

IBM System Storage DS4800 Storage Subsystem



Installation, User's, and Maintenance Guide

IBM System Storage DS4800 Storage Subsystem



Installation, User's, and Maintenance Guide

Note:

Before using this information and the product it supports, be sure to read the general information in “Notices” on page 199.

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Safety

The caution and danger statements that this document contains can be referenced in the multilingual *IBM® Safety Information* document that is provided with your IBM System Storage™ DS4800 Storage Subsystem. Each caution and danger statement is numbered for easy reference to the corresponding statements in the translated document.

- **Danger:** These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure, step, or situation.
- **Caution:** These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could occur.

DANGER

Handling the cord on this product or cords associated with accessories sold with product will expose you to lead, a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. Wash hands after handling.

Before installing this product, read the following danger and caution notices.

Statement 1:



DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To Connect:	To Disconnect:
<ol style="list-style-type: none">1. Turn everything OFF.2. First, attach all cables to devices.3. Attach signal cables to connectors.4. Attach power cords to outlet.5. Turn device ON.	<ol style="list-style-type: none">1. Turn everything OFF.2. First, remove power cords from outlet.3. Remove signal cables from connectors.4. Remove all cables from devices.

Statement 2:



CAUTION:

When replacing the lithium battery, use only an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100° C (212° F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Statement 3:



CAUTION:

When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

- Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.
- Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.



DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Class 1 Laser statement

Class 1 Laser Product

Laser Klasse 1

Laser Klass 1

Luokan 1 Laserlaitte

Appareil À Laser de Classe 1

IEC 825-11993 CENELEC EN 60 825

Statement 4:



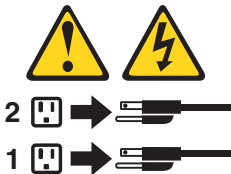
≥ 18 kg (39.7 lb)	≥ 32 kg (70.5 lb)	≥ 55 kg (121.2 lb)

CAUTION:
Use safe practices when lifting.

Statement 5:



CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



Statement 6:



CAUTION:

Never remove the cover on a power supply or any part that has the following label attached.



Hazardous voltage, current, and energy levels are present inside any component that has this label attached. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

Statement 7:



DANGER

Handling the cord on this product, or cords associated with accessories sold with this product, will expose you to lead, a chemical known to the State of California to cause cancer and birth defects or other reproductive harm. *Wash hands after handling.*

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About this document

This document provides instructions for installing and customizing the configuration of your IBM System Storage DS4800 Storage Subsystem. It also provides hardware maintenance procedures and troubleshooting information.

Who should read this document

This document is intended for system operators and service technicians who have extensive knowledge of fibre channel and network technology.

How this document is organized

Chapter 1, "Introduction," on page 1 describes the IBM System Storage DS4800 Storage Subsystem. This chapter includes an inventory checklist and an overview of the storage subsystem features, operating specifications, and components.

Chapter 2, "Installing the storage subsystem," on page 27 contains instructions for installing the DS4800 Storage Subsystem in a standard rack cabinet and setting the interface options.

Chapter 3, "Cabling the storage subsystem," on page 47 contains fibre channel and power cabling information for the DS4800 Storage Subsystem.

Chapter 4, "Operating the storage subsystem," on page 103 contains instructions for powering the DS4800 Storage Subsystem on or off during either normal or emergency situations. It also contains information on how to check the LEDs on the front and back of the storage subsystem.

Chapter 5, "Replacing components," on page 143 contains step-by-step instructions for how to install or remove customer replaceable units (CRUs), such as power supply and fan units, RAID controllers, and interconnect-battery units.

Chapter 6, "Hardware maintenance," on page 169 contains problems, symptoms, and error messages that are specific to the DS4800 Storage Subsystem. It also contains the parts listing for the DS4800 Storage Subsystem.

Appendix A, "Additional DS4000 documentation," on page 179 provides references to other DS4000 publications.

Appendix B, "Records," on page 189 provides a table that you can use to record and update important information about your DS4800, including serial number, model and machine type, and MAC addresses.

Appendix C, "Rack mounting templates," on page 191 provides the rack mounting templates for installation of the DS4800. If you want to tear out the templates from the document for use during installation, use these copies of the templates.

Appendix D, "Power cords," on page 195 lists power cord information for the DS4800.

Appendix E, "Accessibility," on page 197 provides information about DS4000 Storage Manager accessibility features.

DS4000 Storage Subsystem installation tasks - General overview

Table 1 provides a sequential list of many installation and configuration tasks that are common to most DS4000 configurations. When you install and configure your DS4000 storage subsystem, refer to this table to find the documentation that explains how to complete each task.

Table 1. Where to find DS4000 installation and configuration procedures

	Installation task	Where to find information or procedures
1	Plan the installation	<ul style="list-style-type: none">• <i>DS4000 Storage Manager Concepts Guide</i>• <i>DS4000 Storage Manager Installation and Host Support Guide for AIX, HP-UX, Solaris, and Linux on POWER</i>• <i>DS4000 Storage Manager Installation and Host Support Guide for Windows 2000/Server 2003/2008, NetWare, VMWare ESX Server, and Linux</i>• <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i>• <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i>• <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i>
2	Mount the DS4000 storage subsystem in the rack	<ul style="list-style-type: none">• <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i>• <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i>• <i>DS4400 and DS4500 Rack Mounting Instructions</i>• <i>DS4300 Rack Mounting Instructions</i>• <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i>• <i>DS4100 Storage Subsystem Installation, User's and Maintenance Guide</i>

Table 1. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
3	Mount the DS4000 EXP storage expansion unit in the rack	<ul style="list-style-type: none"> • <i>DS4000 EXP100 Storage Expansion Unit Installation, User's and Maintenance Guide</i> • <i>DS4000 EXP420 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>FASTT EXP500 Installation and User's Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i>
4	Route the storage expansion unit Fibre Channel cables	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Cabling Instructions</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i>
5	Route the host server Fibre Channel cables	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Cabling Instructions</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i>

Table 1. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
6	Power up the subsystem	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i>
7	Configure DS4000 network settings	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i>
8	Zone the fabric switch (SAN-attached only)	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Host Support Guide for AIX, HP-UX, Solaris, and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Host Guide for Windows 2000/Server 2003/2008, NetWare, VMWare ESX Server, and Linux</i> • <i>DS4000 Storage Manager Copy Services Guide</i> (describes switch zoning for the Remote Mirror Option) • See also the documentation provided by the switch manufacturer.

Table 1. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
9	Install DS4000 Storage Manager software on the management station	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Host Support Guide for AIX, HP-UX, Solaris, and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Host Support Guide for Windows 2000/Server 2003/2008, NetWare, VMWare ESX Server, and Linux</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i> • DS4000 Storage Manager online help (for post-installation tasks)
10	Install host software (failover drivers) on host server	
11	Start DS4000 Storage Manager	
12	Set the DS4000 Storage Manager clock	
13	Set the DS4000 Storage Manager host default type	
14	Verify DS4000 subsystem health	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Server Installation and Support Guide</i> • <i>DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4700 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
15	Enable DS4000 Storage Manager premium feature keys	<p>Copy Services premium features <i>DS4000 Storage Manager Copy Services Guide</i></p> <p>FC/SATA Intermix premium feature <i>DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i></p> <p>Storage Partitioning (and general premium features information)</p> <ul style="list-style-type: none"> • <i>DS4000 Storage Manager Concepts Guide</i> • <i>DS4000 Storage Manager Installation and Host Support Guide for AIX, HP-UX, Solaris, and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Host Support Guide for Windows 2000/Server 2003/2008, NetWare, VMWare ESX Server, and Linux</i>

Table 1. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
16	Configure arrays and logical drives	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Host Support Guide for AIX, HP-UX, Solaris, and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Host Support Guide for Windows 2000/Server 2003/2008, NetWare, VMWare ESX Server, and Linux</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i> • <i>IBM System Storage Quick Start Guide, Quick reference for the DS4800</i> • DS4000 Storage Manager online help
17	Configure host partitions	
18	Verify host access to DS4000 storage	

Getting information, help, and service

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. This section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your system, and whom to call for service, if it is necessary.

Before you call

Before you call, take these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system.
- Check for technical information, hints, tips, and new device drivers at the IBM support Web site pages that are listed in this section.
- Use an IBM discussion forum on the IBM Web site to ask questions.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the DS4000 Storage Manager online help or in the documents that are provided with your system and software. The information that comes with your system also describes the diagnostic tests that you can perform. Most subsystems, operating systems, and programs come with information that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the information for the operating system or program.

Using the documentation

Information about your IBM system and preinstalled software, if any, is available in the documents that come with your system. This includes printed books, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software.

Finding DS4000 readme files

1. Go to the following Web site:
www.ibm.com/systems/support/storage/disk
2. Click the link for your Storage Subsystem (for example, **DS4800**).
3. When the subsystem support page opens, click the **Download** tab.
4. Under the Download tab, click **Storage Manager, firmware, HBA, tools, support & pubs (including readmes)**.
5. Now, click the appropriate tab for the type of readme file that you are looking for:
 - **Firmware**
 - **Storage Mgr**
 - **HBA**
 - **Tools**A table displays as you click each tab.
6. In the table, click on the appropriate link in the **Current version and readmes** column.
7. Click the link for the readme file.

Web sites

The most up-to-date information about DS4000 storage subsystems and DS4000 Storage Manager, including documentation and the most recent software, firmware, and NVSRAM downloads, can be found at the following Web sites.

DS4000 Midrange Disk Systems

Find the latest information about IBM System Storage disk storage systems, including all of the DS4000 storage subsystems:

www.ibm.com/servers/storage/disk/ds4000

IBM System Storage products

Find information about all IBM System Storage products:

www.storage.ibm.com

Support for IBM System Storage disk storage systems

Find links to support pages for all IBM System Storage disk storage systems, including DS4000 storage subsystems and expansion units:

www.ibm.com/systems/support/storage/disk

System Storage DS4000 interoperability matrix

Find the latest information about operating system and HBA support, clustering support, storage area network (SAN) fabric support, and DS4000 Storage Manager feature support:

www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Storage Area Network (SAN) support

Find information about using SAN switches, including links to user guides and other documents:

www.ibm.com/systems/support/storage/san

DS4000 technical support

Find downloads, hints and tips, documentation, parts information, HBA and Fibre Channel support:

<http://www.ibm.com/systems/support/storage/disk>

Select your Storage Subsystem (for example, **DS4800**).

Premium feature activation

Activate a DS4000™ premium feature by using the online tool:

www-912.ibm.com/PremiumFeatures/jsp/keyInput.jsp

IBM publications center

Find IBM publications:

www.ibm.com/shop/publications/order/

Support for System p™ servers

Find the latest information supporting System p AIX® and Linux® servers:

[www.ibm.com/systems/support/supportsite.wss/
brandmain?brandind=5000025](http://www.ibm.com/systems/support/supportsite.wss/brandmain?brandind=5000025)

Support for System x™ servers

Find the latest information supporting System x Intel®- and AMD-based servers:

[www.ibm.com/systems/support/supportsite.wss/
brandmain?brandind=5000008](http://www.ibm.com/systems/support/supportsite.wss/brandmain?brandind=5000008)

Fix delivery center for AIX and Linux on POWER™

Find the latest AIX and Linux on POWER information and downloads:

www-912.ibm.com/eserver/support/fixes/fcgui.jsp

In the **Product family** drop-down menu, select **UNIX® servers**. Then select your product and fix type from the subsequent drop-down menus.

@server System p and AIX information center

Find everything you need to know about using AIX with System p and POWER servers:

publib.boulder.ibm.com/infocenter/pseries/index.jsp?

Software service and support

Through IBM Support Line, for a fee you can get telephone assistance with usage, configuration, and software problems. For information about which products are supported by Support Line in your country or region, go to the following Web site:

www.ibm.com/services/sl/products

For more information about the IBM Support Line and other IBM services, go to the following Web sites:

- www.ibm.com/services
- www.ibm.com/planetwide

Hardware service and support

You can receive hardware service through IBM Integrated Technology Services or through your IBM reseller, if your reseller is authorized by IBM to provide warranty service. Go to the following Web site for support telephone numbers:

www.ibm.com/planetwide

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

Fire suppression systems

A fire suppression system is the responsibility of the customer. The customer's own insurance underwriter, local fire marshal, or a local building inspector, or both, should be consulted in selecting a fire suppression system that provides the correct level of coverage and protection. IBM designs and manufactures equipment to internal and external standards that require certain environments for reliable operation. Because IBM does not test any equipment for compatibility with fire suppression systems, IBM does not make compatibility claims of any kind nor does IBM provide recommendations on fire suppression systems.

How to send your comments

Your feedback is important to help us provide the highest quality information. If you have any comments about this document, you can submit them in one of the following ways:

E-mail

Submit your comments by e-mail to:

starpubs@us.ibm.com

Be sure to include the name and order number of the document and, if applicable, the specific location of the text that you are commenting on, such as a page number or table number.

Mail

Fill out the Readers' Comments form (RCF) at the back of this document and return it by mail or give it to an IBM representative.

If the RCF has been removed, send your comments to:

International Business Machines Corporation
Information Development
Department GZW
9000 South Rita Road
Tucson, Arizona
USA
85744-0001

Be sure to include the name and order number of the document and, if applicable, the specific location of the text that you are commenting on, such as a page number or table number.

Chapter 1. Introduction

This chapter describes the operating specifications, features, and components for the IBM System Storage DS4800 (Machine Type 1815) Storage Subsystem (hereafter referred to as *DS4800* or *storage subsystem*).

This chapter also includes an inventory checklist and important information on best practices guidelines and product updates for your DS4800.

Overview

IBM DS4000 solutions support the large and growing data storage requirements of business-critical applications. These scalable IBM DS4000 solutions offer you data access and protection to meet your existing enterprise storage requirements and prepare for the future.

The IBM System Storage DS4800 storage system is designed to provide solutions to meet the needs of midrange/departmental storage requirements, delivering high performance, advanced function, high availability, modular and scalable storage capacity, with SAN-attached 4-Gbps fibre channel (FC) connectivity, and support for RAID levels 0, 1, 3, and 5 up to over 89 terabytes (TB).

Note: The stated maximum capacity was calculated using 224 drives of the currently available 400G SATA hard drives.

The DS4800 is designed to deliver up to a twofold IOP performance increase over the current DS4500 offering and represents the sixth-generation architecture of the DS4000 series family. A 4-U rack-mountable enclosure houses the DS4800 redundant, dual-active intelligent RAID controllers equipped with sixteen 4-Gbps fibre channel ports (eight ports per controller), for attachment of host servers and DS4000 storage expansion enclosures.

The DS4800 supports attachment of up to 16 DS4000 EXP100 or EXP710 storage expansion enclosures, or up to 14 DS4000 EXP810 storage expansion enclosures, resulting in the capability to connect to up to 224 disk drives and enabling storage configurations of over 89 TB. DS4800 models 82A/H, 84A/H and 88A/H support the attachment of up to 224 drives as standard. The DS4800 model 80A/H supports only the attachment of up to 112 drives as standard. An entitlement must be purchased to connect up to 224 drives behind a DS4800 model 80A/H.

The DS4800 supports configurations of FC or Serial Advanced Technology Attachment (SATA) disks, or a mix of both types of disk drives by use of the optional DS4800 Fibre Channel/SATA Enclosure Intermix feature.

Advanced DS4000 storage management, copy service options, and optional advanced disaster recovery functions are available for the DS4800, including FlashCopy®, VolumeCopy, and Enhanced Remote Mirroring.

The DS4000 Storage Manager client is also available for the DS4800. This storage management software is designed to help centralize storage management, help simplify partitioning of the DS4000 series storage into as many as 512 virtual servers, and strategically allocate storage capacity to maximize storage space.

The DS4800 RAID controller cache size varies depending on the DS4800 model. Currently, the cache size is either 2 GB, 4 GB or 8 GB. Depending on the model,

the DS4800 either ships with the 8-storage-partition premium feature or can be ordered with upgraded storage-partition premium features. The operating system host kit shipped with the DS4800 also depends on the model ordered. DS4800 models 80H, 82H, 84H, and 88H come with the Windows® operating system and eight storage partitions. Please contact your IBM sales representatives or reseller for information on the various DS4800 models and options.

Fibre channel defined

Fibre channel technology is outlined in the *SCSI-3 Fibre Channel Protocol* (SCSI-FCP) standard. Fibre channel is a high-speed data transport technology that is used for mass storage and networking. Using a fibre-channel arbitrated loop (FC-AL), more than 100 fibre-channel devices¹ can be supported, compared to 15 small computer system interface (SCSI) devices.

The optical fibre channel connection from the DS4800 to fibre channel host bus adapter ports, or from the DS4800 to DS4000 storage expansion enclosure ports, is a 4-Gbps fibre channel connection that supports a data transfer rate up to 400 MBps at half-duplex and 800 MBps at full-duplex.

SATA defined

The Serial Advanced Technology Attachment (SATA) interface offers increased data rate performance over Parallel Advanced Technology Attachment (ATA), while maintaining the benefits of ATA. SATA is designed to overcome the performance barriers that have been forecasted for current parallel technologies while maintaining the cost-efficiency of Parallel ATA. SATA specifications allow for thinner, more flexible cables, and lower pin counts. It also enables easier, more flexible cable routing management and the use of smaller connectors than is possible with the existing Parallel ATA technology.

The Serial ATA Working Group introduced the first SATA specification, Serial ATA 1.0, in 2001, and can be found at the following Web site:

<http://www.serialata.org>.

Features at a glance

Table 2 on page 3 summarizes the features of the storage subsystem. For a list of the operating specifications, such as weight, height, and heat output, see “Specifications” on page 20.

1. For the DS4800, each drive is considered to be a device in a fibre channel loop, even though the DS4800 might connect with SATA as well as fibre channel drives.

Table 2. Features at a glance

<p>General</p> <ul style="list-style-type: none"> Modular components: <ul style="list-style-type: none"> RAID controllers (2), with either 2 GB, 4 GB or 8 GB of cache memory per controller (depending on model) Power supply-cooling fan units (2) Interconnect-battery unit (1) Technology: <ul style="list-style-type: none"> Support for RAID 0, 1, 3 and 5 disk arrays Support for clustering Fibre channel host interface Redundant controllers and power supply/cooling system Hot-swap technology for controllers, power supply and fan units, cache battery, and interconnect-battery unit <p>Attention: Never remove the interconnect-battery unit unless directed to do so by an IBM Service representative.</p>	<ul style="list-style-type: none"> User interface: <ul style="list-style-type: none"> Built-in power, activity, and fault (Needs Attention) light emitting diodes (LEDs) Identification labeling on customer replaceable units (CRUs), rear LEDs, switches, and connectors Easy-to-replace power supply and fan units, RAID controllers, cache battery, and interconnect-battery unit <p>RAID controllers</p> <ul style="list-style-type: none"> Fibre channel interface: sixteen small form-factor pluggable (SFP) ports for incoming and outgoing fibre-channel cables (There are eight SFP ports on each RAID controller: four ports are reserved for host connections and four ports are reserved for drive expansion enclosures connections.) Host connections: Four 1-Gbps/2-Gbps/4-Gbps (auto-negotiated) fibre channel host-side connections per controller 	<p>Attached storage expansion enclosures</p> <ul style="list-style-type: none"> Four dual-ported drive channel connections (2 per RAID controller) enabled to support 2-Gbps/4 Gbps fibre channel connections Supports attachment of DS4000 2 Gbps EXP100 and EXP710, and 2 Gbps/4 Gbps EXP810 storage expansion enclosures <p>Note: DS4000 EXP700s are not supported by the DS4800 unless they have been upgraded (with the DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit) to have the same internal switched capabilities as the DS4000 EXP710.</p> <p>Attention: The DS4800 does not support the attachment of storage expansion enclosures operating at 1 Gbps, such as the EXP500.</p>
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Clustering support

Clustering is a means of sharing array groups among controllers to provide redundancy of controllers and servers. This redundancy is important if a hardware component fails. If a hardware component failure occurs in a cluster, another server takes ownership of the array group.

Clustering requires software specific to your operating system. For more information about clustering, go to the following Web sites:

- www.pc.ibm.com/us/compat/nos/matrix.shtml
- www-03.ibm.com/servers/storage/disk/ds4000/ds4800/interop.html

Inventory checklist

After you unpack the DS4800, verify that you have the following items. See “Storage subsystem components” on page 6 for the locations of hardware components on the DS4800.

Note: Depending on your DS4800 order, your shipping box might contain additional materials not listed in the following checklist. Review the inventory checklist included in the DS4800 shipping box for any additional parts, and use that checklist in combination with the following information.

- Hardware**
 - One DS4800 bezel (front cover)
 - Two RAID controllers (shipped installed in the DS4800)
 - Two power supply and fan units (shipped installed in the DS4800)
 - One interconnect-battery unit with two cache-backup battery packs (shipped installed in the DS4800)
 - Two line cord jumpers

Line cord jumpers are power cables used to connect the DS4800 RAID controller units to the IBM-certified rack power distribution units (PDUs) installed in the rack cabinet.

- Eight 4 Gbps SFP modules (These SFP modules are already installed in the DS4800 drive (4) and host (4) ports.)
- One rack-mounting hardware kit, including:
 - Two rails (right and left assemblies)
 - Eight M5 black hex-head screws
- Wrap plug and coupler kit

Use the wrap plug and coupler kit for FC link diagnostics. See the *IBM System Storage DS4000 Problem Determination Guide* for more information.

Attention: The DS4800 does not ship with region-specific power cords. You must obtain the IBM-approved power cords for your region. See Appendix D, “Power cords,” on page 195 for the IBM-approved power cords for your region.

- **Software and documentation**

- Host software attachment kit

Depending on the DS4800 model you order, your DS4800 will ship with either the Microsoft® Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4800. The kit includes a *DS4000 Storage Manager Version 10 Support* CD that has the appropriate IBM DS4000 Storage Manager host software. The CD also contains includes firmware, online help, and publications in Adobe Acrobat Portable Document Format (PDF). (For a list of available IBM DS4000 publications, see Appendix A, “Additional DS4000 documentation,” on page 179.)

If you order more than one host software kit, the additional kits may also be shipped in the DS4800 shipping box.

Note: Depending on your DS4800 model, you may need to purchase the appropriate host software kit for your host server operating system. Contact your IBM representative or reseller for more information.

- An eight storage partition premium feature activation kit for models 80H, 82H, 84H and 88H. For models 80A, 82A, 84A and 88A, the storage partition premium feature activation kit correlates to the number of storage partitions that you ordered
- *IBM System Storage DS4800 Storage Subsystem Installation, User's, and Maintenance Guide*
- *IBM System Storage Quick Start Guide for the DS4800*
- *IBM Safety Information*
- IBM License Agreement
- Statement of Limited Warranty

If an item is missing or damaged, contact your IBM reseller or your IBM marketing representative.

If you have not already done so, record your storage subsystem serial number, machine type and model number, and RAID controller MAC addresses in Appendix B, “Records,” on page 189. The serial number, machine type, and model number are located on top of the DS4800 subsystem. The MAC addresses are

located near the Ethernet ports on each RAID controller, as shown in Figure 104 on page 189. You may not be able to easily access this information after you install the DS4800.

Rack mounting templates for installing the support rails are provided in this document in Appendix C, “Rack mounting templates,” on page 191.

To connect your DS4800 to other devices, use the following options:

- IBM SFP module
- IBM LC-LC fibre-channel cable
- IBM LC-SC fibre-channel cable (for host-side connections only)

Note: You might need to order these options separately.

Product updates and support notifications

Be sure to download the latest versions of the DS4000 Storage Manager host software, DS4000 storage subsystem controller firmware, DS4000 drive expansion enclosure ESM firmware, and drive firmware at the time of the initial installation and when product updates become available.

Important

Keep your system up to date with the latest firmware and other product updates by subscribing to receive support notifications.

For more information about support notifications or the My Support feature, including instructions on how to register, see the following IBM Support Web page:

www.ibm.com/systems/support/storage/subscribe/moreinfo.html

You can also check the **Stay Informed** section of the IBM Disk Support Web site:

www.ibm.com/servers/storage/support/disk/index.html

Best practices guidelines

To ensure optimal operation of your system, always follow these best practices guidelines:

- Ensure that your system is in an optimal state before you shut it down. Never turn the power off if any Needs Attention LED is lit; be sure to resolve any error conditions before you shut down the system.
- Back up the data on your storage drives periodically.
- To maintain power redundancy, plug the DS4800 right and left RAID controller units into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4800 should be plugged into the same two independent external power circuits as the DS4800. This ensures that the DS4800 and all its attached storage expansion enclosures will have power in the event that only one power circuit is available. In addition, having all the right or all the left power cables plug into the same power circuit enables the DS4000 devices in the configuration to

power on simultaneously during an unattended restoration of power. See Figure 72 on page 101 for an example of redundant power connections.

Note: Do not overload the circuits that power your storage subsystem and storage expansion enclosures. Use additional pairs of power distribution units (PDUs) if necessary. Refer to the Installation, User's, and Maintenance Guide for your storage expansion enclosures for information on storage expansion enclosure power requirements. Contact your IBM service representative for additional information if needed.

- Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), complete the following tasks:

1. Save the storage subsystem profile
2. Save the storage subsystem configuration

Make sure that you save the files in a location other than in the logical drives that were created for the storage subsystem.

For more information on how to complete these tasks, check the DS4000 Storage Manager online help or the Storage Manager guide for your operating system.

- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in "Turning on the storage subsystem" on page 107. Check that each component of the subsystem is powered-on in the proper order during this entire power-up procedure to ensure the controller will be able to optimally access all of your storage subsystems.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in "Turning on the storage subsystem" on page 107 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and arrays are not displayed in the DS4000 Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and arrays do not come online.
 - The storage subsystem logical drives and arrays seem to be degraded.

Storage subsystem components

The DS4800 directs and manages the I/O activity between a host and the drives in a RAID array. The storage subsystem has eight single-ported host channels (four per controller) and can support up to 256 hosts with two FC connections to the DS4800 (one to controller A and one to controller B for redundancy). The storage subsystem has four dual-ported drive channels and can support up to 224 fibre channel or SATA drives with a maximum of 2048 addressable logical drives.

Note: The DS4800 model 80A/H subsystem supports the attachment of up to 112 drives only as a standard. An additional entitlement must be purchased to allow the attachment of up to 224 drives to the DS4800 model 80A/H subsystem.

The DS4800 has Intel Pentium® processors and RAID controllers with either 2, 4 or 8 GB of cache random access memory (RAM) (depending on the DS4800 model).

Its host-side and drive-side fibre channel port can support fibre channel speeds of up to 4 Gb/s. Figure 1 shows the DS4800 with front bezel in place.

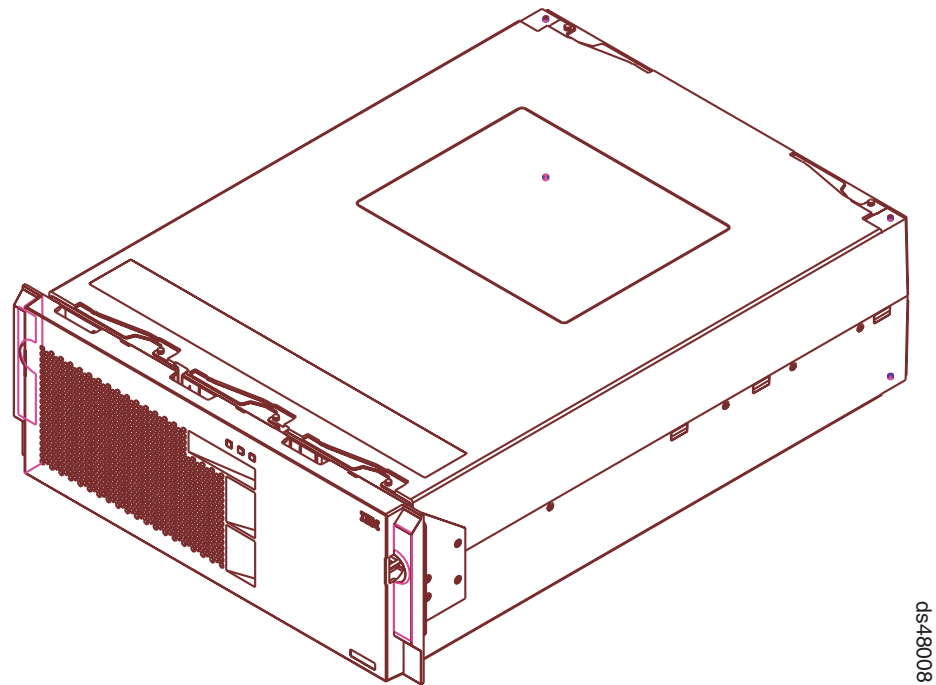


Figure 1. DS4800 Storage Subsystem

The storage subsystem comprises five components. The components, and the quantity of each component in the storage subsystem, are the following:

- RAID controllers (two)
- power supply and fan units (two)
- Interconnect-battery unit (one)

The power supply and fan unit and interconnect-battery unit are located behind the front bezel. The controllers are located in the rear of the storage subsystem. All components are secured in the storage subsystem by quick release latches, enabling each component to be removed by disengaging the latch and sliding the component from the storage subsystem chassis. Figure 2 on page 8 shows the positions of the components in the DS4800.

All DS4800 models support hot-swap RAID controllers, power supply and fan units, cache-protected batteries, and interconnect-battery units, so you can remove and replace these components without turning off the storage subsystem. Hot-swappable devices enable you to maintain the availability of your system while you remove, install, or replace a hot-swap device.

Attention

Refer to the component replacement sections in Chapter 5, “Replacing components,” on page 143, or refer to the DS4000 Storage Manager Recovery Guru, for instructions and prerequisites before performing any CRU replacements. Failure to meet prerequisites or follow replacement instructions might result in a loss of data access.

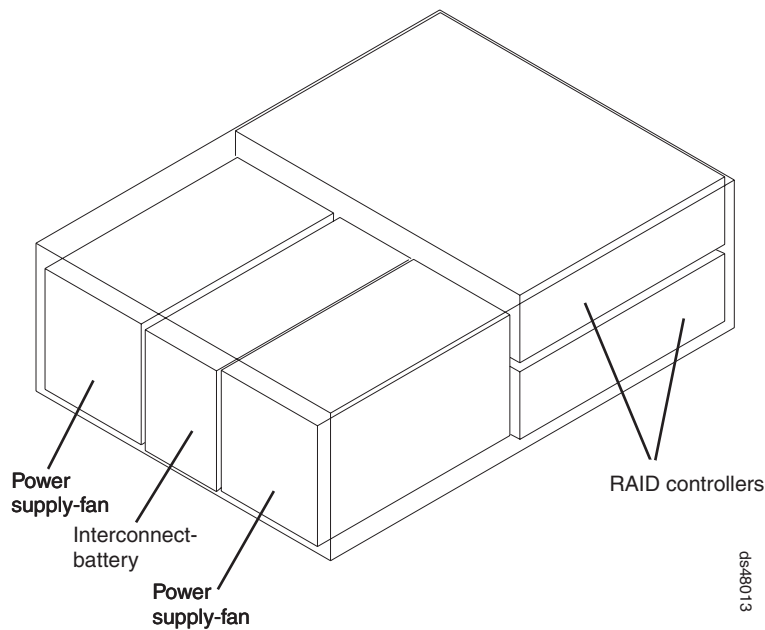


Figure 2. Location of components in the storage subsystem

The storage subsystem provides flexibility in configuring a RAID array. (The DS4800 disk capacity is scalable from 36 GB to over 89 TB.) A minimal storage subsystem configuration would consist of one DS4800 and one DS4000 storage expansion enclosure. The storage expansion enclosure can contain as few as two disk drives. The maximum number of disk drives a DS4800 can support is 224 drives. The maximum number of storage expansion enclosures that can be attached to the DS4800 varies depending on the type of the attached DS4000 storage expansion enclosures and whether there is a mix of different types of DS4000 storage expansion enclosures. Currently, the DS4800 storage subsystem models 80A/H, 82A/H, 84A/H and 88A/H support the following DS4000 storage expansion enclosures:

- EXP100
- EXP710
- EXP810

See Table 3 for the maximum number of storage expansion enclosures that can be attached to the DS4800 storage subsystem by storage expansion enclosure type.

Table 3. Maximum number of storage expansion enclosures

Enclosure type	Maximum number of enclosures in a redundant DS4800 drive channel pair	Maximum number of enclosures in a DS4800 subsystem
EXP100	8	16
EXP710	8	16
EXP710 and EXP100	8	16
EXP810	7	14
EXP710 and EXP810	7	14 (or 15) ¹
EXP100 and EXP810	7	14 (or 15) ¹
¹ The value 15 assumed that one of the redundant DS4800 drive channel pairs must have only EXP710 or only EXP100 enclosures attached.		

Notes:

1. DS4000 EXP700s are not supported by the DS4800 unless they have been upgraded (with the DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit) to have the same internal switched capabilities as the DS4000 EXP710.
2. The DS4800 does not support the attachment of storage expansion enclosures operating at 1 Gbps, such as the EXP500.

Controllers

The DS4800 has two RAID controllers. Both controllers are identical and interchangeable. The controllers install from the rear of the storage subsystem. The upper controller is controller A; the lower controller is controller B. All connections to the hosts and the drives in the storage configuration are through the controllers. Figure 3 shows the controllers in the DS4800.

Note: Although both RAID controller units (A and B) in the DS4800 are identical, they are seated in the DS4800 chassis in opposite orientations. As shown in Figure 3, the controller units must be inserted in the DS4800 so that the latches of each controller are on the exterior of the DS4800 chassis. The latches on controller A line up with the top side of the DS4800 chassis; the latches on controller B line up with the bottom side of the DS4800 chassis.

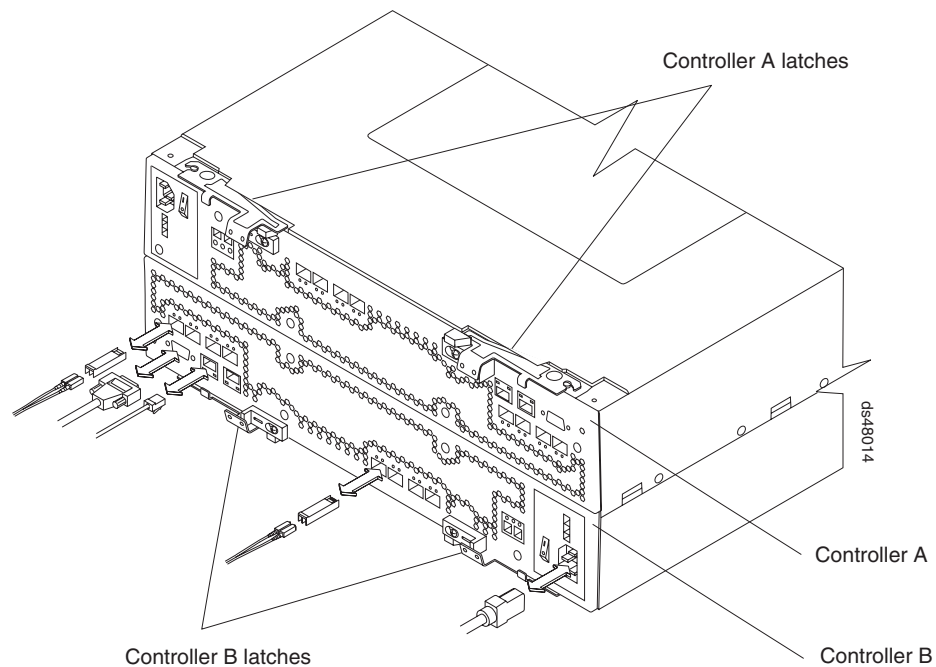


Figure 3. Controllers in the storage subsystem

Information about the condition of the controllers is conveyed by indicator LEDs on the back of each controller. (“RAID controller LEDs” on page 122 identifies the indicator LEDs on the RAID controller and explains the conditions that each LED indicates.)

Controller cable connections

Each controller provides the following connections:

- Two dual-ported fibre channel drive channels
- Four single-ported host channels
- Two RJ-45 Ethernet ports
- One RS-232 serial port
- AC power

Note: DC power connection is not supported in the current release of the DS4800. Although a dc power connection is present on the RAID controller, do not use this connection. Contact IBM for information about possible future dc power support.

Figure 4 identifies the connectors on the back of each controller.

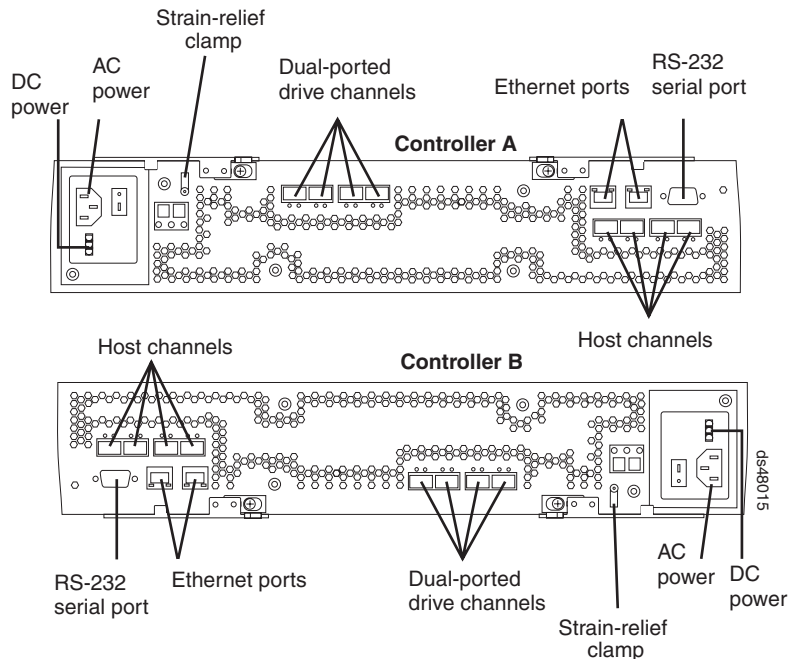


Figure 4. Controller connections

Dual-ported drive channels

Each controller has two drive channels; each drive channel has two fibre channel ports. The drive channels are used to connect storage expansion enclosures to the RAID controllers on the DS4800.

Note: Other DS4000 product documentation might refer to the drive channel ports as *expansion ports*.

Attention: The DS4800 requires the attachment of at least one DS4000 storage expansion enclosure populated with at least two drives to be operational. Without being connected to at least one DS4000 storage expansion enclosure populated with at least two drives, the DS4800 controller will not successfully complete the power-on process.

Two drive channels (one from each controller) are used to form a redundant drive channel pair. Each drive channel pair supports up to a maximum of

112 drives in seven or eight IBM DS4000 storage expansion enclosures, depending on the enclosure types. (See Table 3 on page 8 for more information.)

The drive channel port speeds are auto-negotiated between 2 Gbps and 4 Gbps fibre channel speeds. Both ports of a dual-port drive channel must be connected to storage expansion enclosures operating at the same fibre channel speed. In addition, link-speed negotiation for a given port is limited to the link speeds supported by the Small Form-factor Pluggable (SFP) module plugged in that port.

However, if the 2 Gbps and the 4 Gbps DS4000 storage expansion enclosures are separated into different redundant drive channel pairs, the DS4800 (**1**) will support both 2 Gbps and the 4 Gbps DS4000 storage expansion enclosures at their own fibre channel speed (either 2 Gbps or 4 Gbps). For example, as shown in Figure 5, the redundant drive channel with EXP810s (**4**) operates at 4 Gbps, while at the same time the other redundant drive channel with EXP710s (**5**) operates at 2 Gbps. This is possible because all 4 Gbps EXP810s (**2**) are connected behind a given redundant drive channel pair, and all 2 Gbps EXP710s (**3**) are connected to a different redundant drive channel pair.



Figure 5. DS4800 configuration with 2 Gbps and 4 Gbps enclosures in different drive channel pairs

Host channels

Each DS4800 controller has four single-port host fibre channel ports. The controllers perform link speed negotiation on each host channel fibre channel port (also referred to as auto-negotiation). Each host channel can

operate at either 1, 2, or 4 Gbps fibre channel speeds. The controllers interact with the fibre channel host bus adapter ports in the host server or the fibre channel switch to determine the fastest compatible speed between the controllers and the host or switch. The fastest compatible speed becomes the operating speed of the link. If the host or switch on the other end of the link are either fixed-speed or not capable of negotiating, the controllers automatically detect the operating speed of the other host or switch and set the controller link speed accordingly. Link speed negotiation for a given host channel is limited to link speeds supported by the small form-factor pluggable (SFP) module on that channel.

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

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

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

For a 4 Gbps controller, the supported host-channel link speeds are 1, 2, and 4 Gbps.

Ethernet ports

The Ethernet connections provide for out-of-band management configurations to a host. The Ethernet ports are used for an RJ-45 10BASE-T or 100BASE-T Ethernet connection to each controller. Use the Ethernet connection to directly manage the DS4800.

Use one Ethernet port for daily management of the DS4800. Reserve the other port for use by service personnel or for subsystem monitoring hardware that may be available in the future.

The two Ethernet ports must be connected into networks with two separate subnet masks. Otherwise, the following Recovery Guru error will be generated:

Ethernet Configuration conflict. Both Ethernet ports for a given DS4800 controller have been assigned IP addresses from the same subnet.

You can also make out-of-band management connections to the DS4800 controllers using the default IP addresses. The default IP addresses for the controller A Ethernet ports 1 and 2 are 192.168.128.101 and 192.168.129.101, respectively. The default IP addresses for the controller B Ethernet ports 1 and 2 are 192.168.128.102 and 192.168.129.102, respectively. The default subnet mask for all four Ethernet ports is 255.255.255.0. See “Setting up IP addresses for DS4000 storage controllers” on page 13 for more information.

RS-232 serial port

The RS-232 serial connection provides a diagnostic port *for use by service personnel only* to perform diagnostic operations on the RAID controllers.

Attention: Incorrect use of the serial port can result in loss of data access and, in some cases, in loss of data. *Do not* make any connections to the serial port unless you do so under the direct guidance of IBM support personnel.

Note: The maximum baud rate is 115 200 bps. The default baud rate setting from the factory is 38 400 bps.

Setting up IP addresses for DS4000 storage controllers

After you install DS4000 Storage Manager (as described in the DS4000 Storage Manager Installation and Support Guide for your host operating system), complete one of the following procedures to set up IP addresses:

- “Steps for setting up the DHCP/BOOTP server and network”
- “Steps for assigning static TCP/IP addresses to the DS4000 controllers”

Steps for setting up the DHCP/BOOTP server and network: To complete this procedure, you must have the following components:

- A DHCP or BOOTP server
- A network management station (NMS) for Simple Network Management Protocol (SNMP) traps
- A host that is connected to a storage subsystem through a fibre-channel I/O path
- A management station that is connected by an Ethernet cable to the storage subsystem controllers

Note: You can avoid DHCP/BOOTP server and network tasks either by using the default controller IP addresses, or by assigning static IP addresses to the controller, as described in the next section.

