SGI® InfiniteStorage TP9300 and TP9300S RAID User's Guide

CONTRIBUTORS

Written by Matt Hoy

Updated by Mark Schwenden

Illustrated by Kelly Begley, Matt Hoy, and Jim Ostrom

Production by Karen Jacobson

Engineering contributions by Bill Andrews, Marty Castilla, Bill Lusche, Robert Novak, Henry Ortiz, and Sammy Wilborn

Record of Revision

Version	Description
001	May 2003 Original publication
002	December 2003 Engineering updates for Serial ATA

Contents

Figures

Tables

About This Guide

This guide provides an overview of the SGI Total Performance 9300 (SGI TP9300). It covers routine operation and replacement procedures and provides troubleshooting and reference information for all customer-replaceable components.

The SGI TP9300 is a highly scalable RAID storage system designed for continuous availability. Some of the features of the system include hot-swappable components, easy expansion, and redundant power and cooling systems.

The TP9300S RAID storage subsystem uses Serial Advanced Technology Attachment (SATA) drives rather than fibre channel attached (SCSI-protocol) drives. All references to the TP9300 apply equally to the TP9300S unless otherwise specified.

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 all of the following:

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

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 nmand 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 a permanent burn on the retina of the eye. Optical signals cannot be verified by looking into the fiber end.

Chapter Descriptions

This guide contains the following chapters:

- Chapter 1, "Introduction to the SGI TP9300 and TP9300S," describes the features and components of the system.

- Chapter 2, "Storage Enclosures," gives a detailed overview of the system enclosure and its components.

- Chapter 3, "Operating Storage Enclosures," describes the functions and basic operation of the system enclosures, including power on and troubleshooting with the indicator lights.

- Chapter 4, "Replacing Enclosure Components," gives detailed procedures for replacing failed components.

- Chapter 5, "Cabling," describes cabling between controller and expansion enclosures and between controllers and 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 fully supports the installation, operation, and service of the TP9300 and TP9300S. 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 TP9300 and TP9300S Installation and Upgrade Guide* (108-0401-00*x*)
  This guide gives complete instructions on how to unpack, install, and configure the SGI TP9300/TP9300S and components. It also contains upgrade information.

- *SGI TPSSM Administration Guide* (007-4306-00*x*)
  This guide gives complete instructions on how to install the TPSSM software for host and/or client operation.

- *SGI TPSSM Software Concepts Guide* (007-4305-00*x*)
  This guide explains the terminology and features of the TPSSM storage management software.

- *SGI Storage Area Network Installation Instructions* (108-0252-00*x*)
  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 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.

Product Support

SGI provides a comprehensive product support and maintenance program for its products:

- If you are in North America, contact the Technical Assistance Center at +1 800 800 4SGI or contact your authorized service provider.

- If you are outside North America, contact the SGI subsidiary or authorized distributor in your country.

Reader Comments

If you have comments about the technical accuracy, content, or organization of this document, contact SGI. Be sure to include the title and document number of the manual with your comments. (Online, the document number is located in the front matter of the manual. In printed manuals, the document number is located at the bottom of each page.)

You can contact SGI in any of the following ways:

*   Send e-mail to the following address:
    techpubs@sgi.com

*   Use the Feedback option on the Technical Publications Library website:
    http://docs.sgi.com

*   Contact your customer service representative and ask that an incident be filed in the SGI incident tracking system.

*   Send mail to the following address:

    Technical Publications
    SGI
    1600 Amphitheatre Pkwy., M/S 535
    Mountain View, California 94043-1351

SGI values your comments and will respond to them promptly.

Introduction to the SGI TP9300 and TP9300S

The SGI Total Performance 9300 is a high-bandwidth RAID Fibre Channel storage system. The Total Performance 9300S RAID system is a variant of the TP9300 that uses Serial Advanced Technology Attachment (SATA) disk drives instead of Fibre Channel (SCSI-protocol) disks. Both types of drive arrays are fibre channel attached. All references to the TP9300 apply equally to the TP9300S unless otherwise specified. See "TP9300S RAID Features" on page 2 for a list of specific differences and restrictions regarding the use of TP9300S disks and enclosures.

This chapter gives a brief overview of the features of the TP9300 and TP9300S and its primary components in the following sections:

- "System Features" on page 1
- "System Components" on page 6

System Features

The features of the TP9300 storage systems are listed in the following sections:

- "TP9300S RAID Features" on page 2
- "Performance Features" on page 3
- "RAID Controller Features" on page 4
- "Availability Features" on page 5
- "Supported Platforms" on page 5
- "Adapter and Switch Compatibility" on page 6

TP9300S RAID Features

The Total Performance 9300S RAID system is a variant of the TP9300 that uses Serial Advanced Technology Attachment (SATA) disk drives instead of Fibre Channel (SCSI-protocol) disks. Both types of drive arrays are fibre channel attached.

While the form and function of the TP9300 and TP9300S are very similar, it is important you note the following:

- Serial ATA drives (TP9300S) are **not** compatible with TP9300 Fibre Channel (SCSI-protocol) disks and should never be used as spares in TP9300 Fibre Channel (SCSI-protocol) drive arrays.

- Fibre Channel (SCSI-protocol) drives cannot be used as spares in serial ATA enclosures.

- The serial ATA (TP9300S) drive enclosure's front bezel will always be a different color (purple) than the Fibre Channel (SCSI-protocol) array (TP9300) enclosure.

- The serial ATA drive enclosure will have a different storage capacity than a Fibre Channel (SCSI-protocol) array using the same number of disks.

- The expansion enclosures contain environmental status modules instead of RAID controllers. Each environmental status module contains an environmental services monitor board (ESM) and two slots for SFPs (small form-factor pluggables). The ESM board is the interface between the controller enclosure and the expansion enclosure. The ESMs used in TP9300 and TP9300S are **not** interchangeable.

- The drive interface (ESM) in a TP9300S controller will be slightly different than those in the TP9300. The difference can be confirmed by special marking or part numbers on the SATA drive interface.

- Serial ATA ESMs and Fibre Channel (SCSI-protocol) ESMs are **not** interchangeable.

Performance Features

The SGI TP9300 RAID storage system has the following basic features:

- Outstanding performance, built on multi-channel end-to-end Fibre Channel technology.
- Support for either fibre channel attached (SCSI-protocol) or Serial ATA drive array 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). Support for optical host connections.
- Vast storage capacity with support for large numbers of drives.
- Storage management facilities for installation, configuration, expansion, and monitoring.
- Redundant power supplies and hot-swappable components.
- Easily upgradeable to meet a variety of performance requirements.
- Integrated RAID controllers.
- Battery backup for cache data.

Note: JBOD is not supported.

RAID Controller Features

The RAID controllers in the TP9300 have the following features:

- 112-drive maximum configuration
- 4 RAID levels (0, 1, 3, and 5)
- 2 Gbit/s front end (FE) and back end (BE) Fibre Channel arbitrated loop (FC-AL)
- Immediate LUN availability (ILA)
- Transparent disk drive rebuilds
- Variable stripe size per controller (16K, 32K, and 64K)
- Mirrored cache
- Drive roaming during power off
- Cache coherency
- Transparent failover and failback
- Automatic error recovery
- Write through, write back, or read ahead support
- Automatic detection of failed drives
- Automatic drive rebuilds, using "hot spare" drive
- Hot-swappable drives
- SAN mapping server to LUN mapping
- Automatic firmware flashing: In a dual controller configuration, the firmware of the replacement controller is automatically flashed to match the firmware of the surviving controller.

Availability Features

The TP9300 has the following availability features:

- Dual power feeds with dual power supplies

- Redundant cooling

- Battery back-up (BBU) maintains cache in case of power failure

- IRIX path failover

- Dynamic hot-sparing

- Non-disruptive component replacement

- Enclosure services interface (ESI) for SCSI enclosure services (SES)

Supported Platforms

The TP9300 supports the following hardware and software platforms:

- Hardware: SGI Altix series, SGI Origin 200, Origin 300, Origin 350, Origin 2000, and Origin 3000 family servers

- Software: SGI IRIX operating system 6.5.21 or later, SGI Linux Environment of 7.2 with SGI ProPack 2.1 and SGI Advanced Linux Environment 2.1 or later with SGI ProPack 2.2 or later, CXFS, FailSafe

Adapter and Switch Compatibility

The TP9300 supports the following host bus adapters (HBAs) and switches:

Note: The TP9300 does not support copper Fibre Channel HBAs.

- QLogic 2200 optical 33/66-MHz HBA
- QLogic 2310 optical 66-MHz HBA
- QLogic 2342 optical 66-MHz dual channel HBA
- Brocade family SAN switches
  - SilkWorm 2400 1-Gb/s 8-port switch
  - SilkWorm 2800 1-Gb/s 16-port switch
  - SilkWorm 3200 2-Gb/s 8-port switch
  - SilkWorm 3800 2 Gb/s 16-port switch
  - SilkWorm 3900 2-Gb/s 32-port switch
  - SilkWorm 12000 2-Gb/s 64-port switch
- IRIX release level 6.5.21 or later

System Components

This section contains pictures and brief descriptions of the components that make up the TP9300 in the following sections:

- "Storage Enclosures" on page 7
- "TP9300 Rack" on page 9

Storage Enclosures

The TP9300 is comprised of storage enclosures. These enclosures provide all of the logic, power, and I/O functions of the system. Each enclosure can be operated as an independent storage system, or multiple enclosures can be cabled together to create much larger disk arrays.

There are two types of storage enclosures: controller enclosures and expansion enclosures. The only difference between the types of enclosures is that the controller enclosure contains two integrated RAID controllers. The expansion enclosures do not contain RAID controllers and must be cabled to controller enclosures. Figure 1-1 shows a front view of both a deskside tower and a rackmount controller enclosure.

Note: Controller enclosures and expansion enclosures look identical from the front. TP9300S systems use a different color (purple) front bezel than TP9300 (blue).
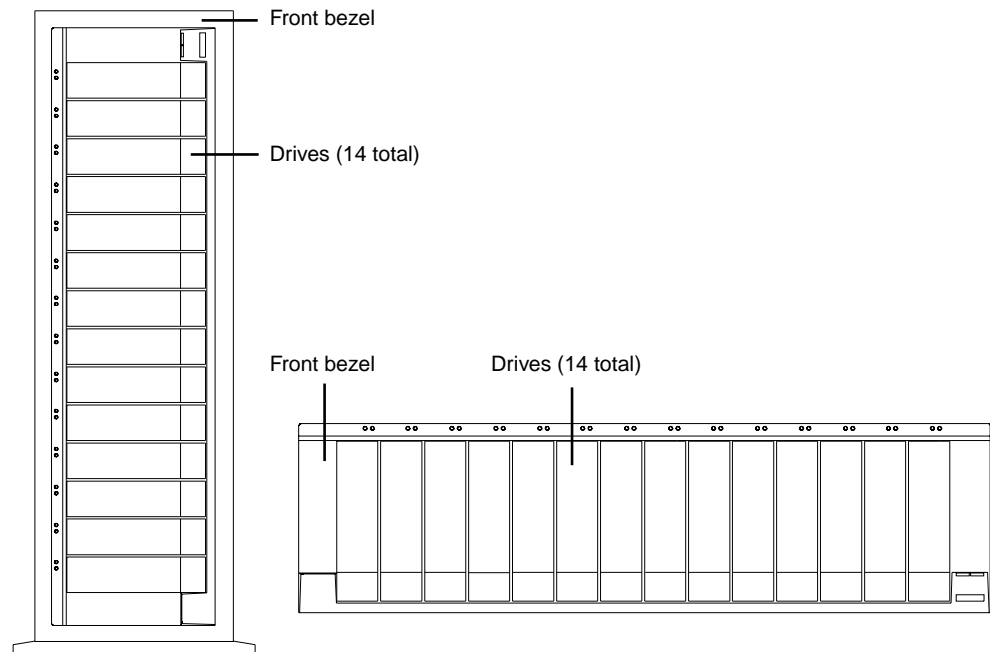
Figure 1-1   TP9300 Tower and Rackmount Storage Enclosures (Front View)

Figure 1-2 shows a rear view of both a controller enclosure and an expansion enclosure.
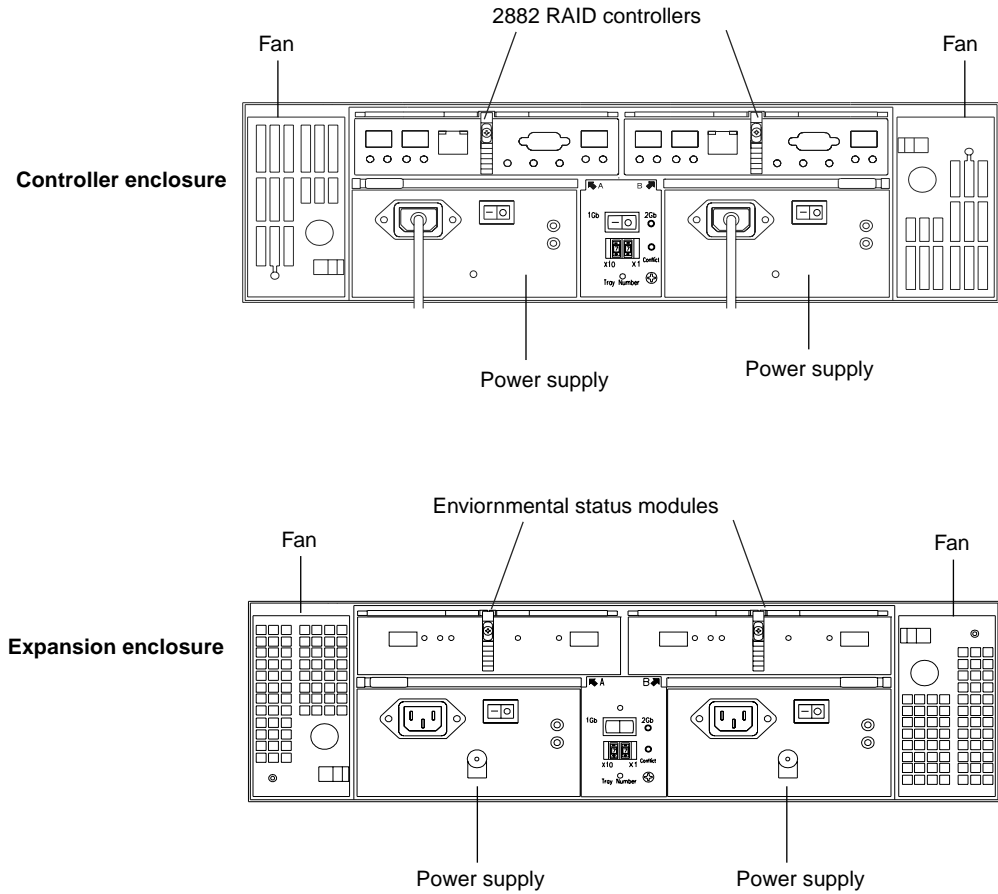
Figure 1-2   TP9300 Controller and Expansion Enclosures (Rear View)

See Chapter 2, "Storage Enclosures" for more information about the controller and expansion enclosures and their components.

TP9300 Rack

The SGI TP9300 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.

- Heavy-duty casters for ease of movement.

- Dual power distribution units (PDUs).

- Optional stabilizer foot to reduce tipping.

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

Figure 1-3 shows a TP9300 rack with controller and expansion enclosures installed in it.

Controller enclosure

Expansion enclosures
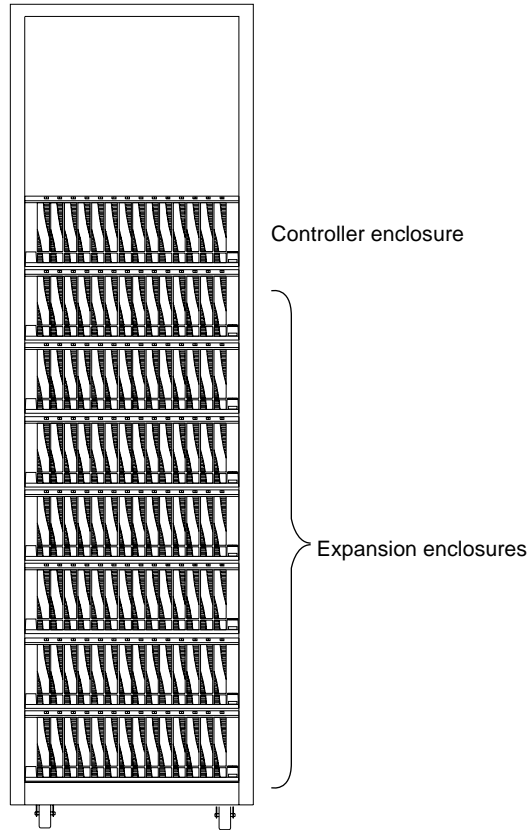
Figure 1-3   TP9300 Rack with Enclosures Installed

Figure 1-4 shows some of the features of the rack.

