Requirement
AC distribution, 250 VAC, 16 A	Approved IEC 320-C19 connector
Domestic, 250 VAC, 30 A	NEMA L6-30P locking plug, 6-30R receptacle (2)
International, 230 VAC, 32 A	IEC 309 locking plug; IEC 309 receptacle (2)
Voltage range	180 to 257 VAC
Frequency	49 to 50.5 Hz or 59 to 60.6 Hz
Current specified at volt/freq	220/50/60
Circuit breaker	20 A

Table A-4   AC Power Requirements for Typical Configurations

Current	Configuration A[a]	Configuration B[b]	Configuration C[c]
Operating current	7.35 A	14.7 A	13.16 A
Surge current	10.95 A	21.9 A	22.20 A

a. Configuration A contains 1 controller enclosure and 5 drive enclosures.

b. Configuration B contains 2 controller enclosure and 10 drive enclosures.

c. Configuration C contains 3 controller enclosure and 8 drive enclosures.

Power Distribution Units

The rack has two PDUs (power distribution units). Each PDU has its own power cord. Because of limited space inside the rack, it may be easier to connect and route power cords before installing the support rails, controller or drive enclosures.

To ensure redundancy, connect the PDUs in the rack to independent power sources. Connect one power cord from each controller and drive enclosure to each PDU in the rack (see Figure A-4).

Figure A-4   Power Connections to Controller and Drive Enclosures

Power Cords and Receptacles

The rack is shipped with three types of power cords:

- **Component power cord**: Connects from each component to the PDU.

- **Domestic power cord**: Connects from the PDU to an independent 20 A circuit breaker.

- **International power cord**: Connects from the PDU to an independent 20 A circuit breaker.

The power distribution unit has two outlets for connecting the power cords from devices installed in the rack. Figure A-5 shows the connectors and receptacles for these cords.

Component
250 VAC, 16 A, IEC 320-C19

Domestic
250 VAC, 30 A, NEMA L6-30

International
230 VAC, 32 A, IEC 309

48214

Figure A-5   AC Power Connectors and Receptacles

Environmental

Table A-5, Table A-6, and Table A-7 list the environmental requirements for the SGI InfiniteStorage 4500.

⚠ **Caution:** If you receive the rack and enclosures in cold weather (below 32 °F (0 °C)), leave them crated for at least 24 hours to prevent condensation. This 24-hour stabilization period can be modified either up or down, depending on the outside temperature at arrival.

Table A-5   Environmental Requirements

Environment	Unit of Measure	Requirement
Air flow	N/A	Air flow is from front to rear
Temperature	Operating range Storage range Transit range	10 °C to 35 °C (50 °F to 95 °°F) -10 °C to 50 °C (14 °F to 122 °F) -40 °C to 60 °C (-40 °F to 140 °F)
Temperature change (maximum allowed)	Operating Storage Transit	10 °C per hour (21 °F per hour) 15 °C per hour (31 °F per hour) 20 °C per hour (42 °F per hour)
Relative humidity (no condensation)	Operating range Storage range Transit range Max. dew point Max. humidity gradient	20% to 80% 10% to 90% 5% to 95% 28° C (82° F) 10% per hour
Noise Level	Steady Non-steady Normal operation	6.8 bels (maximum) 6.8 bels (maximum) 65 dBA

Table A-6   Altitude Requirements

Environment	Unit of Measure	Requirement below Sea Level	Requirement above Sea Level
Altitude	Operating range Storage range Transit range	30.5 m (100 ft.) 30.5 m (100 ft.) 30.5 m (100 ft.)	3,000 m (9,840 ft.) 3,000 m (9,840 ft.) 12,000 m (40,000 ft.)

Table A-7   Heat Dissipation Requirements

Environment	Unit of Measure	Requirement
Heat dissipation	Configuration A[a] 73-GB drives	1.69 kVA 1697.5 W 5797.5 Btu/hr
	Configuration B[b] 73-GB drives	3.37 kVA 3395 W 11595 Btu/hr

a. 1 controller enclosure, 5 drive enclosures.

b. 2 controller enclosures, 10 drive enclosures.

Controller Enclosure Specifications

This section lists the dimensions and weights, as well as the wiring, power, environmental, and airflow requirements for the controller enclosures.

Dimensions

Make sure that the installation site provides a minimum of two feet of space around each side of the rack to install and service the controller enclosure, and to allow adequate ventilation during operation. Figure A-6 shows the dimensions for the controller enclosure and the front cover.

Figure A-6   Dimensions of the Controller Enclosure

Weights

Ensure that the floor space at the installation site has sufficient stability to support the maximum weight of the controller enclosure and associated equipment. The controller enclosure's total weight depends on the number of canisters in the enclosure. Table A-8

and Table A-9 lists the unit and shipping weight of the controller enclosure and the weight of the individual canisters.