Complete the following steps to set up the DHCP/BOOTP server and network:

1. Get the MAC address from each controller blade.
2. Complete whichever of the following steps is appropriate for your server:
 - On a DHCP server, create a DHCP record for each of the MAC addresses. Set the lease duration to the longest time possible.
 - On a BOOTP server, edit the bootptab file to add in the entries that associate the MAC address tab with the TCP/IP address.
3. Connect the DS4000 storage subsystem Ethernet ports to the network.
4. Boot the DS4000 storage subsystem.

The DHCP server automatically assigns new IP addresses to the controller Ethernet port.

Steps for assigning static TCP/IP addresses to the DS4000 controllers: To complete this procedure, you must have the following components:

- A host that is connected to a storage subsystem through a fibre-channel I/O path
- A management station that is connected by an Ethernet cable to the storage subsystem controllers

Complete the following steps to assign static TCP/IP addresses to the DS4000 storage subsystem controllers, using default TCP/IP addresses that are assigned to the DS4000 storage subsystem controllers during manufacturing:

1. Make a direct management connection to the DS4000 storage subsystem, using the default TCP/IP addresses:
 - **Controller A:** 192.168.128.101
 - **Controller B:** 192.168.128.102
 - **Subnet Mask:** 255.255.255.0

Note: For a DS4000 subsystem that has two Ethernet ports per controller, such as the DS4200, DS4700 and DS4800, use the Ethernet port that is labeled #1.

2. Start the DS4000 Storage Manager client software. The Enterprise Management window opens.
3. Add the DS4000 subsystem to the DS4000 Enterprise Management domain using the default IP addresses.
4. In the Enterprise Management window, click on the name of the default storage subsystem. The Subsystem Management window opens.
5. In the Subsystem Management window, right-click the controller icon and select **Change —> Network Configuration** in the pull-down menu. The Change Network Configuration window opens.
6. In the Change Network Configuration window, click on the Controller A and Controller B tabs and type the new TCP/IP addresses in their appropriate fields. Click **OK**.
7. Close the Subsystem Management window, wait at least five minutes, then delete the default DS4000 storage subsystem entry in the Enterprise Management window. The default DS4000 storage subsystem entry still displays, but shows an “unresponsive” icon.
8. If applicable, change the IP address of the Ethernet port in the management station to a value that is on the same TCP/IP subnet as the controller Ethernet port IP addresses that you just assigned. Exit DS4000 Storage Manager, then restart.
9. Add a new storage subsystem entry in the Enterprise Management window, using the new assigned IP addresses.

Note: To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data.

Controller memory

Each RAID controller has up to 8 GB of data cache memory, for a total of up to 16 GB cache memory per DS4800. Each RAID controller also has a total of either 512 MB (for models 80A/H, 82A/H or 84A/H) or 1024 MB (for models 88A/H) of Intel Pentium Xeon™ processor memory. The processor memory stores the controller firmware, while the data cache is a buffer used to temporarily store hard disk drive data during data read and write operations. A Cache Active LED on the controller turns on when the cache contains data that has not been written to hard disk drives. The Cache Active LED turns off when the cache does not contain unwritten data.

Table 4 lists the technical specifications for the RAID controllers.

Table 4. RAID controller specifications

Category	Criteria	Specification
Memory	Cache size	2 GB, 4 GB or 8 GB, depending on the model

Table 4. RAID controller specifications (continued)

Category	Criteria	Specification
Interface	Fibre channel host port	4 fiber-optic ports per controller 2 Ethernet ports per controller (for out-of-band management)
	Fibre channel drive expansion port	4 fiber-optic ports per controller Note: Each DS4800 controller drive channel has two ports. There are two drive channels per DS4800 controller.
Storage Expansion Enclosure support	Redundant drive channel pairs	2 per controller
	Maximum number of drives per redundant drive channel pair	112 drives per redundant drive channel pair (either 8 storage expansion enclosures with 14 drives each or 7 storage expansion enclosures with 16 drives each). See Table 3 on page 8.
	Maximum number of drives supported by one DS4800	224 drives (2 redundant drive channel pairs with 112 drives in each drive channel pair)
Data transfer rates	Fibre channel host	Up to 4 Gb/sec maximum. Support 1, 2 and 4 Gbps FC speeds.
	Fibre channel drives	Up to 4 Gb/sec maximum (depends on storage expansion enclosure speed). Support 2 and 4 Gbps drives only. Does not support 1Gbps drives.
	Ethernet	10BASE-T 100BASE-T

Power supply and fan units

The DS4800 has two power supply and fan units. Each power supply and fan unit contains a power supply, a fan, and a battery charger. Each power supply provides power to the controllers by converting incoming ac voltage to the appropriate dc voltages. If one power supply and fan unit is turned off or malfunctions, the remaining power supply and fan unit can maintain electrical power and cooling to the storage subsystem.

Note: Contact IBM for information about possible future dc-to-dc power supply support.

Install the power supply and fan units from the front of the storage subsystem. Figure 6 on page 16 shows how a power supply and fan unit slides into the storage subsystem. The levers that secure the left power supply and fan unit into the

storage subsystem are shown in the released position. The levers that secure the right power supply and fan unit into the storage subsystem are shown in the latched position.

Note: Although both power supply and fan units in the DS4800 chassis are identical, they are seated in the DS4800 chassis in opposite orientations. The left and right power supply and fan units are installed so that the LED column of each power supply and fan unit is located towards the interior of the DS4800, along the side of the interconnect-battery unit.

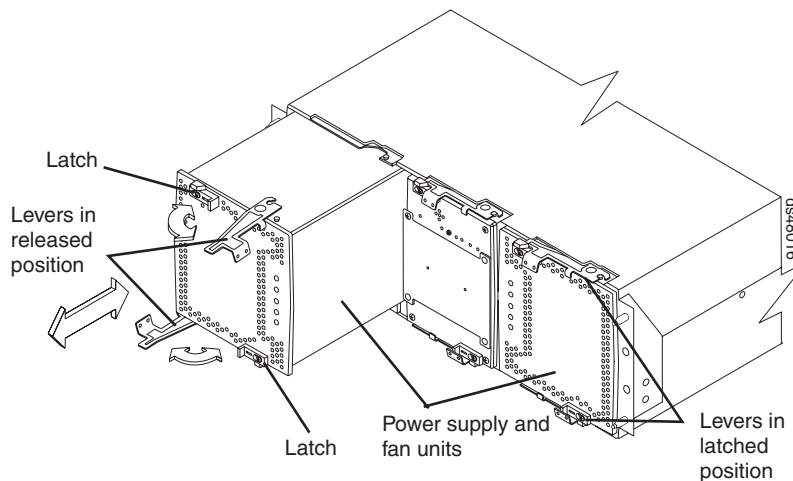


Figure 6. Power supply and fan unit

Information about the condition of the power supplies, fans, and battery charger is conveyed by indicator lights (LEDs) on the front of each of the power supply and fan units and on the interconnect-battery unit. You must remove the front bezel to see the LEDs. ("Power supply and fan unit LEDs" on page 127 identifies the indicator LEDs on a power supply and fan unit and explains the conditions that each LED indicates.)

Note: The order of the LEDs on the power supply and fan unit is different depending on whether the power supply and fan unit is installed in the left or right bay.

In the DS4800 Storage Subsystem, the right power supply and fan unit is linked to controller A, and the left power supply and fan unit is linked to controller B. To increase protection against power loss, always make sure that both power supply and fan units are operational.

Interconnect-battery unit

The interconnect-battery unit is a removable midplane that provides cross-coupled signal connection between the controllers. The control output from each controller is connected to the control input in the alternate controller. An audible alarm is mounted on the interconnect-battery unit display board. A mute switch for the audible alarm is also mounted on the same board. The interconnect-battery unit also provides the electrical communication path between the power supply and fan units and allows their power supplies to load-share and to charge the cache-backup battery packs. There are two cache-backup battery packs mounted inside the interconnect-battery unit.

Attention: Because the interconnect-battery unit provides electrical signal connections between the controllers, removing the interconnect-battery unit interrupts the communications between the controller units in the DS4800, resulting in a loss of communication between controllers A and B. Data access is limited to only controller A when the interconnect-battery unit is removed. Controller B is in an offline state while controller A performs all controller operations. To prevent any problems as a result of this condition, controller B must be placed offline before you remove the interconnect-battery unit. See “Replacing the interconnect-battery unit” on page 158 for more information. Failure to observe the instructions and prerequisites described in “Replacing the interconnect-battery unit” on page 158 might result in a loss of data access.

Figure 7 shows how the interconnect-battery unit slides into the front of the storage subsystem. The levers securing the interconnect-battery units to the storage subsystem are shown in the released position.

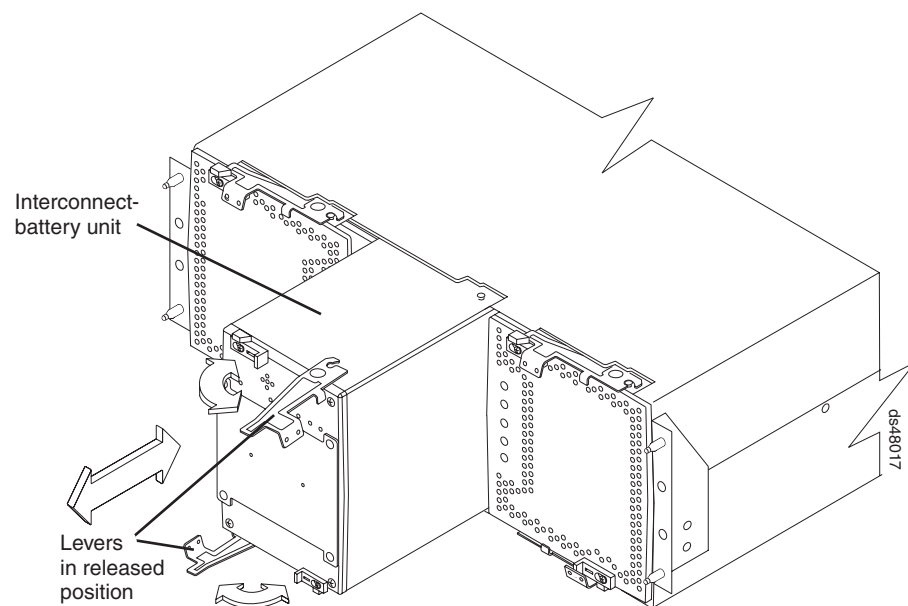


Figure 7. Interconnect-battery unit

The interconnect-battery unit contains two battery packs that provide backup power to the controller cache memory. Each battery pack contains sealed, rechargeable lithium ion batteries. The battery packs can maintain data in the cache for at least three days.

The battery chargers in the power supply and fan units perform a battery test when the storage subsystem is started and on a regularly scheduled interval thereafter. Data caching is suspended during periods when the controllers performed battery tests.

The interconnect-battery unit is hot-swappable. You can remove the interconnect-battery unit for servicing and then reinsert it while the DS4800 continues to perform I/O operations.

Attention

Never remove the interconnect-battery unit unless directed to do so by an IBM support representative. Removing the interconnect-battery unit after a controller or a power supply and fan unit has already been removed results in a loss of data access. Refer to “Replacing the interconnect-battery unit” on page 158 for complete information about the conditions required for safe removal of the interconnect-battery unit. *Do not* replace the interconnect-battery unit without first meeting the requirements described in “Replacing the interconnect-battery unit” on page 158.

Information about the condition of the interconnect-battery unit is conveyed by indicator LEDs on the front of interconnect-battery unit. (“Interconnect-battery unit LEDs” on page 129 identifies the indicator LEDs on the interconnect-battery unit and explains the conditions that each LED indicates.)

You must remove the front bezel in order to see all of the interconnect-battery unit LEDs. With the bezel in place, only the following interconnect-battery unit LEDs are visible:

- Power
- Overall DS4800 Configuration Needs Attention
- Locate/Identify

Note: The displayed order of the Overall DS4800 Configuration Needs Attention and Locate/Identify LEDs on the interconnect-battery unit are reversed when the bezel is removed. See “Front bezel LEDs” on page 120 and “Interconnect-battery unit LEDs” on page 129.

SFP modules

The storage subsystem supports fiber-optic interface cables. You must install a Small Form-factor Pluggable (SFP) module in each interface connector on the controller where a fibre optic cable is to be installed. Do not install an SFP in any port that will not have a fibre optic cable attached. Additionally, it is recommended that you remove any SFP from any port that does not have fibre optic cables attached.

Figure 8 on page 19 shows an SFP module with fiber-optic cable. Note that the SFP module shown might look different from those shipped with your unit. The differences do not affect module performance.

Attention: Currently, the DS4800 supports only short-wave/multimode SFPs. In DS4800 configurations, you may use long-wave SFPs only in fibre channel switches that connect DS4800s over long distances. In addition, there are not any visual markings to identify the maximum operating speeds of the SFPs aside from the option and FRU part number on the SFP label.

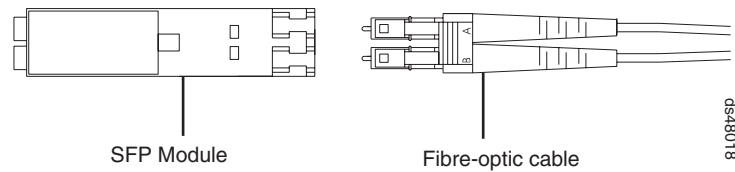


Figure 8. SFP module with fiber-optic cable

Software and hardware compatibility and upgrades

The latest DS4000 controller firmware and NVSRAM, the storage expansion enclosure drive enclosure ESM firmware, and fibre channel and SATA drive CRUs firmware must be installed to ensure optimal functionality, manageability, and reliability.

Unless stated otherwise, you can find the latest DS4000 publications, firmware, and host software at the IBM DS4000 System Storage Support Web site:

www.ibm.com/systems/support/storage/disk

Software and firmware support code upgrades

To enable support for the DS4800, you *must* ensure that your system's are the correct versions. To find the latest DS4000 Storage Manager software, storage subsystem controller firmware, ESM, and NVSRAM firmware, check the firmware readme files. See "Finding DS4000 readme files" on page xxiii to learn how to access the readme files on the Web.

See the *IBM System Storage DS4000 Storage Manager Installation and Host Support Guide* for your operating system for instructions that describe how to install the DS4000 controller firmware and Storage Manager host software.

Note: For the latest information about supported servers and operating systems, refer to the interoperability matrix at this Web site:

www-1.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Determining firmware levels

There are two different methods to determine the DS4000 storage subsystem and firmware versions. Each method uses the DS4000 Storage Manager client that manages the DS4000 storage subsystem.

Method One:

Go to the Subsystem Management window and select **View → Storage Subsystem Profile**. When the Storage Subsystem Profile window opens, select the **All** tab and scroll through the Profile For Storage Subsystem list to locate the following information.

Note: The Profile For Storage Subsystem list contains all the profile information for the entire subsystem. Therefore, it may be necessary to scroll through a large amount of information to locate the firmware version numbers.

DS4000 Storage Server

- NVSRAM version
- Appware version
- Bootware version

Drives

- Firmware version
- ATA translator card firmware version (SATA E-DDMs only)

Note: The ATA translator card firmware and drive firmware are typically packaged together as a single drive firmware upgrade file.

ESM

- ESM card firmware version

Method Two:

Complete the appropriate procedure to obtain the specified firmware version.

To obtain the controller firmware version:

Right-click the Controller icon in the Physical View pane of the Subsystem Management window and select **Properties**. The Controller Enclosure properties window opens and displays the properties for that controller.

You must perform this step for each individual controller.

To obtain the drive firmware (and ATA translator card firmware) version:

Right-click the Drive icon in the Physical View pane of the Subsystem Management window and select **Properties**. The Drive Properties window opens and displays the properties for that drive.

You must perform this step for each individual drive.

To obtain the ESM and drive enclosure component firmware versions:

1. In the Physical View pane of the Subsystem Management window, click the Drive Enclosure Component icon, which is the icon furthest to the right. The Drive Enclosure Component Information window opens.
2. Click the ESM icon in the left pane. The ESM information displays in the right pane of the Drive Enclosure Component Information window.
3. Locate the firmware version of each ESM in the drive enclosure.

Specifications

This section provides site specifications for the DS4800 Storage Subsystem. Before installing a storage subsystem, you must either verify that your planned installation site meets these requirements, or prepare the site so that it does meet these requirements. Preparations might involve meeting area requirements, environmental requirements, and electrical requirements for DS4800 installation, service, and operation.

Area requirements

The floor space at the installation site must provide enough strength to support the weight of the storage subsystem and associated equipment; sufficient space to install, operate, and service the storage subsystem; and sufficient ventilation to provide a free flow of air to the unit.

Dimensions

Figure 9 shows the dimensions of the DS4800 Storage Subsystem, which conforms to the 19-inch rack standard.

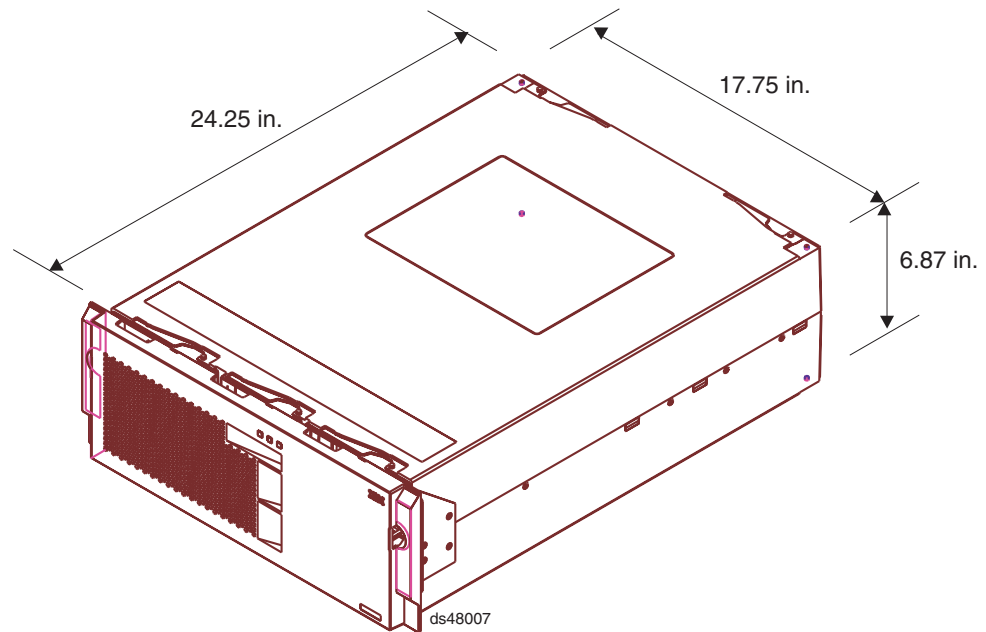


Figure 9. DS4800 Storage Subsystem dimensions

Weight

The total weight of the storage subsystem depends on the number of components installed. Table 5 lists the maximum, empty, and shipping weights for the storage subsystem in different configurations. Table 6 lists the weight of each component.

Table 5. DS4800 Storage Subsystem weights

Unit	Weight		
	Maximum ¹	Empty ²	Shipping ³
DS4800 Storage Subsystem	36.52 kg (80.7 lb)	11.1 kg (24.5 lb)	53.8 kg (118.4 lb)

¹ Maximum weight indicates a storage subsystem with two battery modules installed. Each battery module weighs 1.1 kg (2.5 lb).

² Empty weight indicates a storage subsystem with all components removed.

³ Shipping weight indicates the maximum weight of the storage subsystem and all shipping material.

Table 6. DS4800 Storage Subsystem component weights

Unit	Weight
RAID controller	6.36 kg (14 lb)
Power supply and fan unit	3.72 kg (8.2 lb)
Interconnect-battery unit	5.36 kg (11.8 lb)
Battery module	1.134 kg (2.5 lb)

Shipping dimensions

Table 7 lists shipping carton dimensions. The height shown includes the height of the pallet.

Table 7. DS4800 Storage Subsystem shipping carton dimensions

Height	Width	Depth
44.4 cm (17.5 in.)	62.2 cm (24.5 in.)	78.7 cm (31.0 in.)

Environmental requirements and specifications

This section describes the environmental conditions that are prerequisite to installing the unit, and heat and sound conditions that are generated by normal operation of the unit.

Temperature and humidity

Table 8 lists the acceptable temperature and humidity ranges in which the storage subsystem is designed to operate.

Important: The recommended operating environment air temperature is 22° C (72° F) or lower.

Table 8. Temperature and humidity requirements

Condition	Parameter	Requirement
Temperature ¹	Operating range	10° - 35° C (50° - 95° F)
	Maximum rate of change	10° C (18° F) per hour
	Storage range	1° - 60° C (33° - 140° F)
	Maximum rate of change	15° C (27° F) per hour
	Transit range	-40° C to 65° C (-40° F to 149° F)
	Maximum rate of change	20° C (36° F) per hour
Relative humidity (no condensation)	Operating range	20% to 80%
	Storage range	10% to 93%
	Transit range	5% to 95%
	Maximum dew point	26° C (79° F)
	Maximum gradient	10% per hour

Notes:

1. The non-operating environment must not exceed the operating environment limits for longer than 60 days.
2. The storage environment must not exceed the operating environment limits for longer than 1 year.
3. Substantial deviations from the suggested operating range, in either direction, if sustained for extended periods of time, will expose the unit to greater risk of failure from external causes.

Altitude

Table 9 on page 23 lists the acceptable altitudes for operating, storing, and shipping the DS4800 Storage Subsystem.

Table 9. DS4800 Storage Subsystem altitude ranges

Environment	Altitude
Operating	30.5 m (100 ft.) below sea level to 3048 m (10,000 ft.) above sea level
Storage	30.5 m (100 ft.) below sea level to 3048 m (10,000 ft.) above sea level
Transit	30.5 m (100 ft.) below sea level to 12,000 m (40,000 ft.) above sea level

Airflow and heat dissipation

Figure 10 shows the intended airflow for a DS4800 Storage Subsystem. Allow at least 30 inches in front of the storage subsystem and at least 24 inches behind the storage subsystem for service clearance, proper ventilation, and heat dissipation.

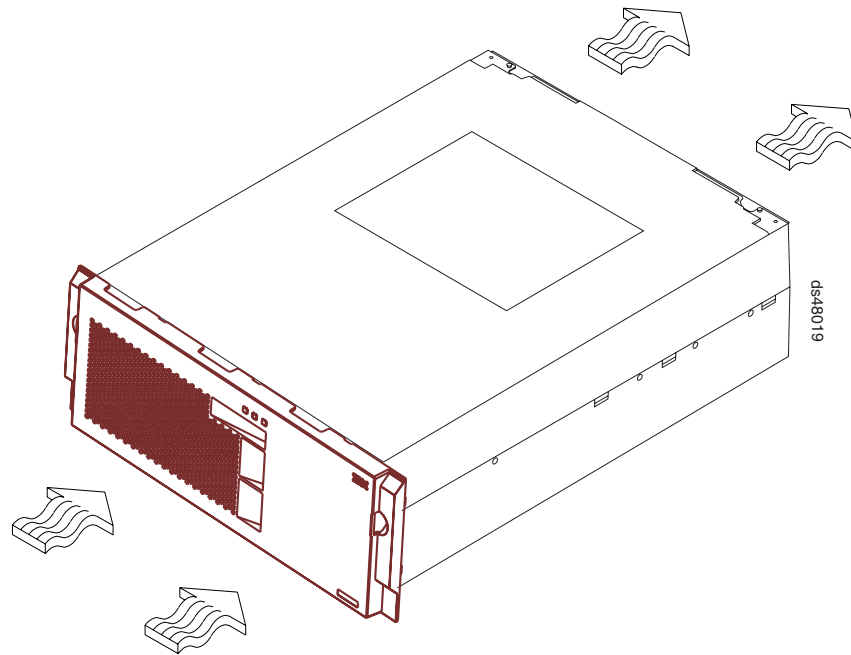


Figure 10. DS4800 Storage Subsystem airflow

Table 10 lists the KVA, watts, and Btu calculations for the DS4800 Storage Subsystem. These values assume the power supplies have a 73 percent efficiency and a power factor of 0.99. These tabulated power and heat dissipation values are typical for the storage subsystem. Maximum configuration units are typically operated at higher data rates, have larger random access memory (RAM) capacities, or have different host interface boards.

Table 10. DS4800 Storage Subsystem power and heat dissipation

Parameter	KVA	Watts (ac)	Btu per hour
RAID controller	.240	235	803.7

Shock and vibration requirements

Operational shock and operational vibration requirements are shown in this section.

Operational Shock: The DS4800 will be able to withstand the following shock. Subjecting the equipment to a single shock pulse with the following characteristics will simulate this level of shock:

- Velocity change = 20 inches per second
- Wave[®] form = Triangular, 10g @3.75 ms

Operational Vibration (Random): While in its normal operating position, the DS4800 will continue operating when subjected to a random vibration test using the criteria shown in Table 11. This test uses a dwell time of 15 minutes at any frequency where vigorous or resonant excitation occurs.

Table 11. DS4800 Storage Subsystem operational vibration specifications

Parameter	Value
Frequency sweep	5 Hz - 150 Hz - 5 Hz
Wave form	Sinusoidal, 0.25 g

Acoustic noise

Table 12 lists the maximum sound levels emitted by the storage subsystem.

Table 12. DS4800 Storage Subsystem sound levels

Measurement	Level
Sound power (normal operation)	6.0 bels
Sound pressure (normal operation)	60 dBA

These levels are measured in controlled acoustical environments according to ISO 7779 and are reported in accordance with ISO 9296. The declared sound power levels indicate an upper limit, below which a large portion of machines operate. Sound pressure levels in your location might exceed the average 1-meter values stated because of room reflections and other nearby noise.

Electrical requirements

This section provides information regarding site power and wiring, storage subsystem ac power requirements, and power cord routing instructions.

Consider the following information when preparing the DS4800 Storage Subsystem installation site:

- Protective ground – Site wiring must include a protective ground connection to the ac power source.

Note: Protective ground is also known as safety ground or chassis ground.

- Circuit overloading – Power circuits and associated circuit breakers must provide sufficient power and overload protection. To prevent possible damage to the unit, isolate its power source from large switching loads (such as air conditioning motors, elevator motors, and factory loads).
- Power failures – If a total power failure occurs, the unit automatically performs a power-up recovery sequence without operator intervention after power is restored.

Table 13. IBM System Storage DS4800 ac power requirements

	Low Range	High Range
Nominal Voltage	110	220
Voltage	90 to 132 VAC	198 to 264 VAC
Frequency (Hertz)	50 to 60 Hz	50 to 60 Hz
Minimum Operating Current	3.0 A ¹	1.5 A ²
Maximum Operating Current	3.0 A ¹	1.5 A ²
Maximum Surge Current	4.0 A ¹	2.0 A ²

¹. Typical voltage: 120 V ac, 60 Hz, assumes 75% power-supply efficiency and 0.99 power factor

². Typical voltage: 240 V ac, 60 Hz, assumes 75% power-supply efficiency and 0.99 power factor

Site wiring and power

The storage subsystem uses wide-ranging redundant power supplies that automatically accommodate voltages to the ac power source. The power supplies operate within the range of 90 VAC to 264 VAC, at a minimum frequency of 50 Hz and a maximum frequency of 60 Hz. The power supplies meet standard voltage requirements for both domestic (inside USA) and international (outside USA) operation. They use standard industrial wiring with line-to-neutral or line-to-line power connections.

The agency ratings for the DS4800 Storage Subsystem are 5 amps at 100 VAC and 2.25 amps at 240 VAC. These are the overall maximum currents for this system.

AC power recovery

After normal power is restored after a total ac power failure, the DS4800 Storage Subsystem performs power-up recovery procedures automatically without operator intervention.

Power cords and receptacles

The DS4800 ships with the line jumper cords used to connect the DS4800 to rack power distribution units (PDUs). If you need the ac power cords to connect the DS4800 to wall receptacle outlets, you must purchase the appropriate power cords for your country or region as described in Appendix D, "Power cords," on page 195.

Heat output, airflow, and cooling

The maximum heat output of the storage subsystem is 235 watts (803.7 BTU/hr). Each storage subsystem rack-mounted unit requires an airflow of 2.5 m³ (87 ft.³) per minute. The input air temperature to all rack cabinets should be in the range 10° C - 35° C (50° F - 95° F). The recommended operating temperature is 22° C (72° F).

When rack cabinets that contain many storage subsystems are to be installed together, the following requirements must be met to ensure that the storage subsystems are adequately cooled:

- Air enters at the front of the rack cabinet and leaves at the back. To prevent the air that is leaving the rack cabinet from entering the intake of another piece of

equipment, you must position the rack cabinets in alternate rows, back-to-back and front-to-front. This arrangement is known as *cold aisle/hot aisle* and is shown in Figure 11.

- Where rack cabinets are in rows, each rack cabinet must touch the rack cabinet that is next to it. This reduces the amount of hot air that can flow around from the back of the rack into the intakes of the storage subsystems that are in that rack cabinet. You should use Suite Attach Kits to completely seal any gaps that remain between the rack cabinets. For details about Suite Attach Kits, contact your marketing representative.
- Where rack cabinets are in rows front-to-front or back-to-back, a gap of at least 1220 mm (48 in.) must separate the rows across the cold aisle.
- To ensure correct airflow in each rack cabinet, the rack filler plates must be installed in unused positions. Also, all the gaps in the front of the rack cabinets must be sealed, including the gaps between the storage subsystems.

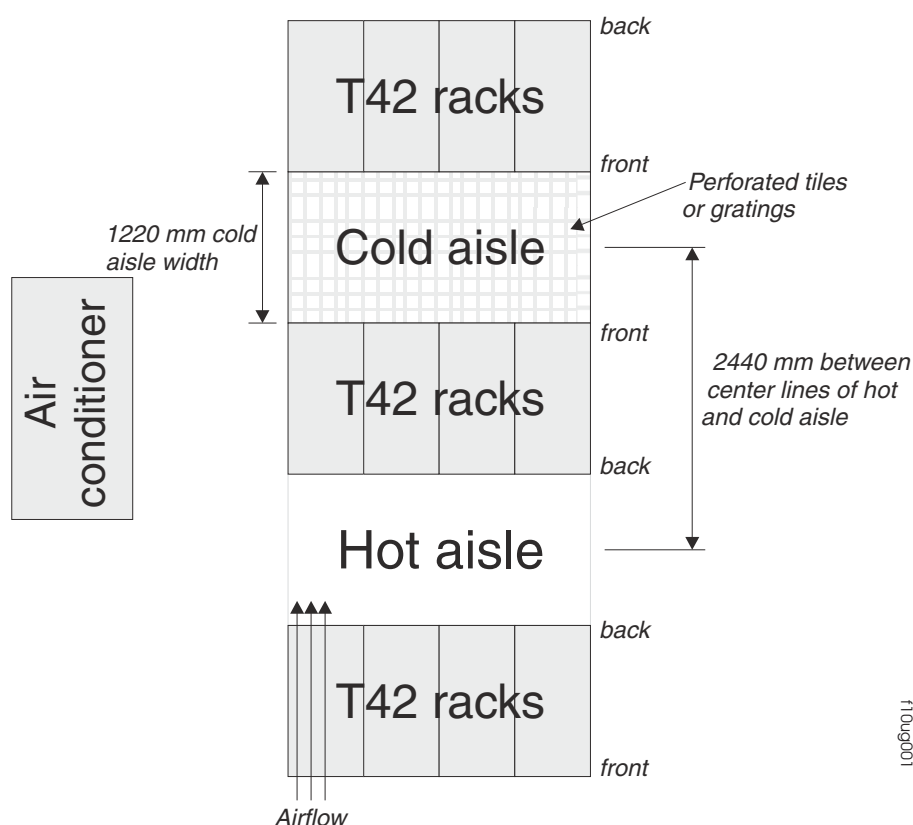


Figure 11. Example of cold aisle/hot aisle rack cabinet configuration

Chapter 2. Installing the storage subsystem

This chapter provides the information that you need to install the storage subsystem into a rack cabinet.

Before you begin the installation, review the safety information in “Safety” on page iii.

Chapter 2, “Installing the storage subsystem” provides an overview of the entire storage subsystem installation process. Read this overview before you begin the installation.

Installation overview

Statement 4:



≥ 18 kg (39.7 lb)	≥ 32 kg (70.5 lb)	≥ 55 kg (121.2 lb)

CAUTION:

Use safe practices when lifting.

Attention: A fully configured DS4800 weighs 36.52 kg (80.7 lbs). For safety reasons, the installation instructions in this chapter direct you to remove the DS4800 components *before* removing the storage subsystem from the shipping box and installing it in a rack cabinet.

The following steps summarize the DS4800 installation process. Each step below is detailed in Chapter 3, “Cabling the storage subsystem” and Chapter 4, “Operating the storage subsystem.”

1. Review the preparation recommendations. See “Preparing for installation” on page 29.
2. Prepare the installation site. See “Preparing the site” on page 31.
3. Prepare the rack cabinet. See “Preparing the rack cabinet” on page 31.
4. Fold down and open the sides of the shipping box. Without removing the DS4800 from box, you can remove the DS4800 rack mounting rails and hardware from the box, which is placed on the bottom of the shipping box underneath the DS4800 enclosure. Install the support rails in the rack cabinet. See “Installing the support rails” on page 32.
5. Before removing the DS4800 from the shipping box, remove the components from the DS4800 chassis to lighten the unit. See “Removing the components” on page 39.

6. Record the serial number, machine type and model number, and RAID controller MAC addresses for your DS4800 Storage Subsystem in Appendix B, “Records,” on page 189.

The serial number, machine type, and model number are located on top of each the DS4800 subsystem unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 104 on page 189. You may not be able to easily access this information after you install the DS4800.

7. Install and secure the DS4800 chassis in the rack cabinet. See “Installing the DS4800 on the support rails” on page 41.
8. Replace the components in the installed DS4800 chassis. See “Replacing the components” on page 43.
9. Install in the rack cabinet the DS4000 storage expansion enclosure or enclosures you will cable to the DS4800. Follow the instructions in the Installation, User’s, and Maintenance Guide for your DS4000 storage expansion enclosure to set up and mount the storage expansion enclosures.

Attention

Before you power on the DS4800 Storage Subsystem, the DS4800 must be cabled to at least one storage expansion enclosure populated with at least two drives. If at least two drives are not installed in each attached storage expansion enclosure when you power on the DS4800, your standard storage partition key will be lost and will need to be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

<https://www-912.ibm.com/PremiumFeatures/>

All drives in the connected storage expansion enclosure or enclosures must contain no prior configuration data. Additionally, if at least two drives are not installed in each attached storage expansion enclosure, the resulting insufficient load to the storage expansion enclosure power supply CRUs might cause the drive expansion enclosure power supply CRUs to intermittently appear as failed and then reappear in an optimal state, falsely indicating that the power supply CRUs are bad.

10. Use SFP modules and fibre channel cables to cable the DS4800 to the DS4000 storage expansion enclosure or enclosures. See “Connecting storage expansion enclosures to the DS4800” on page 60.
11. Set the enclosure IDs for all EXP100 and EXP710 storage expansion enclosures in the configuration to unique values. The EXP810 drive expansion enclosures automatically adjust the enclosure IDs to ensure unique enclosure IDs among themselves. See “Storage expansion enclosure settings” on page 86.
12. Perform one of the following cabling tasks to enable management of the DS4800 configuration:
 - If you are using out-of-band management, cable the DS4800 Ethernet ports to either the management workstation or the host. See “Connecting secondary interface cables” on page 91.
 - If you are using in-band management, cable the DS4800 host channels to the fibre channel host bus adapters (HBAs) in either the hosts or the fibre channel switch that connects to the host HBAs. See “Connecting hosts to the DS4800” on page 89.

13. Connect the power cables for the DS4800. See “Connecting the power cables” on page 98.
14. Power on the attached storage expansion enclosures and the DS4800 Storage Subsystem using the procedure described in “Turning on the storage subsystem” on page 107.
15. Install the DS4000 Storage Manager host software on the management workstation (for out-of-band management) or on the host (for in-band management). Refer to the *IBM System Storage DS4000 Storage Manager Version 10 Installation and Host Support Guide* for the appropriate operating system for instructions on how to install the DS4000 Storage Manager host software.
16. Use the DS4000 Storage Manager host software to verify the configuration.
17. Review and perform the procedures described in “Performing the DS4000 Health Check process” on page 104.

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

To reduce the possibility of electrostatic discharge (ESD), observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the system unit for at least two seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into your system unit without setting it down. If it is necessary to set the device down, place it in its static-protective package. Do not place the device on your system unit cover or on a metal table.
- Take additional care when handling devices during cold weather because heating reduces indoor humidity and increases static electricity.

Preparing for installation

Before installing the DS4800 Storage Subsystem, create a detailed plan of how this unit will be used in your storage configuration. The plan should include determining RAID levels, failover requirements, operating systems to be used, and total storage capacity requirements.

Complete the following steps to prepare the DS4800 for installation into a rack cabinet:

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Specifications” on page 20.
2. Move the shipping box that contains the DS4800 to the site.

Attention: The DS4800 shipping box weighs up to 53.8 kg (118.4 lb).

Statement 4:



≥ 18 kg (39.7 lb)	≥ 32 kg (70.5 lb)	≥ 55 kg (121.2 lb)

CAUTION:

Use safe practices when lifting.

3. Remove the mounting rails, mounting hardware, and line jumper cords from the DS4800 shipping box. Do not remove the DS4800 from the shipping box at this time.

Attention: The mounting rails, mounting hardware, and line jumper cords may be packed beneath the DS4800 in the shipping box. To remove these items from the shipping box without first removing the DS4800, open the two long sides of the shipping box. Then open and fold flat the two short sides of the shipping box. This enables you to access the mounting rails, mounting hardware, and line jumper cords without first removing the DS4800 from the shipping box.

After you open the DS4800 shipping container and remove the mounting rails, mounting hardware, and line jumper cords, check the remaining contents (see “Inventory checklist” on page 3) without removing the DS4800 from the shipping box. If any items are missing, contact your IBM reseller before proceeding.

4. Assemble the tools and equipment that you will need for installation. These include the following:
 - Region-specific power cords required for the DS4800.
 - 5/16 (8 mm) hex nut driver.
 - Medium flat-blade screwdriver.
 - Antistatic protection (such as a grounding wrist strap).
 - Fibre channel and Ethernet interface cables and cable straps.
 - SFP modules.
 - The line cord jumper power cords that are shipped with the DS4800.
 - The rack-mounting hardware that ships with the DS4800.
 - The appropriate host software kit for your operating system.

Depending on the DS4800 model you order, your DS4800 will ship with either the Microsoft Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4800.

The kit includes a *DS4000 Storage Manager Support* CD that has the appropriate IBM DS4000 Storage Manager host software. If you order more than one host software kit, the additional kits may also be shipped in the DS4800 shipping box.

The CD also includes the DS4000 Storage Subsystem controller firmware. Controller firmware can be downloaded from the IBM support Web site for DS4000 storage products:

www.ibm.com/systems/support/storage/disk

Note: Depending on your DS4800 model, you may need to purchase the appropriate host software kit for your host server operating system. Contact your IBM representative or reseller for more information.

5. Continue with “Preparing the site.”

Preparing the site

This section lists the floor space requirements and weight information for the storage subsystem. For information on interface cables and connections, see Chapter 3, “Cabling the storage subsystem,” on page 47.

Floor space: The floor area at the installation site must provide the following conditions:

- Sufficient space to install the storage subsystem
- Enough stability to support the weight of the fully configured storage subsystem and associated systems.

Ensure that all requirements, such as floor space, air conditioning, and electrical service, have been met. Other site preparation activities include the following tasks:

- To ensure that there is enough room to move around the cabinet and install modules, clear space at the installation area.
- Install uninterruptible power supply (UPS) devices.
- If applicable, install host servers with fibre channel host bus adapters (HBAs), fibre channel switches, or other devices.
- Route interface cables from the fibre channel HBA ports in the hosts or fibre channel switches to the installation area.
- Route main power cords to the installation area.

Continue with “Preparing the rack cabinet.”

Preparing the rack cabinet

Important: Before you install the storage subsystem in a rack cabinet, keep in mind the following considerations:

- Review the documentation that comes with your rack enclosure for safety and cabling considerations.
- Install the storage subsystem in a recommended 22° C (72° F) environment. See “Environmental requirements and specifications” on page 22 for details.
- To ensure proper airflow, do not block the air vents; ensure at least 15 cm (6 in.) of air space.
- To ensure rack stability, load the rack starting at the bottom.
- If you install multiple components in the rack, do not overload the power outlets.
- Always connect the storage subsystem to a properly grounded outlet.
- Always connect the IBM-certified rack power distribution units (PDUs) to at least two independent power circuits or sources.

Complete the following steps to prepare the rack cabinet before you install the storage subsystem:

1. Move, unpack, and level the rack at the installation site (if needed).
2. Remove the external rack panels.
3. If necessary, stop all I/O activity to the devices in the rack.
4. If necessary, turn off all drive enclosure and rack power. Disconnect existing power, network, and other external cables.
5. Install any additional interface cables and power cables.

After you have completed these steps, continue with “Installing the support rails.”

Installing the support rails

Attention: Duplicate copies of the rack mounting templates are provided in Appendix C, “Rack mounting templates,” on page 191. If you want to tear out the templates from this document for easier use, use the copies provided in Appendix C, “Rack mounting templates,” on page 191 instead of the copies in this section.

Use the following templates and instructions to identify the proper locations for inserting M5 screws when mounting the support rails and DS4800 to a rack cabinet. The locations for the M5 screws are highlighted in the templates.

Hold the appropriate template up to each side of the rack cabinet at the 4-U section where you will install the DS4800. The highlighted squares on each side of the template mark the positions where you will thread the M5 screws that secure the rails and the DS4800 to the front and rear of the cabinet.

The DS4800 is 4 U high. Align the template with the rack at a U boundary. U boundaries are shown as horizontal dashed lines in the rack mounting templates.

Note: The mounting holes shown in the following rack mounting templates are square. The holes in your rack might be round, square, or threaded. Use the washers supplied under the heads of the M5 screws when mounting to racks with square holes.