Standard
EIA rails

Cable access holes

Casters

Removable
stabilizer foot
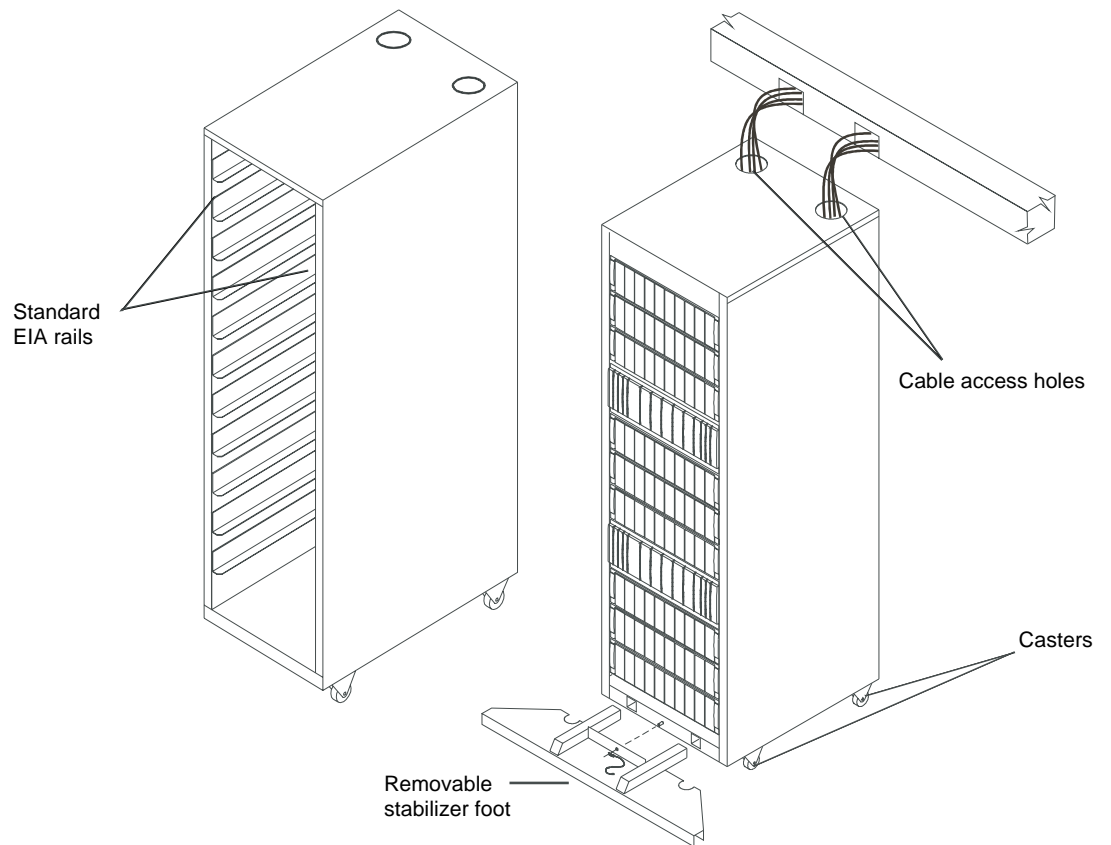
Figure 1-4   Rack Features

For detailed specifications of the rack, see "Rack Specifications" on page 81.

Storage Enclosures

The storage enclosure is the basic building block of the TP9300. Each storage enclosure provides redundant power and cooling to its individual components. The storage enclosures also house the I/O components of the storage system.

There are two types of storage enclosures: controller enclosures and expansion enclosures. As their name implies, controller enclosures contain the RAID controllers for the storage system. The expansion enclosures provide expansion disk drive space. The two types of storage enclosures share many of the same components. The only difference between controller enclosures and expansion enclosures is the presence or absence of the RAID controllers.

This chapter describes the components in both the controller and expansion enclosures in the following sections:

- "Overview" on page 14
- "Disk Drives" on page 18
- "RAID Controllers" on page 19
- "Environmental Status Modules (ESMs)" on page 21
- "Fans" on page 22
- "Power Supplies" on page 23
- "Tray ID Switch" on page 25
- "Link Rate Switch" on page 26
- "SFP Transceivers" on page 27

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 *SGI TP9400 and SGI TP9500 Software Concepts Guide* (007-4305-00*x*).

Figure 2-1 shows a front view of the storage 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 14 sled-mounted drives can be installed in the bays on the front of the enclosure.

- **LEDs:** There are two LEDs for each of the 14 drive bays that indicate the status of the drive: the drive active LED and the drive fault LED. There are also two LEDs that indicate the status of the entire enclosure: the enclosure fault LED and the enclosure power LED.

- **Alarm mute button:** This button silences the audible alarm of the controller enclosure. The expansion enclosure does not have an alarm; therefore, the expansion enclosure does not use this button.

Note: Controller enclosures and expansion controllers look identical when viewed from the front.
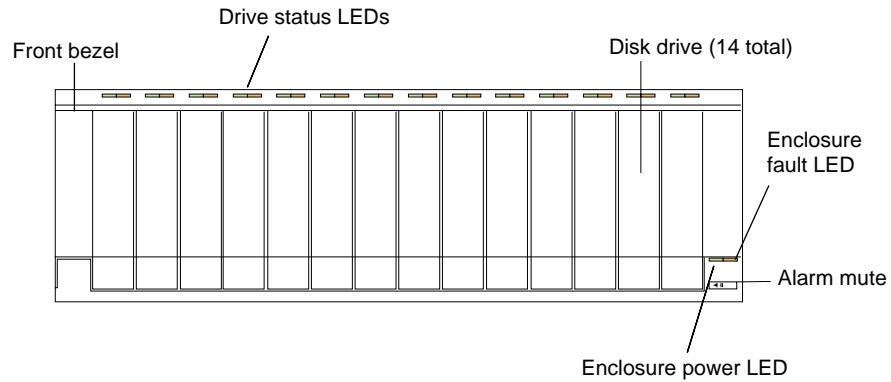
Figure 2-1   Storage Enclosure Components (Front View)

Figure 2-2 shows a rear view of both a controller enclosure and an expansion enclosure. The rear of the enclosures contain the following components:

- **RAID controllers:** Controller enclosures contain two 2882 RAID controllers.

- **Environmental status modules (ESMs):** Expansion enclosures have two ESM modules in place of the RAID controllers.

- **Fans:** Two fans provide redundant cooling for the enclosure.

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

- **Power supplies:** Two power supplies provide redundant power for the enclosure.

2882 RAID controllers

Fan   Fan

Controller enclosure

Power supply   Power supply

Link rate/ enclosure ID switches

Enviornmental Status Modules

Fan   Fan

Expansion enclosure

Power supply   Power supply

Link rate/ enclosure ID switches
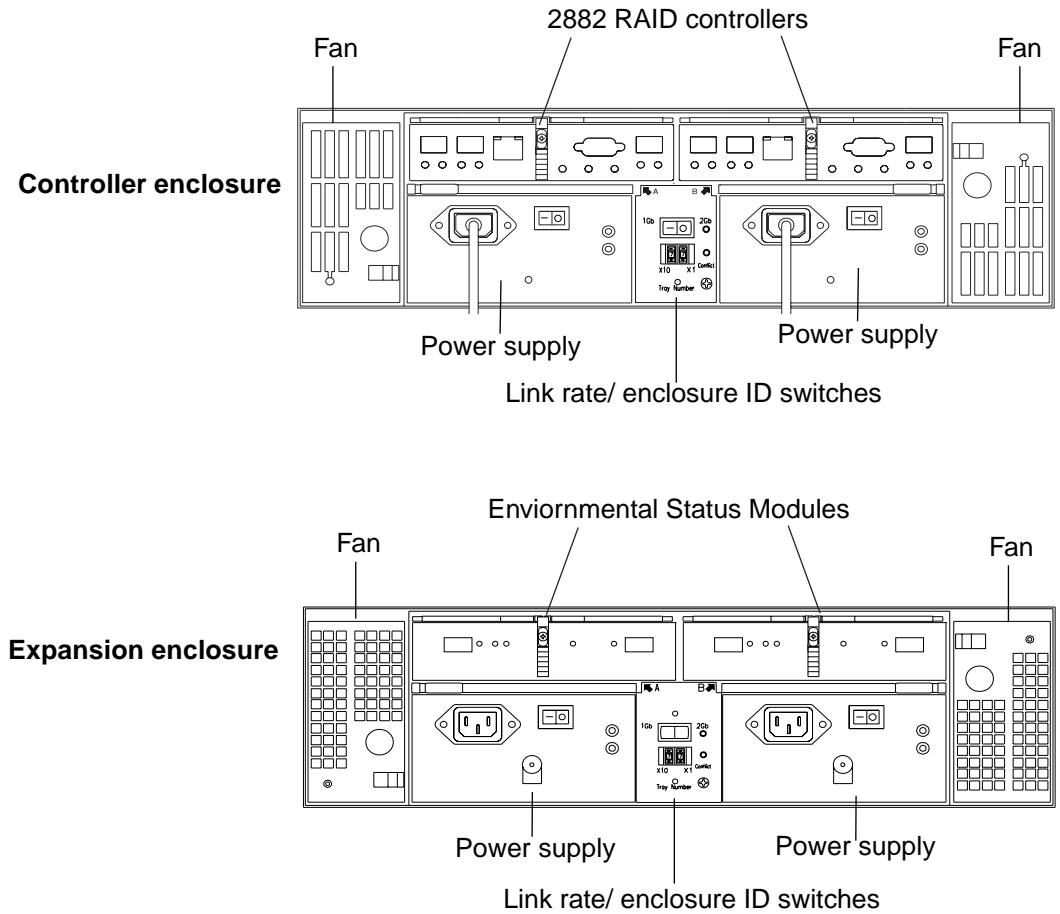
Figure 2-2   Storage Enclosure Components (Rear View)

Disk Drives

Each storage enclosure can contain up to 14 low-profile Fibre Channel disk drives. Controller enclosures can be cabled to as many as seven expansion 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. Figure 2-3 shows the drive sled and drive bay numbering scheme for the TP9300.

Each drive has two status LEDs (see Figure 2-3) as follows:

- **Drive active LED:** This LED illuminates green when a drive is in the drive bay, and it blinks when the drive is active.

- **Drive fault LED:** This LED illuminates amber when there is a problem with the drive.
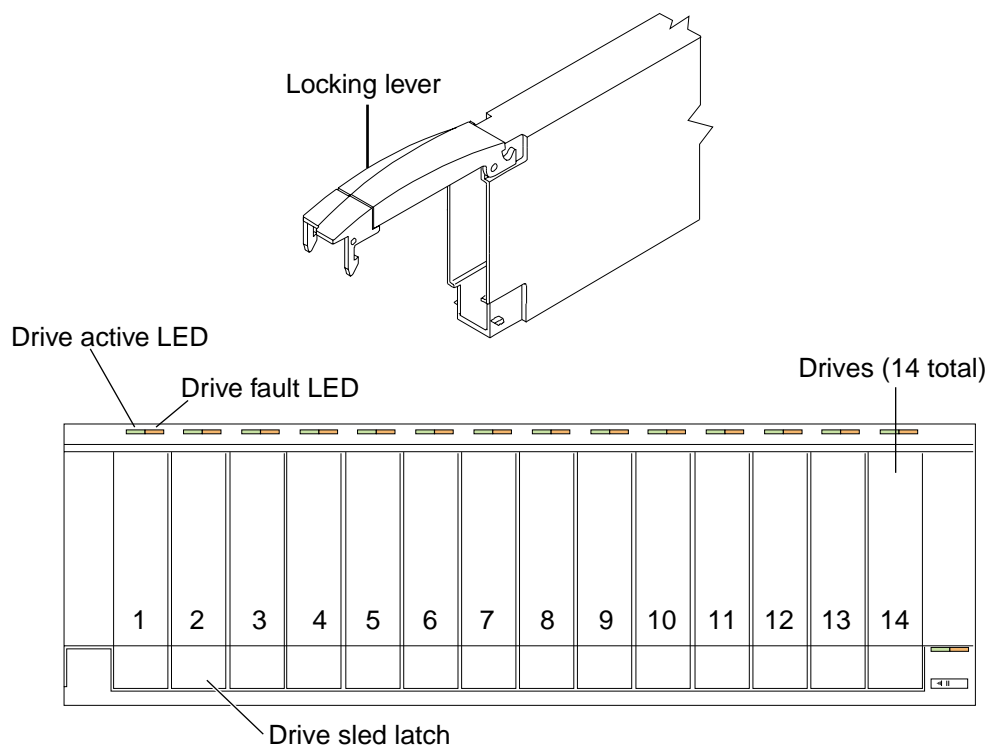
Figure 2-3   Disk Drives and Drive Bay Numbering

RAID Controllers

Each TP9300 controller enclosure contains two 2882 RAID controller modules. These controllers slide into the same opening that the ESMs occupy on the expansion enclosures. Each controller contains RAID logic, cache memory, a rechargeable battery for the cache, and additional environmental monitoring circuitry. Each controller also has two labels on its rear panel: one shows the MAC address of the controller and one shows the battery service date (see Figure 2-4).

The RAID controllers provide the following features and capabilities:

- Support for RAID levels 0, 1, 3, and 5
- Dual-porting for failover
- Support for 2 hosts per controller (4 per controller module)
- 256 MB of cache memory with 7-day battery backup
- Array sizes up to 112 drives
- Data transfer rates up to 200 MB/s

The RAID controller has the following connectors (see Figure 2-4):

- 2 Fibre Channel host ports with small form-factor pluggable transceivers (SFPs)
- 1 Ethernet host port
- 1 Fibre Channel drive expansion port
- 1 RS-232 diagnostic port

The RAID controller has the following LED indicators (see Figure 2-4):

- Host 1 link and speed LEDs
- Host 2 link and speed LEDs
- Battery charging/charged LED
- Cache active LED
- Fault LED
- Expansion loop LED
- Expansion loop bypass LED

For more information about these LEDs, see "Checking the Indicator Lights" on page 36.
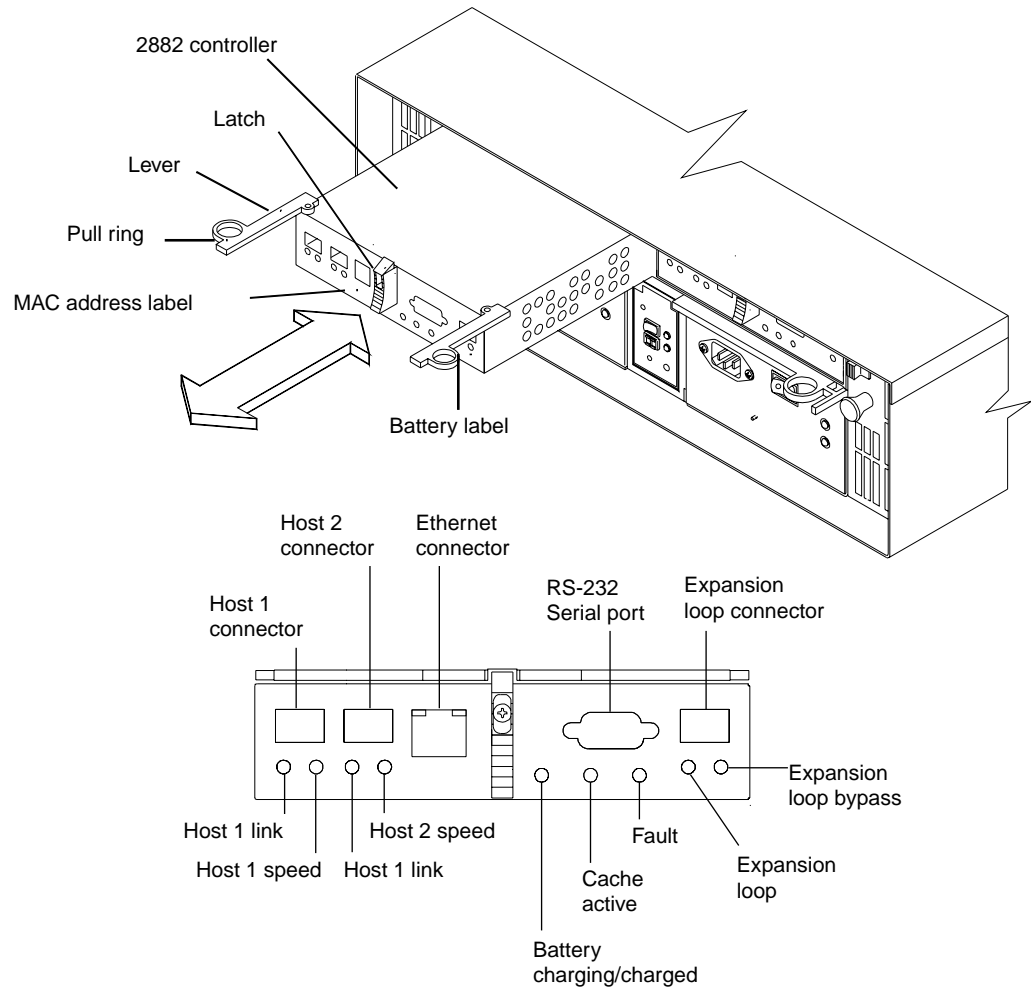
Figure 2-4   2882 RAID Controller