Table A-8   Controller Enclosure Weights

Maximum Weight[a]	Empty Weight[b]	Maximum Shipping Weight[c]	Empty Shipping Weight[d]
44.0 kg (97.0 lb)	18.1 kg (39.8 lb)	54.9 kg (121.0 lb)	29.0 kg (63.8 lb)

a. Includes a controller enclosure containing all applicable canisters.

b. Includes a controller enclosure with all canisters removed.

c. Includes the shipping carton and a fully configured controller enclosure.

d. Includes the shipping carton and a controller enclosure containing no canisters.

Table A-9   Controller Canister Weights

Canister	Weight	Shipping Weight
Controller	3.0 kg (6.6 lb)	5.0 kg (11.0 lb)
Battery	9.7 kg (21.4 lb)	11.8 kg (26.0 lb)
Controller Fan	0.9 kg (1.9 lb)	2.3 kg (5.0 lb)
Fan/Communications	1.84 kg (4.1 lb)	2.5 kg (5.4 lb)
Power Supply	1.5 kg (3.3 lb)	2.9 kg (6.5 lb)
SFP Minihub	0.6 kg (1.3 lb)	0.7 kg (1.6 lb)

Wiring and Power

The controller enclosure is a 120/220 VAC, 50/60 Hz unit that meets standard voltage requirements for both domestic (USA) and international operation. It uses standard industrial wiring with a line-to-neutral power connection (Table A-10). Review the following specifications when preparing the controller enclosure installation site:

- **Earth ground:** The unit must be properly grounded, including an earth ground conductor on the AC power source.

- **Circuit overloading:** Make sure the power circuits and associated circuit breakers in the rack and building provide sufficient power and overload protection. To prevent possible damage to the unit, isolate its power source from large switching loads (for example, air conditioning motors, elevator motors, factory equipment, and so on).

- **Power interruptions:** The unit will withstand the following voltage interruptions:

  - **Input transient:** 50% of nominal voltage

  - **Duration:** One half-cycle

  - **Minimum frequency:** Once every 10 seconds

- **Power failures:** Once power is restored after a complete power failure, the unit automatically performs a power-up recovery sequence without operator intervention.

- **Power supply voltage range:** The wide-ranging, redundant 175 W power supplies operate on 90–264 VAC at 50 or 60 Hz. The power supplies meet domestic and international requirements and can operate at any voltage within the specified range.

Table A-10   Site Wiring Voltages for Controller Enclosures (Single-Phase Line-to-Neutral)

50 Hz	Nominal	100	127	220	230	240
	Minimum	90	114	198	207	216
	Maximum	107	136	235	246	264
60 Hz	Nominal	100	120			
	Minimum	90	104			
	Maximum	107	127			

Environmental

Table A-11 and Table A-12 lists the environmental requirements for the controller enclosure.

Table A-11   Altitude Requirements for Controller Enclosures

Condition	Range	Requirement below Sea Level	Requirement above Sea Level
Altitude[a]	Operating	30.5 m (100 ft.)	3,048 m (10,000 ft.)
	Storage	30.5 m (100 ft.)	3,048 m (10,000 ft.)
	Transit	30.5 m (100 ft.)	12,000 m (40,000 ft.)

a. If planning to operate the controller enclosure at altitudes between 1,000 m (3,280 ft.) and 3,000 m (9,850 ft.), lower the environmental temperature 1.7 °C (3.3 °F) for every 1,000 m (3,280 ft.) above sea level.

Table A-12   Environmental Requirements for Controller Enclosures

Condition	Range	Requirement
Temperature	Operating	10 °C to 40 °C (32 °F to 109 °F)
	Storage	-10 °C to 65 °C (14 °F to 149 °F)
	Transit	-40 °C to 65 °C (-40 °F to 149 °F)
Maximum temperature change allowed	Operating	1 °C (18 °F) per hour
	Storage	15 °C (27 °F) per hour
	Transit	20 °C (36 °F) per hour
Relative humidity (no condensation)	Operating	20% to 80%
	Storage	10% to 93%
	Transit	5% to 95%
	Maximum dew point	26 °C (79 °F)
	Maximum humidity Gradient	10% per hour
Heat Dissipation	557.5 Btu/hr (.1925 kVA or 192.5 W)	
Sound	Power	6.5 bels
	Pressure	65 dBA

Air Flow

Figure A-7 shows the air flow in the controller enclosure. Make sure your installation site will allow the controller enclosure adequate ventilation during operation.

Important: Allow a minimum of two feet of clearance in front of and behind the controller enclosure for proper ventilation and servicing.

Figure A-7   Air Flow Through the Controller Enclosure

Drive Enclosure Specifications

This section lists the dimensions and weights, as well as the wiring, power, environmental, and airflow requirements for drive enclosures.