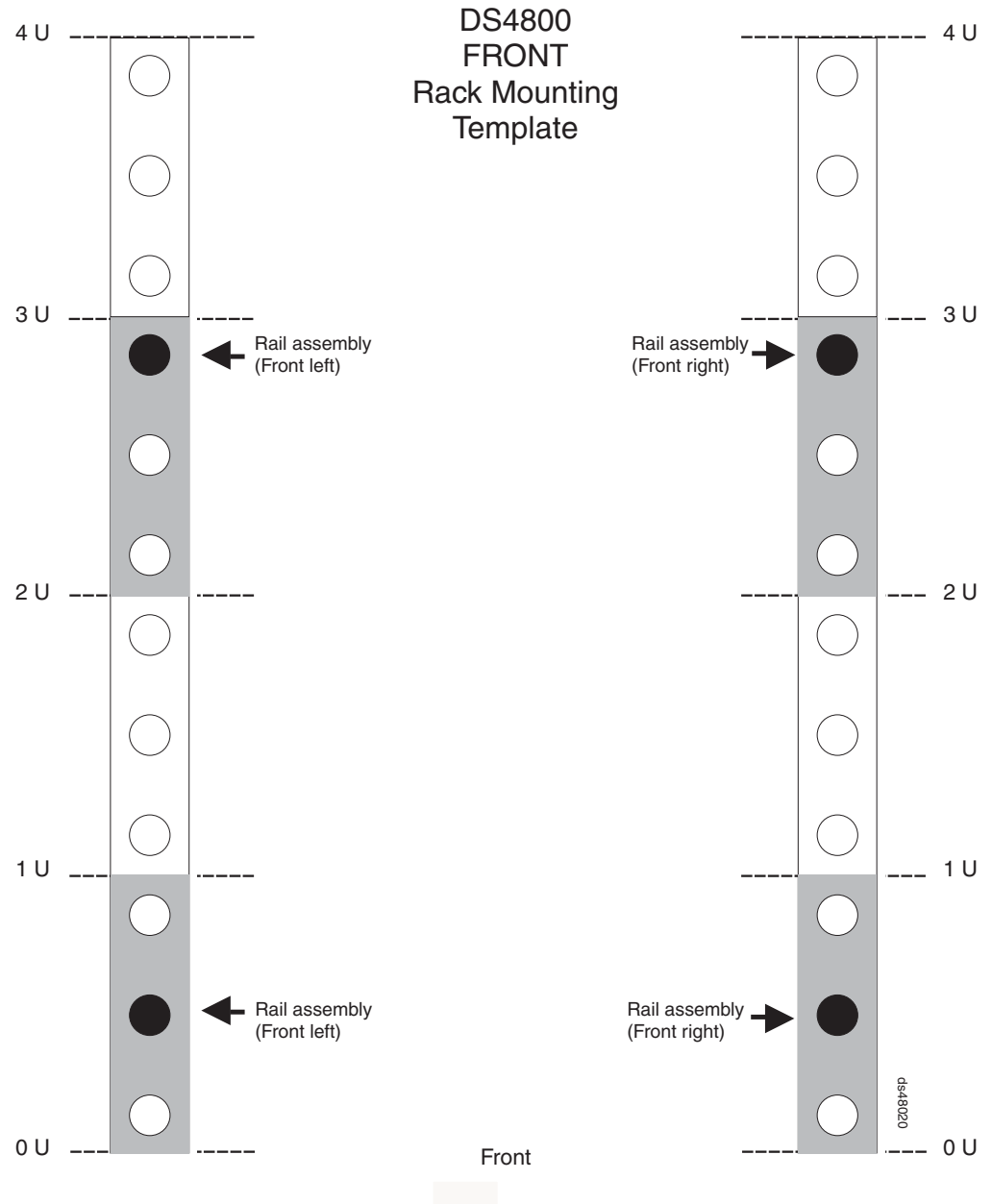


Figure 12. DS4800 front rack mounting template

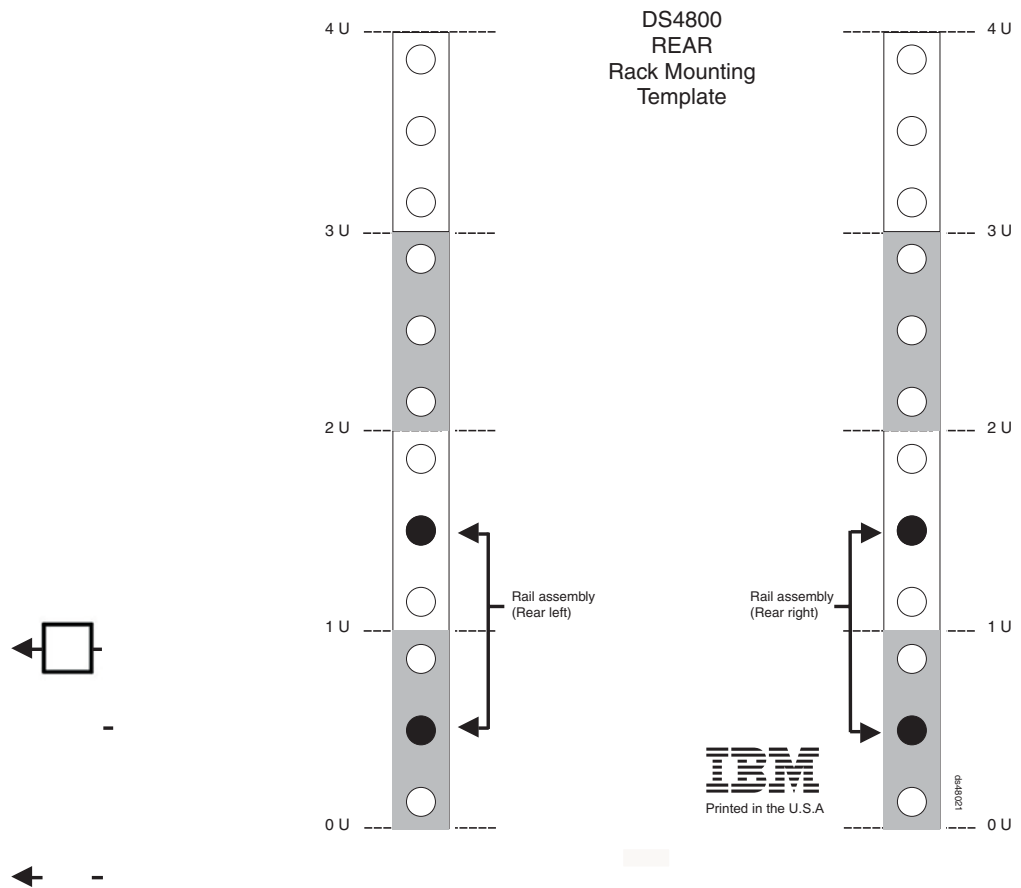


Figure 13. DS4800 rear rack mounting template

Before installing the DS4800 in a rack cabinet, you must install the rails and rack-mounting hardware that come with your storage subsystem. The DS4800 requires an Electronic Industries Association (EIA) 310-D Type A 19-inch rack cabinet. The distance between EIA rails, from the front to the rear of the rack cabinet, is 60.96 cm (24 in.) minimum and 81.28 cm (32 in.) maximum. This rack cabinet conforms to the EIA standard. Where you place the support rails in the rack cabinet depends on where you intend to position the storage subsystem.

Figure 14 on page 35 shows the support rail assembly for the DS4800.

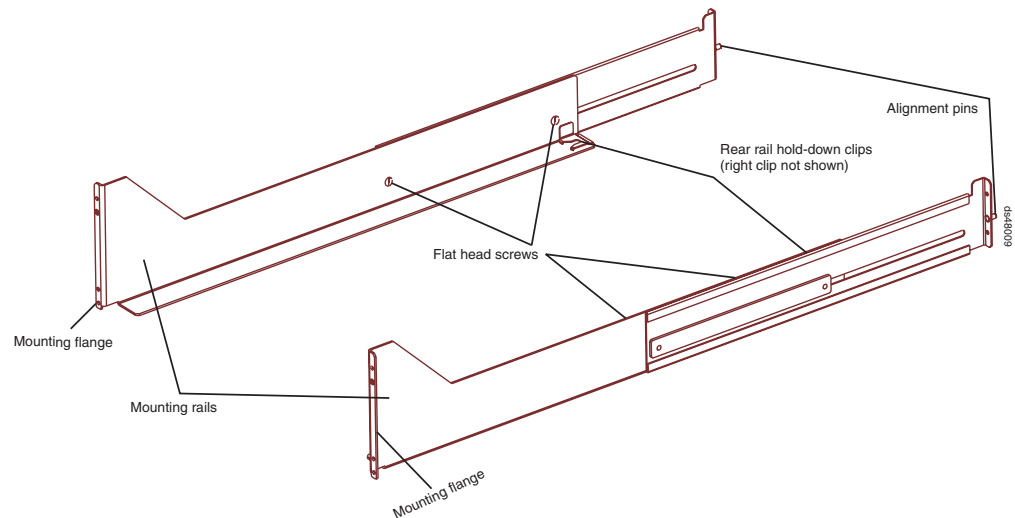


Figure 14. DS4800 support rail assembly

Complete the following steps to install the support rails:

Note: Refer to Figure 14 while performing these steps.

1. Ensure that the rack cabinet has already been installed.
2. Ensure that a stabilizer has been correctly attached to the bottom front of the rack cabinet to prevent the rack cabinet from tipping forward while the DS4800 is being installed.

Refer to the installation and service guide, or equivalent, for the rack cabinet as required.

3. If you have not yet done so, remove the mounting rails, mounting hardware, and line jumper cords from the DS4800 shipping box, which is on the bottom of the shipping box beneath the DS4800 chassis. Do not remove the DS4800 from the shipping box at this time.

Attention: The mounting rails, mounting hardware, and line jumper cords may be packed beneath the DS4800 in the shipping box. To remove these items from the shipping box without first removing the DS4800, open the two long sides of the shipping box. Then open and fold flat the two short sides of the shipping box. This enables you to access the mounting rails, mounting hardware, and line jumper cords without first removing the DS4800 from the shipping box.

4. Locate the two support rails and six of the eight M5 screws that are supplied with the DS4800.
5. The rack-mounted unit is four EIA units high. Decide accordingly where you are going to install the support rails.

Attention: Use the rack mounting templates in this chapter or in Appendix C, “Rack mounting templates,” on page 191 to locate the proper rack mounting holes for installing the support rails into the rack cabinet.

Note the following considerations before you choose where to install the rails:

- Plan the installation so that each DS4800 subsystem and its associated storage expansion enclosures are mounted together in the same rack, or in adjacent racks if necessary.
- When you install the DS4800 and associated storage expansion enclosures into a rack cabinet, install each device in the lowest available position and work upwards so that the rack does not become unstable.

Note: If you are installing more than one DS4800 Storage Subsystem, it is recommended that you install each DS4800 and its associated storage expansion enclosures in a separate rack cabinet.

- If appropriate, allow for possible later installation of other units.
 - If necessary, remove the rack power distribution units (PDUs) before you install the support rails.
 - For procedures and more information, refer to the installation and service guide, or equivalent, for the rack cabinet.
6. Starting with the left rail, use a medium flat-blade screwdriver to loosen the two flat-head rail adjustment screws. See Figure 14 on page 35.
 7. Hold the front of the left rail against the *inside* of the front rack-mounting flange, and then extend the rear of the support rail until it makes contact with the rear rack mounting flange. The alignment pins at the rear of the rail should slide into the holes at the rear of the rack.
 8. From the front of the rack, with the rail mounting flanges *inside* of the front rack-mounting flange, use the 5/16 (8 mm) hex nut driver to thread and loosely tighten the lower M5 screw only. Use the front rack mounting template or use the copy in Appendix C, "Rack mounting templates," on page 191) to locate the proper rack mounting hole for installing this screw.

Attention: Do not completely tighten the screw until you have installed the DS4800 in the rack cabinet.

9. From the rear of the rack, thread and loosely tighten two M5 screws using the 5/16 (8 mm) hex nut driver. Use the rear rack mounting template or use the copy in Appendix C, "Rack mounting templates," on page 191) to locate the proper rack mounting holes for installing these screws. Do not completely tighten the screws until you have installed the DS4800 in the rack cabinet.

When you are finished installing the left rail, the rail should be attached to the cabinet using one M5 screw in the front and two M5 screws at the back. All three M5 screws should be loosely tightened.

10. Repeat step 6 through step 9 for the right rail.
11. Tighten the rail adjustment screws on both rails.
12. Continue with "Installing the DS4800."

Installing the DS4800

The DS4800 Storage Subsystem contains two controllers, two power supply and fan units, and one interconnect-battery unit. The RAID controllers are located at the back of the unit. The two power supply and fan units and the interconnect-battery unit are located behind the front bezel.

Figure 15 on page 37 shows the front bezel of the DS4800 Storage Subsystem, a front view without the cover, and a back view. Figure 15 on page 37 also shows the locations of the components that are referenced during this installation procedure.

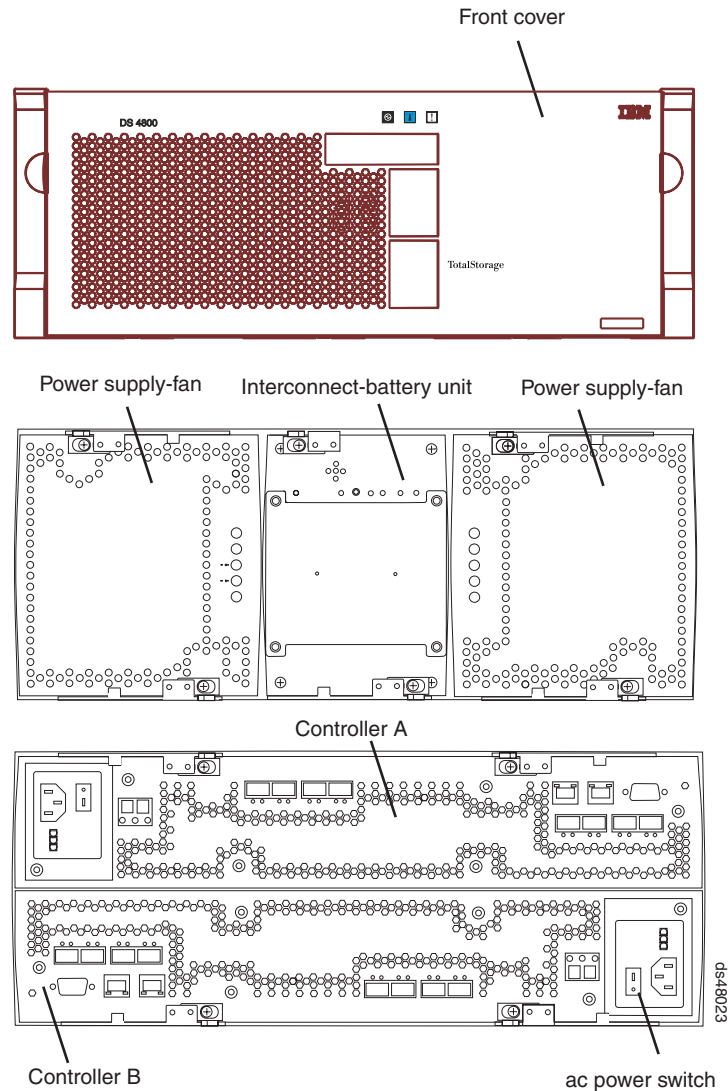


Figure 15. DS4800 Storage Subsystem front views and back view

Assemble these items before proceeding with the installation.

- Antistatic protection, such as a grounded wrist strap
- Cart or other surface to hold the DS4800 and its components
- Two M5 screws
- Tie wraps or other cable management devices (optional)

Releasing and locking a component lever

Each of the components in the DS4800 Storage Subsystem is held in place by two locking levers. Each lever engages a pin on the DS4800 Storage Subsystem enclosure to pull the component securely into the enclosure. Figure 16 on page 38 shows the lever, the latch that locks the lever into position, and the pin. The top view shows the lever in the closed and locked position. The bottom view shows the lever in the released position.

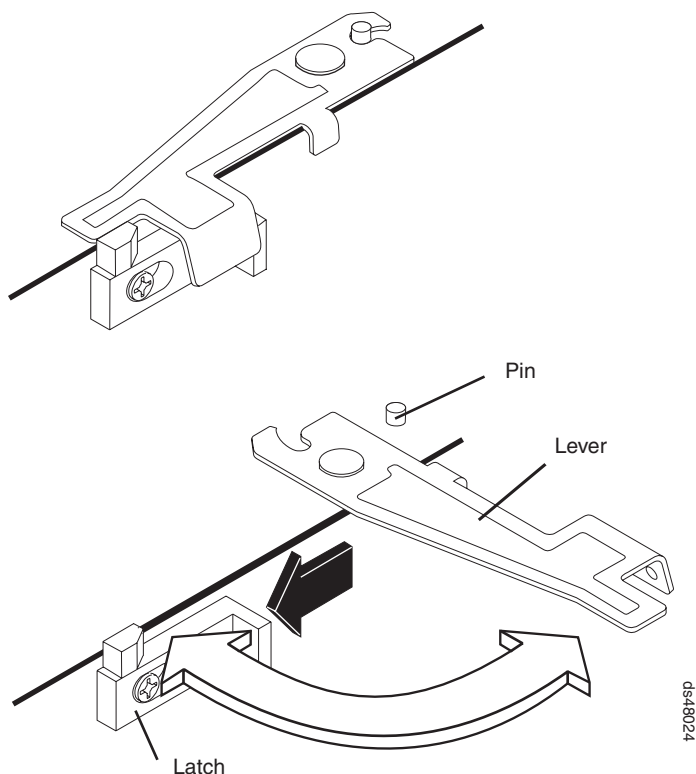


Figure 16. Component lever and latch

In the following sections, you will need to remove and replace each of the components. Use these steps to release and latch the levers on each component.

To release both latches on a component and remove the component, complete the following steps:

1. Push the latches to the side until the latches release the levers.
2. Rotate both levers out simultaneously. When the levers are completely free of the pins, place one hand under the component and use the levers to pull the component from the DS4800 Storage Subsystem.

Note: See Table 5 on page 21 for a listing of the weights of each DS4800 Storage Subsystem component.

To replace a component and lock the latches, complete the following steps:

1. With the levers perpendicular to the face of the component, slide the back of the component into the appropriate slot.
2. Push the component into the slot and, when the component is almost fully installed, ensure that the notches in the levers are aligned with the pins on the enclosure.

Note: Do not force fit. The components are keyed to prevent them from being inserted into the chassis incorrectly.

3. Holding the levers, press the component fully into the slot, engaging the pins on the enclosure.

4. Hold open both latches and rotate both levers simultaneously to the closed position. Release the latches. When you release the latches, you should see both latches slide over the levers, indicating that the component is locked in place.

Removing the components

This section provides procedures for removing components from the DS4800 before lifting it from the shipping box and placing the DS4800 in the cabinet. Removing components from a DS4800 Storage Subsystem makes the storage subsystem lighter and easier to lift from the shipping box and install in the rack cabinet. Place the components on a dry, level, and static-free surface to protect them from electrostatic discharge after you remove them from the DS4800.

Use these instructions after you have completed all applicable site, rack cabinet, and DS4800 preparations (as discussed in “Preparing for installation” on page 29) and installed the support rails (as discussed in “Installing the support rails” on page 32).

You will need an antistatic wrist strap and a cart or level surface (to hold the components). Observe the precautions listed in “Handling static-sensitive devices” on page 29. In the following procedure, you will remove the following components from the storage subsystem before you install it in the rack cabinet:

- RAID controllers
- Power supply and fan units
- Interconnect-battery unit

Statement 4:



≥ 18 kg (39.7 lb)	≥ 32 kg (70.5 lb)	≥ 55 kg (121.2 lb)

CAUTION:

Use safe practices when lifting.

Attention: A fully populated DS4800 Storage Subsystem weighs 36.52 kg (80.7 lb). Do not attempt to lift the DS4800 Storage Subsystem from the shipping box or install the unit in the rack cabinet unless all of the components have been removed. If you choose to lift the DS4800 Storage Subsystem from the shipping box or install the unit in the rack without removing all of the components first, you do so at your own risk. For more information on the weights of the individual DS4800 Storage Subsystem components, see “Specifications” on page 20.

Electrostatic discharge can damage sensitive components. Touching the DS4800 Storage Subsystem or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection before handling any components.

1. Open the two long sides of the shipping box, if you have not done so already. Opening the long sides of the box to a horizontal position provides access to the storage subsystem components.
2. Put on antistatic protection, and keep it on while performing all of the remaining procedures in this section.
3. Remove both power supply and fan units. Figure 17 shows the locations of the power supply and fan units and the power supply and fan unit levers.

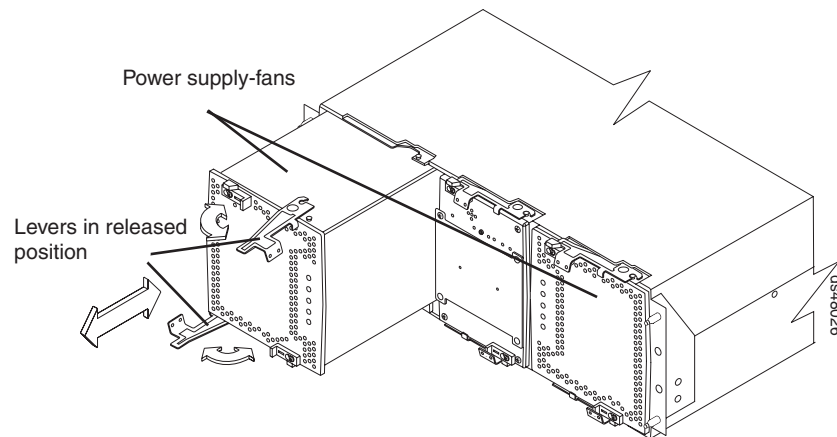


Figure 17. Removing the power supply and fan units

4. Remove the interconnect-battery unit. Figure 18 shows the location of the interconnect-battery unit and the interconnect-battery unit levers.

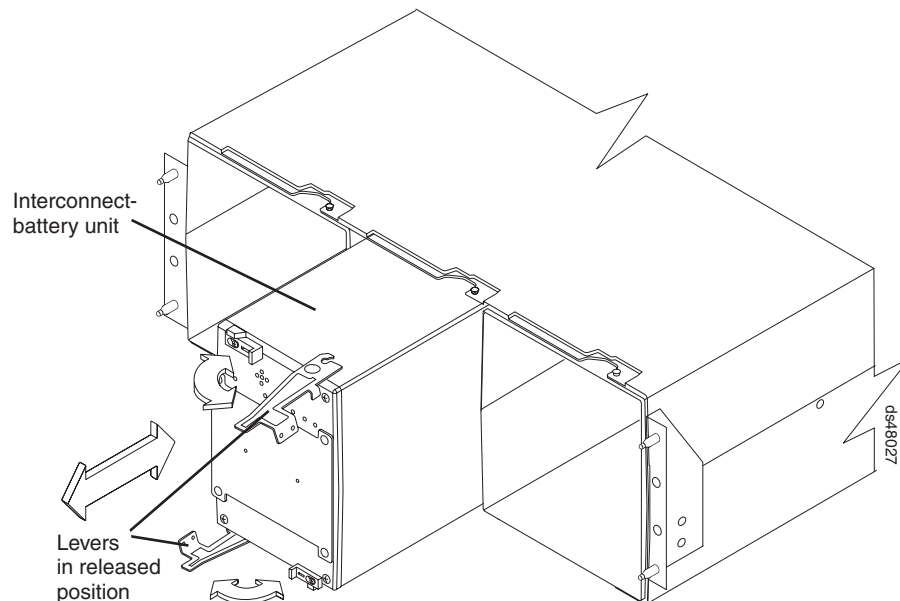


Figure 18. Removing the interconnect-battery unit

5. At the back of the DS4800 Storage Subsystem, use an adhesive note to label each of the controllers. Controller A is in the upper slot; controller B is in the lower slot. Figure 19 shows the locations of the controllers and controller levers.

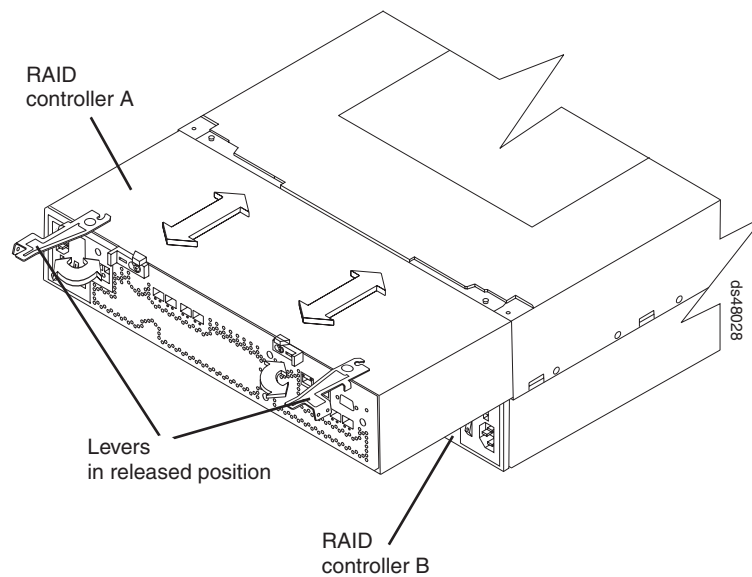


Figure 19. Removing the controllers

6. Remove the controllers. Figure 19 shows the controller locations and the controller levers.
7. After you have removed the components, record the serial number, machine type and model number, and MAC addresses for your DS4800 Storage Subsystem in Appendix B, “Records,” on page 189. The serial number, machine type, and model number are located on top of each RAID controller unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 104 on page 189. You may not be able to easily access this information after you install the DS4800.
8. Go to “Installing the DS4800 on the support rails.”

Installing the DS4800 on the support rails

This section provides instructions on how to install the DS4800 in a rack cabinet.

Attention: If you have not yet done so, record the serial number, machine type and model number, and MAC addresses for your DS4800 Storage Subsystem in Appendix B, “Records,” on page 189, as described in step 7.

Use the following procedure to install the DS4800 Storage Subsystem on support rails in a rack cabinet. To mount a storage subsystem in the rack cabinet, all support rails must be installed in their correct locations. If you need to install the rails, see “Installing the support rails” on page 32.

CAUTION:

Never install components or other equipment in the top half of a rackmount cabinet while the bottom half is empty. Doing so can cause the cabinet to become top-heavy and to tip over. Always install hardware in the lowest available position in the cabinet.

Before installing the storage subsystem in the cabinet, ensure that there are no obstructions, either in the cabinet or outside the cabinet, that would make ready removal and replacement of any of the components impossible. Check for obstructions at the front and rear of the cabinet.

Operational Shock

The DS4000 product will be able to withstand a free-fall drop from 0.5 inches onto a hard surface. Subjecting the equipment to a single shock pulse with the following characteristics will simulate this level of shock:

Velocity change = 20 inches per second ; Wave form = Triangular, 25g @ 3.75 ms

Operational Vibration (Sweep)

While in its normal operating position, the DS4800 will continue operating when subjected to the following vibration sweep. The test will include a dwell time of 15 minutes at any frequency where vigorous or resonant excitation occurs.

- Frequency sweep = 5 Hz – 150 Hz – 5 Hz
- Wave form = Sinusoidal, 0.25g

Attention: If you have removed the components from the DS4800, you should be able to lift the unit from the shipping box and into the cabinet with the help of one other person. (If you have not removed the components before the installation, you should have at least two other people available to help you lift the unit from the shipping box and into the rack cabinet.) For safety reasons, IBM does not recommend moving the DS4800 Storage Subsystem from the shipping box and installing the DS4800 on the support rails without first removing all CRU components.

1. Remove the empty DS4800 Storage Subsystem from the shipping box and set the storage subsystem in the cabinet. Figure 20 on page 43 shows the correct orientation of the empty storage subsystem to the cabinet and support rail.

The following steps will help you safely install the DS4800 on the support rails:

- a. If you have installed a screw in the upper mounting hole at the front of each support rail, remove the upper screws. These two screws are used later to secure the front of the storage subsystem to the rack.
- b. Move the empty storage subsystem from the shipping box and to the front of the cabinet.
- c. With help from another person, place the back of the storage subsystem on the support rails, and then slide the storage subsystem into the cabinet.

Attention: When you slide the storage subsystem into the cabinet, verify that the back of the DS4800 Storage Subsystem is secured by the hold-down clips located at the back of each rail. With the M5 rail screws loosely threaded, you can make minor adjustments to the rails to ensure that the subsystem latches in the hold-down clips. The hold-down clips are shown in Figure 14 on page 35.

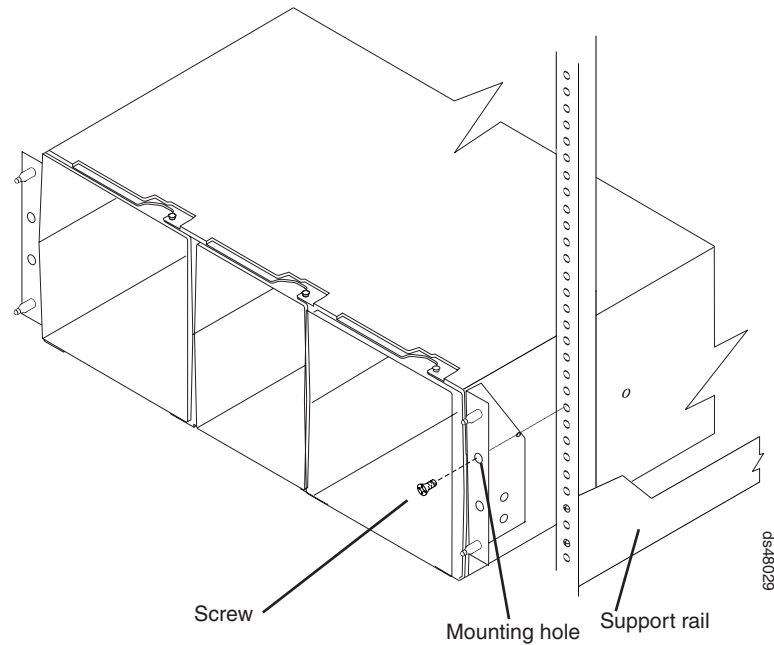


Figure 20. Securing the DS4800 to the rack cabinet

2. Secure the storage subsystem to the cabinet. Figure 20 shows how to secure the DS4800 to the vertical members of the cabinet.
The following steps will help you safely secure the DS4800 in the rack cabinet:
 - a. Align the front mounting holes on the storage subsystem flanges with the mounting holes on the cabinet.
 - b. Using the 5/16 (8 mm) hex nut driver, insert one M5 screw into the hole on each flange, and tighten the screws completely to secure the front of the storage subsystem to the cabinet.
3. At the front and the rear of the rack cabinet, use the 5/16 (8 mm) hex nut driver to finish tightening the other three M5 screws for each rail.
4. Continue with “Replacing the components.”

Replacing the components

Complete the following procedure to replace the components in the storage subsystem:

1. Replace the power supply and fan units. Figure 21 on page 44 shows the locations and correct orientation of the power supply and fan units and the power supply and fan unit levers. The power supply and fan units are keyed to always fit into the enclosure in the proper orientation. When the component is oriented correctly, a relief along one edge of each component aligns with a ledge in the enclosure. Before installing the component, turn the component so that the indicator LEDs are near the center of the storage subsystem.

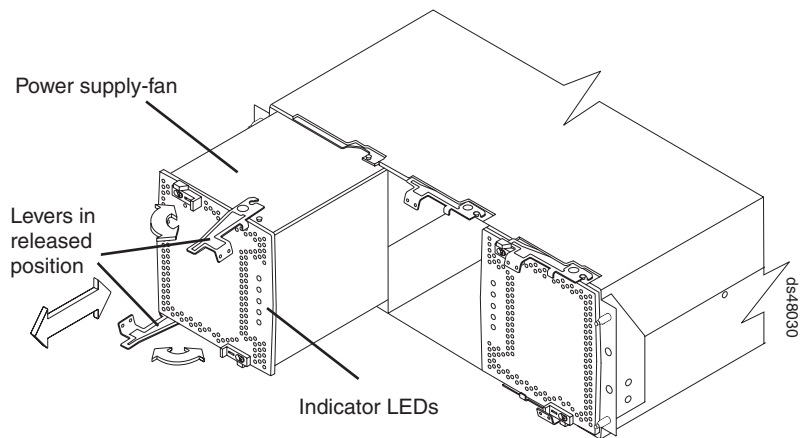


Figure 21. Replacing the power supply and fan units

2. Replace the interconnect-battery unit. Figure 22 shows the location of the interconnect-battery unit and the interconnect-battery unit levers.

The interconnect-battery unit is keyed to always fit into the enclosure in the proper orientation. A large pin located on the back of the component prevents the component from being installed incorrectly. Before installing the component, turn the component so that the LEDs are near the top of the component.

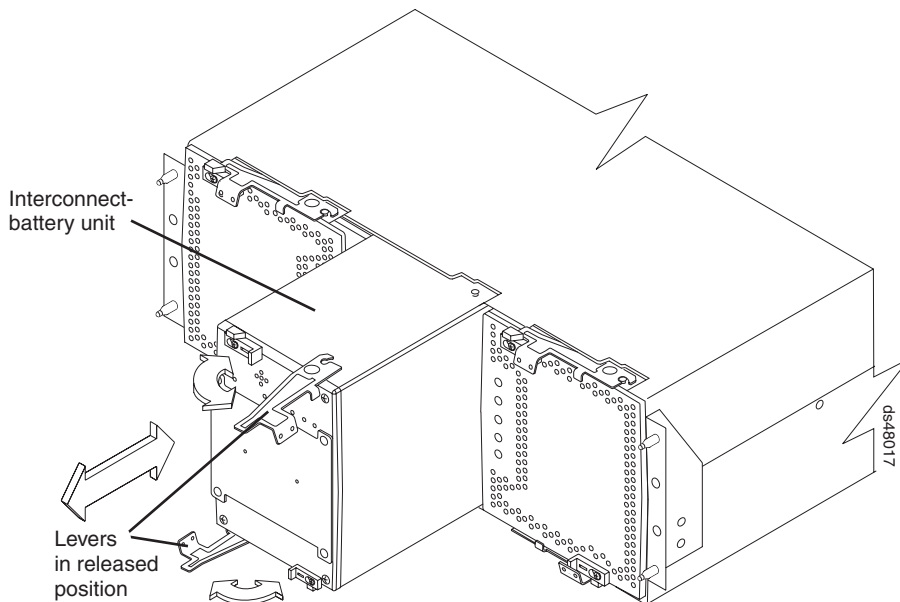


Figure 22. Replacing the interconnect-battery unit

3. Replace the controllers at the back of the DS4800. Figure 23 on page 45 shows the location of the controllers and the controller levers. Ensure that controller A is returned to the upper slot and that controller B is returned to the lower slot.

Note: Controller B is installed in an orientation that is rotated 180 degrees from that of controller A.

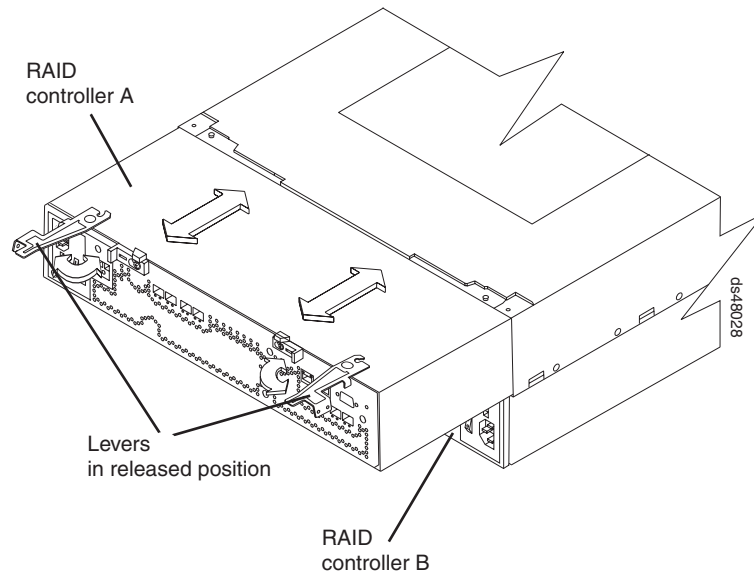


Figure 23. Replacing the controllers

4. Attach the DS4800 front bezel. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover, and then press the cover toward the chassis until the pins snap into place. Figure 24 shows how to install the front bezel in the storage subsystem.

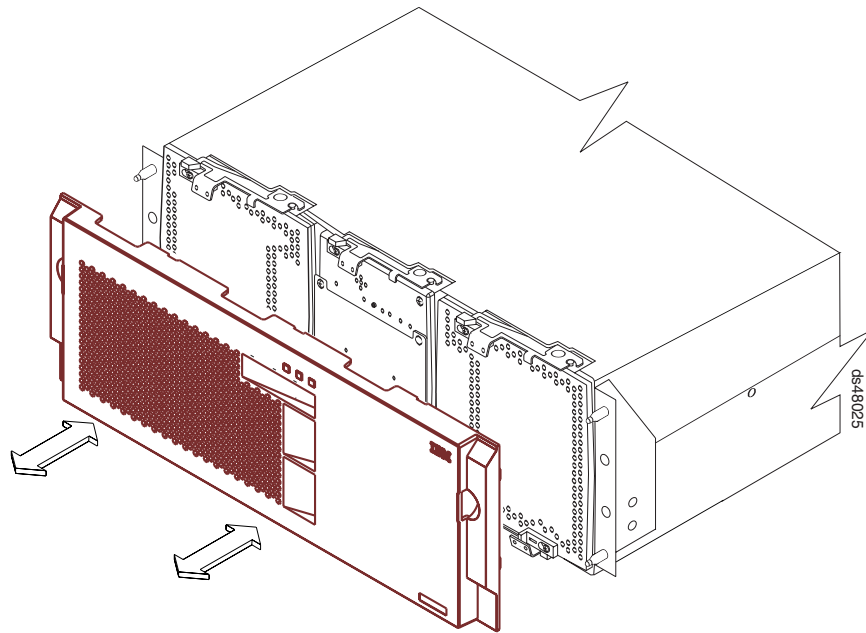


Figure 24. Removing the front bezel

5. Continue with Chapter 3, “Cabling the storage subsystem,” on page 47.

Chapter 3. Cabling the storage subsystem

After the storage subsystem is installed in its permanent location, you must cable it to hosts, drives, and other external devices, depending on your hardware configuration. This chapter provides fibre channel and power cabling information for the storage subsystem. It also provides information about configuring the storage subsystem.

This chapter addresses the following cabling and configuration topics:

- “Working with SFPs and fiber-optic cables”
- “Connecting storage expansion enclosures to the DS4800” on page 60
- “Connecting hosts to the DS4800” on page 89
- “Connecting secondary interface cables” on page 91
- “Configuring the storage subsystem” on page 92
- “Installing the storage subsystem configuration” on page 98
- “Connecting the power cables” on page 98

Working with SFPs and fiber-optic cables

Each RAID controller has up to four single-port host channel connections (depending on the model) and two dual-port drive channel connections. You use a small-form factor pluggable transceiver (SFP) to connect each host channel port and drive channel port to hosts and storage expansion enclosures. The SFP is inserted into the port, and then a fiber-optic cable is inserted into the SFP. The other end of the fiber-optic cable connects to an external device. SFPs are laser products.

Statement 3:



CAUTION:

When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

- **Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.**
- **Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.**



DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Handling fibre-optic cables

Attention: To avoid damage to your fibre-optic cables, follow these guidelines:

- For devices on slide rails, leave enough slack in the cables so they do *not* bend to a diameter of less than 76 mm (3 in.), or a radius less than 38 mm (1.5 in.), when extended or become pinched when retracted.
- Do not overtighten the cable straps or bend the cables to a diameter of less than 76 mm (3 in.), or a radius less than 38 mm (1.5 in.).
- When storing excess or unused fibre-optic cables, do not bend the cables to a diameter of less than 76 mm (3 in.), or a radius less than 38 mm (1.5 in.) or wrap them around themselves. See Figure 25 on page 49.
- Loop diameter of 76 mm (3 in.) and bend radius of 38 mm (1.5 in.) for fibre-optic cables are IBM DS4000 recommended minimums. Loops or bends smaller than this recommendation may cause damage to your fibre-optic cables. It is best practice to use loop diameters and bend radii that are greater than these recommended minimums.
- Do not route the cable along a folding cable-management arm.
- Route the cable away from places where it can be damaged by other devices in the rack cabinet.
- Do not put excess weight on the cable at the connection point. Be sure that the cable is well supported.
- Do not use plastic cable ties in place of the provided cable straps.
- The following are the supported maximum cable lengths:
 - 1 Gbps: 500 meters 50/125 um fiber, 300 meters 62.5/125 um fiber
 - 2 Gbps: 300 meters 50/125 um fiber, 150 meters 62.5/125 um fiber
 - 4 Gbps: 150 meters 50/125 um fiber, 70 meters 62.5/125 um fiber

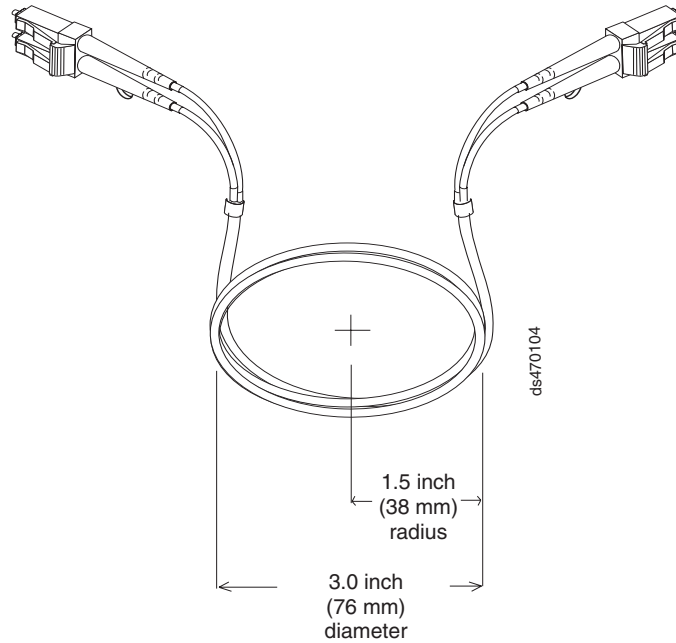


Figure 25. Recommended bending and looping specifications for fibre-optic cables

Installing SFP modules

The DS4800 host and drive channel ports require SFP modules. SFP modules are used to convert electrical signals to optical signals that are required for fibre channel transmission to and from RAID controllers. The DS4800 supports two types of SFP modules: one with a plastic latch and one with a wire latch. After you install the SFP modules, you use fiber-optic cables to connect the DS4800 to other fibre channel devices.

Before you install SFP modules and fiber-optic cables, read the following information:

- Use only short-wave/multimode SFPs in DS4800 host or drive ports. In DS4800 configurations, you may use long-wave SFPs only in fibre channel switches that connect DS4800s over long distances.
- The SFP module housing has an integral guide key designed to prevent you from inserting the SFP module improperly.
- Use minimal pressure when you insert the SFP module into a port. Forcing the SFP module into a port could cause damage to the SFP module or the port.
- You can insert or remove the SFP module while the port is powered on.
- Do not install an SFP in any port that will not have a fibre optic cable attached. Additionally, it is recommended that you remove any SFP from any port that does not have fibre optic cables attached.
- The operational loop performance is not affected when you install or remove an SFP module.
- You must insert the SFP module into a port before you connect the fiber-optic cable.
- You must remove the fiber-optic cable from the SFP module before you remove the SFP module from the fibre channel port. See “Removing SFP modules” on page 52 for more information.