Environmental Status Modules (ESMs)

The expansion enclosures contain environmental status modules instead of 2882 RAID controllers (see Figure 2-5). 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 expansion enclosure, and it monitors expansion enclosure status. If there are internal problems in the expansion enclosure, the environmental services monitor board lights the appropriate fault LED. For more information about this LED, see "Checking the Indicator Lights" on page 36.
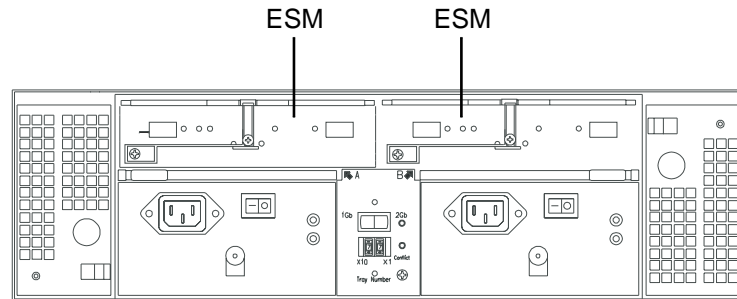
Figure 2-5   Environmental Status Modules

Fans

The storage enclosures each have two fan units. These fan units are mounted in the rear of the enclosure (see Figure 2-6). 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. 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 fan unit has a fault light that illuminates if there is a problem with the units.
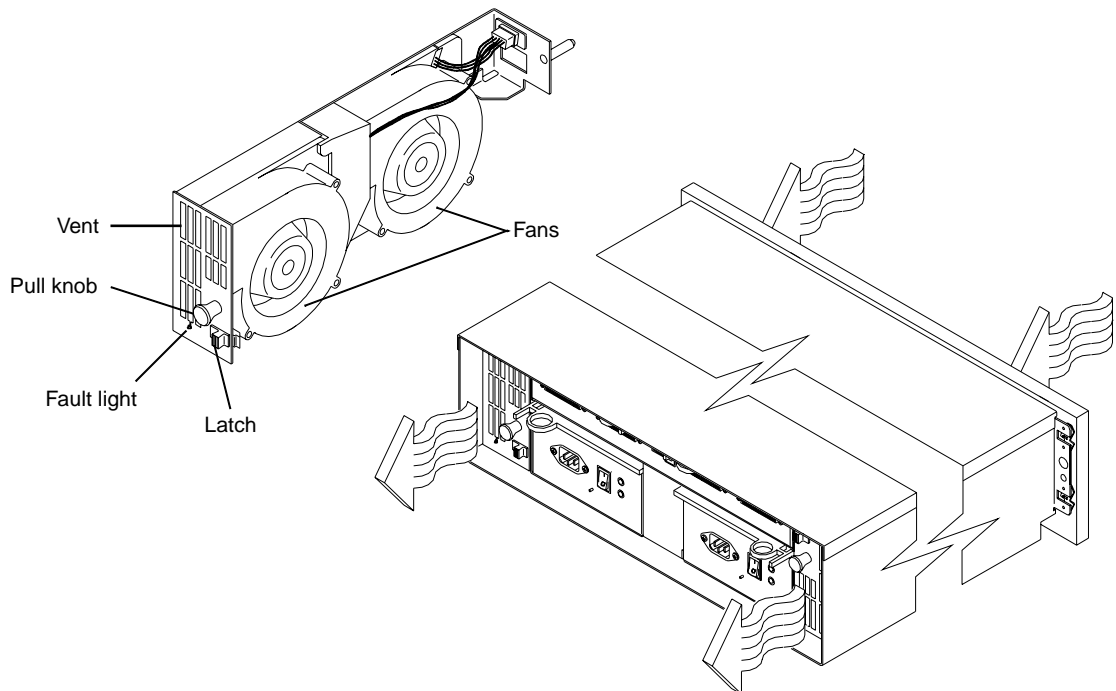
Figure 2-6   Fan Units

Power Supplies

Each storage enclosure contains two power supplies. These power supplies 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 supply has the following components on its rear panel (see Figure 2-7):

- 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 supply, the fault light comes on.

For specification information about the power supplies, see "Wiring and Power" on page 95.
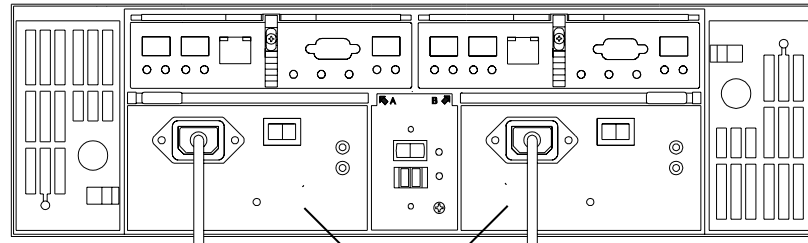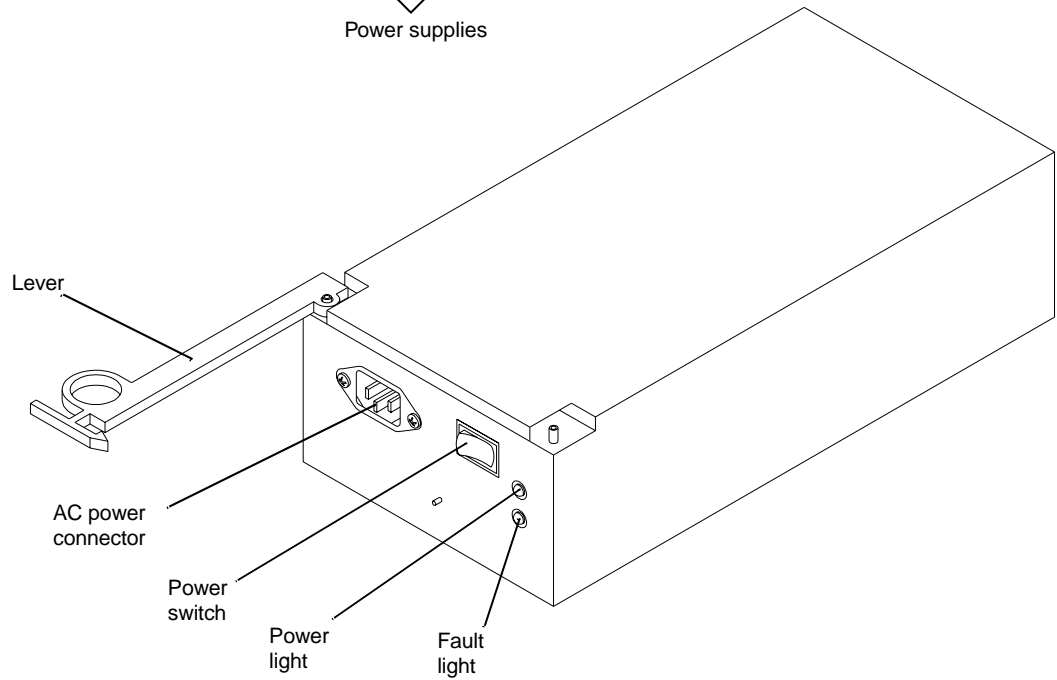
Figure 2-7   Power Supplies

Tray ID Switch

The tray ID switch is located between the power supplies on the rear of the enclosure (see Figure 2-8). This switch assigns a unique identifier to every enclosure in the system. The controller enclosure should always have its tray ID set to "00." The first expansion enclosure should be set to "01." Each subsequent expansion enclosure should be assigned the next highest ID. If more than one enclosure is set to the same ID number, the conflict LED illuminates.

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.
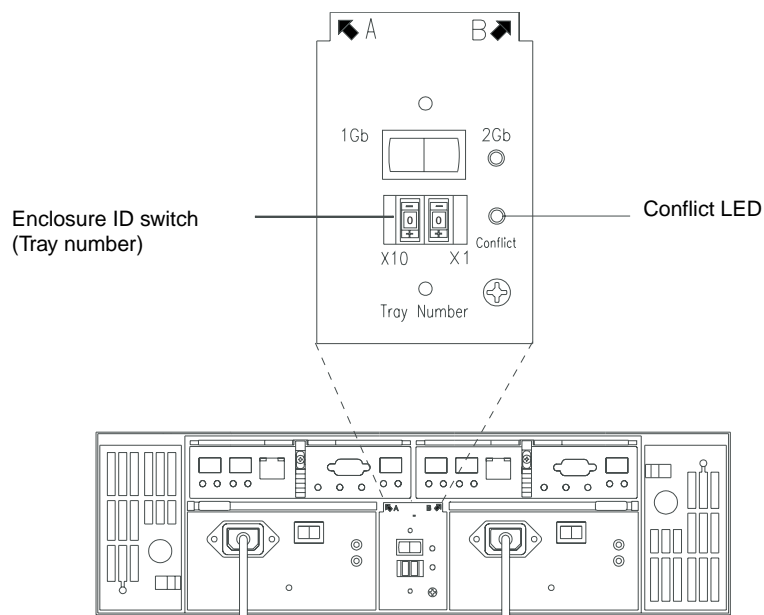
Figure 2-8   Tray ID Switch

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 2-9). The link rate switch controls the speed of the Fibre Channel connections to the enclosure. This switch should always be set to 2 Gbit/s. When there is a 2 Gbit/s link present, the 2-Gbit link rate LED illuminates green.
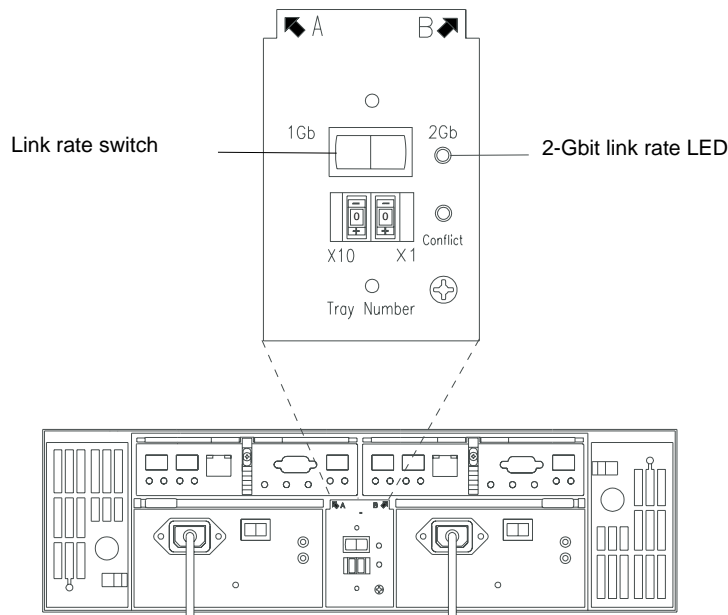
Figure 2-9   Link Rate Switch

Note: The link rate switches on all enclosures in a system should be 2 Gbit/s.

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 2-10). Every Fibre Channel cable that connects to a RAID controller or ESM module requires an SFP transceiver.

SFP tranceiver   Fiber-optic cable
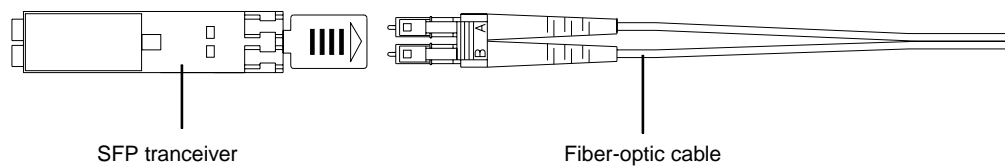
Figure 2-10   SFP Transceiver

You can hot-swap a failed SFP transceiver, which means you can replace it while the controller 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 Storage Enclosures

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

Note: All of the procedures in this chapter apply to both the controller enclosures and the expansion enclosures.

Turning the Power On

If the storage 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 31.

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 34), turn on both power switches on the rear of the enclosure (see Figure 3-1) 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 expansion enclosures before or at the same time as the controller enclosure.

Power supply switches
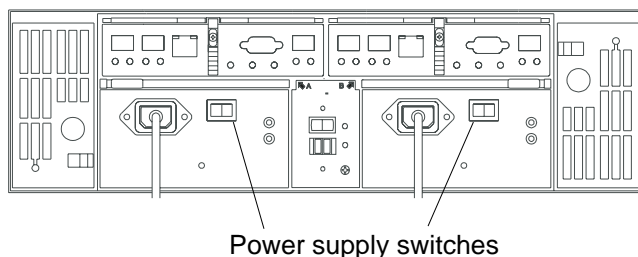
Figure 3-1 Turning the Power On and Off

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 34) 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 32 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 33 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 expansion 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 3-3 on page 39 for the location of the overtemp indicators on expansion enclosures.

The controller enclosure does not have an overtemp indicator. Check the storage management software for temperature information about the controller 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 3-1 on page 30).

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 expansion 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 36) 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 3-1 on page 30).

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 expansion enclosures before or at the same time as the controller enclosure.

3. Turn on the power to the enclosures (see Figure 3-1 on page 30).

4. Use TPSSM and the drive fault indicators (see "Checking the Indicator Lights" on page 36) 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 3-2 on page 37 and Figure 3-3 on page 39).

    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 3-1 on page 30).

    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 29.

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*), the *SGI TPSSM Software Concepts Guide* (007-4305-00*x*), and the *SGI Storage Area Network Installation Instructions* (108-0252-00*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 3-2 and Figure 3-3, 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 3-1 on page 38 (front indicators) and Table 3-2 on page 40 (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 controller and expansion enclosures. Figure 3-2 shows the front indicators for the controller and expansion enclosures.
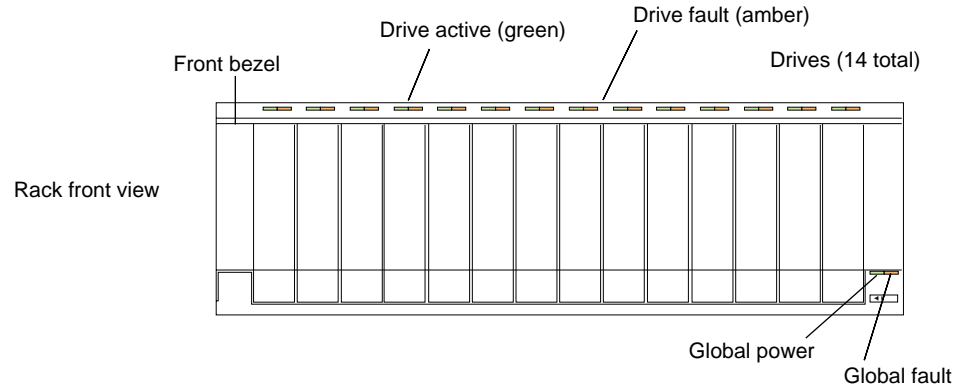
Figure 3-2   Storage Enclosure Front Indicator Lights

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 3-1 describes the front indicator lights on the controller and expansion enclosures.