Dimensions

Make sure that the installation site provides a minimum of two feet of space around each side of the rack to install and service the enclosure, and to allow adequate ventilation during operation. Figure A-6 shows the dimensions for drive enclosures.

Figure A-8   Dimensions of the Drive Enclosure

Weights

Ensure that the floor space at the installation site has sufficient stability to support the maximum weight of the enclosure and associated equipment. The enclosure can hold two to 16 drives and the enclosure's total weight depends on the number of drives and other modules in the enclosure. Table A-8 and Table A-9 lists the unit and shipping weight of the enclosure and the weight of the individual modules.

Table A-13   Enclosure Weights

Enclosure Type	Enclosure weight[a]	Shipping weight[b]	Empty enclosure weight[c]
Rackmount	38.5 kg (85 lb)	52.2 kg (115 lb)	15.9 kg (35 lb)

a. Indicates an enclosure containing all applicable modules.

b. Indicates the shipping carton and a fully configured enclosure.

c. All drives and modules removed.

Table A-14   Enclosure Module Weights

Module	Weight
ESM module	1.88 kg (4.15 lb)
Power/Fan module	3.6 kg (7.95 lb)
Disk drive module	~.75 kg (1.65 lb)

Wiring and Power

The enclosure is a 120/220 VAC, 50/60 Hz unit that meets standard voltage requirements for both domestic (USA) and international operation. It uses standard industrial wiring with a line-to-neutral power connection (see Table A-10). Review the following specifications when preparing the installation site:

- **Earth ground:** The unit must be properly grounded, including an earth ground conductor on the AC power source.

- **Circuit overloading:** Make sure the power circuits and associated circuit breakers in the rack and building provide sufficient power and overload protection. To prevent possible damage to the unit, isolate its power source from large switching loads (for example, air conditioning motors, elevator motors, factory equipment, and so on).

- **Power interruptions:** The unit will withstand the following voltage interruptions:

  - **Input transient:** 50% of nominal voltage

  - **Duration:** One half-cycle

  - **Minimum frequency:** Once every 10 seconds

- **Power failures:** Once power is restored after a complete power failure, the unit automatically performs a power-on recovery sequence without operator intervention.

- **Power supply voltage range:** The wide-ranging, redundant power supplies operate on 90–264 VAC at 50 or 60 Hz. The power supplies meet domestic and international requirements and can operate at any voltage within the specified range.

Table A-15   Site Wiring Voltages for Drive Enclosures
(Single-phase Line-to-neutral)

Frequency		Range				
50 Hz	Nominal	100	127	220	230	240
	Minimum	90	114	198	207	216
	Maximum	107	136	235	246	264
60 Hz	Nominal	100	120			
	Minimum	90	104			
	Maximum	107	127			

Environmental

Table A-11 and Table A-12 lists the environmental requirements for the disk enclosure.

Table A-16   Altitude Requirements for System Enclosures

Condition	Range	Requirement below Sea Level	Requirement above Sea Level
Altitude[a]	Operating	30.5 m (100 ft.)	3,048 m (10,000 ft.)
	Storage	30.5 m (100 ft.)	3,048 m (10,000 ft.)
	Transit	30.5 m (100 ft.)	12,000 m (40,000 ft.)

a. If planning to operate the enclosure at altitudes between 1,000 m (3,280 ft.) and 3,000 m (9,850 ft.),
   lower the environmental temperature 1.7 $^{\circ}$C (3.3 $^{\circ}$F) for every 1,000 m (3,280 ft.) above sea level.

Table A-17   Environmental Requirements for Disk Enclosures

Condition	Range	Requirement
Temperature	Operating	10 $^{\circ}$C to 40 $^{\circ}$C (32 $^{\circ}$F to 109 $^{\circ}$F)
	Storage	-10 $^{\circ}$C to 65 $^{\circ}$C (14 $^{\circ}$F to 149 $^{\circ}$F)
	Transit	-40 $^{\circ}$C to 65 $^{\circ}$C (-40 $^{\circ}$F to 149 $^{\circ}$F)
Maximum temperature change allowed	Operating	1 $^{\circ}$C (18 $^{\circ}$F) per hour
	Storage	15 $^{\circ}$C (27 $^{\circ}$F) per hour
	Transit	20 $^{\circ}$C (36 $^{\circ}$F) per hour
Relative humidity (no condensation)	Operating	20% to 80%
	Storage	10% to 93%
	Transit	5% to 95%
	Maximum dew point	26 $^{\circ}$C (79 $^{\circ}$F)
	Maximum humidity Gradient	10% per hour
Heat dissipation	~1517 Btu/hr (0.454 kVA or 444 W)	
Sound	Power	6.5 bels
	Pressure	65 dBA

007-4843-001

Air Flow

Figure A-7 shows the air flow in the drive enclosure. Make sure your installation site will allow adequate ventilation during operation.