- The speed of the SFP module determines the maximum operating speed of the fibre channel port in which the SFP is installed. For example, a 2 Gbps SFP that is plugged into a 4 Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps.
- The only label that identifies whether an SFP module can be operated at 2 Gbps only, or at both 2 Gbps and 4 Gbps, is the SFP part number that is printed on the manufacturing label attached to the SFP. Verify that you use SFPs with the correct speed requirements in your environment.

Note: You can also use the management software for the DS4800 Storage Subsystem or the fibre channel switches to display the properties of the SFPs used in your configurations.

To install an SFP module, complete the following steps.

Statement 3:



CAUTION:

When laser products (such as CD-ROMs, DVD drives, fiber-optic devices, or transmitters) are installed, note the following:

- Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.
- Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.



DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 29.

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 26 on page 51. Save the protective cap for future use.

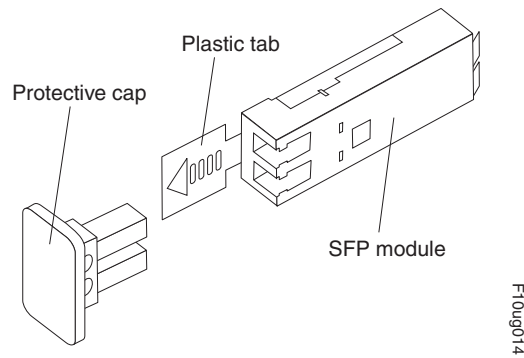


Figure 26. Small Form-Factor Pluggable (SFP) module

3. Remove the protective cap from the fibre channel port. Save the protective cap for future use.
4. Insert the SFP module into the fibre channel port until it clicks into place. See Figure 27.

Note: The alignment of the fibre channel ports on controller A are opposite those of controller B. Before inserting an SFP module into a port, verify that the SFP module is rotated correctly to match the alignment of the port on the RAID controller. Do not force-fit. For fibre channel ports in controller A, SFPs should be inserted with the exposed printed circuit facing up (as shown in Figure 27). For fibre channel ports in controller B, SFPs should be inserted with the exposed printed circuit facing down.

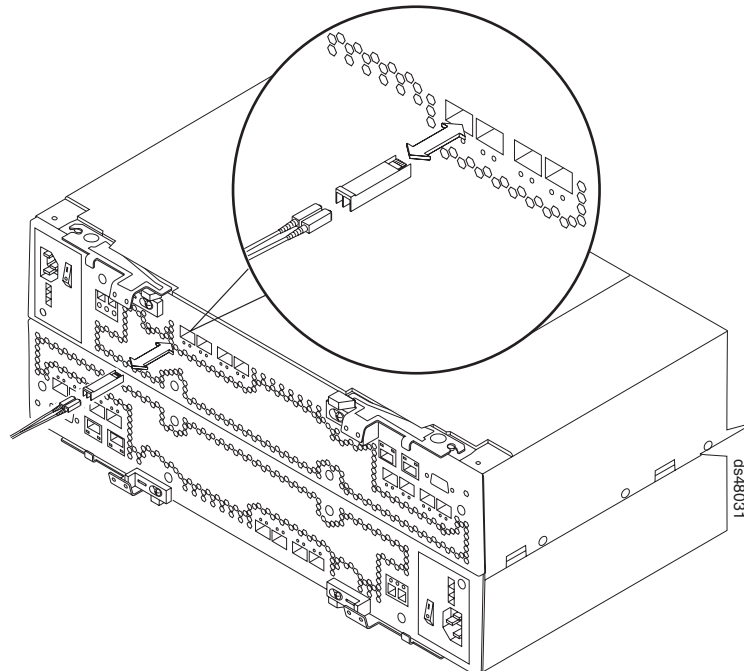


Figure 27. Replacing an SFP module

5. Connect a fibre channel cable.

Removing SFP modules

To remove the SFP module from the fibre channel port, perform the following steps.

Attention: To avoid damage to the cable or to the SFP module, make sure you unplug the LC-LC fibre channel cable *before* you remove the SFP module.

1. Remove the LC-LC fibre channel cable from the SFP module. For more information, see “Handling fibre-optic cables” on page 48.
2. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 28.

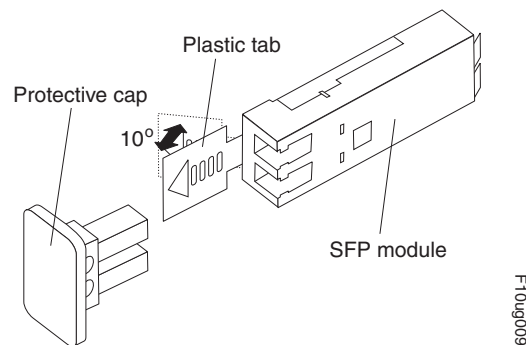


Figure 28. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 29.

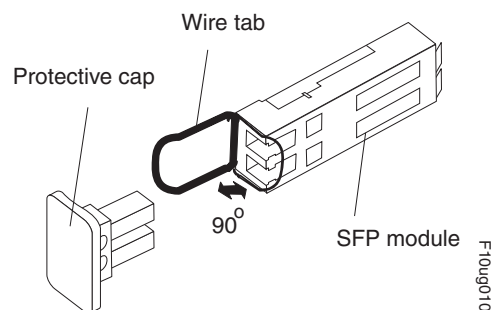


Figure 29. Unlocking the SFP module latch - wire variety

3. With the SFP latch in the unlocked position, extract the SFP module.
 - For SFP modules that contain plastic tabs, slide the SFP module out of the port.
 - For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the port.
4. Replace the protective cap on the SFP module.
5. Place the SFP module into a static-protective package.
6. Replace the protective cap on the port.

Installing fiber-optic cables

To connect the fiber-optic cables, perform the following steps:

1. Remove the protective cap from the fiber-optic cable. See Figure 30.

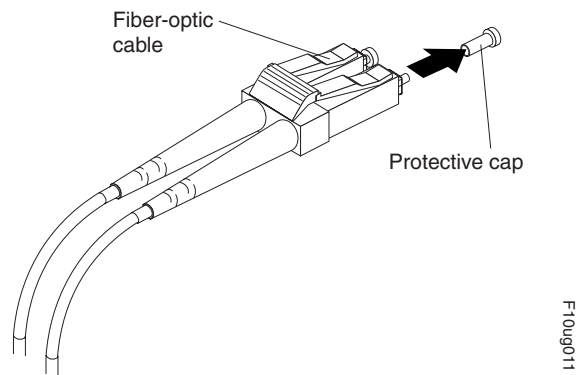


Figure 30. Removing caps from fiber-optic cables

2. Connect the fiber-optic cable to the installed SFP, as shown in Figure 31.

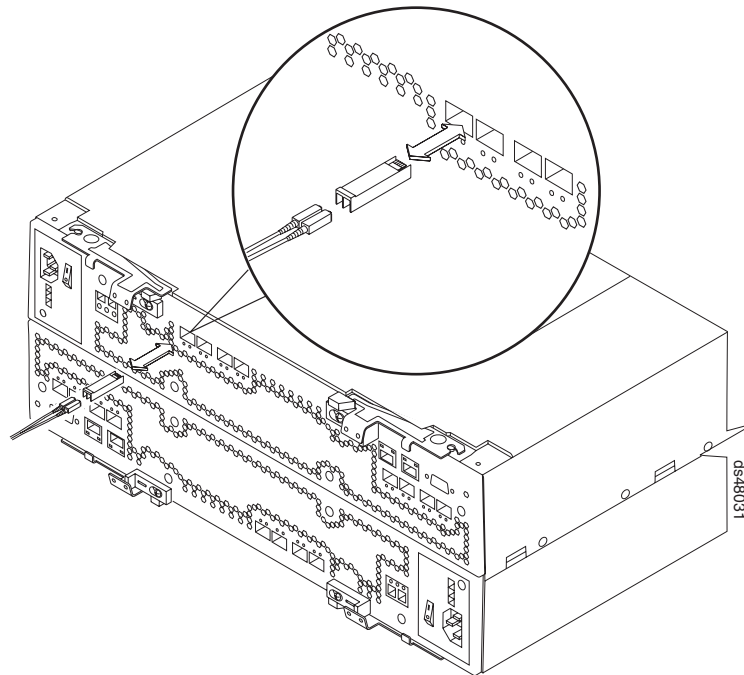


Figure 31. Connecting fiber-optic cable to SFP

3. Check the LEDs on the RAID controller. When the RAID controller is operating properly, the amber Needs Attention LED is off. For information about the status of the RAID controller LEDs, see “RAID controller LEDs” on page 122.
4. To remove the fiber-optic cables, gently pull the fiber-optic cable from the SFP; then replace the protective caps.

Using LC-LC fibre-channel cables

The LC-LC fibre-channel cable is a fiber-optic cable that you use to connect DS4800 fibre channel ports to one of the following devices:

- An SFP module installed in a fibre channel switch port

- An SFP module of the host bus adapter port
- An SFP module installed in an IBM DS4000 storage expansion enclosure

See Figure 32 for an illustration of the LC-LC fibre-channel cable.

For more information about cabling these devices, see the documentation that comes with the LC-LC fibre-channel cable.

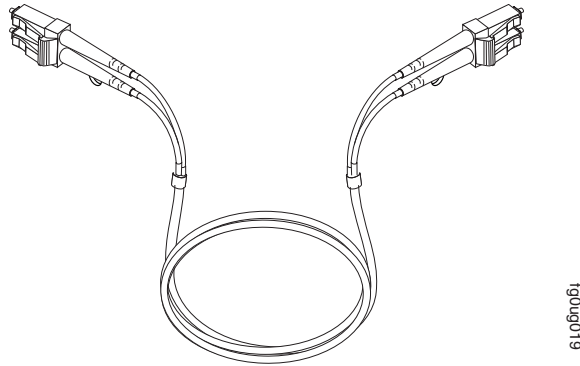


Figure 32. LC-LC fibre-channel cable

Note: If you are connecting the DS4800 Storage Subsystem host ports to a 1 Gbps device (such as a 1 Gbps fibre channel switch), you must also use an LC-SC fibre-channel cable adapter. For more information about using an LC-SC fibre-channel cable adapter, see “Using LC-SC fibre-channel cable adapters” on page 56.

Connecting an LC-LC cable to an SFP module

Complete the following steps to connect an LC-LC fibre-channel cable to an SFP module:

Statement 3:



CAUTION:

When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

- Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.
- Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.



DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

1. Read the information in “Handling fibre-optic cables” on page 48.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 33. Save the protective cap for future use.
3. Remove the two protective caps from one end of the LC-LC cable, as shown in Figure 33. Save the protective caps for future use.

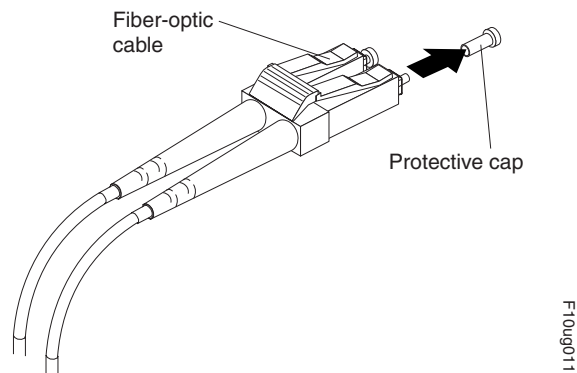


Figure 33. Removing fiber-optic cable protective caps

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the DS4800. The cable connector is keyed to ensure it is inserted into the SFP module correctly. Holding the connector, push in the cable until it clicks into place, as shown in Figure 34.

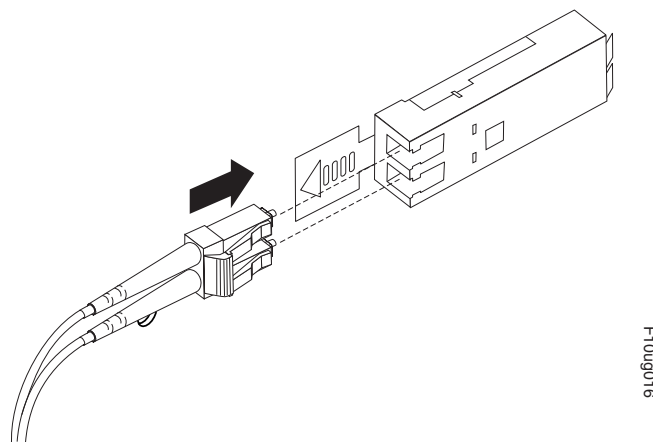


Figure 34. Inserting an LC-LC fibre-channel cable into an SFP module

5. Remove the two protective caps from the other end of the LC-LC cable. Save the protective caps for future use.
6. Connect this end of the LC-LC cable to the SFP module that is installed in one of the following devices.

- DS4000 storage expansion enclosure
- Fibre channel switch
- Host bus adapter

Removing an LC-LC fibre-channel cable

Attention: To avoid damaging the LC-LC cable or SFP module, make sure that you observe the following precautions.

- Press and hold the lever to release the latches before you remove the cable from the SFP module.
- Ensure that the levers are in the released position when you remove the cable.
- Do not grasp the SFP module plastic tab when you remove the cable.

Complete the following steps to remove an LC-LC fibre-channel cable:

1. On the end of the LC-LC cable that connects into the SFP module or host bus adapter, press down and hold the lever to release the latches, as shown in Figure 35.

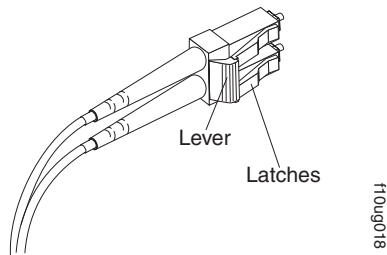


Figure 35. LC-LC fibre-channel cable lever and latches

2. Carefully pull on the connector to remove the cable from the SFP module, as shown in Figure 36.

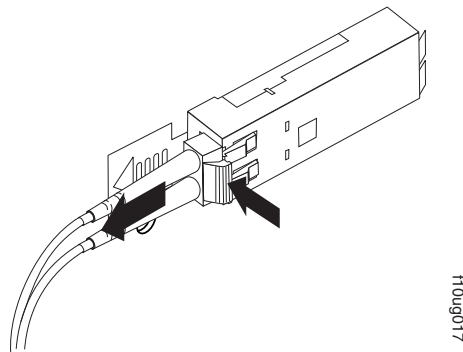


Figure 36. Removing the LC-LC fibre-channel cable

3. Replace the protective caps on the cable ends.
4. Replace the protective cap on the SFP module.

Using LC-SC fibre-channel cable adapters

The LC-SC fibre-channel cable adapter is a fiber-optic cable that is used to connect an LC connector into one of the following devices that require SC connectors:

- 1 Gbps fibre channel switch

- Fibre channel host bus adapter

Attention: The DS4800 does not support the attachment of storage expansion enclosures that operate at 1 Gbps, such as the EXP500.

For more information about connecting to these devices, see the documentation that comes with the LC-SC fibre-channel cable adapter.

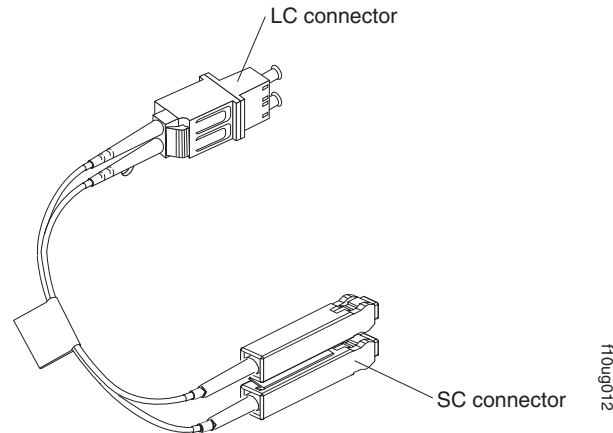


Figure 37. LC-SC fibre-channel cable adapter

The following sections provide the procedures for properly connecting and removing an LC-SC fibre-channel cable.

Connecting an LC-SC cable adapter to a device

Complete the following steps to connect an LC-SC fibre-channel cable adapter to a device:

Statement 3:



CAUTION:

When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

- Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.
- Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.



DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

1. Read the information in “Handling fibre-optic cables” on page 48.
2. Connect one end of an LC-LC cable to an SFP module in the DS4800. For instructions, see “Using LC-LC fibre-channel cables” on page 53.
3. Remove the two protective caps from the LC connector end of the LC-SC cable adapter as shown in Figure 38. Save the protective caps for future use.

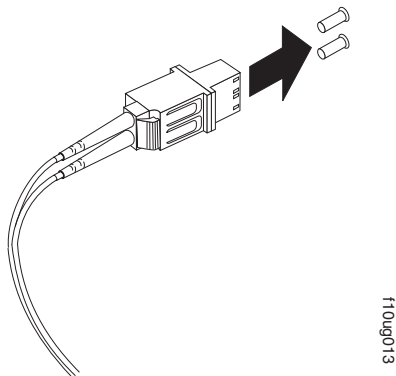


Figure 38. Removing the LC-SC cable adapter protective caps

4. Carefully insert the other end of the LC-LC cable into the LC connector end of the LC-SC cable adapter as shown in Figure 39. Push in the connector until it clicks into place.

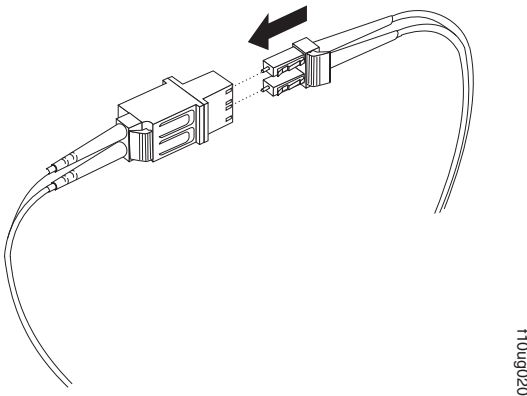


Figure 39. Connecting an LC-LC cable into the LC-SC cable adapter

5. If you are connecting the DS4800 to a 1 Gbps fibre channel switch or fibre channel host bus adapter, connect the SC connector end of the LC-SC cable adapter to a Gigabit Interface Converter (GBIC) that is installed in the 1 Gbps fibre channel switch or fibre channel host bus adapter. For more information about connecting to these devices, see the documentation that comes with the device.

Removing an LC-LC cable from an LC-SC cable adapter

Complete the following steps to remove an LC-LC cable from an LC-SC cable adapter:

Attention: To avoid damaging the LC-LC cable, make sure you press and hold the lever to release the latches before you remove the cable from an LC-SC cable adapter. Ensure that both levers are in the released position when removing the cable. When removing the cable from the SFP module, make sure you do not grasp the SFP module plastic tab.

1. On the end of the cable that connects into the LC connector end of the LC-SC cable adapter, press down and hold the lever to release the latches. Figure 40 shows the location of the lever and latches.

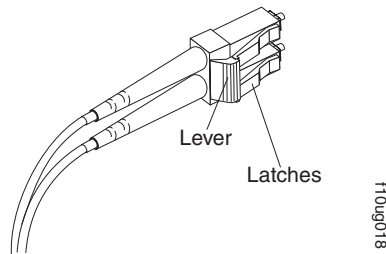


Figure 40. LC-LC fibre-channel cable lever and latches

2. Carefully pull on the connector to remove it. Make sure you grasp the connector and not the cable when removing the LC-LC cable from the LC-SC cable adapter as shown in Figure 41.

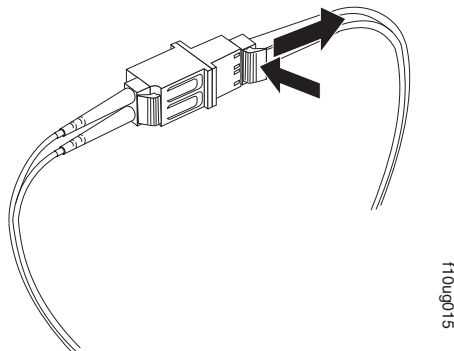


Figure 41. Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter

3. Replace the protective caps on the cable ends.

Connecting storage expansion enclosures to the DS4800

Attention

Before you power on the DS4800 Storage Subsystem, the DS4800 must be cabled to at least one storage expansion enclosure populated with at least two drives. If at least two drives are not installed in each attached storage expansion enclosure when you power on the DS4800, your standard storage partition key will be lost and will need to be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

<https://www-912.ibm.com/PremiumFeatures/>

Additionally, if at least two drives are not installed in each attached storage expansion enclosure, the resulting insufficient load to the storage expansion enclosure power supply CRUs might cause the drive expansion enclosure power supply CRUs to intermittently appear as failed and then reappear in an optimal state, falsely indicating that the power supply CRUs are bad.

In the initial installation of the DS4800, you can add only *new* storage expansion enclosures to the DS4800 Storage Subsystem. This means that there must be no existing configuration information on the storage expansion enclosures that you want to install.

If the storage expansion enclosures that you want to install currently contain logical drives or configured hot spares, and you want them to be part of the DS4800 Storage Subsystem configuration, refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*. Improper drive migration might cause loss of configuration and other storage subsystem problems. Contact your IBM support representative for additional information.

Redundant drive channel pair

For the DS4800, each drive channel (see the *Glossary* definitions for *drive channels* and *drive loops*) is associated with two ports, and there are two drive channels and four associated ports per controller. The total number of drives per drive channel is 112. One channel from each controller combines to form a pair of redundant drive channels. See Table 14 on page 69 for channel and port labeling conventions.

In Figure 42 on page 62 and Figure 43 on page 63, drive channel 1 of controller A and drive channel 3 of controller B combine to form a DS4800 Storage Subsystem drive channel pair. If any component of drive channel 1 fails, the RAID controllers can still access the storage expansion enclosures in drive channel 1 through drive channel 3. Similarly, drive channel 2 of controller A and drive channel 4 of controller B combine to form the second of the two DS4800 Storage Subsystem drive channel pairs. If any component of drive channel 2 fails, the RAID controllers can still access the storage expansion enclosures in drive channel 2 through drive channel 4.

Figure 42 on page 62 shows the storage expansion enclosures in each drive channel pairs connected to only one drive port in the two-ported drive channel. For example, in drive channel pair 1, only port 4 of channel 1 and port 1 of channel 3 are used. Figure 43 on page 63 shows that half of the storage expansion enclosures in each drive channel pair are connected to the first port of the dual-ported drive channel. The other half of the enclosures are connected to the

second port of the dual-ported drive channel. For example, in drive channel/loop pair 1, both ports 4 and 3 of channel 1 and port 1 and 2 of channel 3 are used.

Note: In the following drive cabling figures, the DS4800 graphics are simplified to show only the drive ports of each controller.

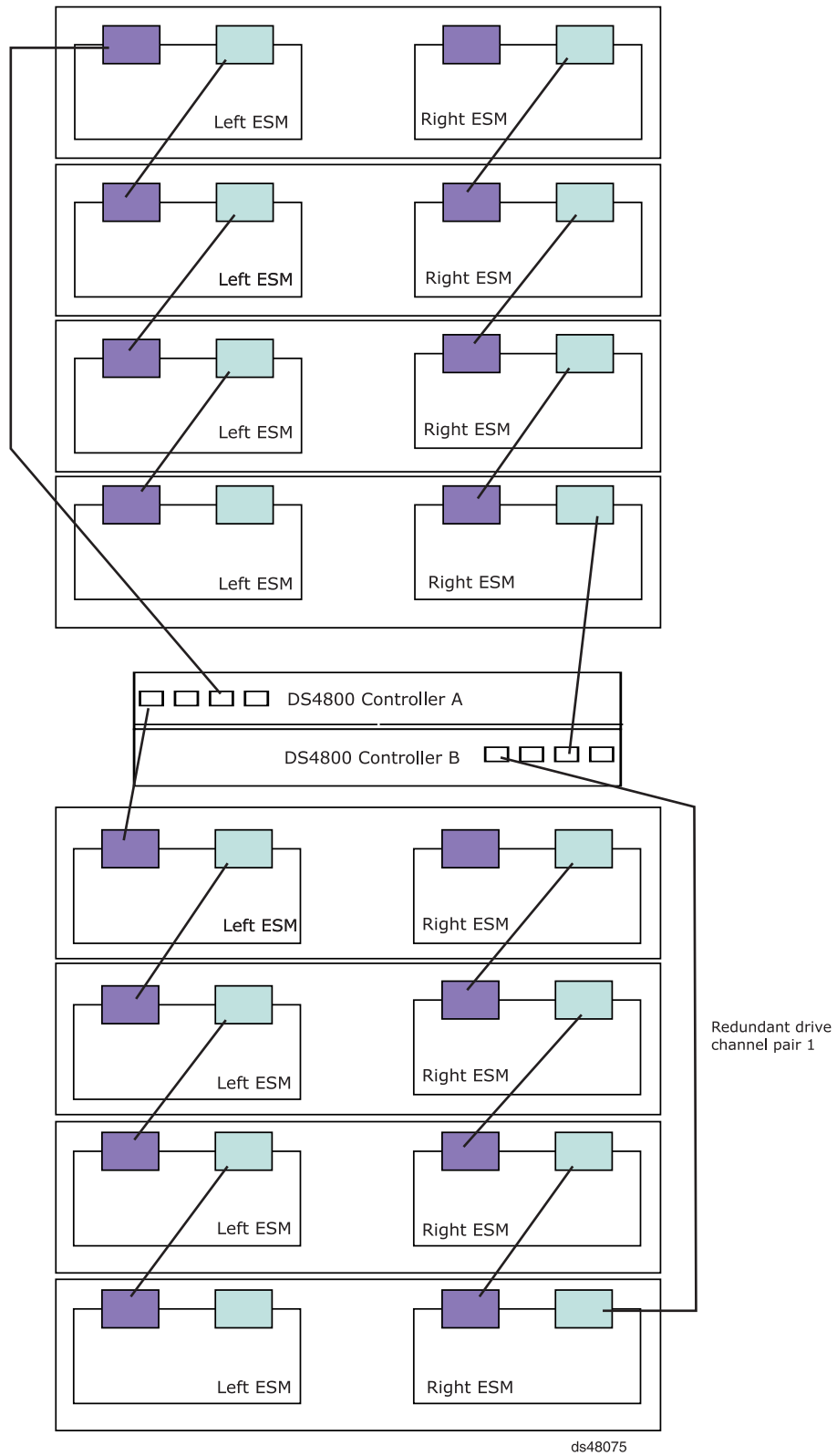


Figure 42. Example 1 of redundant drive channel pairs

Figure 43 on page 63 shows a second example of the drive channel cabling for redundant drive channel pairs.

After you select the cabling topology for your configuration, continue with step 3, following the cabling diagram for your chosen topology.

3. The following steps describe the cabling sequence for connecting at least two storage expansion enclosures to a DS4800 using the preferred topologies identified in “DS4800 Storage Subsystem drive cabling topologies” on page 70.

Note: If you are not using the preferred cabling topology, or if you are only connecting one storage expansion enclosure to the DS4800, your cabling sequence will differ from the following steps.

For either EXP100 or EXP710 storage expansion enclosure connections:

Perform the following steps to cable either the EXP710 or EXP100 storage expansion enclosures to each other and to the DS4800.

Note: If you are intermixing different storage expansion enclosures such as EXP100s, EXP710s, and EXP810s in a DS4800 configuration, refer to the intermixing cabling diagrams provided in “DS4800 Storage Subsystem drive cabling topologies” on page 70.

You can match the connections describing these steps with the cabling diagram (provided in “DS4800 Storage Subsystem drive cabling topologies” on page 70) that most closely matches your configuration. Figure 44 shows the name of the ESM ports in the EXP710 /EXP100 storage expansion enclosures.

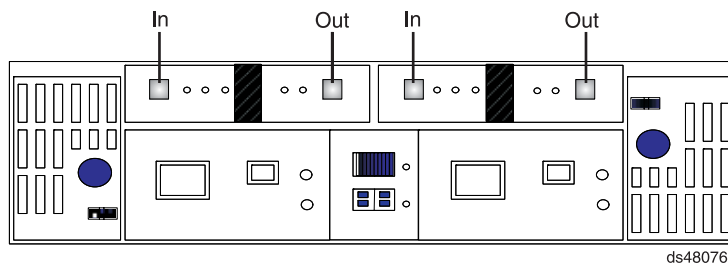


Figure 44. EXP710 /EXP100 port labels

- a. Starting on the DS4800 controller, connect drive port 4 (drive channel 1) of controller A to the In port on the left ESM board of the first storage expansion enclosure in the group. (See callout 1 in Figure 45 on page 65.)
- b. From the first storage expansion enclosure that will be cabled together behind a drive port of a drive channel, connect the Out port on the left ESM board to the In port on the left ESM board of the second (next) enclosure. (See callout 2 in Figure 45 on page 65.)
- c. From the first storage expansion enclosure, connect the Out port on the right ESM board to the In port on the right ESM board of the second (next) enclosure. (See callout 6 in Figure 45 on page 65.)
- d. If you are cabling more storage expansion enclosures to this group, repeat the In port to Out port connections until you reach the last storage expansion enclosure. (See callouts 3 and 4 for the left ESM connections and callouts 7 and 8 for the right ESM connections in Figure 45 on page 65.)

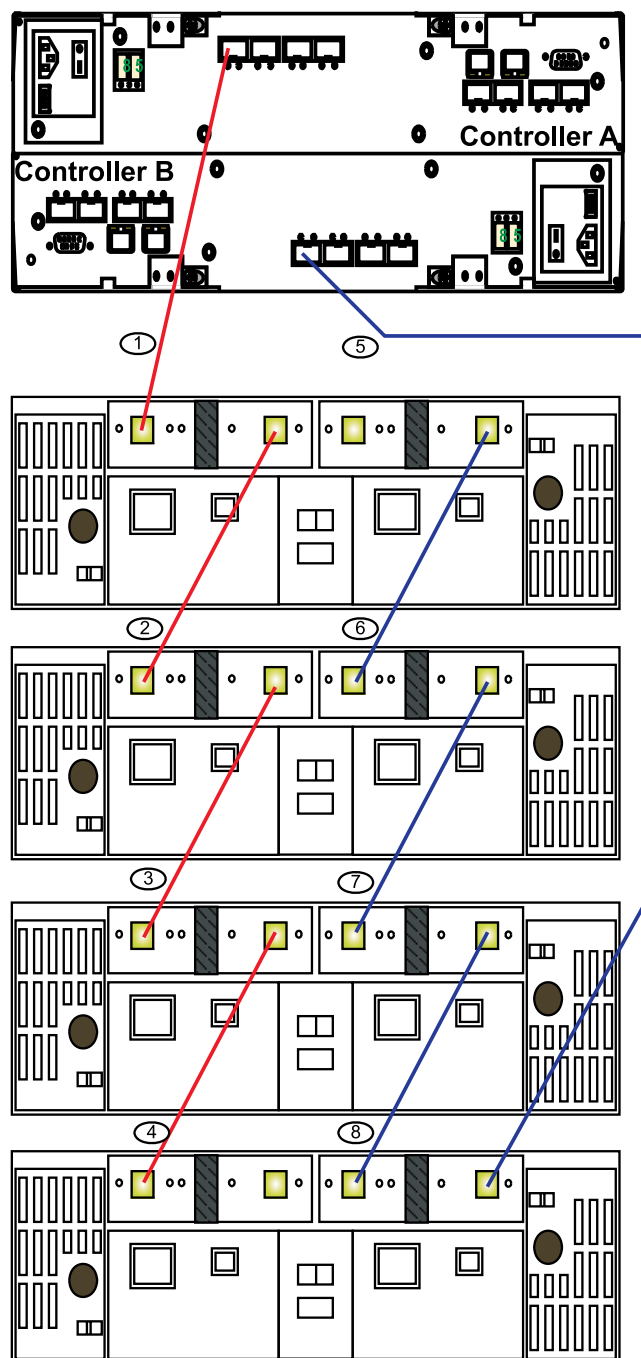


Figure 45. Connecting EXP710 or EXP100 enclosures to DS4800

- e. On the last storage expansion enclosure in the group, connect the Out port on the right ESM board to drive port 1 (drive channel 3) of controller B of the DS4800. (See callout 5 in Figure 45.)

You have now completed the redundant fibre channel cabling of the first group of storage expansion enclosures to the DS4800, using the first ports of the dual-ported drive channels 1 and 3.

For EXP810 storage expansion enclosure connections:

Perform the following steps to cable EXP810 storage expansion enclosures to each other and to the DS4800. You can match the connections described in these steps with the cabling diagram (provided in “DS4800 Storage Subsystem

drive cabling topologies” on page 70) that most closely matches your configuration. Figure 46 shows the name of the ESM ports in the EXP810 storage expansion enclosures.

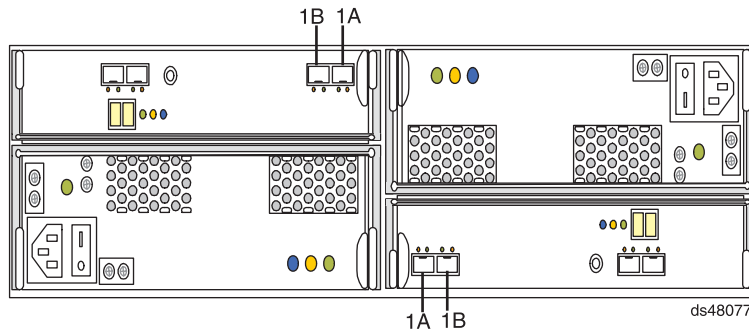


Figure 46. EXP810 port labels

- a. Start with the first storage expansion enclosure from the group of EXP810 drive expansion enclosures that will be cabled together. Connect the 1A port on the left ESM board to the 1B port on the left ESM board of the second (next) enclosure. (See callout 2 in Figure 47 on page 67.)
- b. On the first storage expansion enclosure from the group of drive expansion enclosures that will be cabled together, connect the 1B port on the right ESM board to the 1A port on the right ESM board of the second (next) enclosure. (See callout 8 in Figure 47 on page 67.)
- c. If you are cabling more storage expansion enclosures to this group, repeat steps 5a and 5b for all enclosures except the final enclosure in the loop, starting with the second enclosure. (See callouts 3 and 4 for the left ESM connections and callouts 7 and 6 for the right ESM connections in Figure 47 on page 67.)

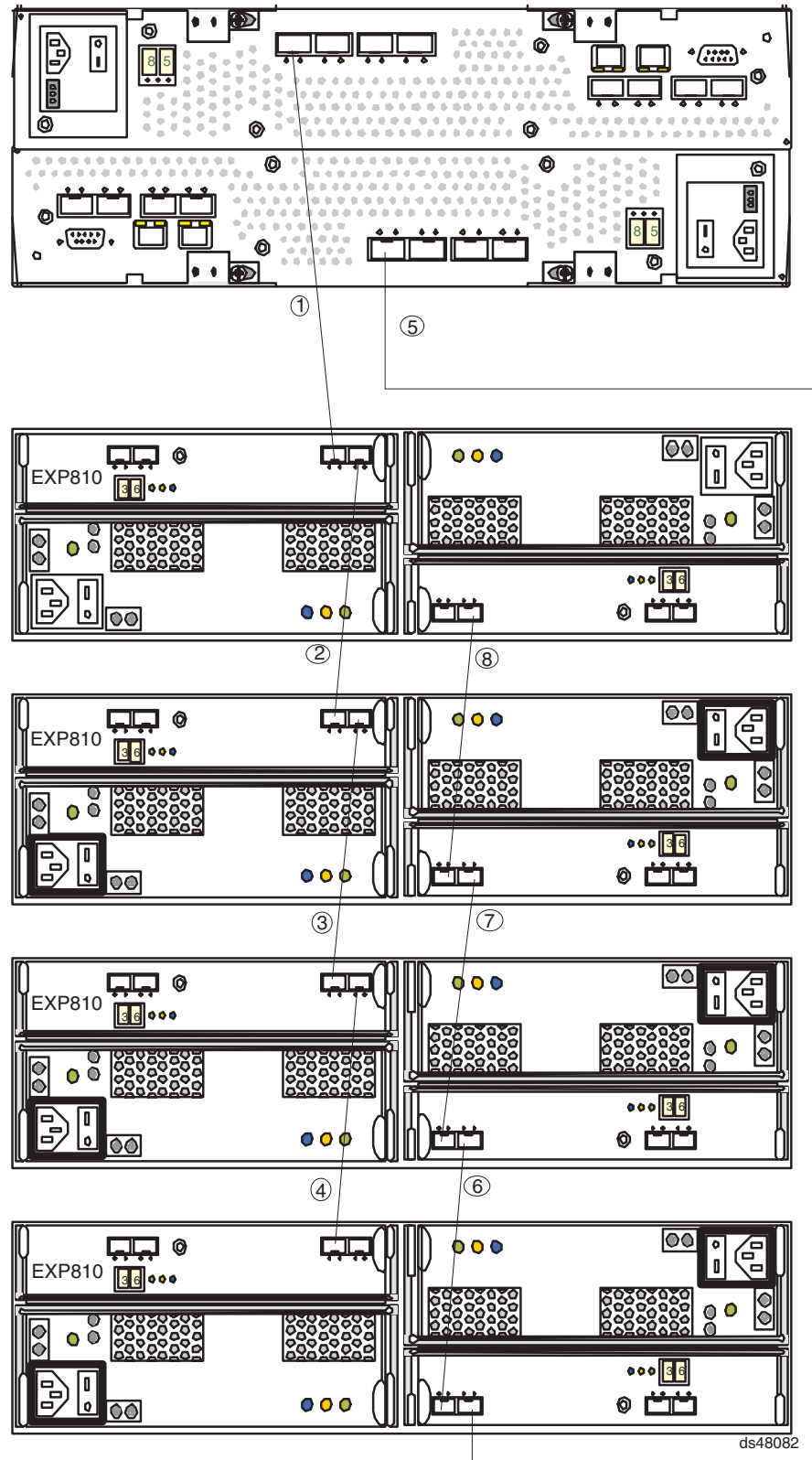


Figure 47. Connecting EXP810 enclosures to DS4800

- d. Connect drive port 4 (drive channel 1) of controller A to the to the 1B port on the left ESM board of the first storage expansion enclosure in the group of drive expansion enclosures. (See callout 1 in Figure 47.)

Important: Always connect the DS4800 controller port to the EXP810 ESM port label 1B to ensure optimal drive channel performance. Do not connect the DS4800 controller port to the EXP810 ESM port label 1A.

- e. Connect drive port 1 (drive channel 3) of controller B to the port 1B on the right ESM board of the last storage expansion enclosure in the group of drive expansion enclosures. (See callout 5 in Figure 47 on page 67.)

Important: Always connect the DS4800 controller port to the EXP810 ESM port label 1B to ensure optimal drive channel performance.

4. You can repeat steps 3a on page 64 to 3e on page 65 in order to connect other groups of storage expansion enclosures to the DS4800, using the second ports of the same dual-ported drive channel pair, and the first and second ports in the other dual-ported drive channel pair, replacing the DS4800 drive ports (mentioned in steps 3d on page 64 and 3e on page 65) with the appropriate drive ports in the drive channels. The DS4800 currently supports a maximum of 112 drives in either eight 14-drive storage expansion enclosures or seven 16-drive storage expansion enclosures per drive channel in each controller. One drive channel from each of controllers A and B must be connected to the same set of storage expansion enclosures to provide drive channel redundancy. This will result in the support of a maximum of 224 drives in 16 or 14 storage expansion enclosures per DS4800, depending on storage expansion enclosure type.
5. Set unique enclosure IDs for all storage expansion enclosures that are cabled to the DS4800 for the EXP710 and EXP100 only. See “DS4000 storage expansion enclosure ID settings” on page 87, and refer to your storage expansion enclosure installation manual for details on setting the enclosure ID.

The DS4800 Storage Subsystem locates the drives in the storage expansion enclosures after you power on the configuration. Always connect power to the storage expansion enclosures first and then connect power to the DS4800. After you have powered on the configuration, use the DS4000 Storage Manager client to check the status of the new drives, correct any errors found, and configure the new drives.

DS4800 drive cabling rules and recommendations

Refer to these general rules and recommendations when completing cabling steps:

1. Do not connect a combination of more than eight EXP710/EXP100 or seven EXP810 storage expansion enclosures to the two ports of a dual-ported drive channel. Failure to observe this limitation might result in loss of data availability.
2. Do not connect more than four EXP810 storage expansion enclosures to each port of the dual-ported drive channel. There are no restrictions to four or less storage expansion enclosures connected per drive port for the EXP710 and the EXP100 storage expansion enclosures; however, IBM recommends using the same rule for the EXP710/EXP100 enclosures to maximize drive channel performance.

Note: As long as there is one EXP810 enclosure behind a controller drive port, the maximum number of enclosures that can be connected behind that controller drive is four.

3. If there are four or more EXP710s to be connected to a channel, split them evenly across the two channel ports associated with the channel. If there is an odd number of EXP710s, then one channel port will have one more EXP710 connected to it than the other channel port.

4. If there are three or fewer EXP710s to be connected to a channel, then they should all be daisy-chained together to one channel port on the channel. The other channel port should be left unconnected.
5. If you are mixing EXP710s and EXP100s, all EXP710s must be grouped together and all EXP100s must be grouped together.
6. It is recommended that you add storage expansion enclosures to the DS4800 drive ports in a round-robin fashion. For example, if you have four EXP810s to be cabled to the DS4800, instead of cabling all four EXP810s to one drive port of a drive channel, distribute the enclosures to all drive ports, which results in one enclosure per drive port of a drive channel.
7. Do not connect more than the recommended maximum number of enclosures per drive channel (eight for 14-drive and seven for 16-drive enclosures). When mixing 14-drive and 16-drive enclosures, the maximum number of expansion enclosures is seven per redundant drive channel pair.
8. DS4800 supports storage expansion enclosures operating at different fibre channel speeds (for example, 2 Gbps or 4 Gbps) only when they are installed in separate redundant drive channel pairs. DS4800 does not support a mix of storage expansion enclosures operating at different fibre channel speeds in the same redundant drive channel pair.
9. DS4800 supports a mix of EXP100, EXP710, and EXP810 storage expansion enclosures in the same redundant drive channel pair. If possible, it is recommended that you cable the storage expansion enclosures of the same type together to ease maintenance and troubleshooting in the event of failures. For specific cabling rules and restrictions when intermixing EXP100, EXP710, and EXP810 storage expansion enclosures, see "One DS4800 to two or more storage expansion enclosures in a mixed environment" on page 82.
10. The DS4000 controller drive port must always be connected to the EXP810 port labeled 1B. Because the left and right EXP810 ESMs (ESMs A and B) are inserted in the ESM bays in different orientations, you must look for the port labeled 1B before making the fibre channel connections.
11. Table 14 indicates a number of ways that four storage expansion enclosures can be attached to the DS4800 controller drive ports. Case 7 is the recommended way. Depending on your need and the type of storage expansion enclosures that you used, you may also choose one of the other ways described in the table. For example, in a given drive channel, you can connect three storage expansion enclosures to the first port and five storage expansion enclosures to the second port, or you can connect four storage expansion enclosures to the first port and four storage expansion enclosures to the second port. You cannot connect three storage expansion enclosures to the first port and six storage expansion enclosures to the second port or one storage expansion enclosure to the first port and eight storage expansion enclosures to the second port; in these cases, the total number of storage expansion enclosures connected to a single drive channel is greater than eight.