Table 3-1   Storage Enclosure Front Indicator Lights

Indicator Light	Color	Normal Operation	Problem Indicator	Condition Indicated[a]
Drive activity indicator	Green	On, steady On, blinking[b]	Off	No power to enclosure; no power to storage array; drive not properly seated in drive enclosure; drive not spun up.
Drive fault indicator	Amber	Off On, blinking[c]	On, steady	Drive failure; drive failed by user.
Global power indicator	Green	On	Off	No power to drive enclosure; no power to storage array; power supply failure; overtemp condition.
Global fault indicator[d]	Amber	Off	On	Enclosure component failure.

a. Always use the storage management software (TPSSM) to precisely identify a failure.

b. The drive activity indicator blinks if data is being processed on the drives; otherwise, the indicator is on, steady.

c. The drive fault indicator blinks when the storage management software (TPSSM) is locating a drive, volume, or storage array. Otherwise, it is off.

d. Not all enclosure component failures will turn this light on. See "Monitoring Status with Software" on page 88 for more information.

Rear Indicator Lights

This section describes the rear indicator lights for the controller and expansion enclosures. Figure 3-3 shows the rear indicators on the expansion enclosure and the RAID controller. Controller enclosures have RAID controller LEDs, but not ESM LEDs.

In bypass
Power   Overtemp
Fault   Out bypass

In bypass
Power   Overtemp
Fault   Out bypass

Fan fault

Enclosure and ESM LEDs

Fan fault

Power

Power supply
fault

Conflict

2-Gbit link rate

Power

Power supply
fault

Host 2   Ethernet
connector   connector

Host 1
connector

RS-232
Serial port

Expansion
loop connector

RAID controller module LEDs

Expansion
loop bypass

Host 1 link

Host 1 speed

Host 2 speed

Host 2 link

Fault

Cache
active

Battery
charging/charged

Expansion
loop

Figure 3-3   Storage Enclosure Rear Indicator Lights

Table 3-2 describes the rear indicators on the expansion enclosure and RAID controller.

Note: 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.

Table 3-2   Storage Enclosure Rear Indicator Lights

Component	Indicator Light	Color	Normal Operation	Problem Indicator	Condition Indicated[a]
RAID controller module	Host 1 link Host 2 link	Green	On	Off	No connection to host
	Host 1 speed Host 2 speed	Green	On: 2 Gbit/s data rate from host Off: 1 Gbit/s data rate from host	None	
	Battery charging/charged	Green	On: battery charged Flashing: battery charging	Off	Battery failure
	Cache active	Green	On	Off	Cache failure
	Fault	Amber	Off	On	General failure
	Expansion loop	Green	On	Off	
	Expansion loop bypass	Amber	Off	On	
Environmental status module	Environmental card fault indicator	Amber	Off	On, steady	Failure of environmental card canister.
	Environmental card power indicator	Green	On, steady	Off	No power to drive enclosure; no power to storage array; overtemp condition; power supply failure.
	In, out bypass indicators	Amber	Off On, steady[b]	On, steady[c]	SFP failure; cable failure; controller enclosure minihub failure.
	Overtemp indicator[d]	Amber	Off	On, steady	Overtemp condition; fan failure.

Table 3-2   Storage Enclosure Rear Indicator Lights **(continued)**

Component	Indicator Light	Color	Normal Operation	Problem Indicator	Condition Indicated[a]
	ID conflict indicator	Amber	Off	On, steady	Enclosure number is set incorrectly; enclosure number is in use by another subsystem on the loop.
Fan canister	Fan fault indicator	Amber	Off	On, steady	Fan canister failure; overtemp condition.
Power supply canister	Power supply fault indicator	Amber	Off	On, steady	Power supply failure; overtemp condition.
	Power supply power indicator	Green	On, steady	Off	Power supply off; power supply disconnected; power supply is seated incorrectly; no power to drive enclosure; no power to storage array.

a. Always use the storage management software (TPSSM) to precisely identify a failure.

b. If nothing is connected to the corresponding connector, this fault light is on. If a cable is connected and it is functioning properly, this light is off.

c. This indicates a problem only if an SFP is plugged into the corresponding connector (see footnote a). Also, more than one bypass indicator will be on if the connection fails. Usually, if an SFP fails, its bypass indicator will come on, as will the bypass indicator of the module to which it is connected.

d. The overtemp indicator comes on if the internal drive enclosure temperature reaches 40 $^\circ$C (104 $^\circ$F). See "Troubleshooting an Overtemp Condition" in this chapter for more information.

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 is provided in Chapter 4, "Replacing Enclosure Components".

Note: If you are removing an expansion enclosure so that you can connect it to a different controller enclosure, you must 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 3-4).

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.
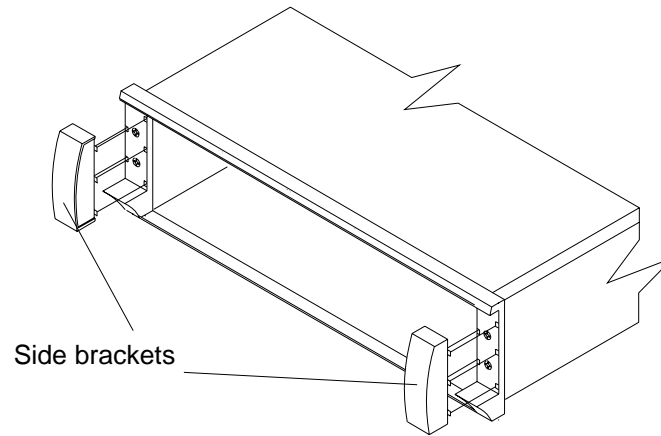
Side brackets

Figure 3-4   Removing the Side Brackets from the Enclosure

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

5. Remove the front and rear mounting screws (see Figure 3-5). There are two mounting screws at the rear, one for each support rail, and two mounting screws in the front, one in each flange.
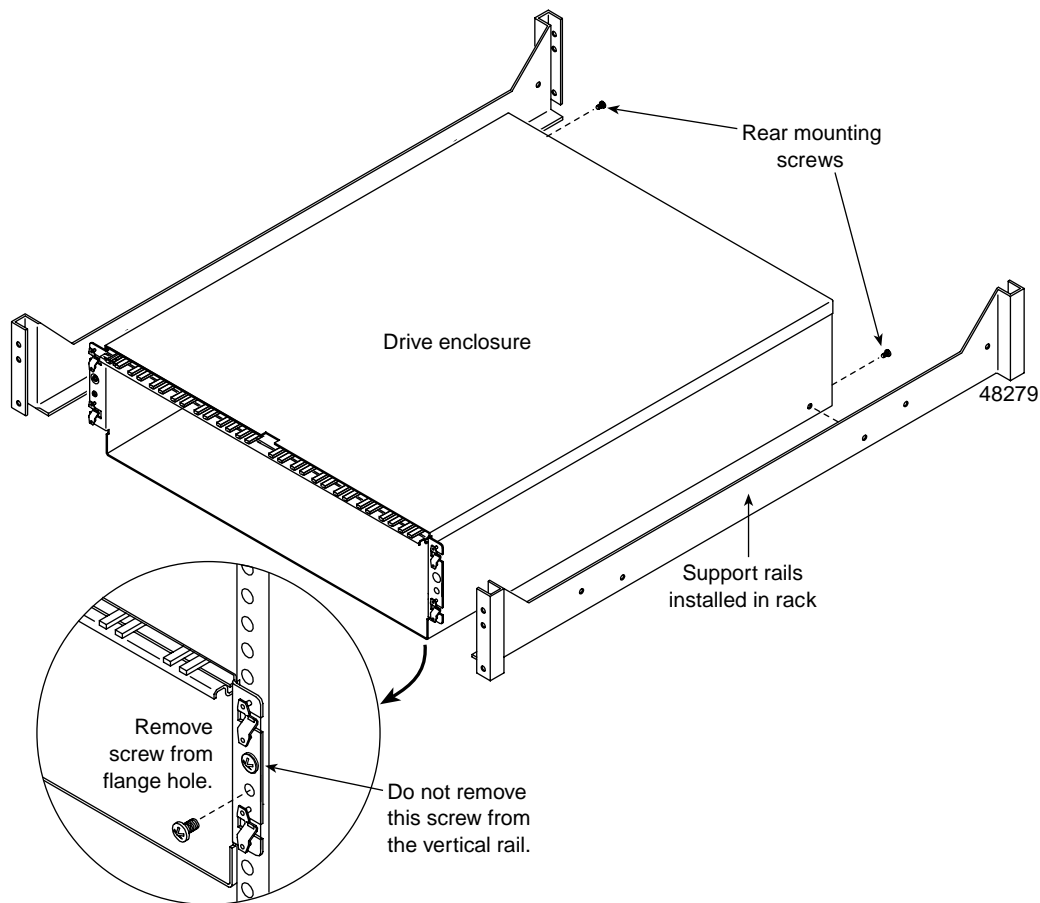
Figure 3-5   Removing the Empty Drive Enclosure

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

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

1. Install the support rails in the rack. See the procedure in the *SGI TP9300 RAID Installation and Upgrade Guide* (108-0401-00*x*).

2. From the front of the rack, slide the enclosure into the rack along the support rails (see Figure 3-5).

3. Fasten the rear and front mounting screws (see Figure 3-5).

4. Slide the top of the front bezel over the indicator lights and snap into place (see Figure 3-4).

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

Replacing Enclosure Components

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

- "Replacing a Failed Disk Drive" on page 47
- "Replacing a Failed Fan" on page 50
- "Replacing a Failed Power Supply Module" on page 52
- "Replacing a Failed SFP Transceiver" on page 54
- "Replacing a Failed RAID Controller Module" on page 56
- "Replacing a Failed Environmental Status Module" on page 58
- "Upgrading Drives" on page 61
- "Adding Expansion Enclosures" on page 65

Replacing a Failed Disk Drive

When the storage management software (TPSSM) instructs you to replace a failed drive module, read "Disk Drives" on page 18, and then follow the steps in this section.

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.

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

Drive

Drive lever
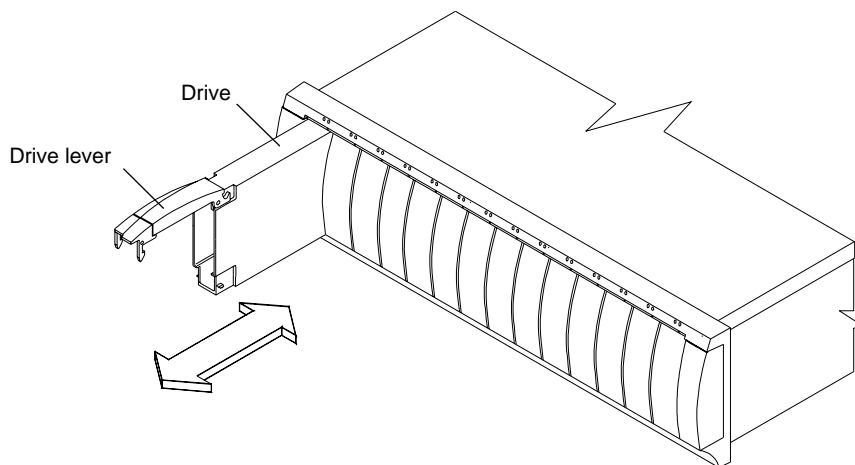
Figure 4-1   Removing and Installing a Drive Module

5. Wait at least 30 seconds for the drive to spin down. Then remove the failed drive module from the enclosure.

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. 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 activity and fault indicators above the new drive module. The activity indicator should be on (either blinking or steady) and the fault indicator 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.

- If the activity indicator is off, the drive module could be installed incorrectly. Remove the drive module, wait 30 seconds, and then reinstall it.
- If the fault indicator stays on, or if the activity indicator stays off, the new drive may be bad. Use TPSSM to determine the problem.

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

> **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 Fan

When TPSSM instructs you to replace a failed fan module, read "Fans" on page 22, 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 fan module failure recovery procedures. Follow any instructions provided before proceeding.

2. Unpack the new fan module. Set the new fan 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 fan 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. 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 fan module replacement procedure within 15 minutes from the time you remove the failed fan module to the time you install the new fan module. Both fan modules must be installed in the enclosure to provide sufficient air circulation within the enclosure.

5. Locate the failed fan module (its fault light should be on).

6. Wearing antistatic protection, slide the latch to unlock the module (see Figure 4-2). The latch is at the bottom of the left-side fan module, and at the top of the right-side fan module.

7. Pull the knob to remove the fan module.

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

9. Slide the new module into the slot.
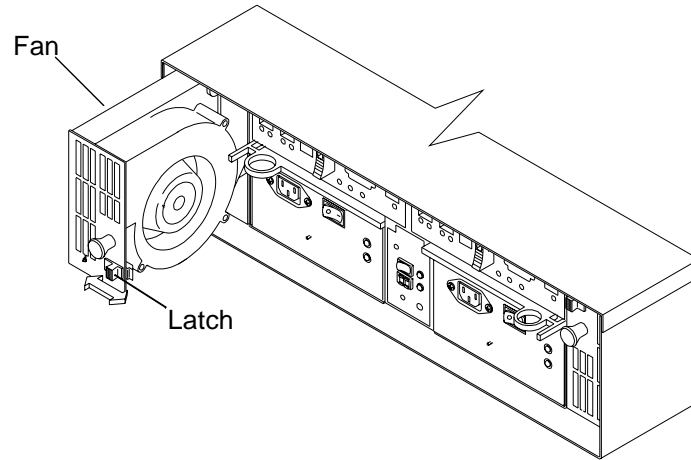
Figure 4-2   Removing and Installing a Fan Module

10. Push firmly until the latch snaps into place.

11. If you turned the power off, turn it back on.

12. Check the fault indicators as follows (see Figure 4-3):

    • 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 4-3 are on, use TPSSM to determine the problem.
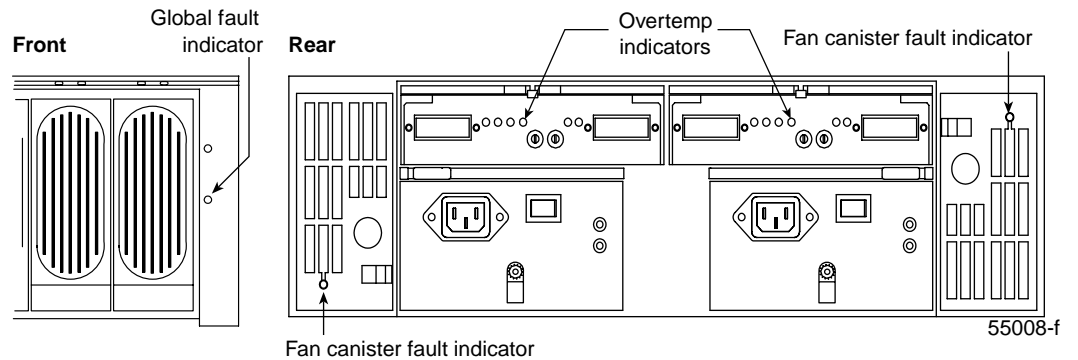
Figure 4-3   Fault Lights for Fan Module Replacement

Replacing a Failed Power Supply Module

When instructed by TPSSM to replace a failed power supply module, read "Power Supplies" on page 23, and then follow these steps:

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 power supply failure recovery procedures. Follow any instructions provided before you proceed.

2. Unpack the new power supply module. Set the new power supply 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 power supply 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.

Danger: **Shock can occur. Make sure the power supply is turned off and unplugged before you remove or install it.**

4. Locate the failed power supply (its fault light should be on).

5. Turn off the power and unplug the power cord from the failed module.

6. Remove the power cord from the power cord clip.

7. Wearing antistatic protection, grasp the pull-ring on the locking lever and squeeze the tab against the ring to unlatch the lever (see Figure 4-4).

8. Pull open the lever and remove the failed module.

9. Check the lever to make sure the orientation is the same as the module it is replacing. If not, move the lever to the pivot post on the other side.