Important: Allow a minimum of two feet of clearance in front of and behind the enclosure for proper ventilation and servicing.

Figure A-9   Air Flow in the Drive Enclosure

SGI Field Engineering Compliance Statements

Electromagnetic Emissions

The equipment described in this guide complies with the Class A limits of Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment does not exceed the Class A limits of Canada's Department of Communications Radio Interference Regulations for radio noise emissions.

This device complies with Class A electromagnetic emissions limits of C.I.S.P.R. Publication 22, Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment, Germany's BZT Class A limits for Information Technology Equipment, and with Japan's VCCI Class A limits.

Caution: Do not modify this product in any way that is not expressly approved by Silicon Graphics, Inc. If you do, you may lose your FCC or other government agency authority to operate this device.

Radio and Television Interference

The equipment described in this guide generates and uses radio frequency energy. If it is not installed and used in accordance with the instructions in this guide, it can cause radio and television interference.

This equipment has been tested and complies with the limits for a Class A computing device in accordance with the specifications in Part 15 of FCC rules. These specifications

are designed to provide reasonable protection against such interference in an industrial or office installation. However, there is no guarantee that the interference will not occur in a particular installation. This system is not certified for home use.

You can determine whether your system is causing interference by turning it off. If the interference stops, it was probably caused by the workstation or one of the peripherals. To tell if the interference is caused by one of the peripherals, try disconnecting one peripheral at a time to see if the interference stops. If it does, that peripheral is the cause of the interference.

If your workstation does cause interference to radio or television reception, try to correct the interference by using one or more of the following suggestions:

- Turn the television or radio antenna until the interference stops.

- Move the workstation to one side or the other of the radio or television.

- Move the system farther away from the radio or television.

- Plug the system into an outlet that is on a different circuit from the radio or television. (Make certain the workstation and the radio or television are on circuits controlled by different circuit breakers or fuses.)

Product Safety

This product has been tested and is listed, certified, or approved to the following product safety standards:

- UL 1950

- CAN/CSA C22.2, No. 950-M89

- IEC 950

- EN 60 950

- Standard for Safety of Information Technology Equipment, including Electrical Business Equipment, Class 1, SELV

Electrostatic Discharge

SGI designs and tests its products to be immune to effects of electrostatic discharge (ESD). ESD is a source of electromagnetic interference and can cause problems ranging from data errors and lockups to permanent component damage.

It is important that while you are operating this equipment you keep all the covers and doors, including the plastics, in place. The shielded cables that came with the system and its peripherals should be installed correctly, with all thumbscrews fastened securely.

An ESD wrist strap is included with some products, such as memory and graphics upgrades. The wrist strap is used when installing these upgrades to prevent the flow of static electricity, and it should protect your system from ESD damage.

Shielded Cables

The equipment described in this guide is FCC-compliant under test conditions that include the use of shielded cables between it and its peripherals. This equipment and any peripherals you purchase from SGI have shielded cables. Shielded cables reduce the possibility of interference with radio, television, and other devices. If you use any cables that are not from SGI, make sure they are shielded. Telephone cables do not need to be shielded.

In Germany, a shielded cable must be used on the Ethernet 10BaseT port.

The monitor cable supplied with your system uses additional filtering molded into the cable jacket to reduce radio frequency interference. Always use the cable supplied with your system. If your monitor cable becomes damaged, a replacement cable should be obtained from SGI.

FCC Warning

This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the users will be required to correct the interference at their own expense.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna.

• Increase the separation between the equipment and the receiver.

• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

• Consult the dealer of an experienced radio/TV technician for help.

Caution: The user is cautioned that changes or modifications to the equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

EMI Collar

For increased radiated emissions margin, you may install an EMI collar to your optical Fibre Channel card. Contact your SGI service representative and ask for SGI part number 0403370-001.

VDE 0871/6.78

The equipment described in this guide has been tested to and is in compliance with the Level A limits per VDE 0871.

European Union Statement

This device complies with the European Directives listed on the "Declaration of Conformity" which is included with each product. The CE mark insignia displayed on the device is an indication of conformity to the aforementioned European requirements.

International Special Committee on Radio Interference (CISPR)

The equipment described in this guide has been tested to and is in compliance with the Class A limits per CISPR publication 22.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Attention

Cet appareil numérique n'emet pas de perturbations radioélectriques dépassant les normes applicables aux appareils numériques de Classe A préscrites dans le Règlement sur les interferences radioélectriques établi par le Ministère des Communications du Canada.

Japanese Class A Compliance Statement

この装置は、情報処理装置等電波障害自主規制協議会 (VCCI) の基準に基づくクラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

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