Table 14. Different ways to connect four storage expansion enclosures to the DS4800

	Drive Channel 1 port 4	Drive Channel 1 port 3	Drive Channel 2 port 2	Drive Channel 2 port 1
Case 1	4	0	0	0
Case 2	3	1	0	0
Case 3	0	3	1	0
Case 4	2	2	0	0
Case 5	0	2	2	0

Table 14. Different ways to connect four storage expansion enclosures to the DS4800 (continued)

	Drive Channel 1 port 4	Drive Channel 1 port 3	Drive Channel 2 port 2	Drive Channel 2 port 1
Case 6	1	3	0	0
Case 7	1	1	1	1

DS4800 Storage Subsystem drive cabling topologies

The following sections provide preferred cabling topologies for cabling storage expansion enclosures to the DS4800 Storage Subsystem. Each example provides redundant paths to the drives. If one of these examples is suitable for your hardware and application, complete the cabling connections as described in the tables. If you have hardware to include in your topology other than what is shown in these examples, use the examples as a starting point for creating your specific topology.

Attention: The DS4800 supports the connection of a maximum of eight storage expansion enclosures per redundant drive channel pair. The DS4800 supports two redundant drive channel pairs.

If you are using fiber-optic cables, install SFP modules into the ports that will receive the cables before installing the cables.

Figure 48 on page 71 shows the locations of controllers A and B, and the single-ported host channels, Ethernet ports, and dual-ported drive channels at the back of the DS4800 Storage Subsystem.

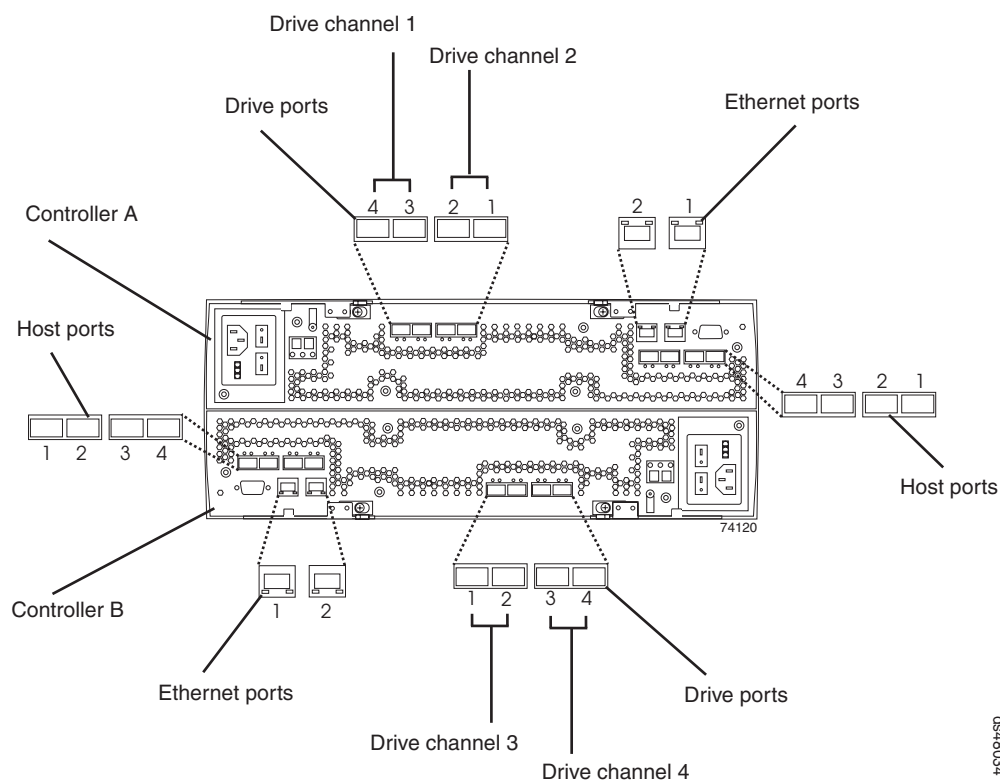


Figure 48. DS4800 Storage Subsystem ports and controllers

Table 15 provides a list of the drive channels that are associated with each of the controller drive ports.

Table 15. DS4800 Storage Subsystem drive ports and drive channels

Drive Channel Number	Controller	Drive Port Numbers	Redundant drive channel pair
1	A	4 and 3	1
2	A	2 and 1	2
3	B	1 and 2	1
4	B	3 and 4	2

Note: In the following drive cabling figures, the DS4800 graphics are simplified to show only the drive ports of each controller. In addition, the storage expansion enclosures are simplified to show only the ESM FC ports. Do not use these graphics for actual cabling diagrams; instead, use the relevant instructions found in “Connecting storage expansion enclosures to the DS4800” on page 60.

One DS4800 and one storage expansion enclosure

If you are cabling one DS4800 Storage Subsystem to one storage expansion enclosure, Figure 49 on page 72 shows the recommended cabling scheme.

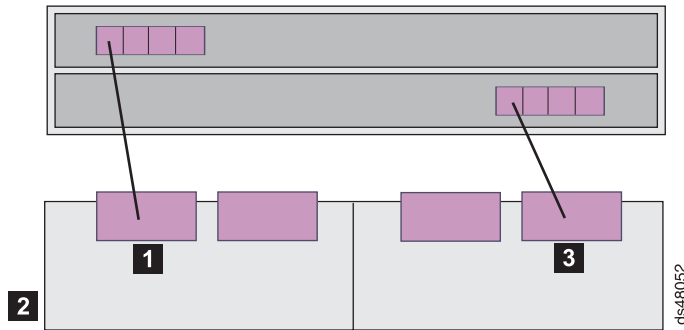


Figure 49. One DS4800 and one storage expansion enclosure — Recommended cabling

Table 16. Description of Figure 48

Number	Description
1	Drive channel 1
3	Drive channel 3
2	Enclosure 1

1. To create drive channel 1, connect drive port 4 of controller A to enclosure 1 (**2**).
2. To create drive channel 3, connect drive port 1 of controller B to enclosure 1 (**2**).

One DS4800 and two storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to two storage expansion enclosures, Figure 50 on page 73 shows the recommended cabling schemes.

As Figure 50 on page 73 and Figure 51 on page 74 show, when you connect additional storage expansion enclosures, you can connect them either by using the additional port of the drive channel or by continuing the connection from the existing redundant drive channel pair. View 1 is the recommended cabling topology; View 2 is a possible cabling topology, however, it is *not* recommended.

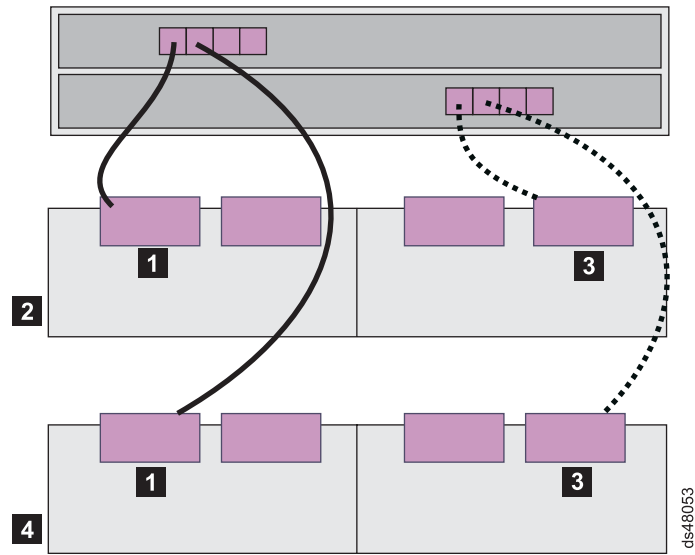


Figure 50. View 1: One DS4800 and two storage expansion enclosures cabling—recommended

Table 17. Description of Figure 49

Number	Description
1	Drive channel 1
3	Drive channel 3
2	Enclosure 1
4	Enclosure 2

1. To create drive channel 1, connect drive port 4 of controller A to enclosure 1 (**2**) and drive port 3 to enclosure 2 (**4**).
2. To create drive channel 3, connect drive port 1 of controller B to enclosure 1 (**2**) and drive port 2 to enclosure 2 (**4**).

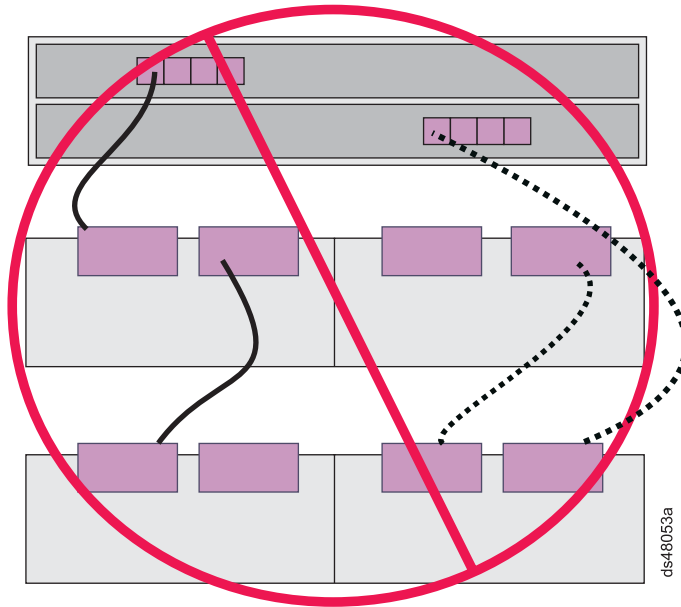


Figure 51. View 2: One DS4800 and two storage expansion enclosures cabling — not recommended

One DS4800 and four storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to four storage expansion enclosures, Figure 52 on page 75 shows the recommended cabling scheme.

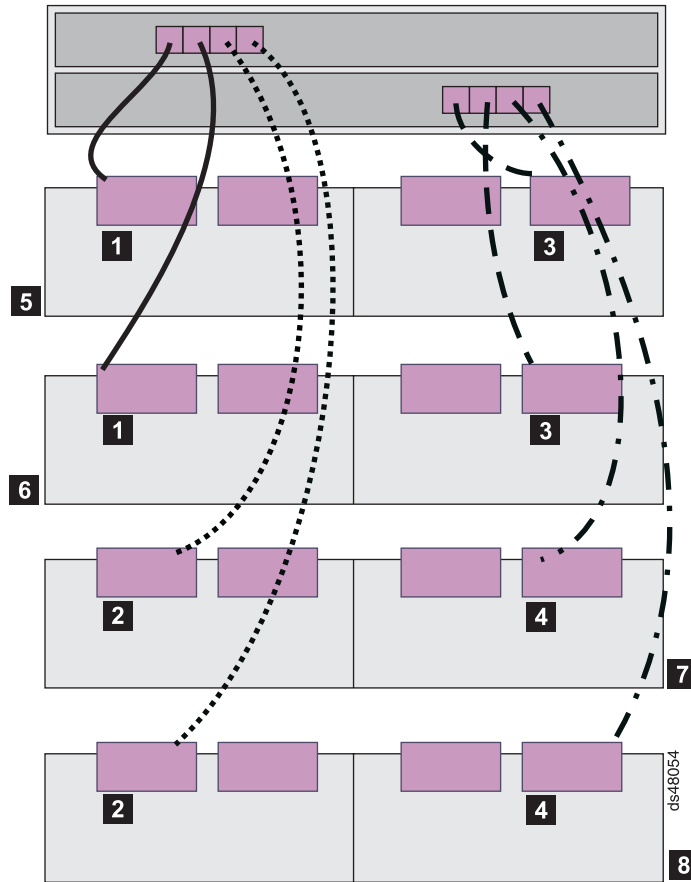


Figure 52. One DS4800 and four storage expansion enclosures—recommended cabling

Table 18. Description of Figure 51

Number	Description
1	Drive channel 1
2	Drive channel 2
3	Drive channel 3
4	Drive channel 4
5	Enclosure 1
6	Enclosure 2
7	Enclosure 3
8	Enclosure 4

1. To create drive channel 1, connect drive port 4 of controller A to enclosure 1 (**5**) and drive port 3 to enclosure 2 (**6**).
2. To create drive channel 3, connect drive port 1 of controller B to enclosure 1 (**5**) and drive port 2 to enclosure 2 (**6**).
3. To create drive channel 2, connect drive port 2 of controller A to enclosure 3 (**7**) and drive port 1 to enclosure 4 (**8**).
4. To create drive channel 4, connect drive port 3 of controller B to enclosure 3 (**7**) and drive port 4 to enclosure 4 (**8**).

One DS4800 and eight storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to eight storage expansion enclosures of the same type, it is recommended that you evenly divide the enclosures between the ports of two redundant dual-ported drive channel pairs, instead of connecting in groups of up to four storage expansion enclosures behind certain ports of the two redundant drive channel pairs. Figure 53 illustrates the cabling topology for one DS4800 Storage Subsystem attached to eight storage expansion enclosures.

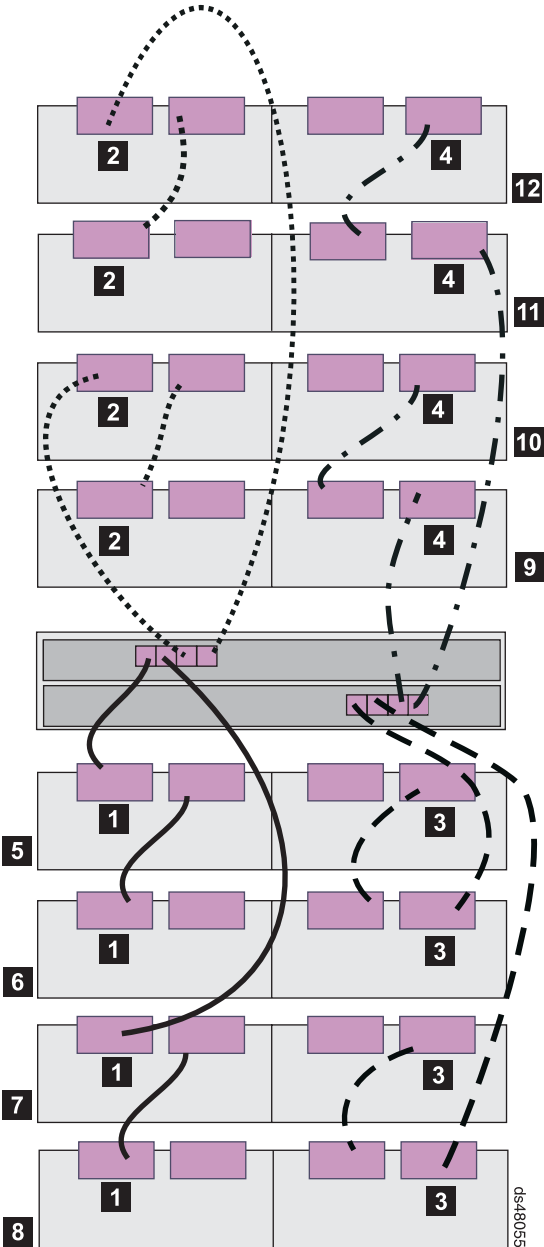


Figure 53. One DS4800 and eight storage expansion enclosures—recommended cabling

Table 19. Description of Figure 52

Number	Description
1	Drive channel 1

Table 19. Description of Figure 52 (continued)

Number	Description
2	Drive channel 2
3	Drive channel 3
4	Drive channel 4
5	Enclosure 1
6	Enclosure 2
7	Enclosure 3
8	Enclosure 4
9	Enclosure 5
10	Enclosure 6
11	Enclosure 7
12	Enclosure 8

1. To create drive channel 1, after connecting enclosures 1 and 2 together, connect drive port 4 of controller A to enclosures 1 (**5**) and 2 (**6**); after connecting enclosures 3 and 4 together, connect drive port 3 of controller A to enclosures 3 (**7**) and 4 (**8**).
2. To create drive channel 3, after connecting enclosures 1 and 2 together, connect drive port 1 of controller B to enclosures 2 (**6**) and 1 (**5**); after connecting enclosures 3 and 4 together, connect drive port 2 of controller B to enclosures 4 (**8**) and 3 (**7**).
3. To create drive channel 2, after connecting enclosures 5 and 6 together, connect drive port 2 of controller A to enclosures 6 (**10**) and 5 (**9**); after connecting enclosures 7 and 8 together, connect drive port 1 of controller A to enclosures 8 (**12**) and 7 (**11**).
4. To create drive channel 4, after connecting enclosures 5 and 6 together, connect drive port 3 of controller B to enclosures 5 (**9**) and 6 (**10**); after connecting enclosures 7 and 8 together, connect drive port 4 of controller B to enclosures 7 (**11**) and 8 (**12**).

One DS4800 and fourteen EXP810 storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to fourteen EXP810 storage expansion enclosures, Figure 54 on page 78 shows the recommended cabling scheme.

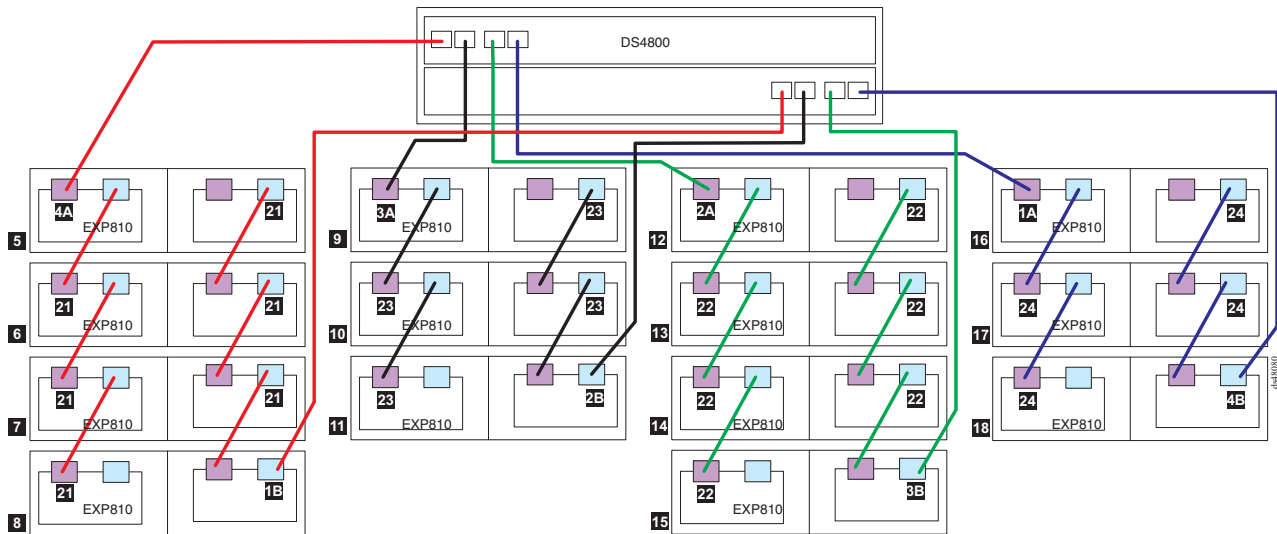


Figure 54. One DS4800 and fourteen EXP810 storage expansion enclosures—recommended cabling

Table 20. Description of Figure 53

Number	Description
4A	Connection from drive port 4 controller A
1B	Connection from drive port 1 controller B
3A	Connection from drive port 3 controller A
2B	Connection from drive port 2 controller B
2A	Connection from drive port 2 controller A
3B	Connection from drive port 3 controller B
1A	Connection from drive port 1 controller A
4B	Connection from drive port 4 controller B
21	Drive channel 1
23	Drive channel 3
22	Drive channel 2
24	Drive channel 4
5	EXP810 enclosure 1
6	EXP810 enclosure 2
7	EXP810 enclosure 3
8	EXP810 enclosure 4
9	EXP810 enclosure 5
10	EXP810 enclosure 6
11	EXP810 enclosure 7
12	EXP810 enclosure 8
13	EXP810 enclosure 9
14	EXP810 enclosure 10
15	EXP810 enclosure 11
16	EXP810 enclosure 12
17	EXP810 enclosure 13

Table 20. Description of Figure 53 (continued)

Number	Description
18	EXP810 enclosure 14

1. Make all connections from the left ESMs to the right ESMs in the expansion enclosures, as indicated by **21** , **23** , **22** , and **24** .
2. To create drive channel 1, after connecting enclosures 1, 2, 3, and 4 together (**21**), connect drive port 4 of controller A (**4A**) to EXP810 enclosures 1 (**5**), 2 (**6**), 3 (**7**), and 4 (**8**); then, connect drive port 1 of controller B (**1B**) to enclosures 4 (**8**), 3 (**7**), 2 (**6**), and 1 (**5**).
3. To create drive channel 3, after connecting enclosures 5, 6, and 7 together (**23**), connect drive port 3 of controller A (**3A**) to enclosures 5 (**9**), 6 (**10**), and 7 (**11**); then, connect port 2 of controller B (**2B**) to enclosures 7 (**11**), 6 (**10**), and 5 (**9**).
4. To create drive channel 2, after connecting enclosures 8, 9, 10, and 11 together (**22**), connect drive port 2 of controller A (**2A**) to enclosures 8 (**12**), 9 (**13**), 10 (**14**), and 11 (**15**); then, connect drive port 3 of controller B (**3B**) to enclosures 11 (**15**), 10 (**14**), 9 (**13**), and 8 (**12**).
5. To create drive channel 4, after connecting enclosures 12, 13, and 14 together (**24**), connect drive port 1 of controller A (**1A**) to enclosures 12 (**16**), 13 (**17**), and 14 (**18**); then, connect drive port 4 of controller B (**4B**) to enclosures 14 (**18**), 13 (**17**), and 12 (**16**).

One DS4800 and sixteen EXP710 storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to sixteen EXP710 storage expansion enclosures, Figure 55 shows the recommended cabling scheme.

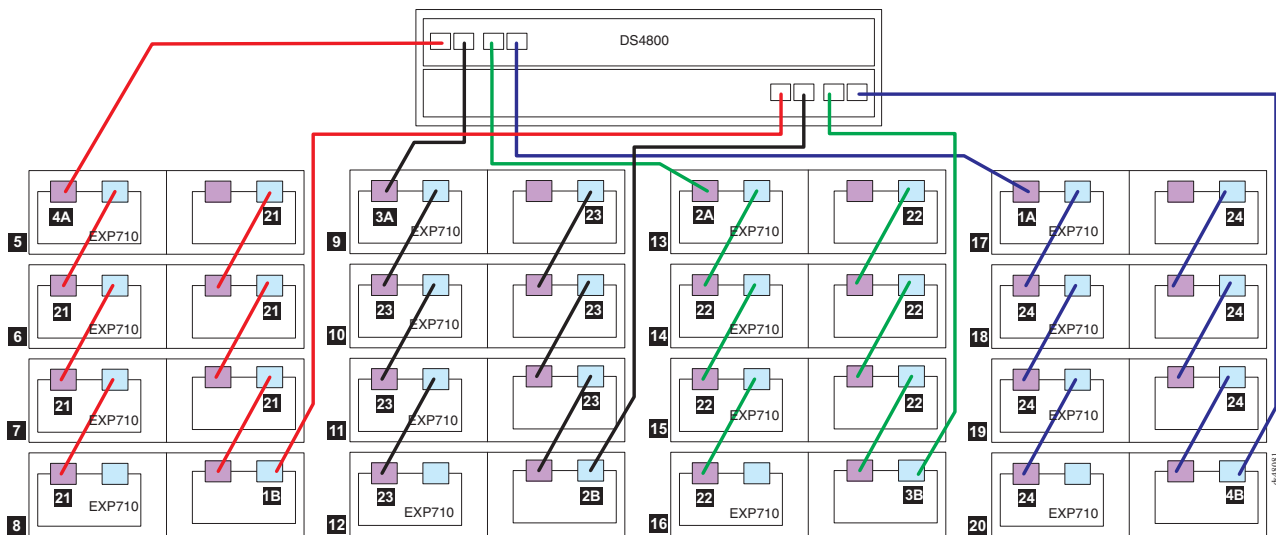


Figure 55. One DS4800 and sixteen EXP710 storage expansion enclosure—recommended cabling

Table 21. Description of Figure 54

Number	Description
4A	Connection from drive port 4 controller A
1B	Connection from drive port 1 controller B

Table 21. Description of Figure 54 (continued)

Number	Description
3A	Connection from drive port 3 controller A
2B	Connection from drive port 2 controller B
2A	Connection from drive port 2 controller A
3B	Connection from drive port 3 controller B
1A	Connection from drive port 1 controller A
4B	Connection from drive port 4 controller B
1	Drive channel 1
2	Drive channel 2
3	Drive channel 3
4	Drive channel 4
5	EXP710 enclosure 1
6	EXP710 enclosure 2
7	EXP710 enclosure 3
8	EXP710 enclosure 4
9	EXP710 enclosure 5
10	EXP710 enclosure 6
11	EXP710 enclosure 7
12	EXP710 enclosure 8
13	EXP710 enclosure 9
14	EXP710 enclosure 10
15	EXP710 enclosure 11
16	EXP710 enclosure 12
17	EXP710 enclosure 13
18	EXP710 enclosure 14
19	EXP710 enclosure 15
20	EXP710 enclosure 16

1. Make all connections from the left ESMs to the right ESMs in the expansion enclosures, as indicated by **21**, **23**, **22**, and **24**.
2. To create drive channel 1, after connecting enclosures 1, 2, 3, and 4 together (**21**), connect drive port 4 of controller A (**4A**) to EXP710 enclosures 1 (**5**), 2 (**6**), 3 (**7**), and 4 (**8**); then, connect drive port 1 of controller B (**1B**) to enclosures 4 (**8**), 3 (**7**), 2 (**6**), and 1 (**5**).
3. To create drive channel 3, after connecting enclosures 5, 6, 7, and 8 together (**23**), connect drive port 3 of controller A (**3A**) to enclosures 5 (**9**), 6 (**10**), 7 (**11**), and 8 (**12**); then, connect port 2 of controller B (**2B**) to enclosures 8 (**12**), 7 (**11**), 6 (**10**), and 5 (**9**).
4. To create drive channel 2, after connecting enclosures 9, 10, 11, and 12 together (**22**), connect drive port 2 of controller A (**2A**) to enclosures 9 (**13**), 10 (**14**), 11 (**15**), and 12 (**16**); then, connect drive port 3 of controller B (**3B**) to enclosures 12 (**16**), 11 (**15**), 10 (**14**), and 9 (**13**).
5. To create drive channel 4, after connecting enclosures 13 (**17**), 14 (**18**), 15 (**19**), and 16 (**20**) together (**24**), connect drive port 1 of controller A (**1A**)

to enclosures 13 (**17**), 14 (**18**), 15 (**19**), and 16 (**20**); then, connect drive port 4 of controller B (**4B**) to enclosures 16 (**20**), 15 (**19**), 14 (**18**), and 13 (**17**).

One DS4800 to seven EXP810 and eight EXP710 storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to seven EXP810 storage expansion enclosures operating at 4 Gbps and eight EXP710 storage expansion enclosures operating at 2 Gbps, Figure 56 shows the recommended cabling scheme.

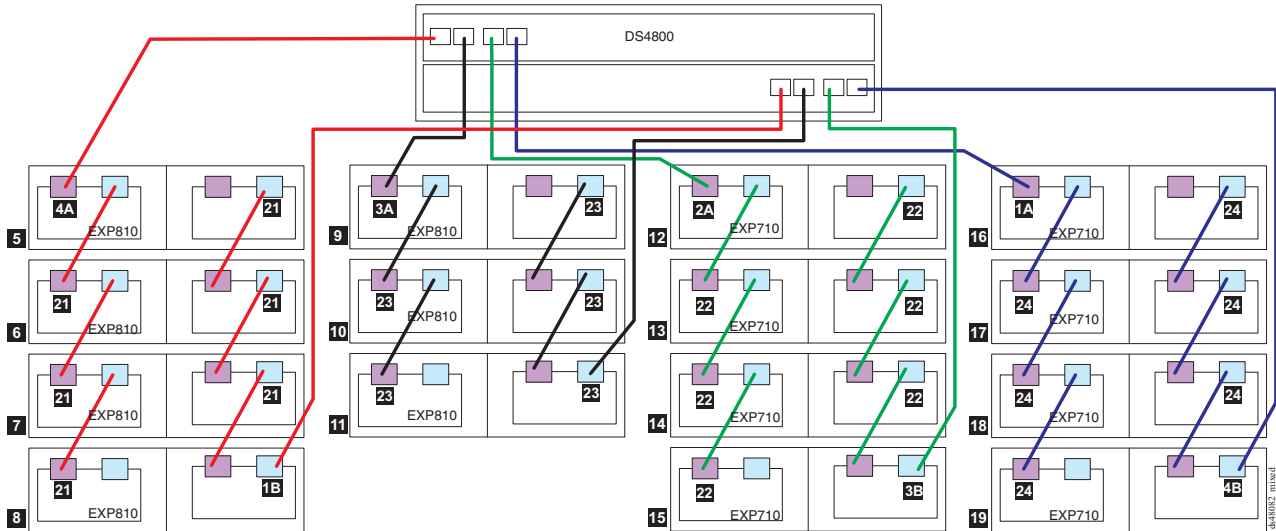


Figure 56. One DS4800 to seven EXP810 and eight EXP710 storage expansion enclosures—recommended cabling

Table 22. Description of Figure 55

Number	Description
4A	Connection from drive port 4 controller A
1B	Connection from drive port 1 controller B
3A	Connection from drive port 3 controller A
2B	Connection from drive port 2 controller B
2A	Connection from drive port 2 controller A
3B	Connection from drive port 3 controller B
1A	Connection from drive port 1 controller A
4B	Connection from drive port 4 controller B
1	Drive channel 1
2	Drive channel 2
3	Drive channel 3
4	Drive channel 4
5	EXP810 enclosure 1
6	EXP810 enclosure 2
7	EXP810 enclosure 3
8	EXP810 enclosure 4
9	EXP810 enclosure 5

Table 22. Description of Figure 55 (continued)

Number	Description
10	EXP810 enclosure 6
11	EXP810 enclosure 7
12	EXP710 enclosure 1
13	EXP710 enclosure 2
14	EXP710 enclosure 3
15	EXP710 enclosure 4
16	EXP710 enclosure 5
17	EXP710 enclosure 6
18	EXP710 enclosure 7
19	EXP710 enclosure 8

1. Make all connections from the left ESMs to the right ESMs in the expansion enclosures, as indicated by **21**, **23**, **22**, and **24**.
2. To create drive channel 1, after connecting enclosures 1, 2, 3, and 4 together (**21**), connect drive port 4 of controller A (**4A**) to EXP810 enclosures 1 (**5**), 2 (**6**), 3 (**7**), and 4 (**8**); then, connect drive port 1 of controller B (**1B**) to enclosures 4 (**8**), 3 (**7**), 2 (**6**), and 1 (**5**).
3. To create drive channel 3, after connecting enclosures 5, 6, and 7 together (**23**), connect drive port 3 of controller A (**3A**) to EXP810 enclosures 5 (**9**), 6 (**10**), and 7 (**11**); then, connect port 2 of controller B (**2B**) to enclosures 7 (**11**), 6 (**10**), and 5 (**9**).
4. To create drive channel 2, after connecting EXP710 enclosures 8, 9, 10, and 11 together (**22**), connect drive port 2 of controller A (**2A**) to enclosures 8 (**12**), 9 (**13**), 10 (**14**), and 11 (**15**); then, connect drive port 3 of controller B (**3B**) to enclosures 11 (**15**), 10 (**14**), 9 (**13**), and 8 (**12**).
5. To create drive channel 4, after connecting EXP710 enclosures 12 (**16**), 13 (**17**), 14 (**18**), and 15 (**19**) together (**24**), connect drive port 1 of controller A (**1A**) to enclosures 12 (**16**), 13 (**17**), 14 (**18**), and 15 (**19**); then, connect drive port 4 of controller B (**4B**) to enclosures 15 (**19**), 14 (**18**), 13 (**17**), and 12 (**16**).

One DS4800 to two or more storage expansion enclosures in a mixed environment

When intermixing EXP100s, EXP710s, and EXP810s in a DS4800 storage subsystem configuration, if it is not possible to cable each group of enclosures by model type (EXP100s, EXP710s, and EXP810s) in a separate redundant drive loop pair or behind each port of the dual-ported redundant drive channel pair, group them so that EXP810s are between EXP100s and EXP710s.

In addition, when an EXP100 is the first storage expansion enclosure cabled directly to the storage subsystem's controller drive port, follow these rules:

- Cable from the storage subsystem controller drive port to the OUT port on the left ESM (ESM A) of the EXP100.

Note: This is a change from previous cabling recommendations where you cabled from the controller drive port to the IN port on the left ESM (ESM A) of the EXP100.

- If an EXP100 follows the initial EXP100, cable from the IN port on the left ESM (ESM A) of the first EXP100 to the OUT port on the left ESM of the next

EXP100. Continue this cabling pattern until you encounter an EXP710 or EXP810, then cable from the IN port on the left ESM (ESM A) of the EXP100 to the IN port of the EXP710 or EXP810.

- If an EXP710 or EXP810 follows the initial EXP100, cable from the IN port on the left ESM (ESM A) of the EXP100 to the IN port of the EXP710 or EXP810. To cable to the next storage expansion enclosure in the chain, cable from the OUT port of the left ESM of the EXP710 or EXP810 to the IN port of the next storage expansion enclosure.
- Continue the left ESM (ESM A) cabling pattern by cabling from the OUT port to the IN port on subsequent storage expansion enclosures until you complete the chain.

Figure 57 shows an acceptable EXP710, EXP810 and EXP100 intermix configuration in a DS4800 environment. The cabling is acceptable because it follows the cabling recommendations.

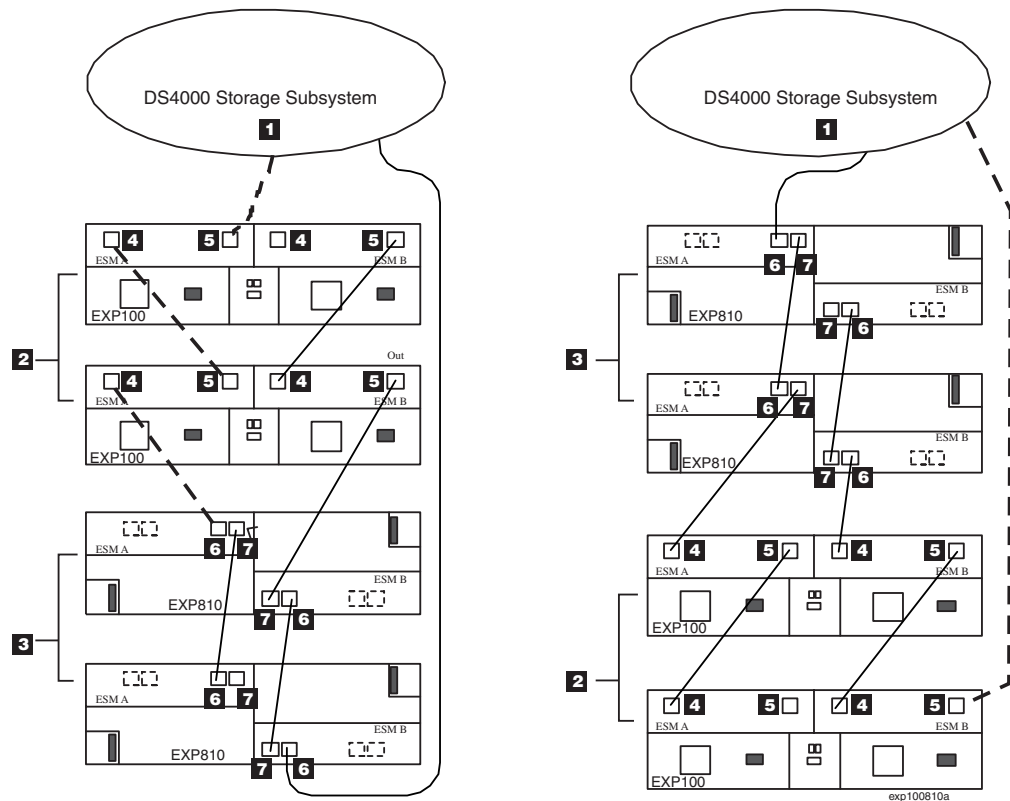


Figure 57. Acceptable EXP710, EXP810 and EXP100 intermix configuration in a DS4800 environment

Table 23. Description of Figure 57

Number	Description
1	DS4800 Storage Subsystem
2	EXP100
3	EXP810
4	IN port
5	OUT port
6	Port 1B

Table 23. Description of Figure 57 (continued)

Number	Description
7	Port 1A

Figure 58 shows an unacceptable EXP710, EXP810, and EXP100 intermix configuration in a DS4800 environment. The cabling is unacceptable because storage subsystem controller is cabled to the IN port on the left ESM of the first EXP100.

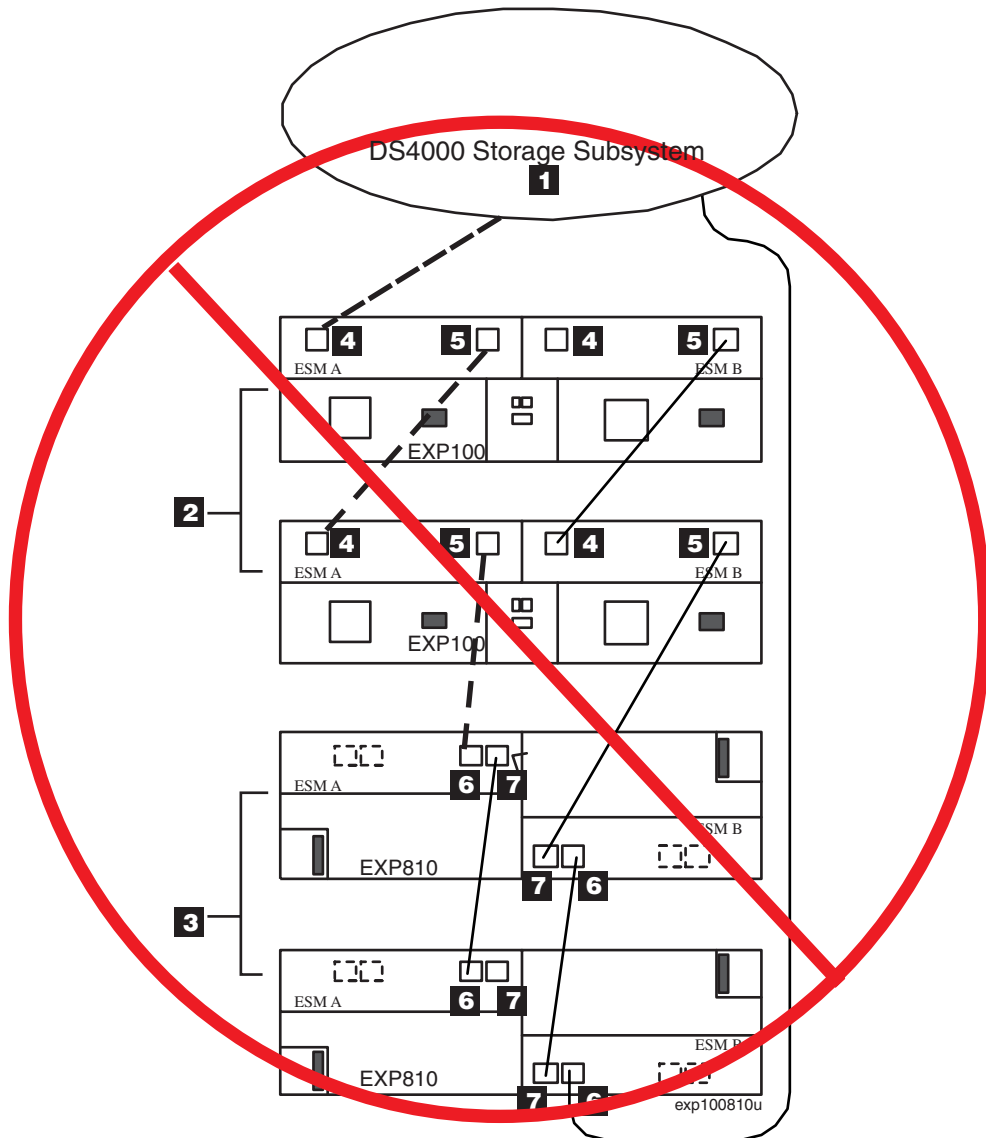


Figure 58. Unacceptable EXP710, EXP810 and EXP100 intermix configuration in a DS4800 environment

Table 24. Description of Figure 58

Number	Description
1	DS4800 Storage Subsystem
2	EXP100

Table 24. Description of Figure 58 (continued)

Number	Description
3	EXP810
4	IN port
5	OUT port
6	Port 1B
7	Port 1A

Figure 59 shows cabling variations when intermixing EXP100, EXP710, and EXP810 storage expansion enclosures behind a DS4800 Storage Subsystem.