Locking lever
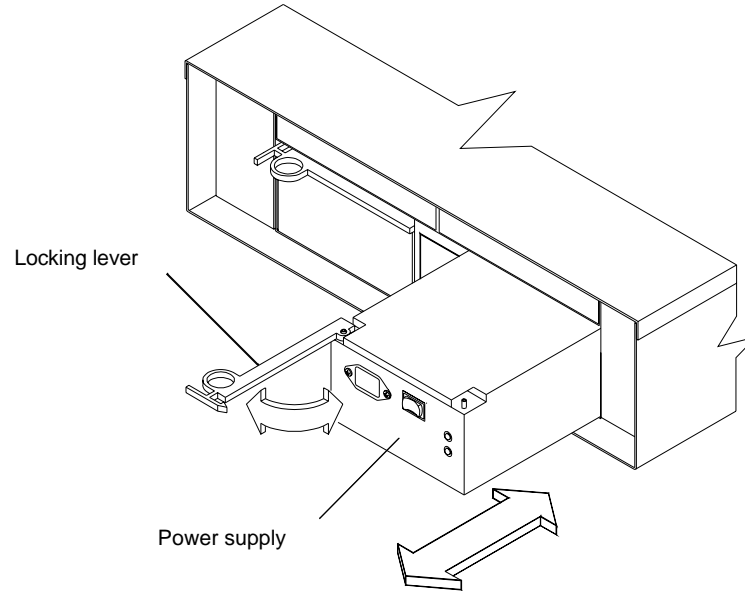
Power supply

Figure 4-4   Removing and Installing a Power Supply Module

Danger: **Shock can occur. Make sure the power supply is turned off and unplugged before you remove or install it.**

10. Make sure that the power switch on the new power supply module is turned off.

11. Wearing antistatic protection, slide the new power supply module into the slot.

12. Close the lever and lock it into place.

13. Secure the power cord in the power cord clip.

14. Plug in the power cord and turn on the power switch.

15. Check that the power indicator on the new canister is on and that the fault indicator is off (see Figure 4-4).

   • If the power indicator is off, the canister might be installed incorrectly. Remove it and reinstall it.

   • If the fault indicator is on, or the power indicator stays off, use TPSSM to determine the problem.

Replacing a Failed SFP Transceiver

To replace a failed SFP transceiver, read "SFP Transceivers" on page 27, 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 SFP failure recovery procedures. Follow any instructions provided before you proceed.

2. Unpack the new SFP transceiver. Set it on a dry, level surface near the enclosure. Save all packing materials in case you need to return the SFP transceiver.

3. Review all documentation shipped with the new SFP transceiver 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 SFP transceiver.

Important: When an SFP transceiver fails, its bypass indicator glows amber, and so does the bypass indicator of the module to which it is connected (including the fault light on the controller enclosure). Make sure you remove the correct SFP transceiver. Use the fault lights and TPSSM to locate the failed SFP transceiver.

---

5. Wearing antistatic protection, remove the Fibre Channel cables from the failed SFP transceiver (see Figure 4-5).

⚠ **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 sharp angles.
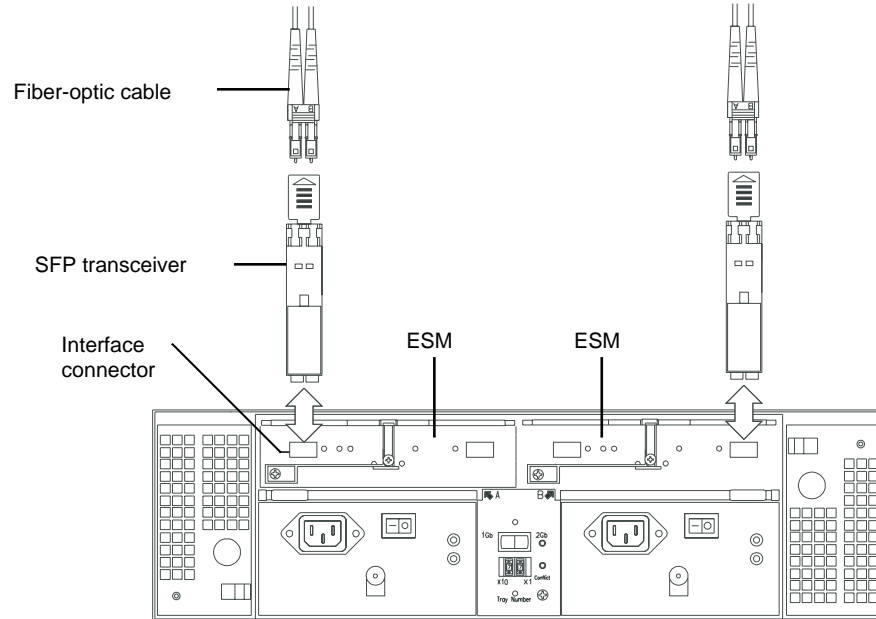
Figure 4-5   Removing and Installing an SFP Transceiver

Note: Figure 4-5 shows SFPs being replaced in an expansion enclosure. The procedure is the same for controller enclosures.

6. Remove the failed SFP transceiver from the environmental status module or RAID controller.

7. Insert the new SFP transceiver into the environmental status module or RAID controller.

8. Connect the Fibre Channel cables to the new SFP transceiver.

9. Check the bypass indicator next to the new SFP transceiver as follows (see Figure 4-5):

    •   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.

Replacing a Failed RAID Controller Module

When TPSSM instructs you to replace a failed RAID controller module, read "RAID Controllers" on page 19, 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 RAID controller module failure recovery procedures. Follow any instructions provided before you proceed.

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

3. Review all documentation shipped with the new RAID controller 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 RAID controller module (its fault indicator should be on).

5. Disconnect the Fibre Channel cables from the SFP transceivers in the failed controller module and then remove the SFP transceivers (see Figure 4-5). 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 RAID controller module. The levers will pop out of the locked position (see Figure 4-6).

7. Grasp the pull-rings and pull on the levers to remove the failed canister.

8. Wearing antistatic protection, slide the new RAID controller 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.
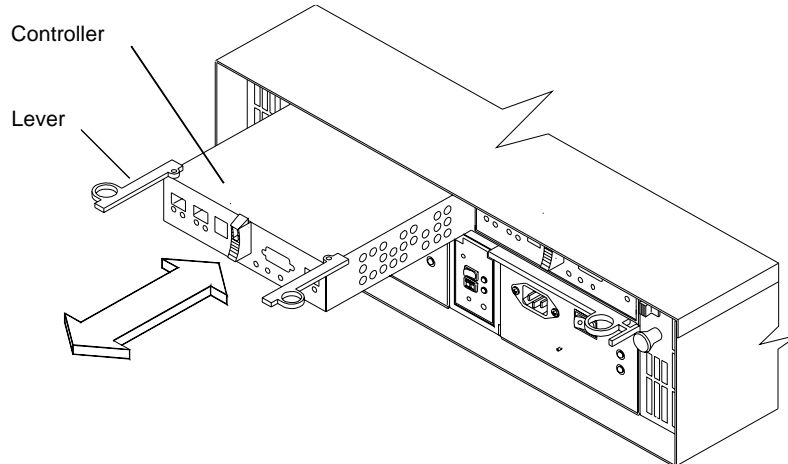
Figure 4-6   Removing and Installing a RAID Controller Module

11. Check the power and fault indicators on the new controller as follows (see Figure 4-5):

   • If the power indicator is off, the controller 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 RAID controller online.

Replacing a Failed Environmental Status Module

When TPSSM instructs you to replace a failed environmental status module, read "Environmental Status Modules (ESMs)" on page 21, 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 Figure 4-7). 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.
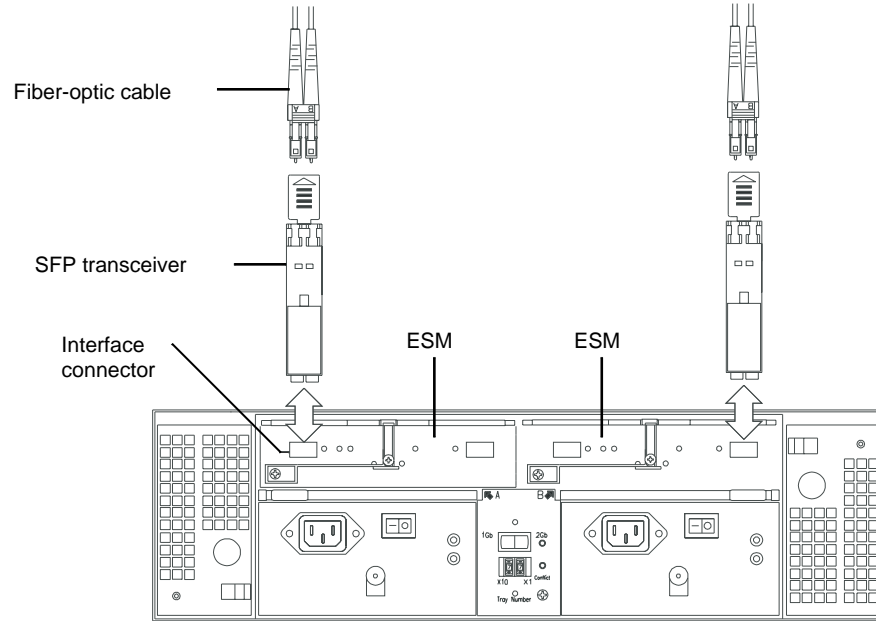
Figure 4-7   Removing SFPs from the Environmental Status Module

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 4-8).

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 (see Figure 4-7).

•   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.

Latch

Lever

55020
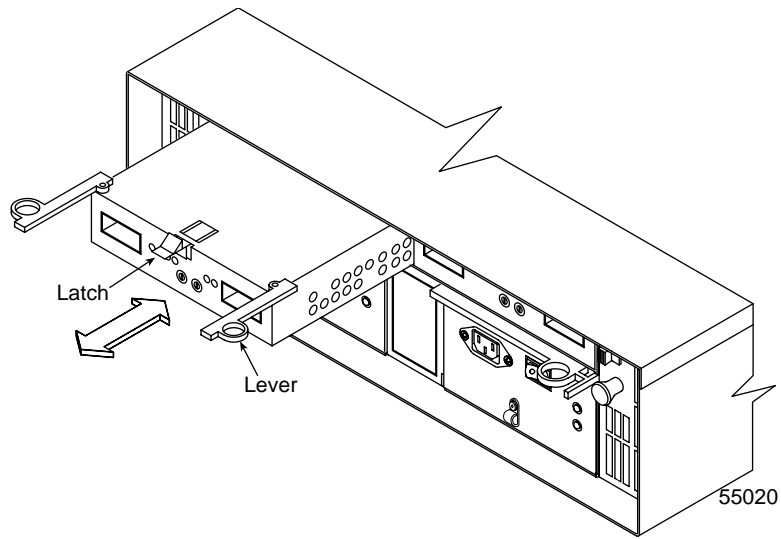
Figure 4-8   Removing and Installing an Environmental Status Module

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 61).

- Replace existing drives with drives of larger capacity (see "Adding Drives of Larger Capacity" on page 63).

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 4-1 on page 48).

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 61.

    - 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 4-1 on page 48).

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 Expansion Enclosures

You can add new expansion enclosures to an existing storage array without turning off the array or interrupting data flow.

Caution: You can add only new expansion enclosures to the storage array. This means that there must be no existing information on the drives in the expansion 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 need to refer to the installation manual accompanying your controller and expansion enclosures to complete this procedure.

To install one or more new expansion enclosures into an existing loop, follow these steps:

1. Follow the instructions in the *SGI TP9300 RAID Installation and Upgrade Guide* to set up and mount the new expansion enclosures and to connect them to each other.

2. Using Figure 4-9 as a guide, connect the cables from the controller enclosure to the new expansion enclosure(s). Then, if applicable, connect the cables from the existing expansion enclosure(s) to the new expansion enclosure(s).

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 expansion enclosures, 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 expansion enclosures in the loop. This error will not interfere with data flow, and will disappear after you finish installing the expansion 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.

Controller A
Drive channel 1

Controller B
Drive channel 2

Drive loop A

Drive loop B

Controller
enclosure ID 00

Expansion
enclosure ID 01

Expansion
enclosure ID 02

Expansion
enclosure ID 03

Expansion
enclosure ID 04

Expansion
enclosure ID 05

Expansion
enclosure ID 06

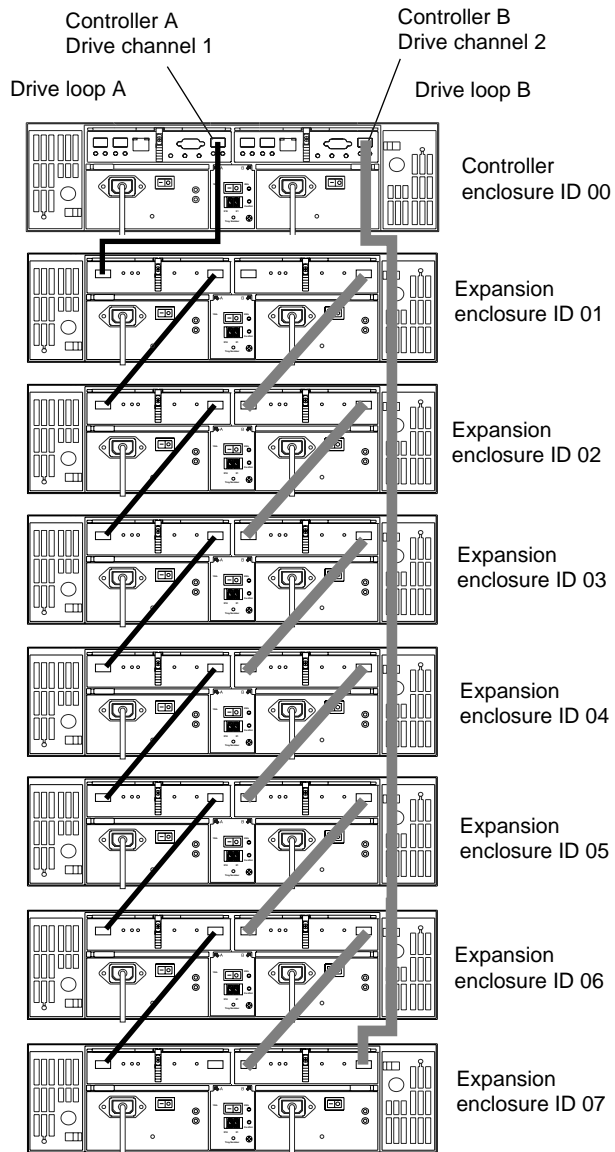Expansion
enclosure ID 07

Figure 4-9   Adding New Expansion Enclosures to an Existing Array

Cabling

This chapter describes the cabling between the controller enclosure, the front-end host, and the expansion enclosures. It also covers Ethernet, serial port, and power connections in the following sections:

- "Connecting the Drive Loop Cables" on page 67
- "Connecting the System to the Hosts" on page 71
- "Powering On the System" on page 77

Connecting the Drive Loop Cables

The system is designed to support redundant drive loops. A redundant drive loop consists of one or more expansion enclosures connected to the controller enclosure using two sets of data cables. If one data path fails, the controller uses the other data path to maintain access to the drive group.

Follow these instructions to cable a group of enclosures into a redundant drive loop. If the drive loop contains only one enclosure, skip this procedure and proceed to "Connecting the System to the Hosts" on page 71.

Warning: **Electrostatic discharge can damage sensitive components. Use appropriate antistatic precautions before handling any components.**

To complete this procedure, you will need two optic interface cables.

1. Connect the drive loops in the first two enclosures (see Figure 5-1). Starting with the controller enclosure, connect an interface cable from the drive loop connector on the left RAID controller module to the **drive channel in** connector on the left environmental status module in the expansion enclosure.