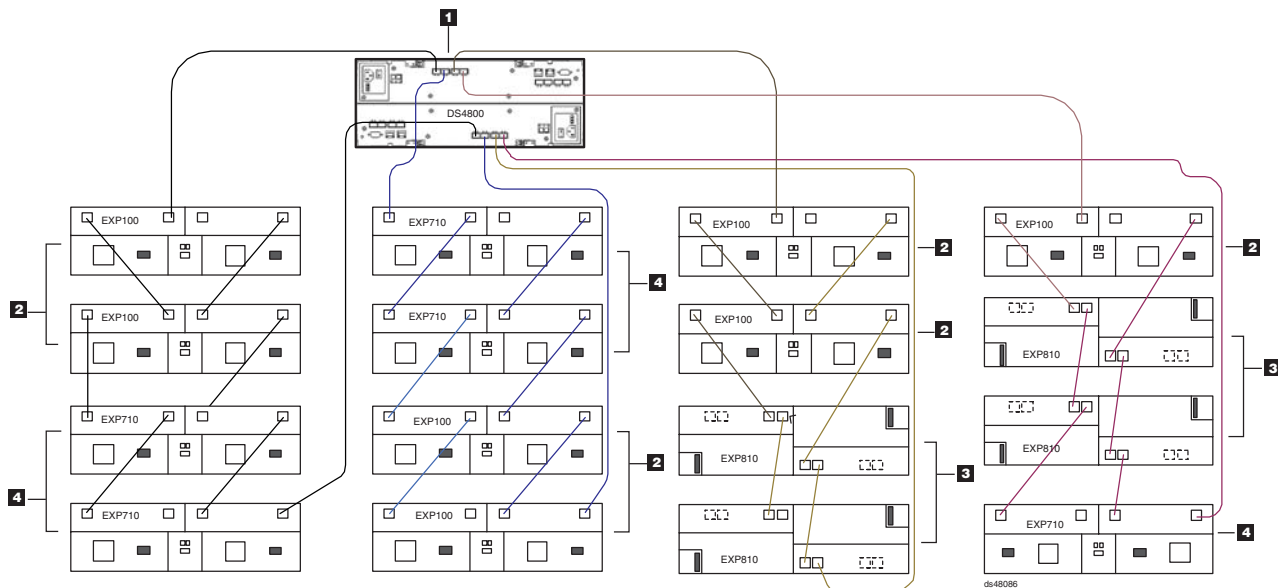


Figure 59. Cabling variations when intermixing EXP100, EXP710, and EXP810 storage expansion enclosures behind a DS4800 Storage Subsystem

Table 25. Description of Figure 59

Number	Description
1	DS4800 Storage Subsystem
2	EXP100
3	EXP810
4	EXP710

Cabling the storage expansion enclosures to a DS4800 storage subsystem

Complete the following steps to cable the storage expansion enclosures to a DS4800 Storage Subsystem:

1. Install an SFP module in the drive mini hub port on the back of the DS4800 Storage Subsystem, as shown in Figure 60 on page 86.
2. Connect an LC-LC fiber-optic cable into the SFP module, as shown in Figure 61 on page 86.

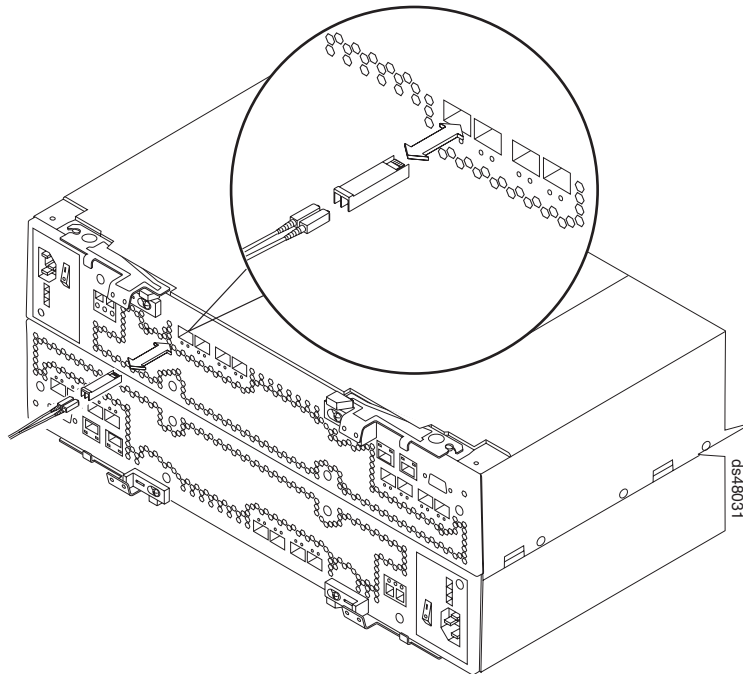


Figure 60. Installing an SFP module and LC-LC cable in a DS4800

Install an SFP module in the SFP port on the back of the storage expansion enclosures; then, connect the other end of the LC-LC cable into the SFP module, as shown in Figure 61.

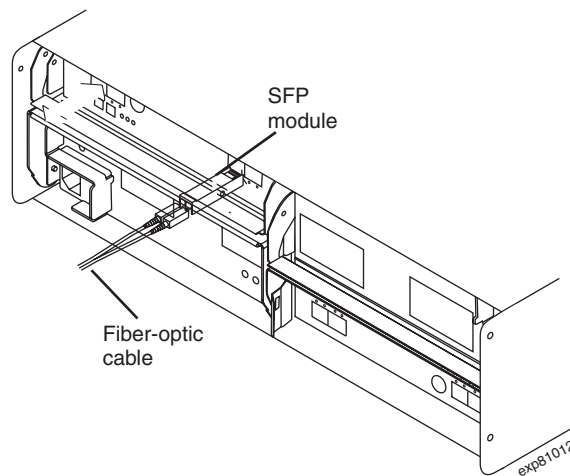


Figure 61. Installing an SFP module and connecting an LC-LC cable to the storage expansion enclosures

For important information about connection rules and recommendations, see step 4 on page 68.

Storage expansion enclosure settings

This section provides information about storage expansion enclosure settings. For additional detail, refer to the *Installation, User's, and Maintenance Guide* for your storage expansion enclosure.

Fibre channel loop and ID settings

When you install a hard disk drive in the storage expansion enclosure, the drive tray plugs into a printed circuit board called the *midplane*. The midplane sets the fibre channel loop ID automatically, based on the enclosure ID switch setting and the physical location (bay) of the hard disk drive.

DS4000 storage expansion enclosure ID settings

DS4000 storage expansion enclosures have an enclosure ID switch that is used to identify the DS4000 storage expansion enclosure on a fibre channel loop. The enclosure ID switch is located on the back of the unit.

Use the small buttons above and below each enclosure ID digit to change the enclosure ID setting. Press the button located above the digit to lower the digit by one. Press the button located below the digit to raise the digit by one.

Note: Some DS4000 storage expansion enclosures ship with a panel installed over the enclosure ID switch to prevent the enclosure ID from being changed accidentally. If your DS4000 storage expansion enclosure has a protective panel over the ID switch, use a pencil or a small screwdriver to change the enclosure ID.

Each storage expansion enclosure in a DS4000 Storage Subsystem drive loop must have a unique enclosure ID. DS4000 controllers use a combination of the enclosure ID and the number of the physical slots that a hard drive occupies to create a unique fibre channel loop address, or arbitrated loop physical address (AL_PA), for each drive in a fibre channel drive loop. The enclosure ID consists of two digits, a tens digit (x10) and a ones digit (x1). The enclosure IDs of the EXP710 and EXP100 storage expansion enclosures must be manually set, whereas the enclosure IDs of the EXP810s are automatically adjusted to be unique values by the EXP810 ESM and the DS4800 controller firmware.

Attention: When connecting storage expansion enclosures, it is recommended that you use the tens digit (x10) enclosure ID setting to distinguish different redundant loops and use the ones digit (x1) enclosure ID setting to distinguish storage expansion enclosures IDs within a redundant loop. If you do not set the single digit value of the enclosure IDs to be unique among storage expansion enclosures (including the DS4000 storage subsystem with drives installed) in a redundant drive channel/loop pair, then drive loop errors might be randomly posted in the DS4000 subsystem Major Event Log (MEL) when you intermix different types of storage expansion enclosures in a redundant drive loop pair (such as an EXP100 with an EXP810). For example, in a DS4800 configuration with 16 storage expansion enclosures distributed equally behind the four controller drive ports, the recommended enclosure ID settings for the enclosures are shown in Table 26.

Table 26. Recommended enclosure ID settings scheme

	Enclosure ID behind the first controller drive port	Enclosure ID behind the second controller drive port	Enclosure ID behind the third controller drive port	Enclosure ID behind the fourth controller drive port
Enclosure 1	00	04	10	14
Enclosure 2	01	05	11	15
Enclosure 3	02	06	12	16
Enclosure 4	03	07	13	17

The DS4800 normally ships with an enclosure ID outside the range of 00–77. However, if your DS4800 enclosure ID was set to a value within the range of 00–77, it may be in conflict with the enclosure ID of one of the EXP100 or EXP710 drive expansion enclosures that you are trying to attach to the DS4800. If this is the case, the amber ID Conflict LED on the storage expansion enclosure will light up after you power on the storage subsystem.

Give each storage expansion enclosure in a redundant drive channel pair a unique ones digit (x1) ID. This setting will enforce hard AL_PAs (unchangeable between fibre channel Loop Initializations [LIPs]) for the drives and facilitate drive channel problem troubleshooting in the event of an error. If the ones digits are not unique, two or more devices will have the same hard AL_PA. In such a case, the DS4800 controller will use soft AL_PAs for the devices that have identical hard AL_PAs.

The problem with soft addressing is that addresses may change between LIPs. This possibility increases the difficulty of troubleshooting drive channel problems, since one cannot easily ascertain whether the same device with a different address or a different device may be causing a problem.

Intermixing storage expansion enclosures in the same drive loop

You can intermix EXP810s, EXP710s, and EXP100s. When intermixing EXP810s with EXP710s or EXP100s in the same drive loop, the Link Rate switch for all storage expansion enclosures in the intermixed drive loop must be 2 Gbps because the EXP710 and EXP100 only operate at 2 Gbps.

There are maximum limits to the number of fibre channel hard drives that you can configure in redundant drive channel pairs. The maximum number of drives dictates a fixed number of supported EXP710 or EXP100 and EXP810 drive enclosure combinations.

Table 27 lists the numbers of 14-drive and 16-drive storage expansion enclosures you can combine for use in a single redundant drive channel/loop pair in a DS4800 configuration. Table 27 shows the supported storage expansion enclosures combinations per redundant drive channel/loop pair in a DS4800 configuration. The table assumes that a DS4800 storage subsystem is generally capable of addressing the maximum of 112 fibre channel hard drives for each redundant drive channel/loop pair.

Table 27. Possible combinations of 14-drive and 16-drive storage expansion enclosures per redundant drive/channel loop pair in a DS4800 configuration

Number of EXP810s (16 drives/unit)	Total number of drives in EXP810s	Number of EXP710/ EXP100s (14 drives/unit)	Total number of drives in EXP710/ EXP100s	Total number of drives in the DS4800		Total number of drives in a mixed EXP710s and EXP810s drive loop
0	0	7	98	16	=	114
1	16	5	70	16	=	102
2	32	4	56	16	=	104
3	48	3	42	16	=	106
4	64	2	28	16	=	108
5	80	1	14	16	=	110
6	96	0	0	16	=	112

For more information about intermixing storage expansion enclosures and the most current information on the DS4000 Fibre Channel and Serial ATA (FC/SATA) Enclosure Intermix premium feature, see the following Web site:

www-1.ibm.com/support/docview.wss?rs=1100&uid=psg1MIGR-57823

Connecting hosts to the DS4800

The DS4800 supports redundant connections to up to four hosts. To ensure full protection against the loss of any one fibre channel path from the host servers to the DS4800 Storage Subsystem, always use redundant host connections by connecting each host to the appropriate single-ported host channels on both RAID controllers A and B.

To connect a host adapter to the DS4800 RAID controllers, perform the following steps:

1. Install SFP modules in host ports on RAID controllers A and B.

Note: The alignment of the single-ported host channels on controller A are opposite those of controller B. Before inserting an SFP module into a host port, verify that the SFP module is rotated correctly to match the alignment of the host port on the RAID controller. Do not force-fit.

2. Connect the fibre channel cables from the SFP modules in the DS4800 RAID controller host ports to either the SFP modules in the fibre channel switch or the

SFP modules of the host bus adapters. Figure 62 shows the location on the RAID controllers where the host-system cables connect.

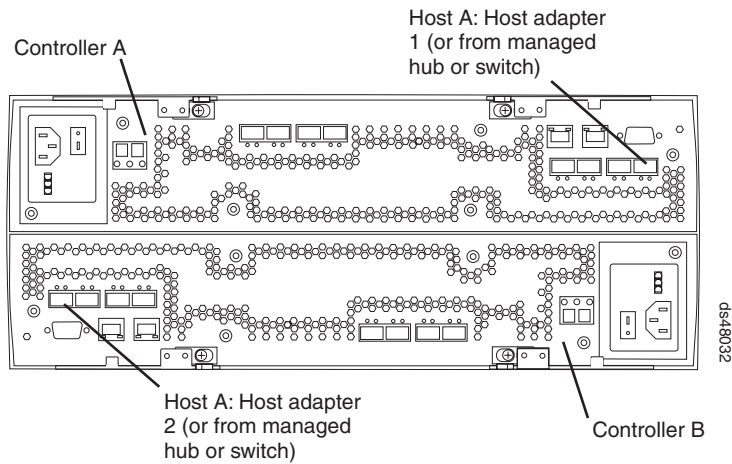


Figure 62. Location of host cables on RAID controllers

3. Repeat steps 1 on page 89 and 2 on page 89 for each additional redundant host connection. You can create a maximum of four redundant host connections, as shown in Figure 63 on page 91.

Note: Figure 63 on page 91 shows that the DS4800 host ports are connected to four sets of FC host bus adapters (HBAs). You can replace one or all of these sets of FC HBAs with FC switches as required.

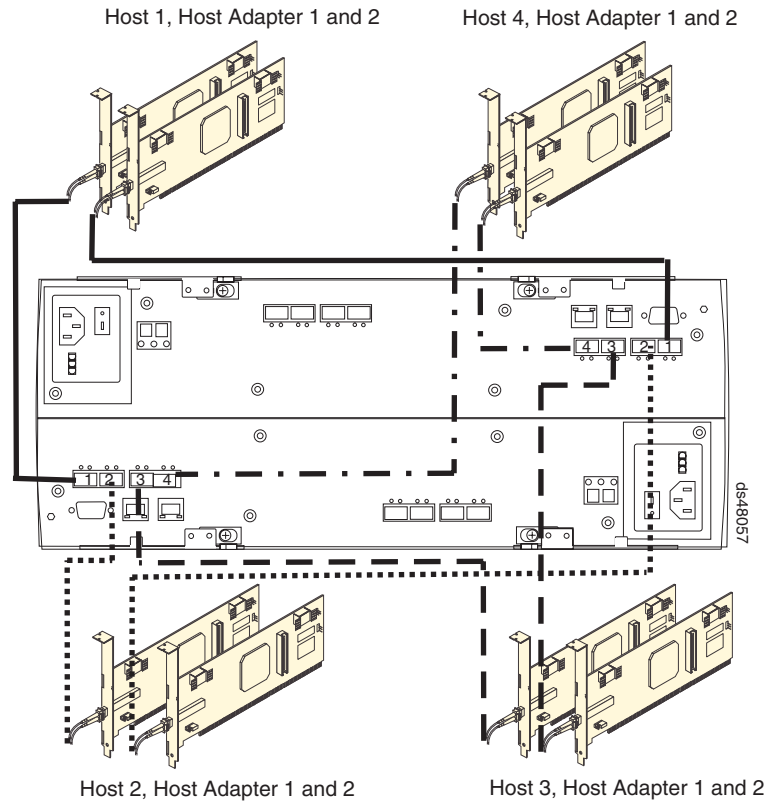


Figure 63. Cabling diagram for four redundant host connections

For examples of redundant, partially redundant, and non-redundant host and drive channel configurations, see “Fibre channel host loop configurations” on page 95.

Connecting secondary interface cables

This section is applicable to (direct) out-of-band management configurations only. If your configuration uses host-agent (in-band) management, skip this section.

Use the Ethernet interface ports on the back of the storage subsystem to connect the controllers for direct management of the storage subsystems (see “Direct (out-of-band) management method” on page 93).

Important:

1. The serial interface ports are intended to be used by service technicians to perform diagnostic operations on the storage subsystem. Incorrect use of the serial port can result in loss of data access and, in some cases, in loss of data. Do not make connections to the serial port unless you do so under the direct supervision and guidance of IBM support personnel.
2. To minimize security risks, do not connect the DS4800 in a public LAN or public subnet. Use a local private network for the DS4800 and the management station Ethernet ports.
3. To ensure proper EMI shielding, always use quality braided and shielded serial cables.

Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for controller A (located on the top) and controller B (located on the bottom) on the back of the storage subsystem. Figure 64 on page 92 shows the

location of the ports. Only one Ethernet port connection from each controller is required to establish a direct (out-of-band) management connection to the DS4800 Storage Subsystem.

Note: The alignment of the Ethernet and serial ports on controller A are opposite those of controller B. Before inserting an Ethernet or serial cable, verify that the cable connection is rotated correctly to match the alignment of the port on the RAID controller. Do not force-fit.

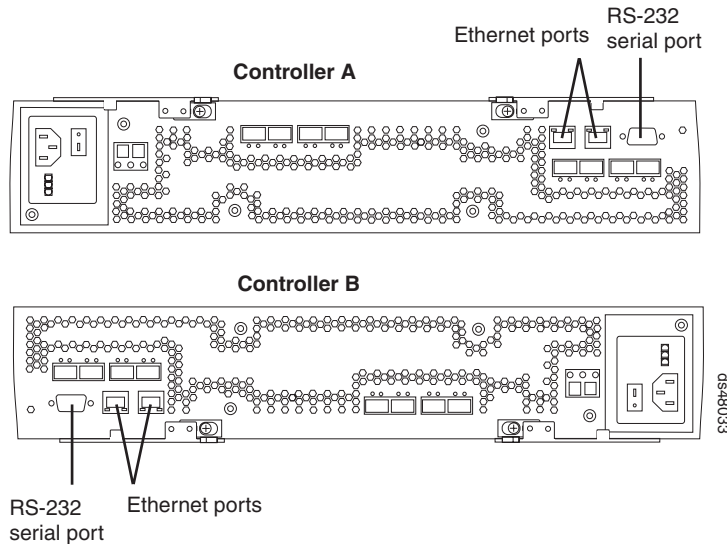


Figure 64. Ethernet and serial port locations

Configuring the storage subsystem

You must configure the storage subsystem configuration after you install the storage subsystem in a rack cabinet. Use the following information to configure your storage subsystem configuration.

Storage subsystem management methods

Before you configure the storage subsystem, determine which method of storage subsystem management you want to use. You can manage the storage subsystems in either of two ways: host-agent (in-band) management or direct (out-of-band) management.

For more information on setting up in-band or out-of-band management connections, refer to the *DS4000 Storage Manager Installation and Support Guide* for the operating system of the host computer that will be used to manage the storage subsystem.

Important: If the operating system of the host server to which the storage subsystem logical drives are mapped is not Microsoft Windows 2000 or Server 2003, then you first have to make a direct (out-of-band) management connection to the storage subsystem to set the correct host type. The server will then be able to recognize the storage subsystem correctly for host-agent (in-band) management.

Host-agent (in-band) management method

This method requires host-agent software that you install on the host server. The host-agent software allows the DS4000 Storage Manager client program to manage the DS4000 Storage Subsystem using the same fibre channel connections between the host server and the storage subsystem. You must install at least one management station and a software agent host. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Figure 65 shows the host-agent (in-band) management method.

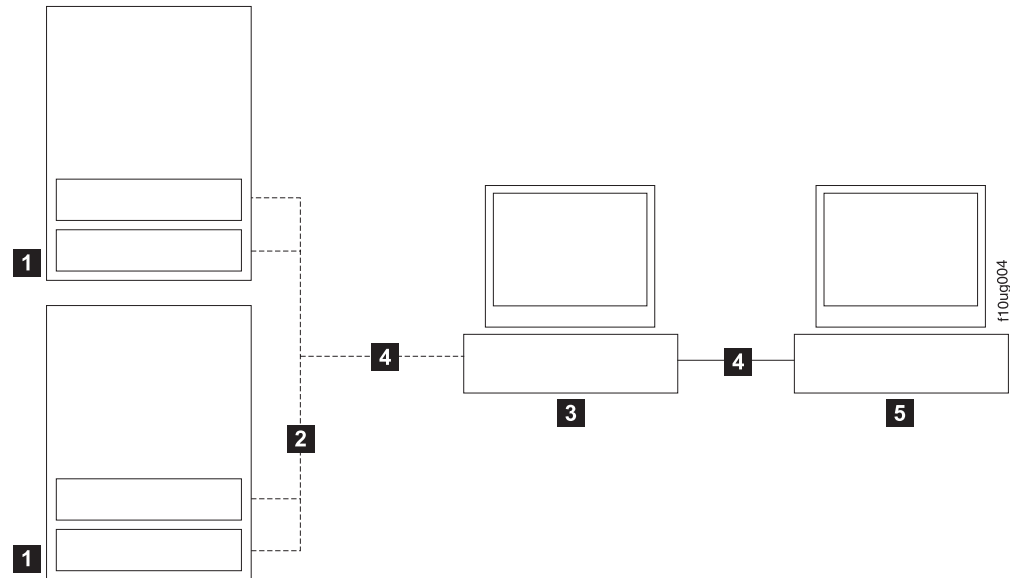


Figure 65. Host-agent (in-band) managed storage subsystems

Table 28. Description of Figure 61

Number	Description
1	Two storage subsystems
2	Fibre channel I/O path
3	Host server
4	Ethernet network
5	Management station

Direct (out-of-band) management method

This method uses Ethernet connections from a management station to each controller. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Attach Ethernet cables to each management station (one pair per storage subsystem). You will connect the cables to each storage subsystem controller later when you install the storage subsystem. Figure 66 on page 94 shows the direct (out-of-band) management method.

You can either use the default controller Ethernet IP addresses for out-of-band connection or change the default controller Ethernet IP addresses by using Dynamic Host Configuration Protocol (DHCP) or Storage Manager client. Refer to the *DS4000 Storage Manager Installation, User's and Maintenance Guide* for the

appropriate operating system for more information on setting the management connections and installing the DS4000 storage subsystem management software.

For a listing of default IP addresses, see 12.

Note: Do not connect the storage subsystem Ethernet ports to a public network or public subnet. It is strongly recommended that you create a private network between the storage subsystem and the management station.

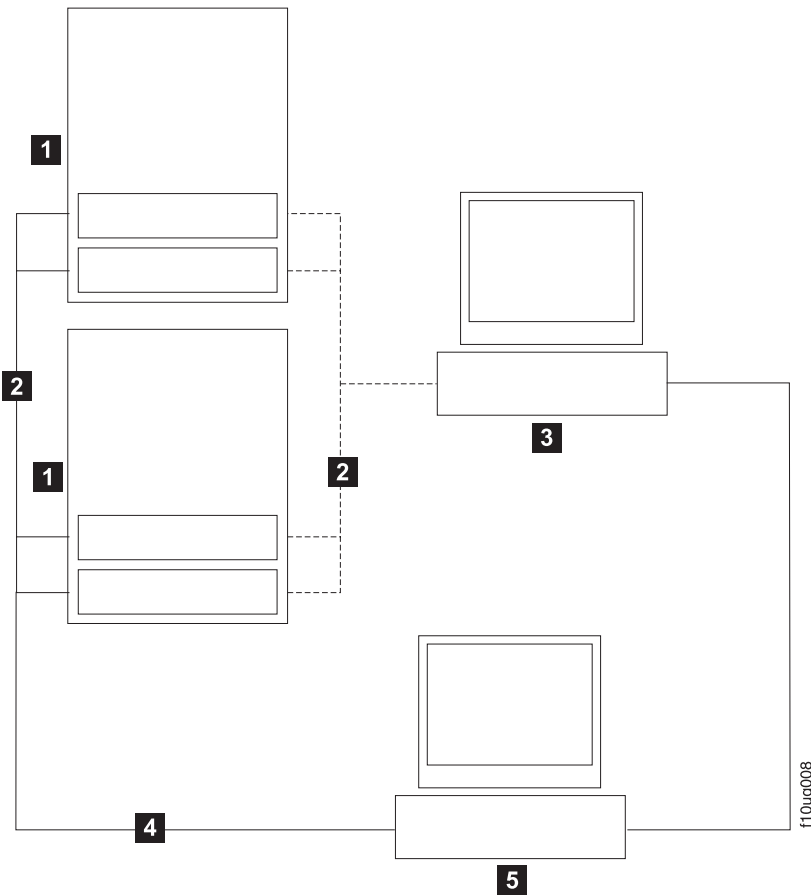


Table 29. Description of Figure 62

Number	Description
1	Two DS4800s
2	Fibre channel I/O path
3	Host server
4	Ethernet network
5	Management station

Figure 66. Direct (out-of-band) managed storage subsystems

Fibre channel connections

The storage subsystem fibre channel connection consists of up to four host fibre-channel loops and a redundant drive fibre-channel loop. The host fibre-channel loops provide the fibre path for host attachment. They can consist of fibre-channel

cables, SFPs, host bus adapters, fibre-channel switches, and RAID controllers. The redundant drive fibre-channel loop provides the fibre path from the DS4800 Storage Subsystem to the hard disk drives (HDDs) in the storage expansion enclosures. The redundant drive fibre-channel loop consists of the DS4800 Storage Subsystem, the storage expansion enclosures, fibre-channel cables, and SFPs.

The DS4800 supports redundant drive channel pair configurations. You can build a redundant drive channel pair by connecting one or more storage expansion enclosures to the redundant RAID controllers. Then, use dual fiber-optic cables to connect one storage expansion enclosure to another in a daisy-chain. For more information, see “Connecting storage expansion enclosures to the DS4800” on page 60.

Fibre channel host loop configurations

You must determine how the host systems will connect to the storage subsystem. You can connect up to four host systems directly to the storage subsystem, or you can connect more than two hosts to the fibre channel storage subsystem through switches. The illustrations in the following sections show common host system configurations.

Note: The minimum DS4800 configuration is eight partitions. Sixteen-partition and sixty-four-partition configuration upgrades are available as upgrade options. Contact your IBM reseller or marketing representative for more information.

Redundant host and drive loops

This section provides examples of DS4800 host fibre channel configurations.

DS4800 host configurations: This section provides the following examples of DS4800 host fibre channel configurations:

- Redundant host and drive fibre channel loop configurations, as shown in Figure 67 on page 96
- Single SAN fabric configuration, as shown in Figure 68 on page 97
- Dual SAN fabric configuration, with an additional DS4800 attached, as shown in Figure 69 on page 97
- Two clusters, as shown in Figure 70 on page 98

Notes:

1. These configurations have host and drive path failover protection and are recommended for high availability.
2. The following illustrations do not accurately represent the controller locations in the DS4800.

Figure 67 on page 96 gives an example of one host system to one DS4800; two host systems, with fibre channel switches, to one DS4800; and, two host systems, without switches, to one DS4800.

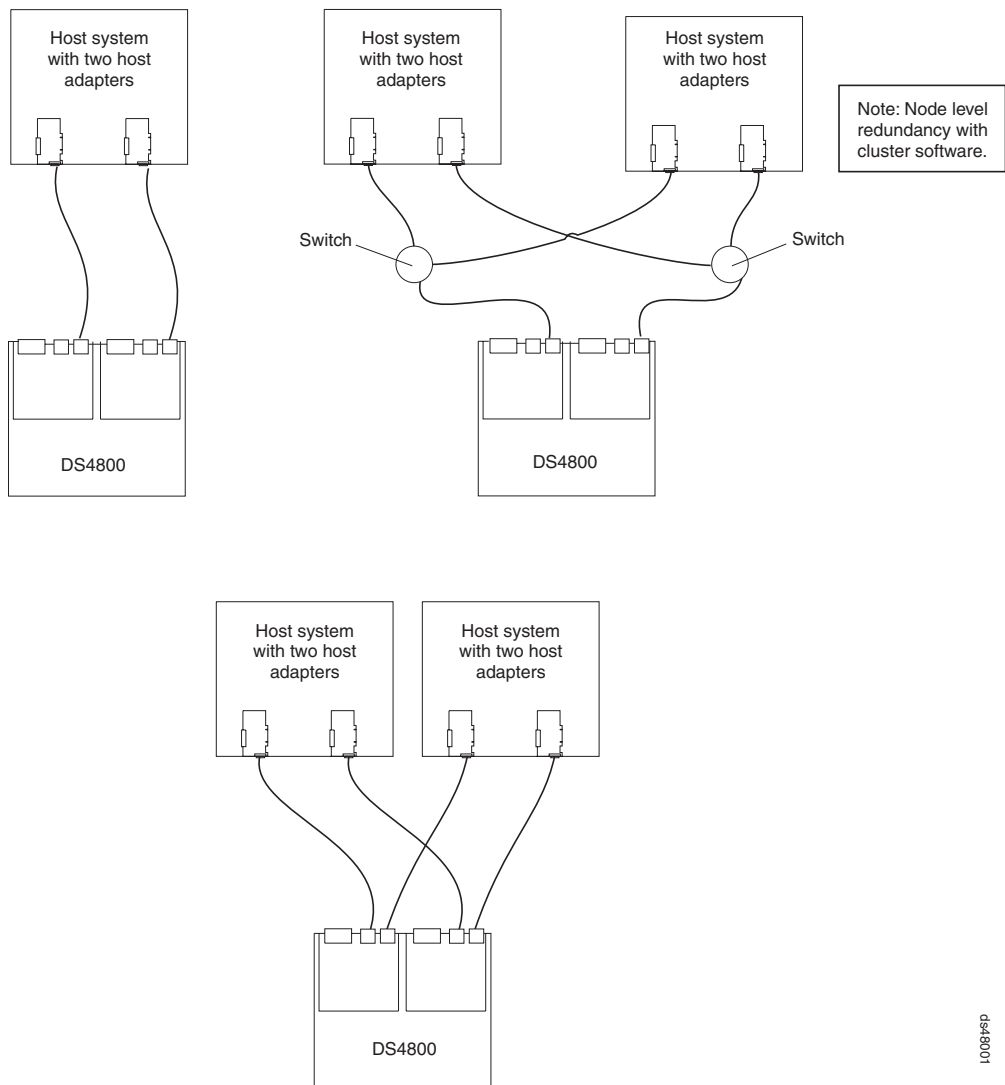


Figure 67. Examples of redundant host direct attached fibre channel configurations

In Figure 68 on page 97, gives an example of two host systems, with fibre channel switches connected by an interswitch link, forming a single SAN fabric configuration.

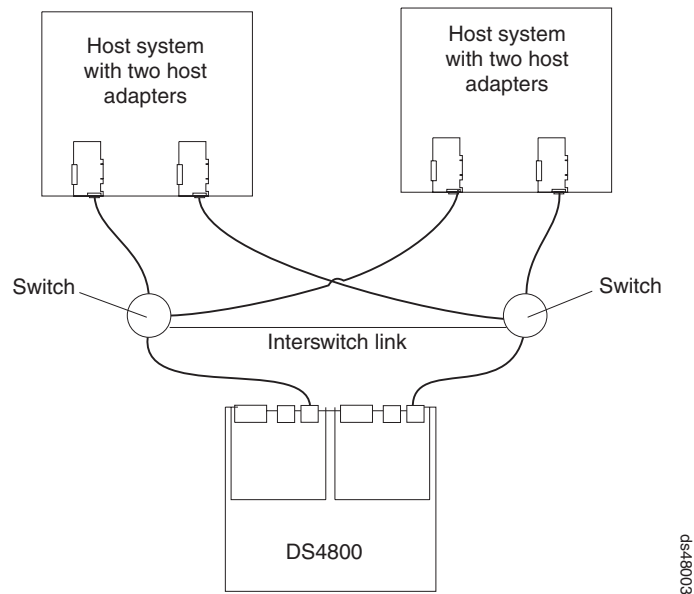


Figure 68. Example of a single SAN fabric configuration

In Figure 69, the fibre channel switches are not connected together. Each switch forms its own SAN fabric.

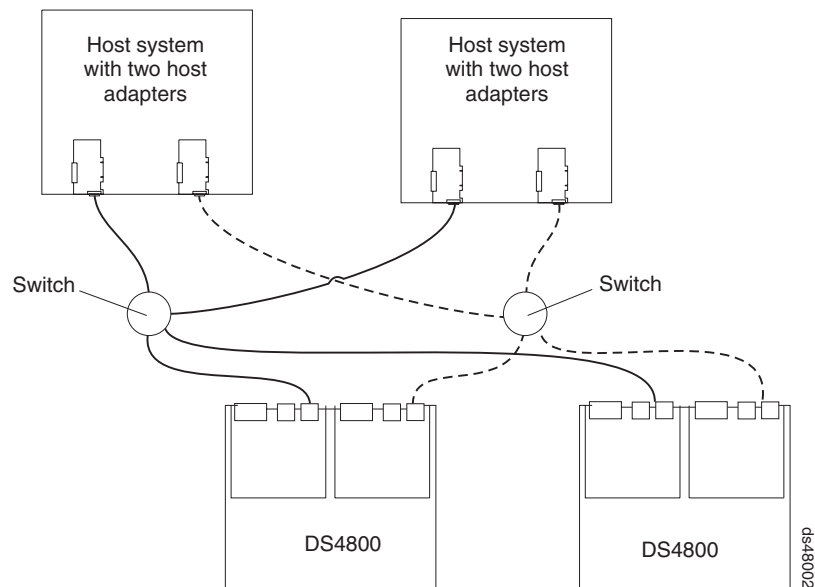


Figure 69. Example of two storage subsystems in a dual SAN environment

Figure 70 on page 98 gives an example of one DS4800 and four host systems configured into two clusters; each cluster comprised of two host systems and two fibre channel switches.

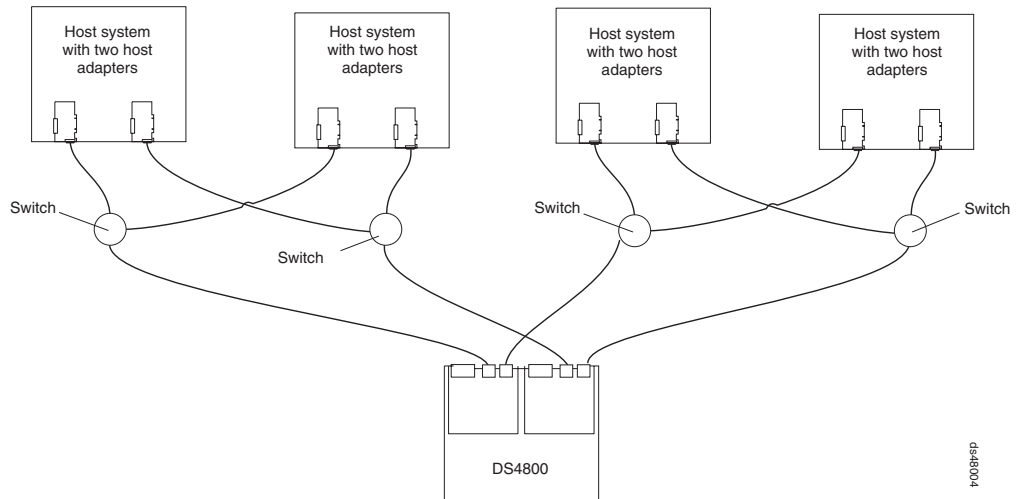


Figure 70. Example of a two-cluster configuration

Installing the storage subsystem configuration

Using the information gathered in the previous sections, install the host systems and host adapters.

Notes:

1. See the documentation provided with your host adapters for installation requirements and procedures.
2. Use the correct host adapter driver. For the latest supported host adapters and drivers, go to the following Web site:
www.ibm.com/systems/support/storage/disk

Attach fiber-optic interface cables to each host adapter. You will connect the other end of the cables to the controller later in the installation process. For more information about handling fiber-optic cables, see “Handling fibre-optic cables” on page 48.

Connecting the power cables

This section describes the procedure for connecting power cables to the storage subsystem.

The DS4800 uses two standard power cords. You can connect the power cords to a primary power unit inside the rack cabinet, such as a properly grounded ac distribution unit, or to an external source, such as a properly grounded electrical outlet.

The DS4800 does not ship with the power cords used to connect the DS4800 to the electrical outlets outside the rack cabinet. Refer to Appendix D, “Power cords,” on page 195 for the list of IBM-approved power cords for your region. The DS4800 does ship with two line jumper cords for connecting the DS4800 RAID controller units to IBM-approved rack PDUs.

Use the following procedure to connect the power cables to the storage subsystem. Before you connect power cords, turn off all power switches on all modules in the

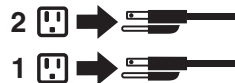
cabinet. If your cabinet contains components that you do not want to power off, turn off all power switches on the components of the storage configuration you are currently installing.

Statement 5:



CAUTION:

The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



1. Verify that the main circuit breakers in the cabinet are turned off.
2. If you have not already done so, turn off all power switches on each storage subsystem and storage expansion enclosure in the cabinet. Figure 71 on page 100 shows the locations of the power switches and connectors on the storage subsystem.

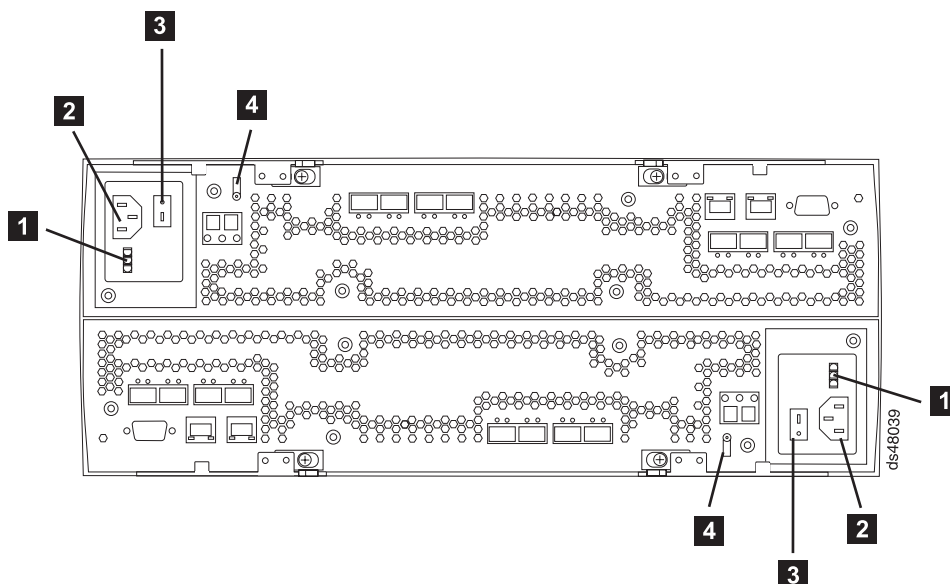


Table 30. Description of Figure 67

Number	Description
1	dc power connector
2	AC power connector
3	AC power switch
4	Strain-relief clamp

Figure 71. AC power switch and ac and dc power connectors

3. Connect the line jumper power cords to the ac power connectors on the RAID controllers.

Note: The dc power connection is not supported in the current release of the DS4800. Contact your IBM service representative or reseller for information about possible future dc power support.

4. On each RAID controller, remove the nut that holds the power cable strain-relief clamp, and then remove the strain-relief clamp.
5. Wrap the strain-relief clamp around the line jumper power cord approximately 20 cm (8 in.) from the RAID controller connection end. Leave some slack between the clamp and the RAID controller end of the line jumper power cord.
6. Replace the strain-relief clamp, and then tighten it securely with the nut.
7. Connect the other end of the line jumper cords to two independent IBM-approved power distribution units in the rack cabinet. Connecting each RAID controller to independent power sources maintains power redundancy. If applicable, repeat this step for each additional storage subsystem and storage expansion enclosure.
8. Connect the right and left power supplies of the attached storage expansion enclosures to the same IBM-approved power distribution units in the rack cabinet. For more information, refer to the *Installation, User's, and Maintenance Guide* for your DS4000 storage expansion enclosures.
9. If you have not already done so, connect the primary power cables from the rack cabinet to the external power source.

Note: To maintain power redundancy, plug the PDUs that power the storage subsystem's right and left RAID controllers and the right and left power supplies of the DS4000 storage expansion enclosures into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles.

It is recommended that you determine the maximum surge current possible when all devices in the power circuit are started at the same time. Based on the total number of devices on a power circuit, find the maximum (worst-case) specification value in order to prevent the circuit from tripping. When both RAID controllers are connected and the storage subsystem is powered on, each RAID controller unit will handle approximately one-half of the current load. To ensure maximum protection against power loss due to RAID controller unit failure or a power circuit tripping, both RAID controller units must be connected and powered on. See Table 13 on page 25 for the DS4800 ac power requirements.

Do not overload the circuits that power your storage subsystem and storage expansion enclosures. Use additional pairs of IBM-approved power distribution units (PDUs) if necessary.

See Figure 72 for an example of redundant power cabling.

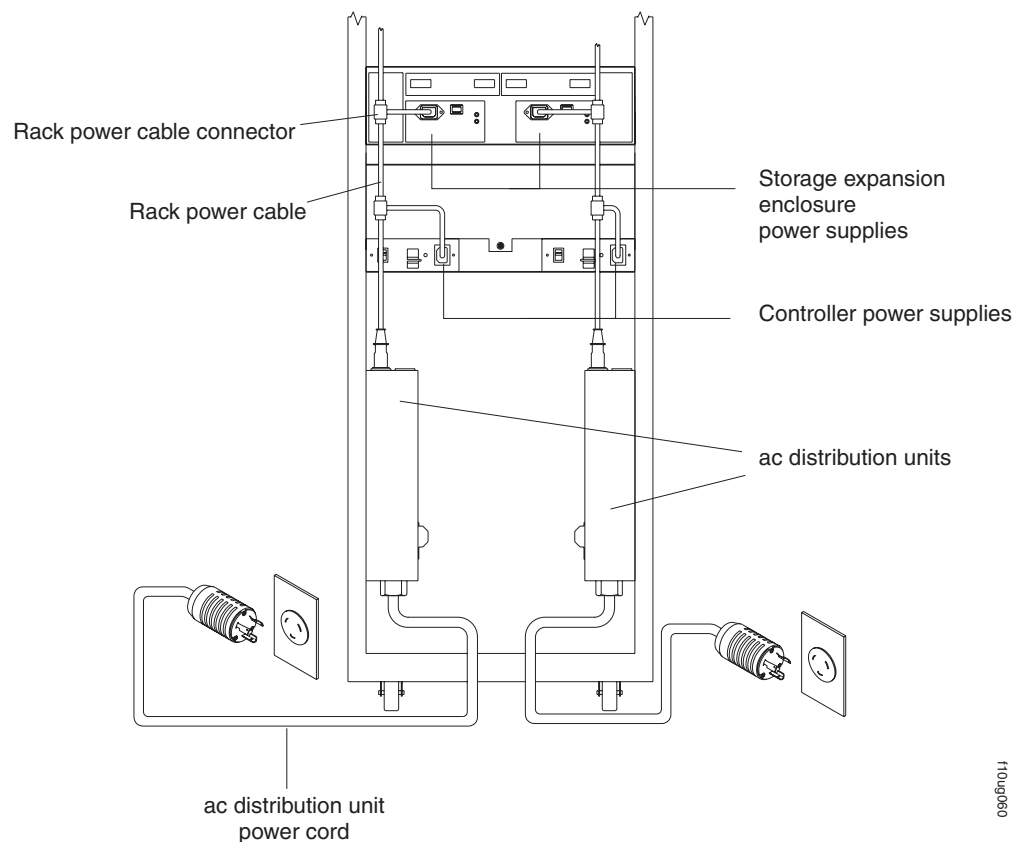


Figure 72. Redundant ac power connections to controllers and storage expansion enclosures

For details about power requirements, see “Electrical requirements” on page 24.