2. Connect an interface cable from the drive loop connector on the right RAID controller module to the **drive channel out** connector on the right environmental status module in the expansion enclosure. This creates a redundant drive loop between the two enclosures (see Figure 5-1).
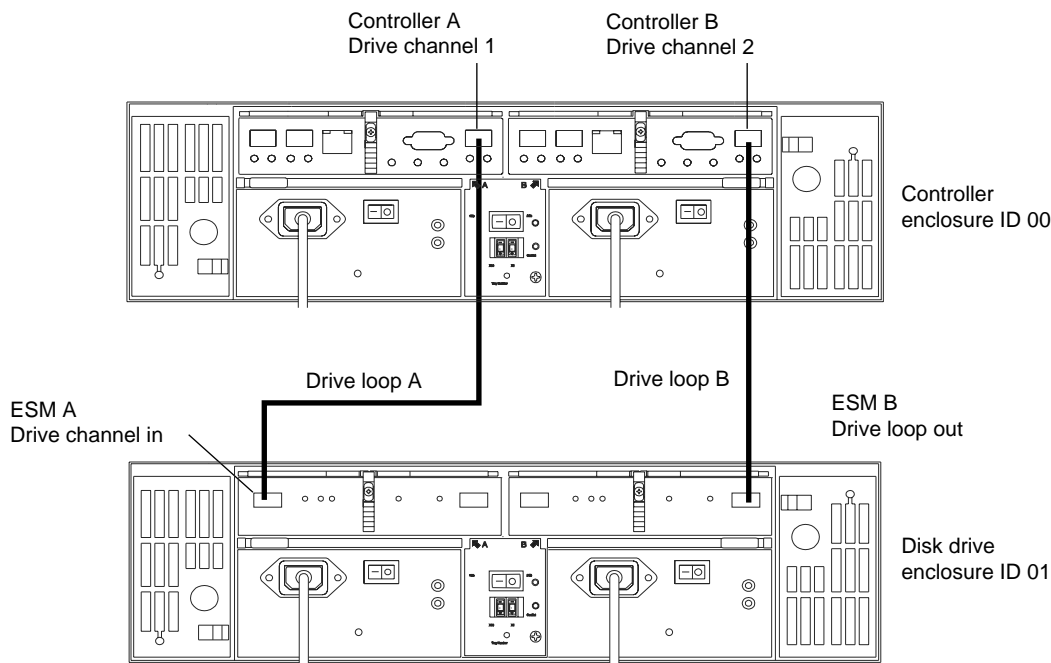
Figure 5-1   Drive Loop Cabling for Systems with Two Enclosures

3. Connect additional drive enclosures to drive loops A and B by connecting the **drive channel out** connectors on the new enclosure to the **drive channel in** connectors of the expansion enclosure directly beneath it (see Figure 5-2). Then connect the **drive loop out** cable from the left side RAID controller to the left-side **drive channel in** connector on the new expansion enclosure. The **drive channel out** connector on the first expansion enclosure should remain connected to the right-side RAID controller drive loop connector.

Figure 5-2   Drive Loop Cabling for Systems with Three or More Enclosures

4. Repeat step 3 to add up to seven expansion enclosures to the drive loop (see
    Figure 5-3).

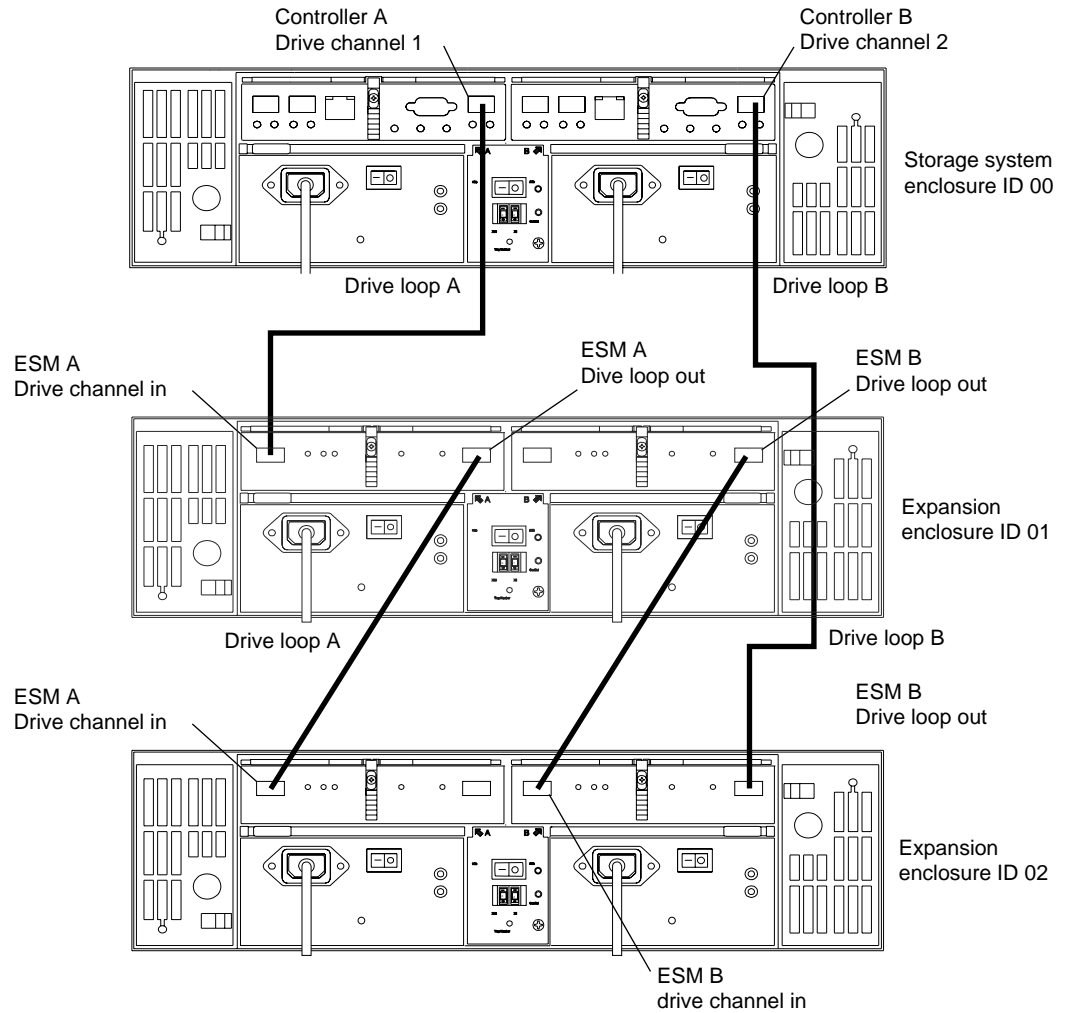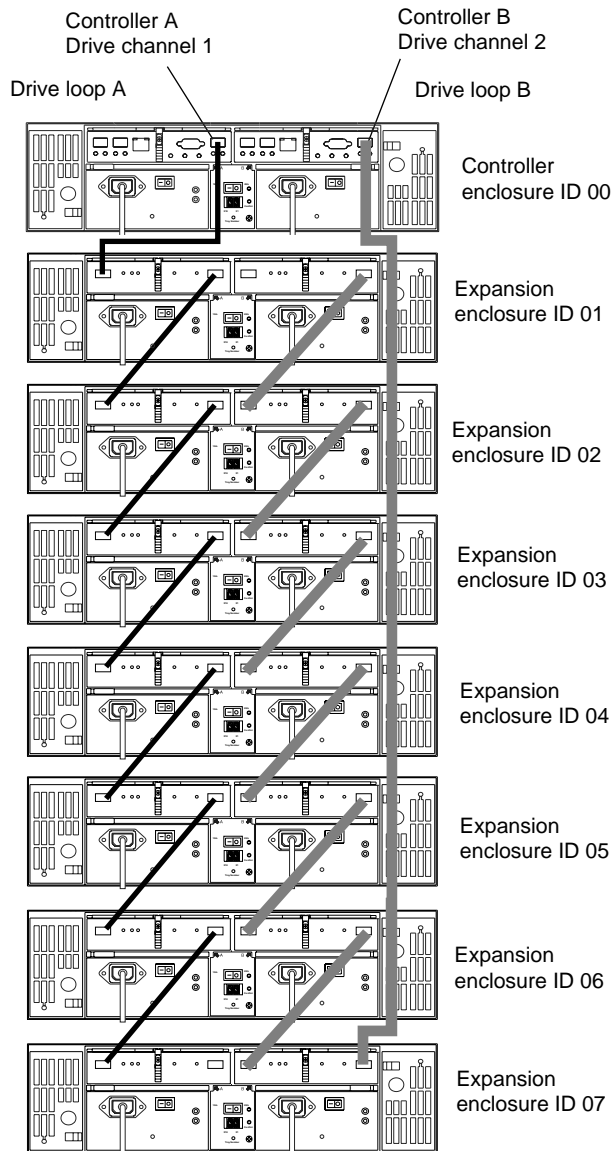**Figure 5-3**   Drive Loop Cabling for Systems with Eight Enclosures

Connecting the System to the Hosts

You can connect your system to a host computer (or multiple host computers) in many ways. The following figures show typical examples of connecting either by direct connect or fabric connect. All examples assume dual-controller high -availability (HA) configurations. The following topics are covered:

- "Examples of Direct Host Connection Cabling" on page 71
- "Examples of Fabric/Switch Host Connection Cabling" on page 74
- "Connecting Ethernet and Serial Cables for Array Management" on page 75

Warning: **Electrostatic discharge can damage sensitive components. Use appropriate antistatic precautions before handling any components.**

Examples of Direct Host Connection Cabling

The TP9300 can be connected directly to one or two hosts. These connections can be configured with or without failover. Failover is a method of transferring I/O requests from one controller to another when a component failure or other error occurs on the data path to the first controller. Depending on the operating system of your host(s), you may be able to choose from several failover options.

Note: If the host's operating system does not support failover, the host can only be connected to one controller. See Figure 5-5.

The following sections contain more information:

- "Direct Connection with Failover" on page 72
- "Direct Connection without Failover" on page 73

Direct Connection with Failover

Figure 5-4 shows the possible configurations for direct connection systems with failover.
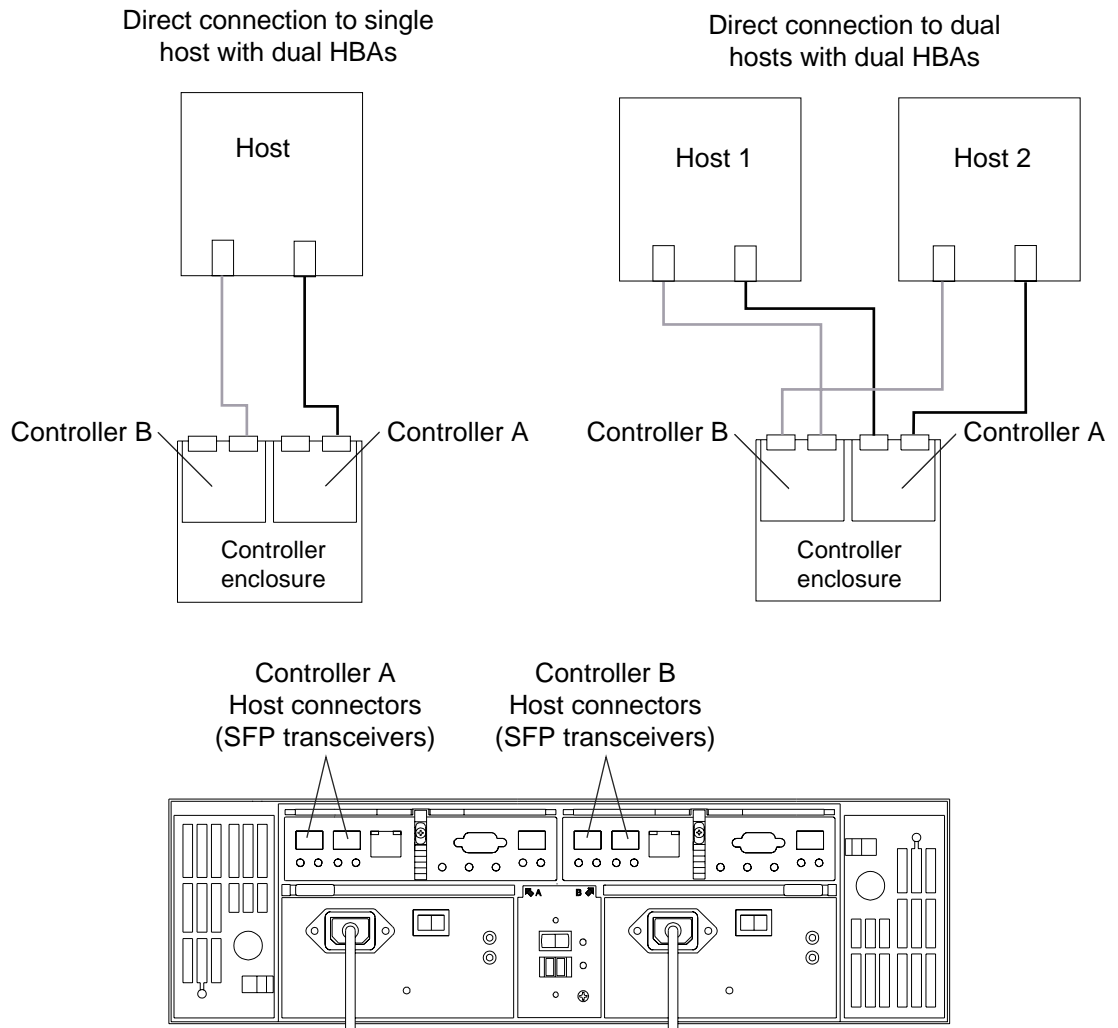
Figure 5-4   Direct Host Connection with Failover

Direct Connection without Failover

Figure 5-5 shows the possible configurations for direct connection systems without failover.
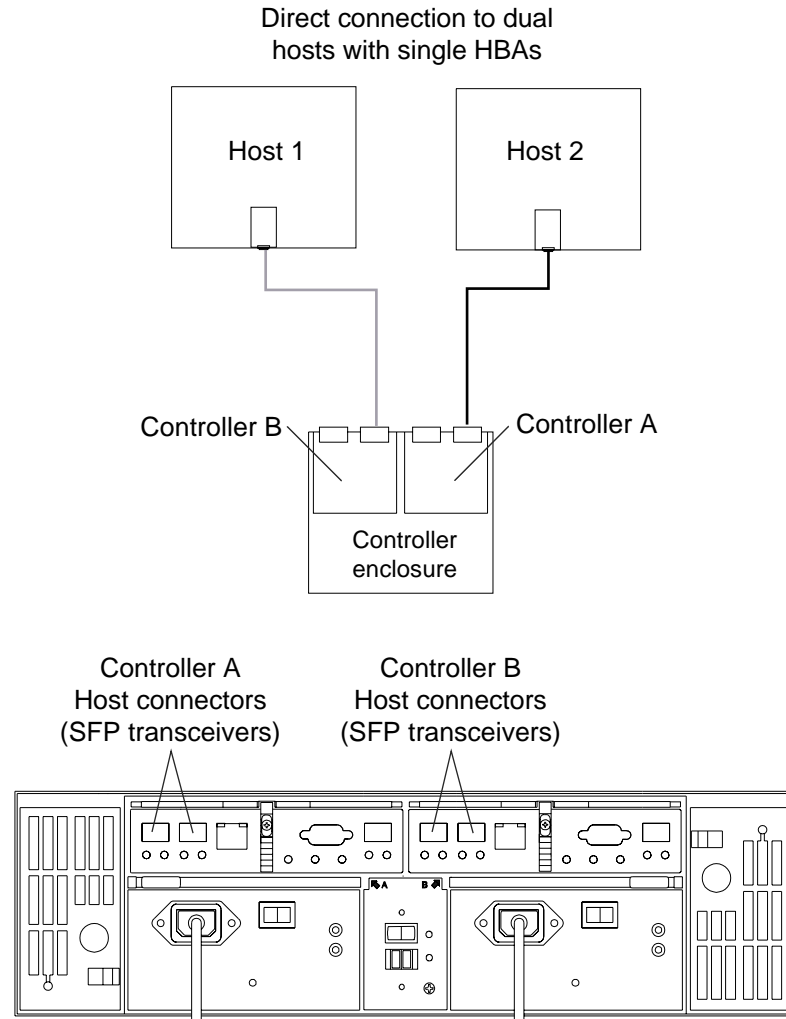
Figure 5-5   Direct Host Connection without Failover

Examples of Fabric/Switch Host Connection Cabling

Figure 5-6 shows an example of connecting the TP9300 to hosts using a Fibre Channel switch. For more information, see the "SGI Storage Area Network Installation Instructions" (108-0252-00*x*) shipped with the Fibre Channel switch.

Figure 5-6 shows a simple switch configuration.
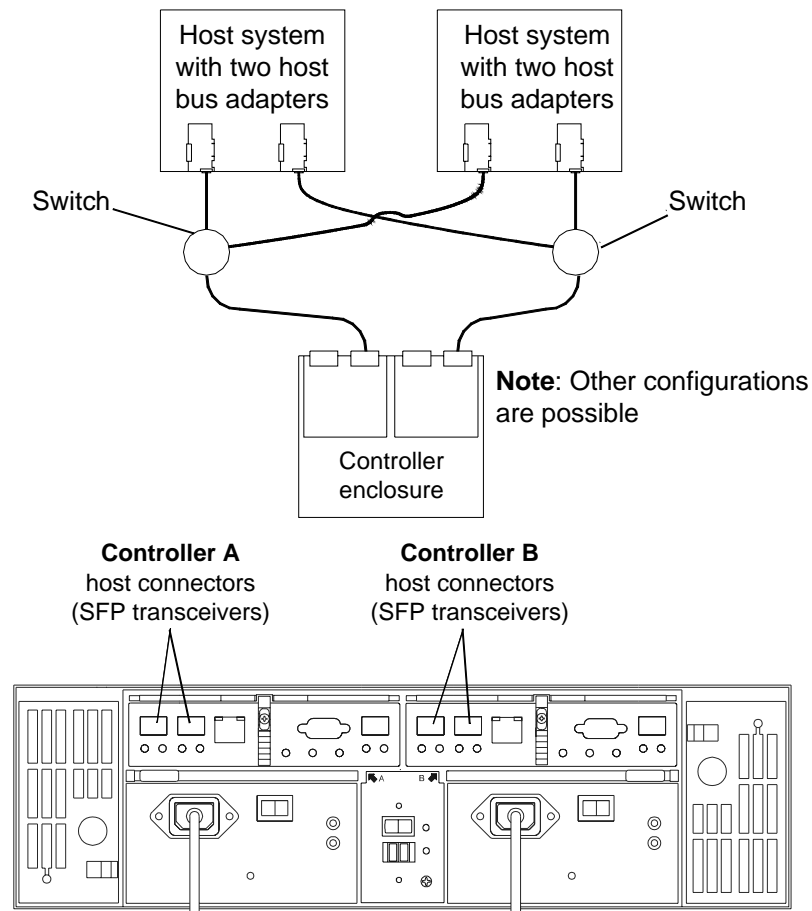
Figure 5-6   Connecting to Hosts via a Fibre Channel Switch

Connecting Ethernet and Serial Cables for Array Management

There are two methods of managing the storage system: in-band management and out-of-band management. In-band management requires that only the Fibre Channel host interface is present and functional. Out-of-band management requires that Ethernet or serial connections are cabled to each controller.

Note: For more information on storage management, see the *SGI TPSSM Administration Guide* (007-4306-00x), the *SGI TPSSM Software Concepts Guide* (007-4305-00*x*), and the *SGI Storage Area Network Installation Instructions* (108-0252-00*x*).

To connect Ethernet or serial (RS-232) interface cables to the controller enclosure for direct management of the storage array, follow the steps in this section. Optionally, you can use the Ethernet or serial connectors for diagnostic procedures.

Warning: **Electrostatic discharge can damage sensitive components. Use appropriate antistatic precautions before handling any components.**

1. To cable the system for direct management via Ethernet, connect a pair of Ethernet interface cables from the storage management station to the Ethernet connectors for controller A (left) and controller B (right) on the rear of the controller enclosure (see Figure 5-7).

2. To cable the system for direct management via the RS-232 serial ports, connect a pair of serial cables from the storage management station to the serial connectors for controller A (left) and controller B (right) on the rear of the controller enclosure.
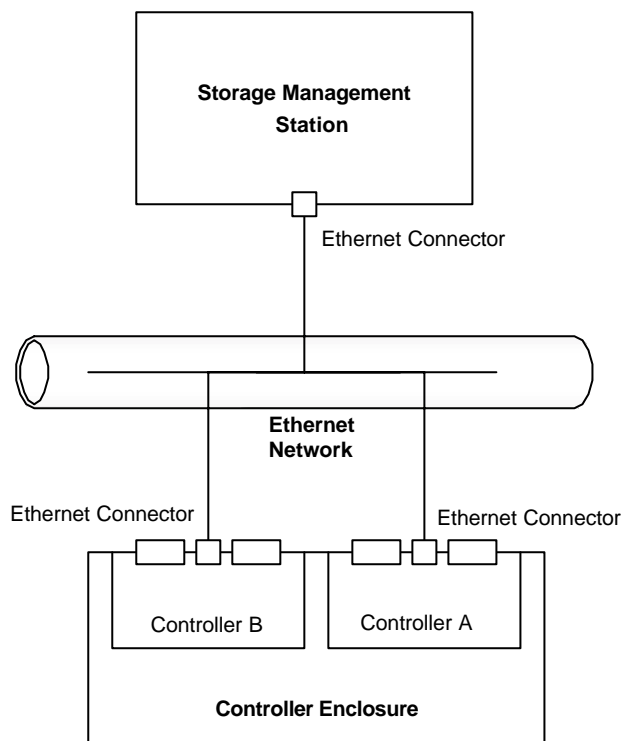
Figure 5-7   Connecting Ethernet Cables

Powering On the System

To connect the controller and the expansion enclosures to the AC power source and power on the system, follow these steps:

Warning: **Electrostatic discharge can damage sensitive components. Use appropriate antistatic precautions before handling any components.**

1. Make sure the switches on the power distribution units (on the rear of the rack inside the access panel) are in the OFF position.

2. Make sure both power switches on each of the controller and expansion enclosures are off.

3. Plug the power cords into each power supply of the storage enclosures (see "AC power in" in Figure 5-8). Plug the left-side power cords into the left PDU and plug the right-side power cords into the right PDU.
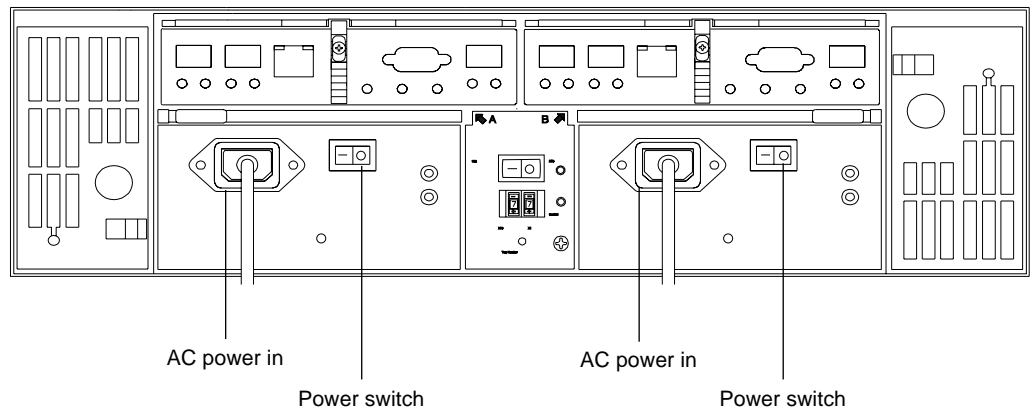
Figure 5-8   Power Connections and Switches of the Enclosures

Note: See Appendix A, "Specifications and Requirements" for details on power requirements.

4. To keep the power cords from being accidently pulled from the power connections, secure the cords in the strain relief power cord clips.

5. To ensure power redundancy, plug each power distribution unit into a separate AC
    power circuit (see Figure 5-9).
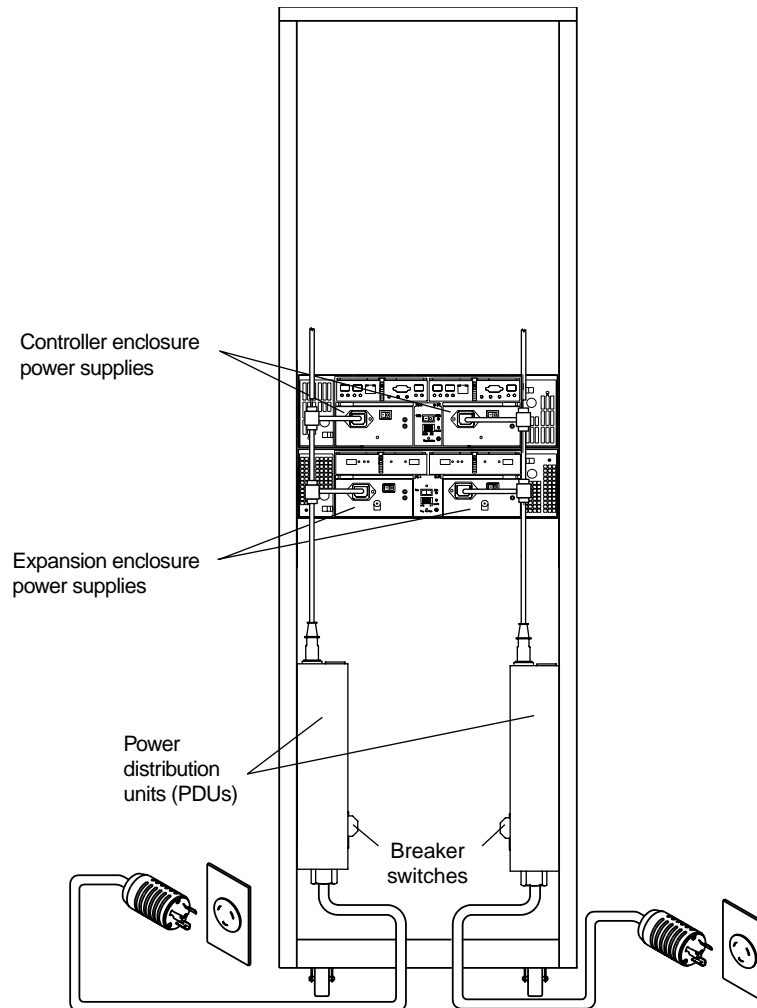
Figure 5-9   PDU Cabling

Note: To speed drive spin-up, it is recommended that you start the expansion enclosures before or at the same time as the controller enclosure. This procedure powers up all components in the system at the same time by turning on the power distribution units.

6. Turn on both power switches on the rear of each expansion enclosure. Then turn on both power switches on the rear of the controller enclosure (see Figure 5-8).

7. When all controller and drive enclosure power switches are in the ON position, flip the breaker switches of both PDUs to the ON position (see Figure 5-9).

8. Check the indicator lights on the front and rear of each component. If any lights indicate a fault, see "Checking the Indicator Lights" on page 36.

Specifications and Requirements

This appendix describes the technical specifications and requirements of the TP9300 system rack and components in the following sections:

- "Rack Specifications" on page 81
- "Enclosure Specifications" on page 93

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 rack that contains eight enclosures: one controller enclosure and seven expansion enclosures.
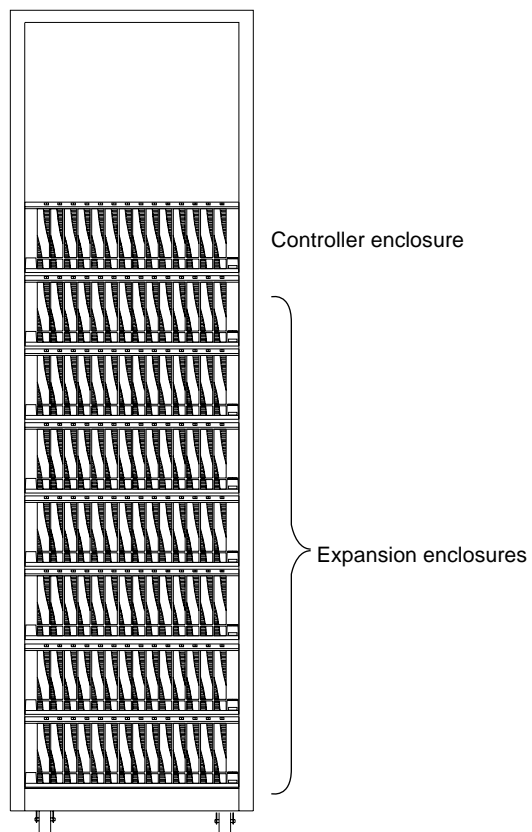
Figure A-1   Populated Rack

For more information on installation and cabling schemes, see the *SGI TP9300 RAID Installation and Upgrade Guide* (108-0401-00*x*).

Dimensions

Figure A-2 shows the system rack and its dimensions.

183 cm
(72 in.)

91 cm
(36 in.)

56 cm
(22 in.)
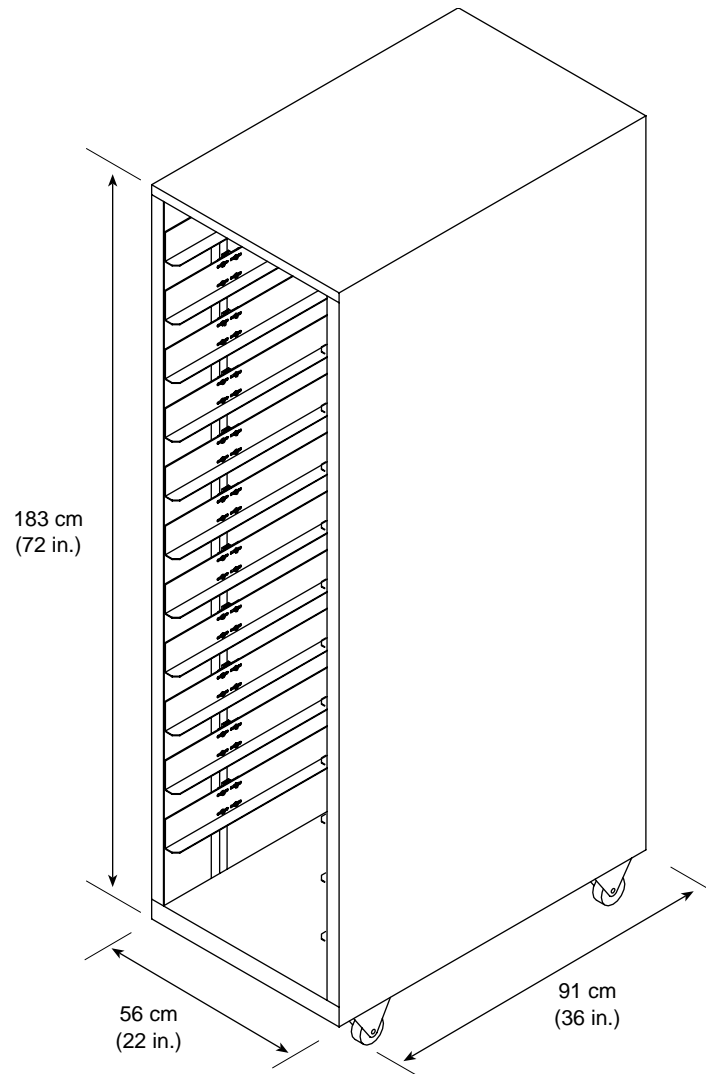
Figure A-2   Dimensions of the System Rack

Weight

The total weight of the system depends on the quantity of enclosures installed. Table A-1 lists the overall weight of the rack, plus the maximum weight of an enclosure. You can use these weights to estimate the total weight of your system, based on the number of enclosures installed in the rack. Figure A-3 provides an example of calculating the weight of a rack.

Table A-1   Rack, Crate, and Enclosure Weights

Rack (Empty)	Crate (Empty)	System Enclosure (Maximum)
121 kg (270 lb)	97 kg (215 lb)	44.5 kg (98.1 lb)

TP9300 empty rack weight
121 kg (270 lb)

7 enclosures
(7 x 44.5 kg)=311.5 kg (686.7 lb)

Total weight uncrated
433.9 kg (956.7 lb)

Figure A-3   Rack Weights

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-1).