10. Go to “Turning on the storage subsystem” on page 107.

Attention: Before you power on the DS4800 Storage Subsystem, the DS4800 must be cabled to at least one storage expansion enclosure populated with at least two drives. If at least two drives are not installed in each attached storage expansion enclosure when you power on the DS4800, your standard storage partition key will be lost and will need to be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

<https://www-912.ibm.com/PremiumFeatures/>

Additionally, if at least two drives are not installed in each attached storage expansion enclosure, the resulting insufficient load to the storage expansion enclosure power supply CRUs might cause the drive expansion enclosure power supply CRUs to intermittently appear as failed and then reappear in an optimal state, falsely indicating that the power supply CRUs are bad.

Chapter 4. Operating the storage subsystem

To ensure optimal operation of your system, always follow these best practices guidelines:

- Ensure that your system is in an optimal state before you shut it down. Never turn the power off if any Needs Attention LED is lit; be sure to resolve any error conditions before you shut down the system.
- Back up the data on your storage drives periodically.
- To maintain power redundancy, plug the storage subsystem's right and left RAID controller units into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4800 should be plugged into the same two independent external power circuits as the DS4800. This ensures that the DS4800 and all its attached storage expansion enclosures will have power if only one power circuit is available. In addition, having all the right or all the left power cables plug into the same power circuit will enable the components in the storage subsystem to power on simultaneously during an unattended restoration of power. See Figure 72 on page 101 for an example of redundant power connections.

Note: Do not overload the circuits that power your storage subsystem and storage expansion enclosures. Use additional pairs of power distribution units (PDUs) if necessary. Refer to the *Installation, User's, and Maintenance Guide* for your storage expansion enclosures for information on power requirements. Contact your IBM service representative for additional information if needed.

- Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), save the storage subsystem profile as explained in the DS4000 Storage Manager guide for your operating system. Save the profile in a location other than the logical drives created for the DS4800.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in "Turning on the storage subsystem" on page 107. You should check that each component of the subsystem is powered-on in the proper order during this entire power-up procedure to ensure that the controller will optimally access all of your storage subsystems.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in "Turning on the storage subsystem" on page 107 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and arrays are not displayed in the DS4000 Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and arrays do not come online.
 - The storage subsystem logical drives and arrays seem to be degraded.

Performing the DS4000 Health Check process

The DS4000 Health Check process is a sequence of suggested actions developed by IBM to help users verify and maintain the optimal performance of their DS4000 storage configurations. The information that you collect in these steps also helps provide IBM Service with important information needed for problem troubleshooting during IBM Service calls.

Perform the following Health Check tasks after the initial configuration of your DS4000 Storage Subsystem, and after all configuration sessions. It is also recommended that you set a regular schedule of periodic Health Check evaluations in order to keep your DS4000 code current and to preserve optimal data access and performance.

1. Monitor the Recovery Guru in the Storage Manager client for any obvious storage subsystem errors or problem conditions.
2. Gather and save the following DS4000 storage subsystem event logs for review by IBM Service. These event logs should be gathered periodically for regular Health Check monitoring regardless of the state of the Recovery Guru. (You can collect all these logs at once and zip them into a single file by clicking **Advanced ► Troubleshooting ► Collect All Support Data** in the DS4000 Storage Manager Subsystem Management window.)
 - DS4000 storage subsystem management event log (MEL)
 - Storage Subsystem Profile or DS4000 Profile
 - Read-Link Status (RLS) data

In addition, you should also collect event logs for the host servers that have mapped logical drives from the storage subsystem.

Attention: Save these event log files to a server disk that will remain accessible in the event of a DS4000 storage configuration failure. Do not save these event log files only to a LUN in the DS4000 Storage Subsystem.

3. Use the Storage Subsystem Profile or DS4000 Profile to verify that the following firmware levels are at the latest versions supported for your DS4000 Storage Subsystem:
 - Controller firmware
 - ESM firmware
 - Drive firmware

If you discover your firmware is not up-to-date, upgrade the firmware and software to the latest level appropriate to your DS4000 storage configuration. See “Web pages” on page 105 for information about where to find the latest firmware and software.

Attention: You must resolve Recovery Guru errors or problems before upgrading firmware.

Save the storage subsystem profile before performing any controller or ESM firmware upgrades. Save the storage subsystem profile and all *.cfg files to a server disk that will remain accessible in the event of a DS4000 storage configuration failure.

Note: When you upgrade firmware, you must upgrade all client package components to the same release level. For example, if you are upgrading your controller firmware from version 5.x to version 6.x, you must also upgrade your Storage Manager client to version 9.x or higher. If your host system uses RDAC, upgrading controller firmware from version 5.x

to version 6.x might also require host software updates, such as RDAC updates and HBA driver updates. Refer to the IBM DS4000 Web site for detailed instructions.

4. Use the Storage Subsystem Profile or DS4000 Profile to verify that the following functions are enabled:
 - For all DS4000 models, Media Scan should be enabled both at the controller level and at the LUN level.
 - For all DS4000 models, the read/write cache should be enabled. In addition, use the Storage Subsystem Profile to verify that cache is matched between the controllers.

Web pages

IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates.

For DS4000 information, go to the following Web site:

www.ibm.com/servers/storage/support/disk/

For the latest information about operating system and HBA support, clustering support, SAN fabric support, and Storage Manager feature support, see the TotalStorage DS4000 Interoperability Matrix at the following Web site:

www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Hardware responsibilities

In addition to the Health Check steps described above, regular hardware inspection and maintenance helps to support the optimal performance of your DS4000 storage configuration. You should periodically inspect the Fibre Channel components of your DS4000 storage configuration.

IBM suggests you follow these guidelines:

- Maintain an up-to-date storage subsystem profile for your DS4000 storage configuration. Save the profile to a server disk that will remain accessible in case of a DS4000 storage configuration failure. Do not save the profile only to a LUN in the DS4000 Storage Subsystem.
- Develop a Change Management plan. The plan should include schedules for updating subsystem firmware and server host software.

Note: Some updates might require storage subsystem downtime.

- Use IBM-approved Fibre Channel cables for all situations. Note in your configuration documentation whether any cables are not IBM-approved.
- Create and maintain a cabling diagram of the current SAN configuration. Keep this diagram updated as you make configuration changes, and keep the cabling diagram available for review.
- Create and maintain a list of other components that are being used within the cabling diagram (such as the host system, Fibre Channel switches, and other SAN attachments).
- Ensure that all ESMs are properly seated.
- Ensure that all drives are properly seated.
- Ensure that all SFP modules are properly seated.

- Confirm Fibre Channel cable loop size. (IBM specifications call for at least 3-inch cable loops, but it is recommended that you use 6-inch cable loops or longer.)
- Ensure proper Fibre Channel cable management.
- Ensure proper air flow and temperature for all components in your DS4000 storage configuration.

Note: You can find details on many of these inspection and maintenance responsibilities in this publication.

In addition to these inspection and maintenance responsibilities, IBM also strongly recommends DS4000 training for staff that supports DS4000 storage configurations. Although training is not a part of the Health Check process, DS4000 training reduces the potential for configuration problems and contributes to the overall health of the system.

Removing and replacing the front bezel

The storage subsystem is equipped with a front bezel, which you must remove in order to access the power supply and fan units and interconnect-battery unit, or to view the indicator LEDs on the front of those units.

Figure 73 shows the following steps to remove and replace the front bezel:

1. Remove the front bezel by grasping the sides and pulling the cover toward you.
2. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover, and then press the cover toward the chassis until the pins snap into place.

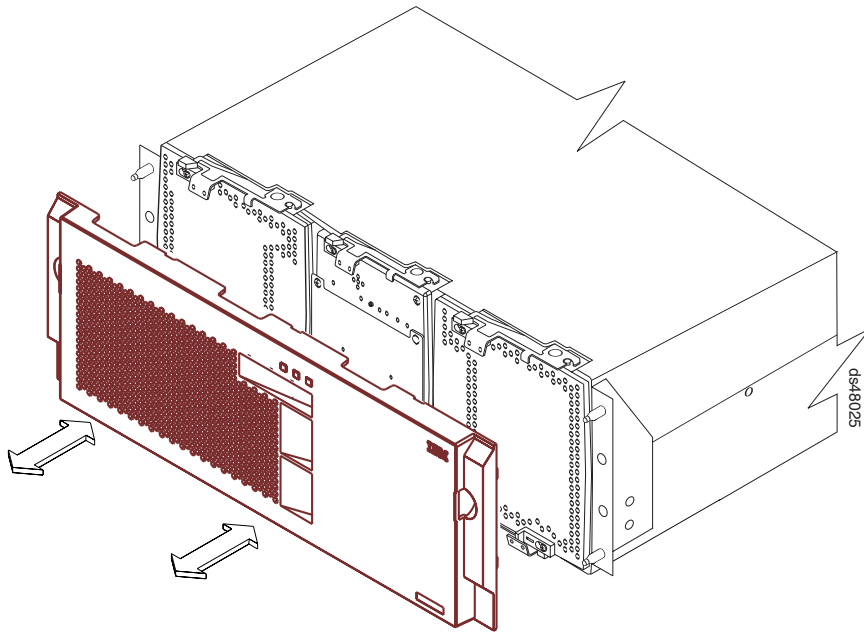


Figure 73. Installing the front bezel

Turning the storage subsystem on and off

This section contains instructions for turning the storage subsystem on and off under normal and emergency situations.

If you are turning on the storage subsystem after an emergency shutdown or power outage, see “Restoring power after an unexpected shutdown” on page 112.

Turning on the storage subsystem

Power-on overview

Review the following information before you continue with the power-on procedure below.

Check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:

1. Turn on the power to the supporting devices (for example, Ethernet switches and management stations) before the storage subsystem.

Attention: If you will use out-of-band (direct) configuration management (using the Ethernet), you must set up the Dynamic Host Configuration Protocol (DHCP) or BOOTP server before you turn on the power. Setting up the server allows the controllers to obtain the corresponding IP address when you turn on the power to the storage subsystem. To configure the server, you need the controller’s Media Access Control (MAC) address. The MAC addresses appear on labels near the Ethernet ports on each controller.² For more information, see the software installation guide for your operating system.

2. **Important:** You *must* turn on the storage expansion enclosures and verify that the storage expansion enclosure fibre channel connections are optimal by checking the indicator LEDs *before* you turn on the DS4800. The controllers might not recognize the correct configuration if the storage expansion enclosure hard disk drives are powered up after the DS4800. For instructions on how to power up the storage expansion enclosures, refer to the storage expansion enclosure documentation.
3. Turn on the power to the storage subsystem; then restart or turn on the power to the host.

Note: Depending on your operating system, you might not have to restart the host. For more information, see the software installation guide for your operating system.

Use this procedure to turn on power to a storage configuration at the initial startup or after a normal shutdown. To restore power after an unplanned shutdown, see “Restoring power after an unexpected shutdown” on page 112.

Important:

1. If needed, remove the front bezel, as described in “Removing and replacing the front bezel” on page 106.
2. Ensure that all power cords are connected, as described in “Connecting the power cables” on page 98.

2. You can also make out-of-band management connections to the DS4800 controller using the default IP addresses. The default IP addresses for the controller A Ethernet ports 1 and 2 are 192.168.128.101 and 192.168.129.101, respectively. The default IP addresses for the controller B Ethernet ports 1 and 2 are 192.168.128.102 and 192.168.129.102, respectively. The default subnet mask for all four Ethernet ports is 255.255.255.0.

Note: If the power cords are not connected, turn off both power switches on all modules in the configuration before connecting power cords or turning on the main circuit breakers.

Attention: If you are restarting the system after a normal shutdown, wait at least 60 seconds before you turn on the power.

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

Attention: You *must* turn on power to each attached storage expansion enclosure *before* turning on power to the DS4800 Storage Subsystem to ensure that the controllers complete the startup process. If the DS4800 controllers do not find any drives present during the initial power on sequence, the DS4800 will not complete the startup process. This will prevent controllers A and B from communicating with each other, and any factory-installed premium features will not be activated correctly.

4. Turn on both power switches on each storage expansion enclosure attached to the storage subsystem. While each storage expansion enclosure powers up, the green and amber LEDs on the front and back of the storage expansion enclosure turn on and off intermittently. Depending on your configuration, it can take several minutes for each storage expansion enclosure to power up.

Check the LEDs on the front and back of all the storage expansion enclosures. Verify that no Needs Attention or Enclosure ID LEDs light on any of the storage expansion enclosures. To verify the fibre channel connections between the drive expansion enclosures, make sure that no Port Bypass LEDs for connections to other storage expansion enclosures are lit. Only the Port Bypass LED of the ESM port that connects directly to the DS4800 Storage Subsystem drive port should be lit.

Note: The drive activity LEDs will flash slowly (once every 2 seconds) until the drive is started by the DS4800 controller.

5. Turn on the ac power switch on the back of each controller in the storage subsystem. Figure 74 shows the location of the ac power switches on the controllers.

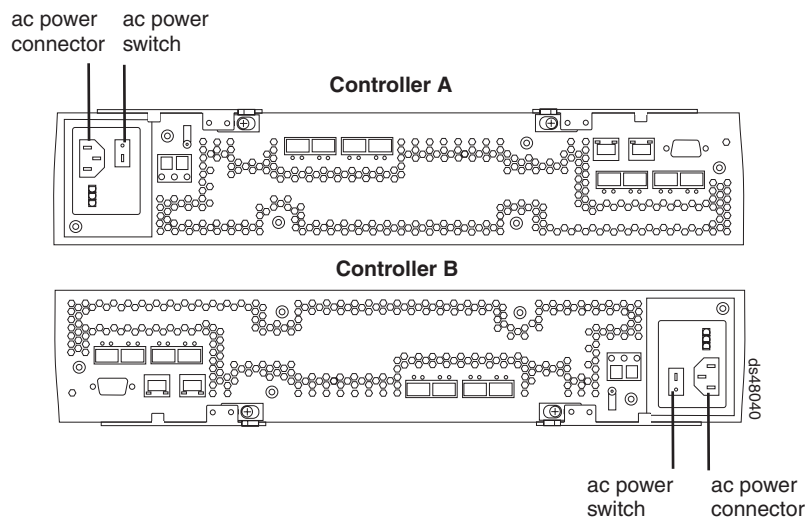


Figure 74. AC power switches on the controllers

Depending on the number of storage expansion enclosures in the configuration, the DS4800 Storage Subsystem might take several minutes to power up. The battery self-test might take an additional 15 minutes. The LEDs will blink

intermittently until the storage subsystem powers up and completes the battery self-test. Before attempting any operations, wait at least five minutes for the storage subsystem to completely power up.

Note: If your DS4800 has been shipped directly from the factory, you might have wait up to 24 hours for the battery to fully charge. You do not have to wait for the battery to fully charge in order to continue with other DS4800 setup tasks.

The DS4800 Storage Subsystem will spin up all the drives in the storage expansion enclosures during the startup process.

6. Determine the status of all storage subsystems and components in the configuration by completing the following steps:
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status. For more information on LED status for storage expansion enclosures, see the *Installation, User's, and Maintenance Guide* for your DS4000 storage expansion enclosure.
 - b. Check all LEDs on each component in the storage subsystem. Ensure that all the LEDs show normal status. For information about LED status, see "Checking the LEDs" on page 120.
 - c. Open the DS4000 Storage Manager Subsystem Management window, and display the Physical View for the configuration.
The status for each component will be either Optimal or Needs Attention.
 - d. Review the status of the configuration components shown in the Subsystem Management window by selecting the appropriate component button for each storage subsystem.
7. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes – End of procedure. Replace front bezel, as described in "Removing and replacing the front bezel" on page 106.
 - No – Go to step 8.
8. Diagnose and correct the fault by completing the following steps:
 - a. Run the DS4000 Storage Manager Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure.
If the **Recovery Guru** directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the failed component. (For procedures to replace a failed component, see Chapter 5, "Replacing components," on page 143.)
 - c. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This action reruns the Recovery Guru to ensure that the problem has been fixed.
 - d. If the problem has not been fixed, contact your IBM service representative.

Turning off the storage subsystem

Attention: Except in an emergency, never turn off the power if any storage subsystem's Needs Attention LEDs are on. Correct the fault before you turn off the power. Use the DS4000 Storage Manager client and the Needs Attention LEDs to check the overall status of the storage subsystem and its components. All LEDs should be green on the front of the storage subsystem. If they are not, use the DS4000 Storage Manager client to diagnose the problem (see "Monitoring status through software" on page 117). This ensures that the storage subsystem will power up correctly later.

The storage subsystem is designed to run continuously, 24 hours a day. After you turn on the storage subsystem, do not turn it off except in the following situations:

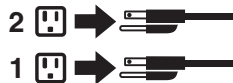
- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.
- A planned power outage or emergency situation occurs (see "Performing an emergency shutdown" on page 113).

Statement 5:



CAUTION:

The power control button on the device and the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



Attention: Turning the power off and on without waiting for the storage expansion enclosure disk drives to spin down, can damage the drives and might cause data loss. Wait *at least* 70 seconds after turning the power off before turning it on, again.

Power-off overview

Review the following information before you continue with the power-off procedure below.

Turn off the power to each device based on the following shutdown sequence:

1. Turn off power to the host before the storage subsystem. If the host must stay powered on to support an existing network, see the operating system documentation for information about disconnecting the storage subsystem logical drives from the host before the storage subsystem is powered off.
2. Turn off power to the storage subsystem before you turn off power to the storage expansion enclosures. Turn off both power supply switches on the back of the storage subsystem.
3. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).

Note: You do not need to perform this step if you are servicing only the storage subsystem.

Use the following procedure to turn off power to one or more storage subsystems for a planned shutdown. To turn off power for an unplanned shutdown, see “Performing an emergency shutdown” on page 113.

Before proceeding, use the DS4000 Storage Manager client to determine the status of the system components and special instructions. The operating system software might require you to perform other procedures before you turn off the power.

1. Stop all I/O activity to the storage subsystems.
2. Determine the status of all storage subsystems and components in the configuration by completing the following steps.
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status.
 - b. Check all LEDs on each component in the storage subsystem. Ensure that all the LEDs show normal status. For information about LED status, see “Checking the LEDs” on page 120.
 - c. Open the Subsystem Management window for the configuration and display the Physical View for the configuration.
 - d. Review the status of the configuration components shown in the Subsystem Management window by selecting the appropriate component button for each storage subsystem.

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

3. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes – Go to step 5 on page 112.
 - No – Go to step 4.
4. To diagnose and correct the fault, complete the following steps:
 - a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure.

If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the failed component.

- c. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This action reruns the Recovery Guru to ensure that the problem has been fixed.
 - d. If the problem has not been fixed, contact your IBM service representative. Do not turn off power until all problems are corrected.
5. Check the back of the storage subsystem, and verify that the Cache Active LED is off.

If the Cache Active LED is on steady, the cache contains data. Wait for the data to clear from cache memory before turning off the power.
6. Check the LEDs on the storage expansion enclosures to verify that all Drive Active LEDs are on steady (not blinking).

If one or more LEDs are blinking, data is being written to or from the drives. Wait for all Active LEDs to stop blinking.
7. Turn off the ac power switch on the back of each controller in the storage subsystem. (Figure 71 on page 100 shows the location of the ac power switch on a controller.)

Note: Until the power switch on each controller is turned off, power still remains turned on for the both controllers; therefore, the seven-segment display on each controller stays on until the power switch on each controller is turned off.
8. Turn off both power switches on the back of each storage expansion enclosure in the configuration.
9. After you perform the necessary maintenance procedures, turn on the power using the procedure in “Turning on the storage subsystem” on page 107.

Restoring power after an unexpected shutdown

The storage subsystem might shut down unexpectedly under any of the following conditions:

Attention: There might be a loss of access to data in each of the following cases.

- The internal temperature of the storage subsystem exceeds the maximum operating temperature (an over-temperature condition).

If both power supply and fan units fail or are unable to maintain an internal temperature below 70° C (158° F), one or both of the power supplies in the storage subsystem will shut down. If both power supply and fan units shut down, the unit is inoperable.

The DS4000 Storage Manager client warns you if the temperature of the unit is rising before it has risen sufficiently to shut down the power supplies. The first warning comes when the storage subsystem internal temperature exceeds 45° C (113° F). The storage subsystem shuts down if the temperature rises to 70° C (158° F).
- In the DS4800 Storage Subsystem, the right power supply and fan unit is linked to controller A, and the left power supply and fan unit is linked to controller B. If one power supply and fan unit has shut down and the controller that is linked to the *other* power supply and fan unit is removed, the DS4800 will be inoperable. To increase protection against power loss, always make sure that both power supply and fan units are plugged in and are operational.
- There is a general power failure or a loss of power to the unit.

- You are forced to shut down the storage subsystem without performing the normal shutdown procedures (listed in “Turning off the storage subsystem” on page 110) because of an emergency situation.

Attention: To avoid damage to the hardware, take special care when you restart the system after an unexpected shutdown.

Note: Unattended restoration of power is supported; however, if power restoration is attended, you should follow the best practices guidelines and the power restoration sequence in “Turning on the storage subsystem” on page 107.

Performing an emergency shutdown

Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This will help safeguard your equipment from potential damage due to electrical surges when power is restored. If the storage subsystem loses power unexpectedly, it might be due to a hardware failure in the power system or midplane (see Chapter 6, “Hardware maintenance,” on page 169).

Use the following procedure to shut down the storage subsystem during an emergency:

1. If you have time, stop all I/O activity to the storage subsystem by shutting down the host or disconnecting the storage subsystem logical drives through the host.
2. Check the LEDs (front and back). Make note of any Needs Attention LEDs that are on so you can correct the problem when you turn on the power again.
3. Turn off all power-supply switches; then unplug the power cords from the storage subsystem.

Restoring power after an emergency shutdown

Use the following procedure to restore power to the storage subsystem in a configuration after an unplanned shutdown.

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

1. Visually check the equipment for damage. Is there evidence of damage to any of the storage subsystem components, cables, or equipment attached to the storage subsystem?
 - Yes – Do not continue with this procedure. Contact your IBM service representative for assistance. Depending on the current service agreements, you might need to return the equipment to the factory or local service center for repair.
 - No – Go to step 2.

Potential data loss – Before resetting circuit breakers in the cabinet, ensure that the storage subsystem and storage expansion enclosures power switches are turned off. Resetting circuit breakers after an emergency situation while the storage subsystem and storage expansion enclosure power switches are turned on can cause potential data loss because the configuration components might not be powered on in the correct sequence. See “Turning on the storage subsystem” on page 107 for details about the correct power-on sequence.

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

3. Verify the main circuit breakers in the cabinet are turned off.
4. Verify that the ac power switch on each DS4800 Storage Subsystem is turned off. (Figure 71 on page 100 shows the location of the ac power switch on each controller.)
5. Verify that both power switches on all storage expansion enclosures in the configuration are turned off.
6. Turn on the main circuit breakers in the cabinet.
7. Turn on both power switches on the back of each storage expansion enclosure.

Attention: You must turn on power to each attached storage expansion enclosure before turning on power to the storage subsystem to ensure that the controllers acknowledge each storage expansion enclosure.

8. Verify that no ESM port bypass LEDs are lit on any storage expansion enclosures.
If any ESM port bypass LEDs are lit, reseal the ESMs and check the ESM port bypass LEDs again.

If the ESM port bypass LEDs remain lit, then reseal the SFP modules and the fibre channel cables at both ends of the connections.

If the problem is not resolved, use the fibre channel wrap-plug and coupler to attempt to isolate the problem to the ESM port, SFP, or fibre channel cable. See the *IBM System Storage DS4000 Problem Determination Guide* for information on performing wrap plug tests.

9. Turn on the ac power switch on the back of each controller in the storage subsystem. Figure 71 on page 100 shows the location of the ac power switch on the controller. The storage subsystem might take several minutes to power up, depending on the number of attached storage expansion enclosures. The battery self-test might take an additional 15 minutes. The LEDs will blink intermittently until the storage subsystem powers up and completes the battery self-test.
10. Determine the status of all storage subsystems and their components in the configuration, by completing the following steps:
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status.
 - b. Check all LEDs on each component in the DS4800 Storage Subsystem. Ensure that all the LEDs show normal status. For information about LED status, see “Checking the LEDs” on page 120.
 - c. Open the Subsystem Management window, and display the Physical View for the configuration.
 - d. Review the status of the configuration components shown in the Subsystem Management window by selecting the appropriate component button for each storage subsystem. The status for each component will be either Optimal or Needs Attention.
11. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes – End of procedure.
 - No – Go to step 12.
12. Diagnose and correct the fault by completing the following steps:
 - a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management window.
 - b. Complete the recovery procedure. If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage

subsystem to locate the specific failed component. (For more on troubleshooting the storage subsystem, see “Troubleshooting the storage subsystem” on page 119.)

- c. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This action reruns the Recovery Guru to ensure that the problem has been fixed.
- d. If the problem has not been fixed, contact your IBM service representative.

Responding to the audible alarm

Attention: The DS4800 ships with the audible alarm option disabled. You can enable the audible alarm with the DS4000 Storage Manager client. If the audible alarm is enabled, you must remove the DS4800 bezel in order to mute the alarm.

The alarm provides an audible warning of potentially serious problems with the storage subsystem. The storage subsystem is shipped with the alarm disabled. You can enable or disable the Audible Alarm feature using the DS4000 Storage Manager Subsystem Management window graphical user interface (GUI). Any change you make takes effect after approximately five minutes. If you enable the alarm, the DS4800 alarm will sound upon the next detection of a storage subsystem failure.

Note: The alarm will not sound when it is enabled if it detects a subsystem failure that has been detected by the controllers prior to the enabling of the alarm.

The GUI indicates alarm status for the storage subsystem as follows:

- Alarm control (enabled/disabled)
- Alarm state (inactive/sounding/muted)

The GUI provides the following alarm controls for the storage subsystem:

- Enable/disable alarm. (Error status is displayed if an attempt is made to enable an alarm that is not present.)
- Mute alarm.

The alarm sounds and the Overall DS4800 Configuration Needs Attention turns on when one of the following conditions occur:

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

When a subsystem failure is detected after the alarm has been enabled, the alarm sounds until one of the following occurs:

- The alarm is muted using the DS4000 Storage Manager Subsystem Management window GUI.
- The alarm is muted using the Mute button on the interconnect-battery unit.
- The problem that is indicated by the lit Overall DS4800 Configuration Needs Attention LED is resolved.

If the alarm sounds, check the storage subsystem for faults. For troubleshooting procedures, see “Troubleshooting the storage subsystem” on page 119.

Installing the DS4000 Storage Manager client

Refer to the *IBM System Storage DS4000 Storage Manager Installation and Host Support Guide* for the appropriate operating system for instructions on how to install the Storage Manager software. Use that document and the online help to configure the logical drives, partitions, and so on for the RAID controllers. Use your operating system documentation to make the new logical drives accessible to the operating system. Do not proceed with the configuration setup until you have completed the DS4000 Storage Manager installation.

Assemble any additional items in preparation for software installation. These items might include the following:

- HBA drivers.
- Controller firmware version listed at the IBM DS4000 System Storage Support Web site:
www.ibm.com/systems/support/storage/disk
- IP addresses for RAID controllers (for in-band management only).
- Additional documentation for switches and HBAs, if needed.
- *DS4000 Storage Manager Support* CD, which includes the storage subsystem controller firmware.
- The DS4800 controller firmware should be updated to the correct version. See “Software and hardware compatibility and upgrades” on page 19 for version information. The latest level of DS4800 controller firmware is available for download from the IBM support Web site for DS4000 storage products.
- Appropriate host kit for your operating system.

Depending on the DS4800 model you order, your DS4800 will ship with either the Microsoft Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4800. The kit includes a *DS4000 Storage Manager Version 10 Support* CD that has the appropriate IBM DS4000 Storage Manager host software. The CD also contains includes appropriate controller firmware version.

For the latest controller firmware, check the IBM support Web site for DS4000 storage products.

www.ibm.com/systems/support/storage/disk

Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), save the storage subsystem profile as explained in the DS4000 Storage Manager guide for your operating system. Save the profile in a location other than the logical drives created for the DS4800.

Always refer to the readme that is included with the DS4800 Storage Subsystem firmware package (whether the firmware is accessed by the Web or CD) for any special requirements or restrictions that apply to that particular firmware version. See “Finding DS4000 readme files” on page xxiii to learn how to access the DS4000 readme files on the Web.

Note: Make sure that you install the DS4000 Storage Manager event monitoring service to enable continuous monitoring of the status of the storage

subsystem. For more information about the importance of this information, see “Monitoring status through software.”

Monitoring status through software

Use the DS4000 Storage Manager client to monitor the status of the storage subsystem. Run the software constantly, and check it frequently.

Notes:

1. You can only monitor storage subsystems that are within the management domain of the storage-management software.
2. If you have not installed the DS4000 Storage Manager Event Monitor service as part of the storage-management software installation, the DS4000 Storage Manager Enterprise Management window must remain open. (If you close the window, you will not receive any alert notifications from the managed storage subsystems.)

For more information, see the Enterprise Management online Help.

Important: Refer to the *IBM System Storage DS4000 Storage Manager Version 10 Installation and Support Guide* for the appropriate operating system for instructions on how to install the DS4000 Storage Manager host software.

In addition, to download the latest version of the DS4000 Storage Manager host software, the DS4800 Storage Subsystem controller firmware and NVSRAM, and the latest DS4000 ESM firmware, go to the following Web site:

www.ibm.com/systems/support/storage/disk

Note: The version of controller firmware determines which version of the DS4000 Storage Manager interface is displayed. For example, the interface for DS4000 Storage Manager version 9.19 subsystem management would be displayed when managing a DS4800 Storage Subsystem with controller version 06.19.xx.xx installed, even if the installed version of the DS4000 Storage Manager client code is actually 9.23.

The DS4000 Storage Manager client provides the best way to diagnose and repair storage-server failures. The software can help you do the following:

- Determine the nature of the failure
- Locate the failed component
- Determine the recovery procedures to repair the failure

Although the storage subsystem has Needs Attention LEDs, these LEDs 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 in the case of a hard disk drive exceeding its PFAs), the Needs Attention LED does not turn on. Only the DS4000 Storage Manager client can detect the failure.

For example, the recovery procedure for a Predictive Failure Analysis® (PFA) flag (impending drive failure) on a drive varies depending on the drive status (hot spare, unassigned, RAID level, or current logical drive status). 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 the DS4000 Storage Manager client can identify the risk level and provide the necessary recovery procedures.

Note: For PFA flags, the General-system-error and Drive Needs Attention LEDs do not turn on; checking the LEDs will not notify you of the failure, even if the risk of data loss is high.

Recovering from a storage-server failure might require you to perform procedures other than replacing the component (such as backing up the logical drive). The DS4000 Storage Manager client gives these procedures.

Attention: Not following the software-recovery procedures can result in data loss.

Finding controller, storage expansion enclosure, and drive information

You can view a Storage Subsystem Profile to find controller, enclosure, and drive information for the storage subsystem and attached storage expansion enclosures. To view a Storage System Profile, perform the following steps:

1. Open the Storage Subsystem Management window from the DS4000 Storage Manager Enterprise Management window.
2. Select **Storage Subsystem → View → Profile**.
A Storage Subsystem Profile window opens.
3. Select the Controllers tab.
4. Scroll through the list to find Board ID, Submodel ID, Product ID, and Product revision for the storage subsystem.
5. Select the Enclosures tab.
6. Scroll through the list to find the Product ID for supported storage expansion enclosures.
7. Select the Drives tab.
8. Scroll through the list to find the drive values such as Product ID.

Firmware updates

Attention: Save the storage subsystem profile before performing any controller or ESM firmware upgrades. Save the DS4800 storage subsystem profile and all configuration (*.cfg) files to a server disk that will remain accessible in the event of a DS4000 storage configuration failure. Do not save these files only to a LUN in the DS4000 Storage Subsystem.

In order to ensure the optimal operation of the DS4800 and its attached storage expansion enclosures, the storage expansion enclosure ESM firmware, the DS4800 controller firmware, the hard drive firmware, and the NVSRAM (for controllers only) must be up to date. Go to the following Web site to get the latest updates:

www.ibm.com/systems/support/storage/disk

Apply the necessary updates before configuring the storage subsystem arrays and logical drives. Subscribe to My Support for automatic notifications of firmware or Storage Manager software updates or any important information about your DS4000 subsystems (see “Product updates and support notifications” on page 5).

Attention: Read the readme file that is included in each firmware or DS4000 Storage Manager software package for any limitations, subsystem firmware prerequisites, or download-sequence information. For example, the controller firmware code might require the storage expansion enclosure ESM firmware to be upgraded first to a particular version, or the controller firmware download might require the halting of I/Os to the DS4800's logical drives. Failure to observe the limitations, prerequisites, and dependencies in the readme file might result in a loss of data access. See "Finding DS4000 readme files" on page xxiii to learn how to access the DS4000 readme files on the Web.

Unless the readme file contains special requirements for the sequence in which you upgrade firmware, you should perform firmware upgrades in the following sequence:

1. ESM firmware for the storage expansion enclosures
2. Controller firmware
3. Controller NVSRAM
4. Drive firmware

Troubleshooting the storage subsystem

The DS4000 Storage Manager client software enables you to monitor the storage subsystem, diagnose problems, and recover from failures. For best configuration operation, run the DS4000 Storage Manager client software continuously, and frequently check the configuration status.

Use the following procedure to check the status of the storage subsystem. If a problem has occurred, use the DS4000 Storage Manager client software and the LEDs on the storage subsystem to help locate a failed component.

1. If applicable, turn off the alarm.
2. If another fault occurs, the alarm sounds again. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
3. Using the Enterprise Management window, view the status storage subsystem. Do any components in the storage subsystem indicate Needs Attention?
 - Yes – Go to step 4.
 - No – All components are Optimal. Go to step 8 on page 120.
4. Open the Subsystem Management window, and display the Physical View for the components in the storage subsystem.
5. View the status of the storage subsystem by selecting the **View Storage Subsystem** button and expanding the Overall Component Information when the Status window opens.

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

- Interconnect-battery unit and battery packs in the component
- SFPs
- Power supply and fan units
- Temperature sensors

The status for each component is either Optimal, Charging (applicable to battery packs only), or Needs Attention.

6. Do any components have a Needs Attention status?
 - Yes – Go to step 7 on page 120.
 - No – All components are Optimal. Go to step 8 on page 120.

7. Select the Recovery Guru toolbar button. Perform the procedure in the Recovery Guru to correct the problem. The Recovery Guru might direct you to replace the failed component; if so, go to step 10, otherwise continue with step 8.
8. Check the LEDs on the storage subsystem to determine if a fault has occurred in the storage subsystem.
For the definition of the LED statuses, see “Checking the LEDs.”
9. Are any Needs Attention LEDs indicating a fault condition?
 - Yes – Go to step 10.
 - No – You are finished with this procedure.

If you are still experiencing a problem with this storage subsystem, go to step 11.
10. Replace the failed component. For instructions on replacing the controllers, power supply and fan units, interconnect-battery, battery pack, and SFP modules, see Chapter 5, “Replacing components,” on page 143.
11. If the problem has not been fixed, contact your IBM service representative.
Print a storage subsystem profile, and save the storage subsystem support data. The profile and support data are helpful when troubleshooting storage subsystem problems. (For information about printing a storage subsystem profile and saving the support data, refer to the Subsystem Management window online help.)

Checking the LEDs

The LEDs display the status of the storage subsystem and components. Green LEDs indicate a normal operating status; amber LEDs (Needs Attention) indicate a possible failure; a blue LED indicates that is safe to remove a component.

It is important to check all the LEDs on the front and back of the storage subsystem when you turn on the power. In addition to checking for faults, you can use the LEDs on the front of the storage expansion enclosures to determine if the drives are responding to I/O transmissions from the host.

Front bezel LEDs

You must remove the front bezel in order to see all of the interconnect-battery unit LEDs. With the bezel in place, only the following LEDs are visible:

- Power
- Overall DS4800 Configuration Needs Attention
- Locate/Identify

Important: The displayed order of the Overall DS4800 Configuration Needs Attention and Locate/Identify LEDs on the interconnect-battery unit are reversed when the bezel is removed. See “Interconnect-battery unit LEDs” on page 129.

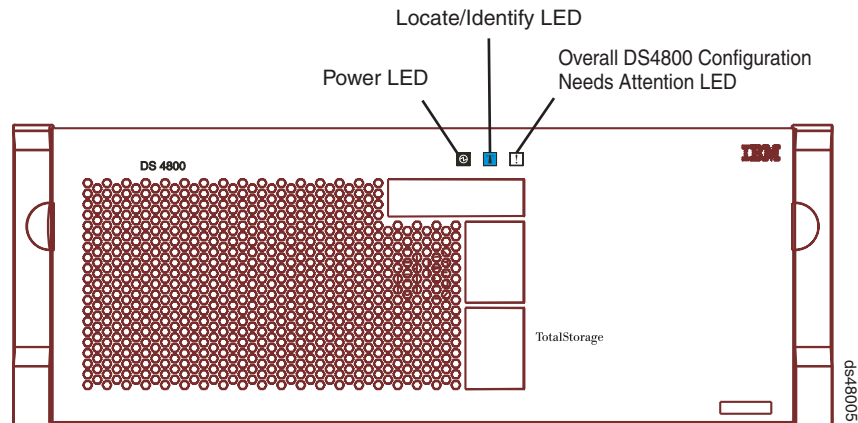


Figure 75. Front bezel LEDs

Table 31. Description of Figure 71

LED	Color	Normal Status	Problem Status	Procedure
Power	Green LED	On = Storage subsystem is powered on	Off = Storage subsystem is powered off	
Locate/Identify	Blue LED Note: This LED is shown as white (and displayed in a different order) on the interconnect-battery unit when the DS4800 bezel is removed. See "Interconnect-battery unit LEDs" on page 129.	Off	On = Storage subsystem locate	
Overall DS4800 Configuration Needs Attention	Amber LED	Off	On = There are one or more failures in the DS4800 storage subsystem configuration. The cause of failure could be one of the components in the DS4800 chassis or one of the components in the attached DS4000 storage expansion enclosures.	"Troubleshooting the storage subsystem" on page 119

RAID controller LEDs

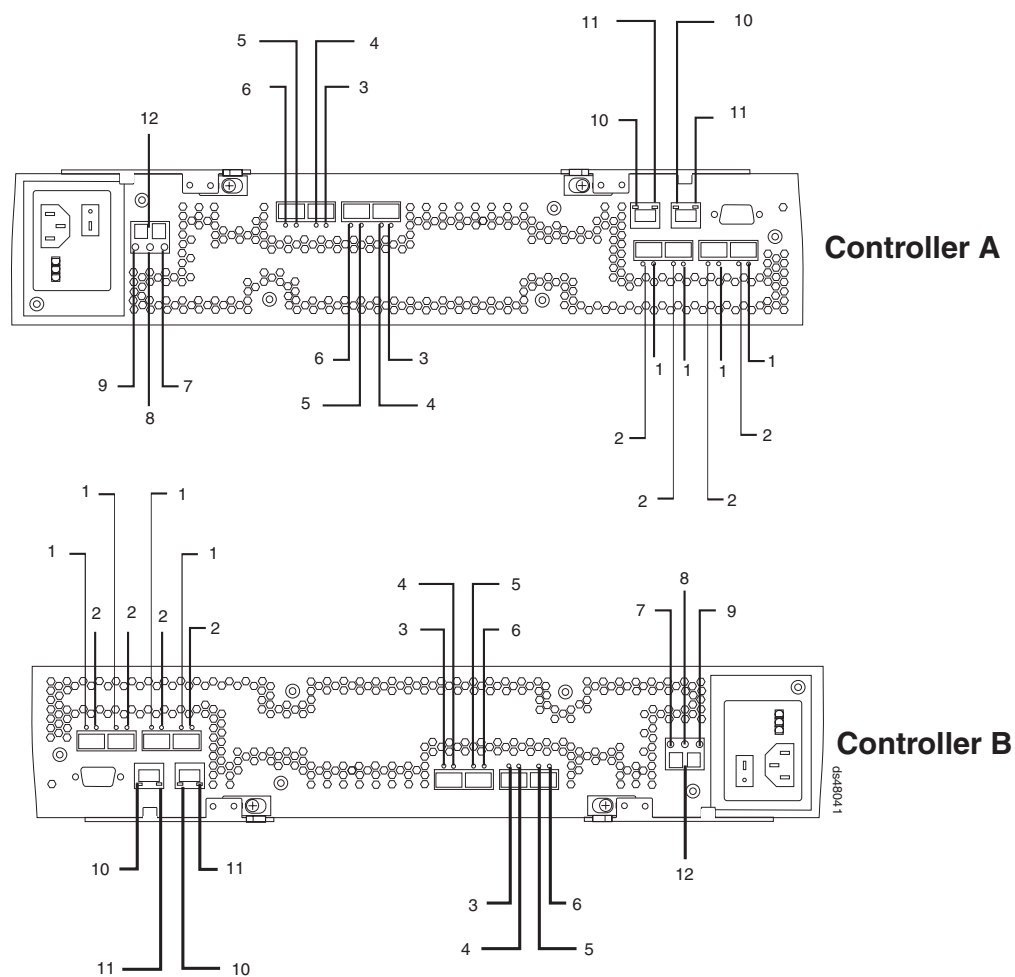


Figure 76. RAID controller LEDs

Table 32. RAID controller LEDs

Legend	LED	Color	Normal Status	Problem Status	Procedure
1	Host Channel Speed – L1	Green LED	See Table 33 on page 125.		
2	Host Channel Speed – L2	Green LED			

Table 32. RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status	Procedure
3	Drive Port Bypass (one LED per port) Note: The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that made up a drive channel. The LED marked 6 shows the status of the other port.	Amber LED	Off	On = Bypass problem <ul style="list-style-type: none"> An SFP module is inserted in the port and the connected fibre channel is either absent or not properly connected. The storage expansion enclosure connected to this port is not powered on. There is a problem with the fibre channel connection between this port and the fibre channel port of the connected ESM in the storage expansion enclosure. 	
4	Drive Channel Speed – L1	Green LED	See Table 33 on page 125.		
5	Drive Channel Speed – L2	Green LED			

Table 32. RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status	Procedure
6	Drive Port Bypass (one LED per port) Note: The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that made up a drive channel. The LED marked 3 shows the status of the other port.	Amber LED	Off	On = Bypass problem <ul style="list-style-type: none"> An SFP module is inserted in the port and the connected fibre channel is either absent or not properly connected. The storage expansion enclosure connected to this port is not powered on. There is a problem with the fibre channel connection between this port and the fibre channel port of the connected ESM in the storage expansion enclosure. 	
7	Service Action Allowed	Blue LED	Off	On = Safe to remove	"Replacing a controller" on page 147
8	Needs Attention	Amber LED	Off	On = Controller needs attention There is a controller fault or a controller is offline.	"Troubleshooting the storage subsystem" on page 119
9	Cache Active	Green LED	On = Data in cache Off = No data in cache	Not applicable	
10	Ethernet Link Speed	Green LED	Off = 10BASE-T On = 100BASE-T	Not applicable	

Table 32. RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status	Procedure
11	Ethernet Link Activity	Green LED	Off = No link established On = Link established Blinking = Activity	LED is off when a Ethernet cable is connected:	<ul style="list-style-type: none"> • Check to see whether there are problems with the Ethernet cables or Ethernet switch. • Verify that the controller is not offline. • Verify that the controller Ethernet port has not been disabled. • Verify that the controller Ethernet port is not bad.
12	Numeric Display (enclosure ID and Diagnostic Display)	Green/yellow seven-segment display	Diagnostic LED = flashing: Controller enclosure ID is displayed Diagnostic LED = on: Diagnostic code is displayed The Diagnostic LED is located on the Numeric Display. See "Numeric display LEDs."		