- Sufficient space to install and service the rack and components (see Figure A-4).
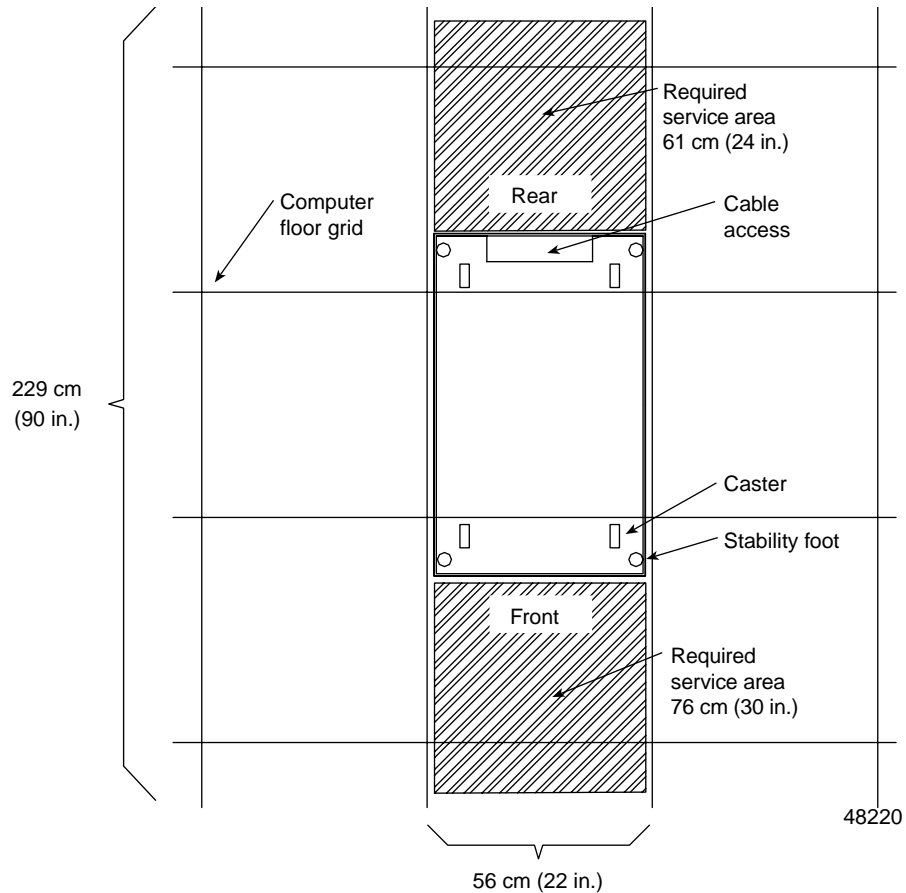
Figure A-4   System Area Requirements

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.

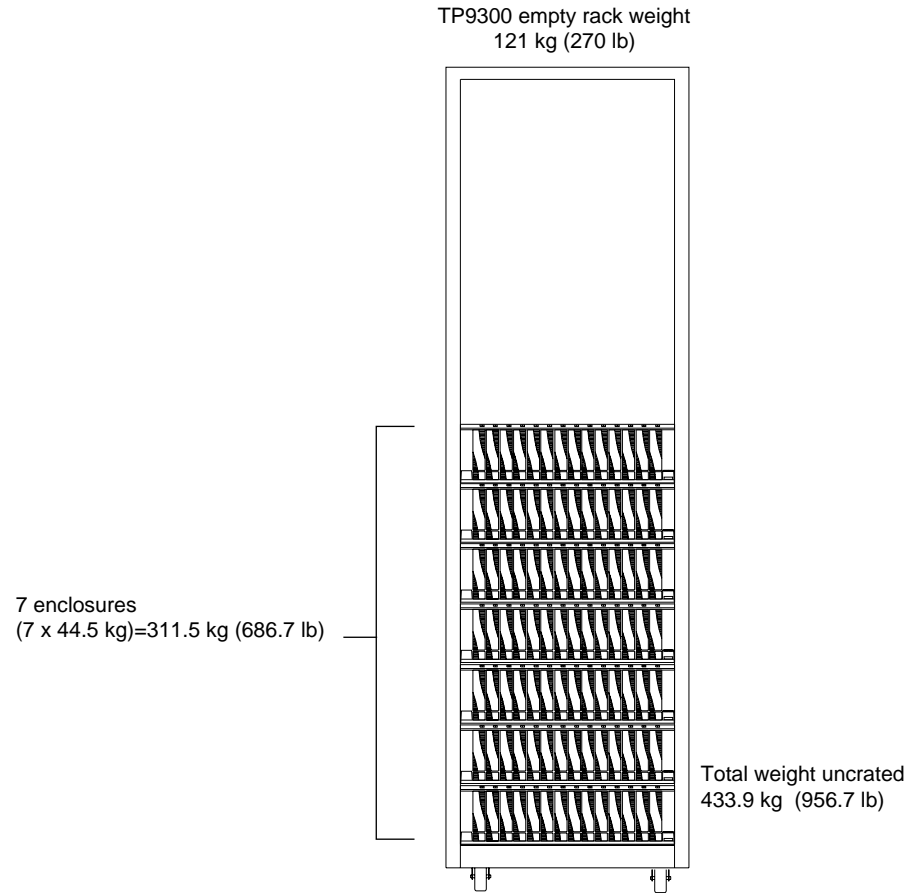- **Circuit overloading:** Make sure the power circuits and associated circuit breakers provide sufficient power and overload protection. To prevent possible damage to the AC distribution boxes and other components in the rack, isolate its power source from large switching loads (such as air conditioning 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 TP9300 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

- **Power failures:** After total power failure, the SGI TP9300 enclosure will automatically perform a power-on recovery without operator intervention, once power is restored.

Power Requirements

Table A-2 lists the power requirements for the rack.

Table A-2   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	25 A

Power Distribution Units

The rack has two PDUs (power distribution units). Each PDU has its own power cord. Due to limited space inside the rack, it may be easier to connect and route power cords before installing the support rails and enclosures.

To ensure redundancy, connect the PDUs in the rack to independent power circuits. Connect one power cord from each enclosure to each PDU in the rack (see Figure A-5).

Controller enclosure
power supplies

Expansion enclosure
power supplies

Power
distribution
units (PDUs)

Breaker
switches
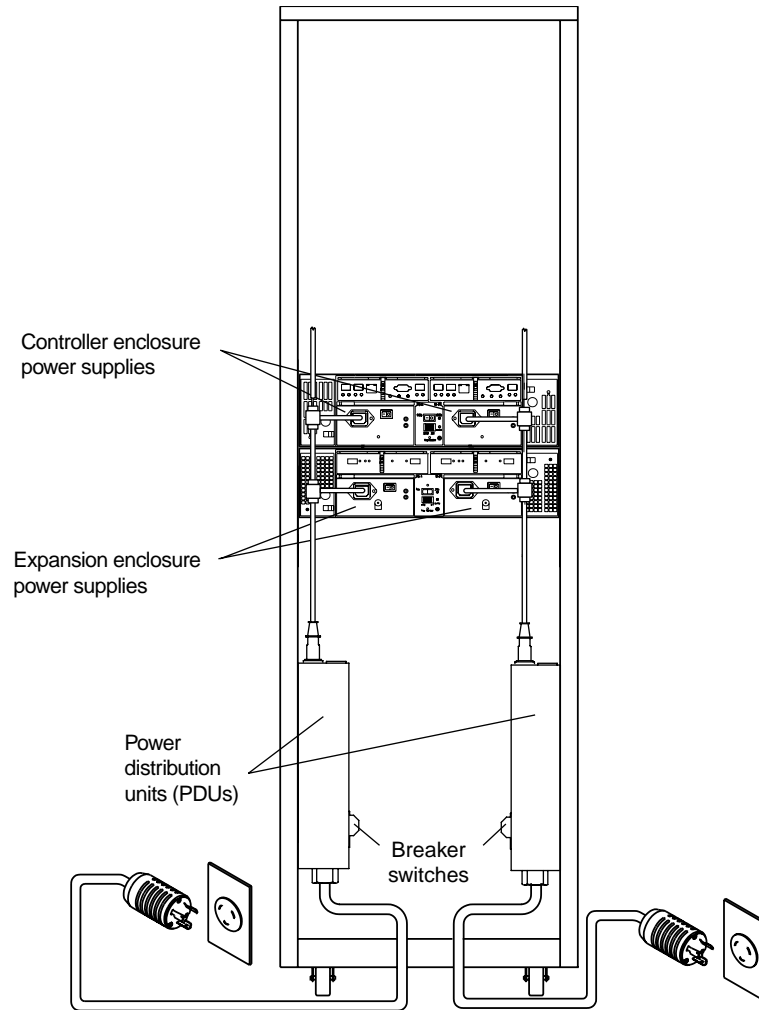
Figure A-5   Power Connections to Controller and Expansion Enclosures

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 30-A circuit breaker.

- **International power cord**: Connects from the PDU to an independent 32-A circuit breaker.

The power distribution unit (PDU) has two outlets for connecting the power cords from devices installed in the rack. Figure A-6 shows the connectors and receptacles for these cords.

Component

250 VAC, 16 A, IEC 320-C19
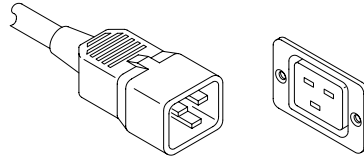
Domestic

250 VAC, 30 A, NEMA L6-30P/L6-30R
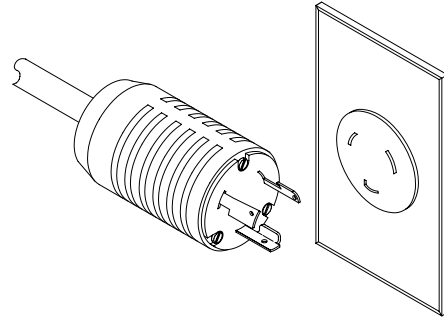
International

230 VAC, 32 A, IEC 309
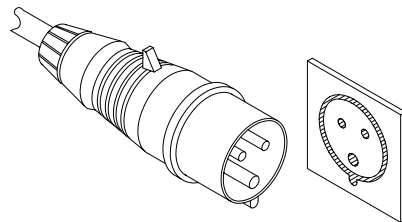
Figure A-6   AC Power Connectors and Receptacles

Environmental

Table A-3 list the environmental requirements for the TP9300.

⚠ **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-3   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 10 °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
Altitude		
Below Sea Level	Operating range Storage range Transit range	30.5 m (100 ft) 30.5 m (100 ft) 30.5 m (100 ft)
Above Sea Level	Operating range Storage range Transit range	3,000 m (9,840 ft) 3,000 m (9,840 ft) 12,000 m (40,000 ft)

Enclosure Specifications

This section lists the dimensions and weights, as well as the wiring, power, environmental, and airflow requirements for the 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-7 shows the dimensions for the controller enclosure and the front cover.
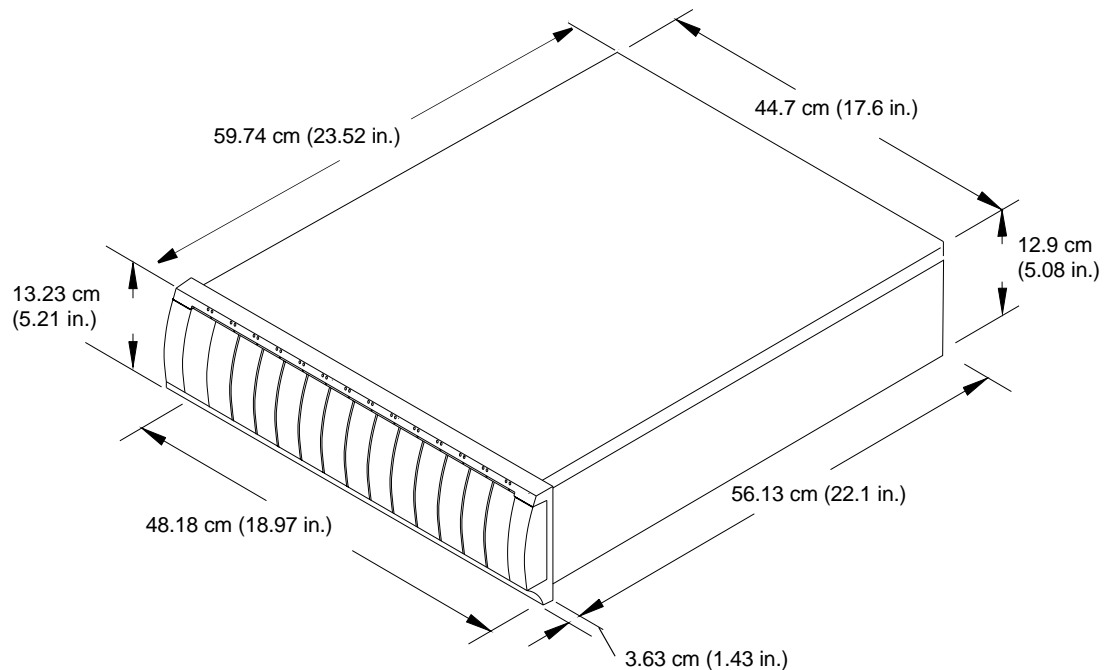
Figure A-7   Dimensions of the System Enclosure

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 modules in the enclosure. Table A-4 and Table A-5 lists the unit and shipping weight of the controller enclosure and the weight of the individual modules.

Table A-4   Enclosure Weights

Enclosure Type	Enclosure Weight[a]	Shipping Weight[b]
Rackmount	44.45 kg (98.0 lb)	58.06 kg (128.0 lb)
Deskside tower	57.15 kg (126.00 lb)	70.76 kg (156 lb)

a. Indicates an enclosure containing all applicable modules.

b. Indicates the shipping carton and a fully configured enclosure.

Table A-5   Enclosure Module Weights

Module	Weight
Controller module	2.18 kg (4.80 lb)
ESM module	1.59 kg (3.7 lb)
Fan module	1.01 kg (2.23 lb)
Disk drive module	
36-GB drive	1.03 kg (2.27 lb)
73-GB drive	1.04 kg (2.29 lb)
146-GB drive	1.05 kg (2.32 lb)
Power supply module	1.5 kg (3.3 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-6). 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-on 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-6   Site Wiring Voltages for System 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-7 and Table A-8 lists the environmental requirements for the system enclosure.

Table A-7   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 $°$C (3.3 $°$F) for every 1,000 m (3,280 ft.) above sea level.

Table A-8   Environmental Requirements for System 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	1118 Btu/hr (0.328 kVA or 327 W) with 36-GB drives	
	1135 Btu/hr (0.332 kVA or 332 W) with 146-GB drives	
Sound	Power	6.5 bels
	Pressure	65 dBA

Air Flow

Figure A-8 shows the air flow in the system 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 controller enclosure for proper ventilation and servicing.
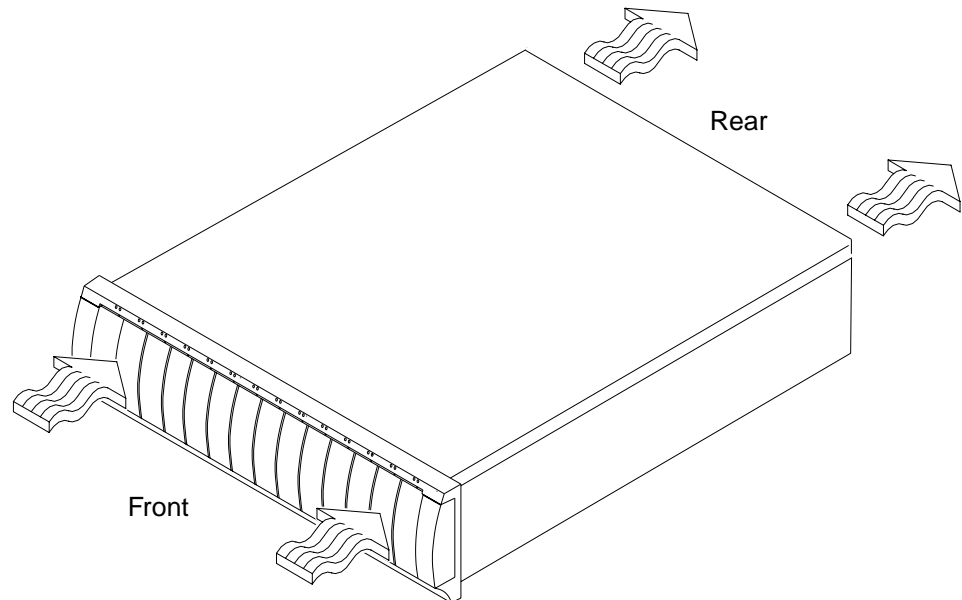
Figure A-8   Air Flow in the System Enclosure

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 system.

If your system 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 system 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 system 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.

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, try to correct the interference with 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 or an experienced radio/TV technician for help

Caution: 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.

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。