The L1 and L2 LEDs for each host and drive channel combine to indicate the status and the operating speed of each host or drive channel.

Table 33. Host and drive channel LED definitions

L1	L2	Definition
Off	Off	When both LEDs for a host or drive channel are off, this indicates one or more of the following conditions: <ul style="list-style-type: none"> • The host or drive channel ports are bad. • An SPF module is inserted with no fibre channel cable attached. • No SFP module is inserted in one or both of the host or drive ports in the channel.
On	Off	The host channel is operating at 1 Gbps.
Off	On	The host or drive channel is operating at 2 Gbps.
On	On	The host or drive channel is operating at 4 Gbps.

Numeric display LEDs

The numeric display consists of two seven-segment LEDs that provide information about enclosure identification and diagnostics. Figure 77 on page 126 shows the numeric display and the diagnostic LED.

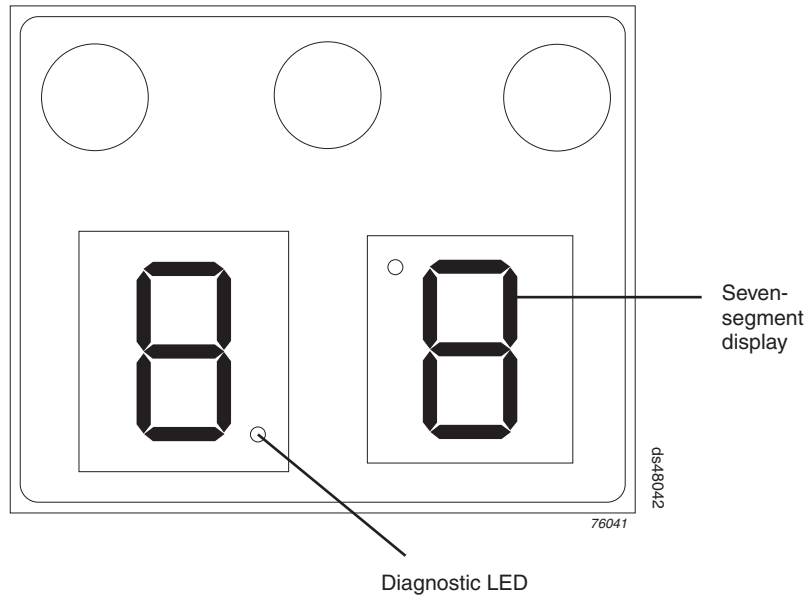


Figure 77. Numeric display LEDs

When the storage subsystem is operating normally, the numeric display shows the enclosure identification (enclosure ID) of the storage subsystem and the diagnostic LED flashes once every two seconds. The storage subsystem tray ID is normally set at the factory to either values 85 or 00. Verify that the attached storage expansion enclosures are not set to either of these enclosure IDs.

Note: It is not recommended, but you can set the storage subsystem enclosure ID through the DS4000 Storage Manager software. The enclosure ID is an attribute of the storage subsystem; both controllers display the same enclosure ID. It is possible, however, that one controller will display the enclosure ID, while the other controller displays a diagnostic code.

If an error has occurred and the controller Needs Attention LED is on, the numeric display shows diagnostic information. The numeric display indicates the information is diagnostic by illuminating an LED that appears as a decimal point between the display numbers. The diagnostic LED turns off when the numeric display shows the storage subsystem enclosure ID. The numeric display shows various diagnostic codes as the controllers perform the startup process after each power cycle or reset. After diagnostics are complete, the current storage subsystem enclosure ID is displayed.

Diagnostic codes in the form of Lx, where x is a hexadecimal digit, indicate controller state information. In general, these codes are displayed only when the controller is in a non-operational state. The controller might be non-operational due to a configuration problem (such as mismatched controller types), or it might be non-operational due to hardware faults. If the controller is non-operational due to system configuration, the controller Needs Attention LED is off. If the controller is non-operational due to a hardware fault, the controller Needs Attention LED is on. The definitions for Lx diagnostic codes are listed in Table 34 on page 127.

Table 34. Numeric display diagnostic codes

Value	Controller State	Description	Storage Manager View
L0	Suspend	Mismatched controller types	Needs Attention condition for board type mismatch
L1	Suspend	Missing interconnect-battery unit	Needs Attention condition for missing interconnect-battery unit
L2	Suspend	Persistent memory errors	Needs Attention condition for offline controller
L3	Suspend	Persistent hardware errors	Needs Attention condition for offline controller
L4	Suspend	Persistent data protection errors	Needs Attention condition for offline controller
L5	Offline	The alternate controller has incompatible firmware but automatic controller firmware synchronization (ACS) cannot be performed	Needs Attention condition for offline controller
L7	Suspend/Offline	Controller with different controller submodel ID inserted	Needs Attention for offline controller
L8	Offline	Unsupported memory is present or memory is not populated in the correct memory slots	Need Attention because the controller is in offline/failed state
88	Reset	Controller is held in reset by alternate controller	

Power supply and fan unit LEDs

The LED positions on the right and left power supply and fan units are in mirror positions. The five LED positions for the left power supply and fan unit are aligned vertically on the right side of the unit. The five LED positions for the right power supply and fan unit are aligned vertically, on the left side of the unit. On the left power supply and fan unit, from top to bottom, the LEDs are: Service Action Allowed LED, Needs Attention LED, Battery 1 charging LED, Battery 2 charging LED, and the Power LED. On the right power supply and fan unit, from bottom to top, the LEDs are: Service Action Allowed LED, Needs Attention LED, Battery 1 charging LED, Battery 2 charging LED, and the Power LED

Note: The right power supply and fan unit is linked with RAID controller A. The left power supply and fan unit is linked with RAID controller B in the DS4800.

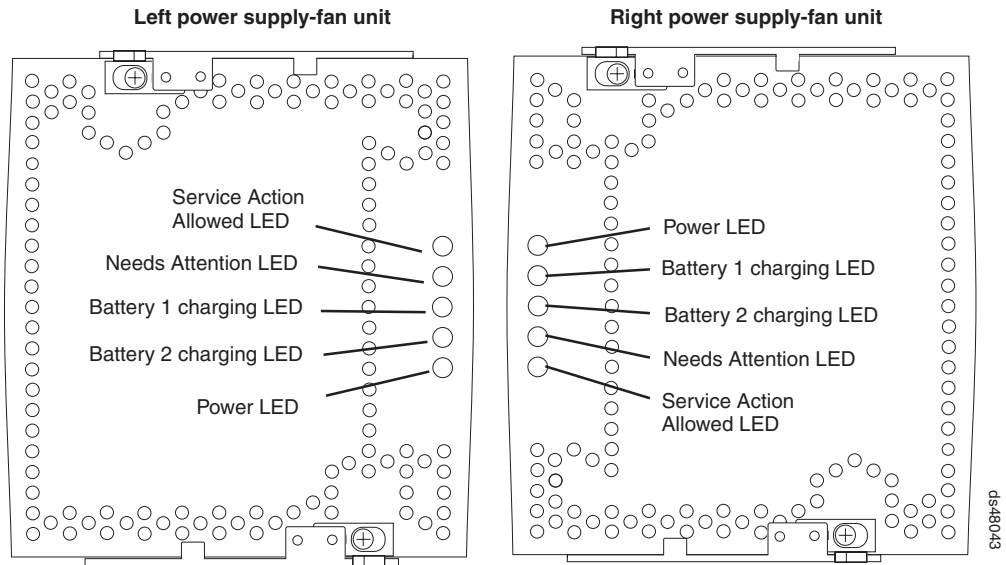


Figure 78. Power supply and fan unit LEDs

Table 35. Power supply and fan unit LEDs

LED	Color	Normal Status	Problem Status	Procedure
Power	Green LED	On = Power supply and fan unit is providing power	Off = Power supply and fan unit is not providing power	Examine the power supply and fan unit, connected PDUs, and connected power circuits for any of the following conditions: <ul style="list-style-type: none"> The power supply and fan unit power switch is off. A circuit breaker has tripped in the controller linked to this power supply and fan unit is linked. (The right power supply and fan unit is linked to controller A; the left power supply and fan unit is linked to controller B.) The connected PDUs are turned off or have been tripped. There is no power at the wall circuit. The power supply and fan unit is bad.
Battery 1 Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted, discharged, or missing	

Table 35. Power supply and fan unit LEDs (continued)

LED	Color	Normal Status	Problem Status	Procedure
Battery 2 Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted, discharged, or missing	
Needs Attention	Amber LED	Off	On = Power supply and fan unit needs attention	"Troubleshooting the storage subsystem" on page 119
Service Action Allowed	Blue LED	Off	On = Safe to remove	"Resetting the controller circuit breakers" on page 133 "Replacing a power supply and fan unit" on page 154

Interconnect-battery unit LEDs

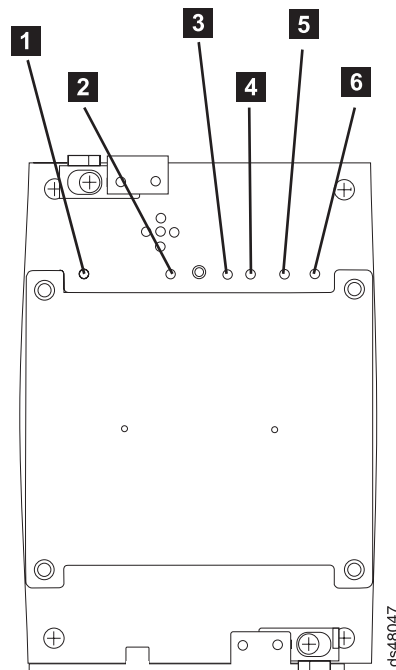


Figure 79. Interconnect-battery unit LEDs

Table 36. Interconnect-battery unit LEDs

Legend	LED	Color	Normal Status	Problem Status/Procedure
1	Battery Needs Attention	Amber LED	Off	On = Battery failed See "Replacing a backup battery pack" on page 162.

Table 36. Interconnect-battery unit LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status/Procedure
2	Power	Green LED	On = storage subsystem is powered on	<p>Off = storage subsystem is powered off</p> <p>If the storage subsystem is powered on but this LED remains off, examine the power supply and fan units, the connected PDUs, and the connected power circuits for any of the following conditions:</p> <ul style="list-style-type: none"> • Both power supply and fan units are not turned on. • A circuit breaker has tripped. • The connected PDUs are turned off or have been tripped. • There is no power at the wall circuit. • The interconnect-battery unit is bad.
3	Overall DS4800 Configuration Needs Attention	Amber LED	Off	<p>On = A component in the storage subsystem configuration has developed a fault.</p> <p>Inspect the Needs Attention LEDs on the other components in the DS4800 Storage Subsystem and in all connected DS4000 storage expansion enclosures to isolate the fault.</p> <p>However, it is recommended that you use the DS4000 Storage Manager Subsystem Management window to identify the cause of the problem and use the Recovery Guru to help fix the problems. Some of the problems may not cause the Needs Attention LED on the individual CRU to light, but they will cause this Overall DS4800 Configuration Needs Attention LED to light. For example, a hard disk drive that exceeds its PFA errors will cause this LED to light, but the drive Needs Attention LED for the individual drive in the attached storage expansion enclosure will not light.</p> <p>See "Troubleshooting the storage subsystem" on page 119.</p>

Table 36. Interconnect-battery unit LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status/Procedure
4	Locate/ Identify	White LED Note: This LED is shown as blue (and displayed in a different order) when the DS4800 bezel is installed. See “Front bezel LEDs” on page 120.	Off	On = storage subsystem locate
5	Service Action Allowed	Blue LED	Off	On = Safe to remove See “Replacing the interconnect-battery unit” on page 158.
6	Battery Needs Attention	Amber LED	Off	On = Battery failed See “Replacing a backup battery pack” on page 162.

The Power, Overall DS4800 Configuration Needs Attention, and Locate LEDs are general indicators for the entire DS4800 storage subsystem (or configuration, in the case of the Overall DS4800 Configuration Needs Attention), not specifically for the interconnect-battery unit. The Overall DS4800 Configuration Needs Attention LED turns on if a fault condition is detected in any component in the storage subsystem configuration, including all attached storage expansion enclosures. The Power, Overall DS4800 Configuration Needs Attention, and Locate LEDs shine through the front bezel.

Attention: If the Overall DS4800 Configuration Needs Attention LED lights, refer to the DS4000 Storage Manager client software to determine the problem with the storage subsystem. Also, inspect the Needs Attention LEDs on the other components in the storage subsystem to help isolate the fault to a specific component.

Recovering from an overheated power supply and fan unit

The storage subsystem has two power supply and fan units. Each power supply and fan unit contains a power supply, a cooling fan, a battery charger, and a built-in temperature sensor designed to prevent the power supplies from overheating. Under normal operating conditions, with an ambient air temperature range of 10° C to 35° C (50° F to 95° F), the cooling fans maintain a proper operating temperature inside the storage subsystem.

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

- Unusually high room temperature
- Fan failure

- Defective circuitry in the power supply
- Blocked air vent
- Failure in other devices installed in the cabinet

If the internal temperature rises above 70° C (158° F), one or both power supplies automatically shut down. If one power supply shuts down, the DS4000 Storage Manager client software displays a Needs Attention status in the Subsystem Management window, the alarm sounds (if enabled), and the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem turns on.

If a common environmental stress causes both power supplies to shut down, the storage subsystem shuts down, and the DS4000 Storage Manager client software displays a Not Responding status in the Subsystem Management window.

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

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

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

Attention: Power supplies automatically shut down when air temperature inside the cabinet reaches 70° C (158° F) or above. If the power supplies have shut down, immediately remove all cabinet panels to help cool the cabinet air temperature and prevent damage to the storage subsystem.

Note: If both power supply and fan units have shut down, start with step 4 below.

1. If applicable, turn off the alarm.
2. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
3. In the DS4000 Storage Manager client Subsystem Management window, select **Advanced ► Troubleshooting ► View Event Log** to display the DS4800 critical events. Look for one of the following critical event entries:
 - Event 281B - Nominal temperature exceeded
 - Event 281C- Maximum temperature exceeded
4. Try alleviating the overheating problem by doing the following:
 - Removing all panels from the cabinet.
 - Cooling the area using external fans.
 - Shutting down the power to the storage subsystem or storage expansion enclosures (Follow the power-down procedure described in “Turning off the storage subsystem” on page 110.)
5. Stop all I/O activity to the storage subsystem and to all attached storage expansion enclosures.
6. Wait until the ambient air temperature around the storage subsystem cools.
The storage subsystem is capable of power-up recovery without operator intervention after the temperature inside the power supply and fan unit cools to

below 70° C (158° F). After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers reset and return to normal operation.

7. Did the power supplies restart automatically?
 - Yes – Go to step 9.
 - No – Go to step 8.
8. Turn off the power switch on each controller in the storage subsystem and then power off all connected storage expansion enclosures. Wait 1 minute and then turn on power to all connected storage expansion enclosures and then to the storage subsystem. If the power supplies go into operation, go to step 9. If not, call your IBM service representative.
9. Check the status LEDs on the front and back of the storage subsystem.
For information about storage subsystem LEDs, see “Checking the LEDs” on page 120.
10. Are the LEDs on the storage subsystem indicating normal status?
 - Yes – Go to step 11.
 - No – Go to step 12.
11. Use the DS4000 Storage Manager client software to check the status of all storage subsystems in the configuration. Is the status Optimal for each storage subsystem?
 - Yes – End of procedure. Resume normal operation.
 - No – Go to step 12.
12. Diagnose and correct the fault by completing the following steps:
 - a. Select the Recovery Guru toolbar button in the Subsystem Management window to run the Recovery Guru.
 - b. Complete the recovery procedure.
If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the specific failed component.
 - c. When the procedure is completed, select **Recheck** in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.
 - d. If the problem has not been fixed contact your IBM service representative.
Print a storage subsystem profile and save the storage subsystem support data. The profile and support data will be helpful when troubleshooting storage subsystem problems. (For information about printing a storage subsystem profile and saving the support data, refer to the Subsystem Management window online help.)

Resetting the controller circuit breakers

Each storage subsystem controller has two circuit breakers that provide over-current protection to the power supply in a power supply and fan unit. The circuit breakers are mounted inside the controller, in line with the internal power cable. One circuit breaker provides protection for ac input, and the second circuit breaker provides protection for dc input.

Note: DC power input is not currently supported for the DS4800. Contact your IBM service representative or reseller for information about possible future support for dc power input.

The internal power cable runs from the ac connector on a controller to the power supply in a power supply and fan unit. Power to the right power supply and fan unit (as viewed from the front of the storage subsystem) is routed through the top controller (controller A); power to the left power supply and fan unit is routed through the bottom controller (controller B).

If a circuit breaker has tripped, the condition might appear as if a power supply and fan unit has failed. The power supply is no longer providing power to the storage subsystem. A tripped circuit breaker is indicated when all of the following conditions are present:

- The Overall DS4800 Configuration Needs Attention LED on the storage subsystem front bezel is turned on.
- The controller Needs Attention LEDs are not turned on.
- The power supply and fan unit Needs Attention LEDs are not turned on.
- The Service Action Allowed LED is turned on for the power supply and fan unit connected to the controller with the open circuit breaker.
- The DS4000 Storage Manager client shows the power supply and fan unit has failed.

Use the following procedure to reset the circuit breaker.

Tools and Equipment

- Antistatic protection
- Nonconducting stylus

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

1. If the alarm is sounding, turn off the alarm.
2. Check to ensure that the external power cables are completely plugged into the controllers and into the power source.
3. Put on antistatic protection.
4. Remove the front bezel by grasping the sides and pulling the cover toward you.
5. Check the Needs Attention LED on each power supply and fan unit. (Figure 80 on page 135 shows the left power supply and fan unit Service Action Allowed LED is the top, or first, LED, and the Needs Attention LED is the second LED. On the right power supply and fan unit the Service Action Allowed LED is the bottom, or fifth LED, and the Needs Attention LED is the next, or fourth, LED.)

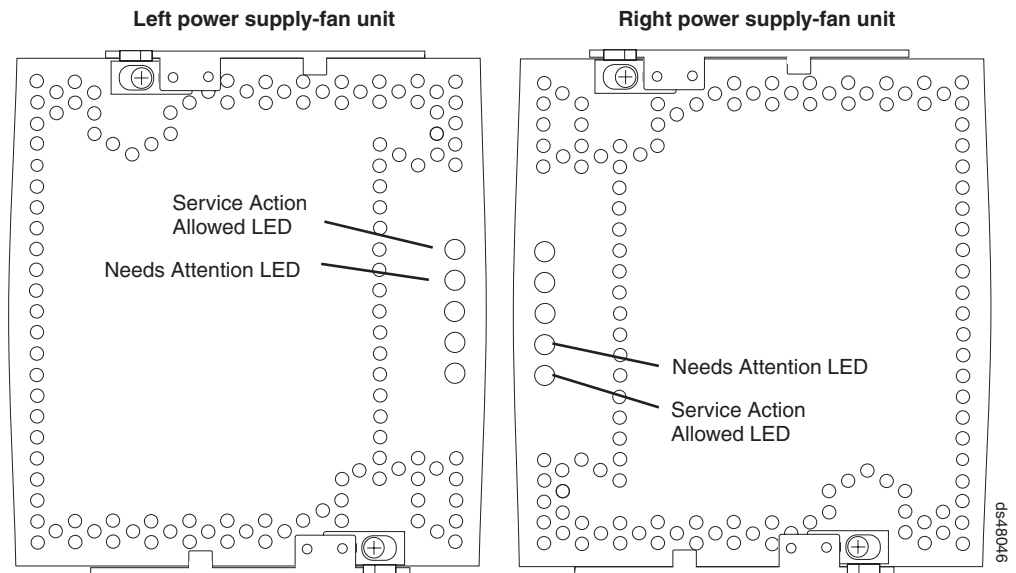


Figure 80. Power supply and fan unit Needs Attention LEDs

Is a power supply and fan unit Needs Attention LED on?

- Yes – A power supply and fan unit has failed. To replace the failed power supply and fan unit, see “Replacing a power supply and fan unit” on page 154.
- No – Go to step 6 on page 136.

Attention: Fiber-optic cables are fragile. Bending, twisting, folding, or pinching fiber optic cables can cause damage to the cables, degraded performance, or data loss. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables in less than a 2-inch radius.

Note: You do not need to remove the interface cables from the controllers to reset the circuit breakers; however, IBM recommends that you remove the cables to make this procedure easier. If you choose to remove the interface cables, ensure that you label each cable so that you can reconnect them correctly to the controller. Figure 81 on page 136 identifies all of the connectors on the back of the controller.

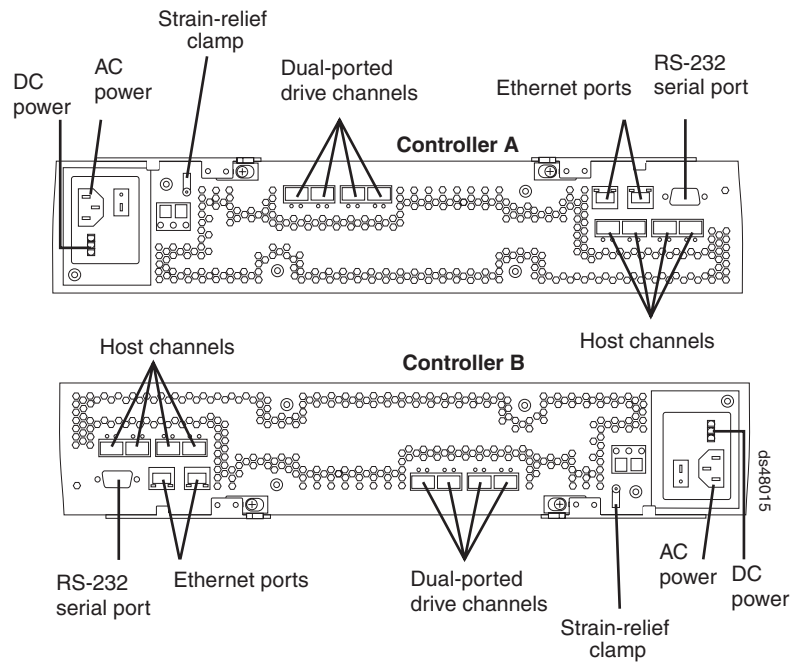


Figure 81. RAID controller connections

6. Use the DS4000 Storage Manager client software to take the controller offline. After the controller is offline, the Service Action Allowed LED turns on, and you can safely remove the controller.
7. Slide the controller with the open circuit breaker from the storage subsystem. You do not need to completely remove the controller. Only slide it out far enough to reveal the holes over the circuit breakers.
 - a. Using your index fingers, simultaneously push the latches to release the levers, and rotate the levers to disengage them from the locking pins.
 - b. Use the levers to slide the controller from the storage subsystem chassis. (Figure 82 on page 137 shows a controller sliding from the storage subsystem chassis.)

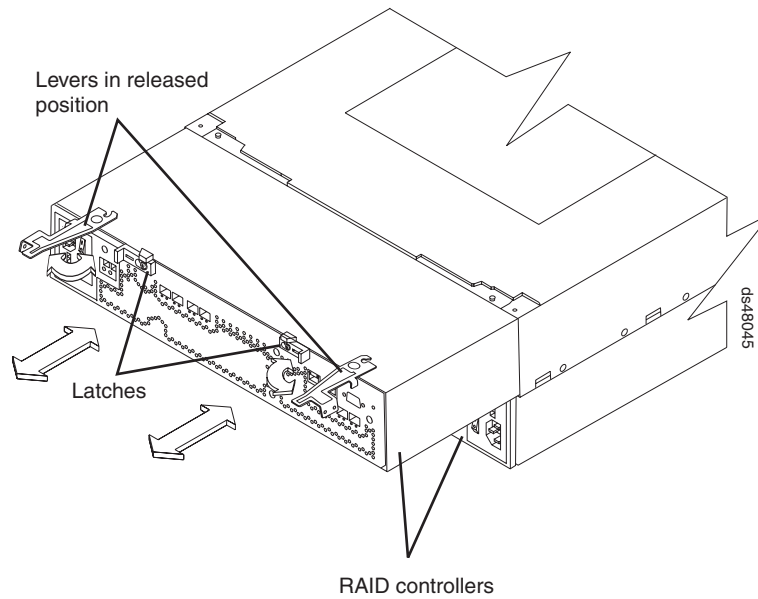


Figure 82. Removing the controller from the storage subsystem

8. Insert a nonconducting stylus through the appropriate hole in the cover of the controller and press down gently. One hole is over the ac circuit breaker, a second hole is over the dc circuit breaker. (DC is not currently supported for the DS4800.) Figure 83 shows the location of the circuit breaker access holes in the controller B cover.

Note: When controllers A and B are inserted in their respective controller slots in the DS4800, the location of the circuit breaker access holes are as follows. On controller A, the circuit breaker access holes are located on the left side on the bottom of the controller. On controller B, the circuit breaker access holes are located on the right side on the top of the controller (as shown in Figure 83).

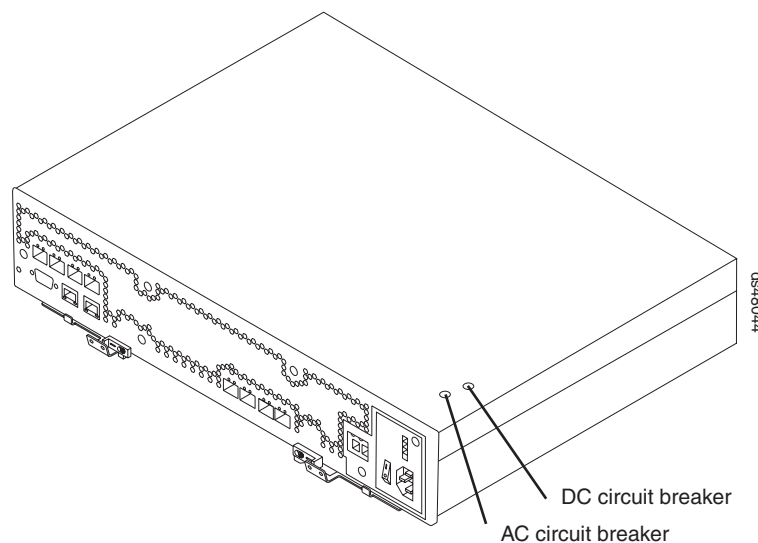


Figure 83. Circuit breaker access holes

9. Reset the circuit breaker that tripped by pressing down with the stylus on the rocker switch.
10. Slide the controller into the storage subsystem chassis.
 - a. Holding both levers, slowly push the controller until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the controller is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on all interface pins.

Attention: Verify that the controller does not snag any other DS4800 cables when you slide it into the controller bay.
 - b. Press the controller fully into the slot, engaging the pins on the enclosure.
 - c. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the component is locked in place.
11. If you removed the interface cables, reconnect all host interface cables and drive interface cables, including the SFP modules.
12. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the controller.
13. Complete any remaining Recovery Guru procedures for controller replacement, if needed.
14. Based on the Host Channel Speed, Drive Channel Speed, and Needs Attention LED status, proceed to one of the following steps:
 - All channel speed LEDs are on and the Needs Attention LED is off – Go to step 16.
 - All channel speed LEDs are off or the Needs Attention LED is on – Verify the controller has been installed correctly. Remove and reinstall the controller. Go to step 15.

Note: If a host channel or drive channel does not have a cable connected, the channel speed LEDs are not illuminated.
15. Did this action correct the problem?
 - Yes – Go to step 16.
 - No – If the problem has not been fixed, contact your IBM service representative.
16. Remove the antistatic protection.
17. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover and then pressing the cover toward the chassis until the pins snap into place.
18. Using the Enterprise Management window, view the status of the storage subsystems. Do any storage subsystems indicate Needs Attention?
 - Yes – Go to step 19.
 - No – All components display Optimal status. You are finished with this procedure.
19. Use the Subsystem Management window to check the status of all storage subsystems in the configuration.
20. Do any storage subsystems have a Overall DS4800 Configuration Needs Attention status?
 - a. Yes – Select the Recovery Guru toolbar button in the Subsystem Management window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.

- b. No – Contact your IBM service representative. Print a storage subsystem profile, and save the storage subsystem support data. The profile and support data are helpful when troubleshooting storage subsystem problems. (For information about printing a storage subsystem profile and saving the support data, refer to the Subsystem Management window online help.)

Cache memory and cache battery

Each RAID controller in the DS4800 Storage Subsystem contains either 2 GB, 4 GB, or 8 GB of cache memory to store read and write operations. (Both RAID controllers in the DS4800 must have the same amount of cache memory.) The interconnect-battery unit contains two Lithium Ion battery packs that can maintain the data in the RAID controller caches for up to three days in the event that the DS4800 Storage Subsystem loses power.

Important:

Do not replace the battery until it is marked failed by the controller. If the batteries are shown as expired, use the reset battery age function in the SM client subsystem management window to reset the age.

Attention: There are different replacement FRU part numbers for the DS4800 controller with certain cache sizes. The DS4800 storage subsystem profile has the information on the installed cache memory size in the DS4800 controllers. Refer to the storage subsystem profile and see “Parts list” on page 176 for the correct FRU part number for the DS4800 controller. In addition, the DS4800 model 80A/H has different replacement FRU part numbers than the DS4800 model 82A/H controllers, even though they both have the same cache size.

Cache memory

Cache memory is memory on the RAID controller that is used for intermediate storage of read and write data on the DS4800 RAID controllers. Using cache memory can increase system performance. The data for a read operation from the host might be in the cache memory from a previous operation (thus eliminating the need to access the drive itself), and a write operation is completed when it is written to the cache, rather than to the drives.

The RAID controller has a Cache Active LED that displays the current status of the cache. The LED is on if there is data in the cache, and it is off if there is no data in the cache.

If caching is enabled and the Cache Active LED never comes on during I/O activity, it indicates one of the following conditions:

- The cache memory from either controller A or controller B has failed.
- The cache sizes in controller A and controller B are not the same.
- The battery has failed. (In this case, one or both of the green Battery LEDs will be off and one or both amber Battery Needs Attention LEDs will be lit.)

Note: Always use the DS4000 Storage Manager client to check your cache memory settings before assuming a hardware failure.

Figure 84 on page 140 shows the locations of the Cache Active LEDs on the front of the RAID controllers.

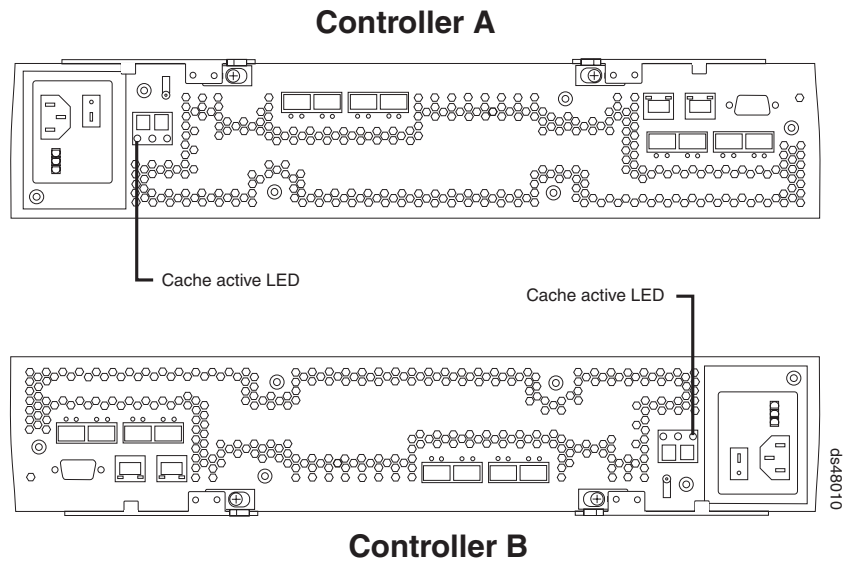


Figure 84. Cache Active LEDs

Subsystem cache battery

The DS4800 interconnect-battery unit contains two battery packs that provide backup power to maintain any cached data not written to disks in the event of a power loss. The battery packs can provide power to the data caches in the RAID controllers for up to three days.

Statement 2:



CAUTION:

When replacing the lithium battery, use only an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100° C (212° F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Replace the battery packs in the DS4800 interconnect-battery unit when they are identified as failing by the DS4000 Storage Manager Subsystem Management window, or when the Battery LEDs or Battery Needs Attention LEDs light. (These LEDs are located on the power supply and fan units and on the interconnect-battery unit respectively, as shown in Figure 85 on page 141.)

Replace only the battery pack that is indicated as failed by the LEDs or in the DS4000 Storage Manager Subsystem Management window. You do not need to replace both battery packs when the Battery LEDs indicate that only one battery pack has failed.

In the event that the battery age expires, do not call on IBM technical support to replace the battery. Instead, reset the battery age using the procedure described in the Storage Manager online help. You should only replace the battery when it is in a failed state, as reported by the Storage Manager Recovery Guru.

Note: Controller firmware version 6.14.xx.xx does not provide the Storage Manager menu option to reset the battery age. This option is available with controller firmware version 6.15.xx.xx or later.

Each power supply and fan unit has green Battery LEDs on the back that indicates the battery status of each battery pack, as follows:

- The LED is on and remains steady when the battery is fully charged.
- The LED flashes when the battery is charging or performing a self-test.
- The LED is off if the battery or the battery charger has failed.

The interconnect-battery unit also has a battery failure indicator LED for each battery pack that is located on the interconnect-battery unit. This LED will light if the battery fails to hold a charge.

The battery performs a self-test at startup and every 25 hours thereafter (during which time the Battery LED flashes). If necessary, the battery begins recharging at that time. If the battery fails the self-test, the Battery LED turns off, indicating a battery fault.

Data caching starts after the battery completes the startup tests.

Attention: Write caching is suspended while a battery pack is either charging or self-testing.

Figure 85 shows the location of the Battery LEDs and the Battery Needs Attention LEDs on the power supply and fan units and the interconnect-battery unit.

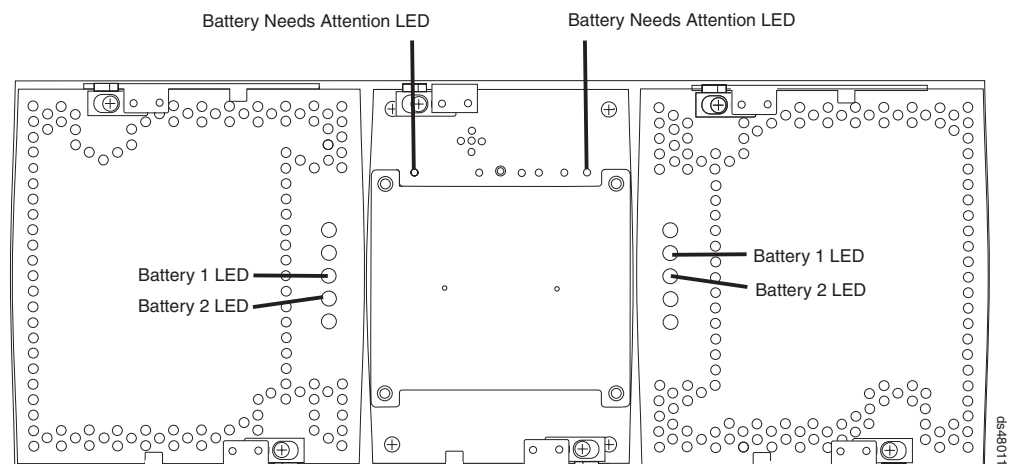


Figure 85. Battery LEDs

Chapter 5. Replacing components

This chapter lists replacement parts and explains the procedures for replacing a controller, a power supply and fan unit, an interconnect-battery unit, and an SFP module. Before using the procedures in this chapter, perform the appropriate troubleshooting steps described in “Troubleshooting the storage subsystem” on page 119, and in the Recovery Guru.

The following list shows the components that you can replace on site. To order parts, contact your IBM service representative.

- RAID controllers
- Power supply and fan units (containing power supplies, fans, and battery chargers)
- Interconnect-battery unit (containing the midplane and batteries for the cache backup)
- SFP modules
- Interface cables
- Ethernet cables

Attention: Never remove the interconnect-battery unit unless directed to do so by an IBM Service representative. Refer to “Replacing the interconnect-battery unit” on page 158 for complete information about the conditions required for safe removal of the interconnect-battery unit.

Instructions are also provided to help you add new DS4000 storage expansion enclosures to existing DS4800 configuration.

You can perform all replacement procedures in this chapter as hot-swap procedures. Hot swap refers to the ability to remove and replace a storage subsystem component while the storage subsystem is under power and processing data. The DS4800 Storage Subsystem has three major components you can replace on site: the controller, power supply and fan unit, and interconnect-battery unit. In a fully configured storage subsystem, the controllers and power supply and fan units are redundant. If any one of these redundant components fails, the component can be replaced without powering off the storage subsystem, and without interrupting data processing.

For more CRU and Option part number information, see the following Web site:

www.ibm.com/systems/support/storage/disk

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

To reduce the possibility of electrostatic discharge, observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or its frame.

- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the storage subsystem for at least two seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into your storage subsystem without setting it down. If it is necessary to set the device down, place it in its static-protective package. Do not place the device on your storage subsystem cover or any metal surface.
- Take additional care when handling devices during cold weather because heating reduces indoor humidity and increases static electricity.

Service Action Allowed status LED

Each controller, power supply and fan unit, and battery unit has a blue Service Action Allowed status LED. The purpose of the Service Action Allowed status LED is to help ensure that a component is not removed before it is safe to do so. Do not remove any storage subsystem component unless the component's Service Action Allowed status LED is lit.

Attention

Never remove a controller, power supply and fan unit, or interconnect-battery unit unless the Service Action Allowed status LED is turned on. Doing so can result in a potential loss of data. If the Needs Attention LED is lit and the associated Service Action Allowed status LED is *not* lit, then you must perform additional diagnostics *before* you can remove the indicated component. Use the Recovery Guru instructions in the DS4000 Storage Manager Subsystem Management window or refer to the appropriate component replacement instructions for the additional diagnostics required in this case.

The Service Action Allowed status LED automatically turns on or off as conditions change. Wait at least two minutes after you replace each component for the controller to recognize the new component and update the LED status. In most cases when a single component fails, the Service Action Allowed status LED turns on steadily when the Needs Attention status LED is turned on for the component.

Single component failures

When a single component in the DS4800 has failed, the following list indicates the behavior of the Service Action Allowed status LED lights:

- If a controller or power supply and fan unit fails and needs to be replaced, the amber Needs Attention status LED on that component turns on to indicate that a service action is required. If there are no data availability dependencies or other conditions that dictate that the component should not be removed, the blue Service Action Allowed status LED turns on. Do not remove any components other than the component indicated by the lit blue Service Action Allowed status LED.
- The interconnect-battery unit contains the midplane that communicates between controllers A and B in the DS4800 Storage Subsystem. If the interconnect-battery unit needs to be replaced, the Service Action Allowed status LED does *not* automatically turn on. Before the interconnect-battery unit Service Action Allowed status LED can turn on, you must use the DS4000 Storage Manager client to

place controller B offline. (Controller A is the controller designated to receive all I/O activity when the interconnect-battery unit is removed from the DS4800.) By placing controller B offline, you route all controller and I/O activity through controller A. This maintains data availability while the interconnect-battery unit is removed, preventing any problems that would normally arise from the loss of communication between controllers A and B.

Attention: Before you remove the interconnect-battery unit, you must verify that controller A is in an optimal state, and the power supply and fan unit CRU that is connected to controller A (the right power supply) is optimal. *Never* remove the interconnect-battery unit when controller A or the power supply and fan unit CRUs are not in an optimal state.

Multiple component failures

When multiple components in the DS4800 have failed, the behavior of the Service Action Allowed and Needs Attention LEDs can vary from situation to situation. In some cases, multiple Service Action Allowed status LEDs light when their corresponding Needs Attention LEDs are lit. In other cases, none of the Service Action Allowed status LEDs light when their corresponding Needs Attention LEDs are lit. This variance exists because the ability to remove a component depends on the different data availability dependencies of the storage subsystem components.

If replacing any one of the multiple components that have their Needs Attention LEDs lit will cause the DS4800 Storage Subsystem to shut down, the Service Action Allowed status LEDs will *not* light on any of the components that need attention. For example, if both the right power supply and fan unit (which is linked to controller A) and controller B need attention, then neither of the Service Action Allowed status LEDs on these components would light. Removing the controller B before replacing the failed right power supply and fan unit would cause controller A to lose power, resulting in a loss of data availability. (This linkage exists because the power distribution from each power supply and fan unit runs through the controller physically connected to that power supply and fan unit.)

However, if replacing any one of the multiple components that have their Needs Attention LEDs lit will *not* cause the DS4800 Storage Subsystem to shut down, then the Service Action Allowed status LEDs will light on all of the components that need attention. For example, if the right power supply and fan unit (which is linked to controller A) and controller A both need attention, then the Service Action Allowed status LEDs on both of these components would light, indicating that either component can be replaced first.

Important: In this situation (in which replacing any one of the multiple components that have their Needs Attention LEDs lit will *not* cause the DS4800 Storage Subsystem to shut down), after you remove one failed component, the Service Action Allowed status LEDs on the remaining components that need attention might turn off. This change in the Service Action Allowed status LEDs indicates that removing additional components now might cause the storage subsystem to shut down.

For example, if both power supply and fan units have failed, the Needs Attention and the Service Action Allowed status LEDs would be lit for both components. However, when you remove one power supply and fan unit from the system, the Service Action Allowed status LED on the remaining power supply and fan unit turns off, indicating that you now cannot remove the second power supply and fan unit (because the

storage subsystem requires that at least one power supply and fan unit, functioning or not, must be present in the storage subsystem at all times).

Releasing and locking a component lever

Each component is secured into the storage subsystem chassis by two cam lock levers mounted to the component. The lever engages with a pin on the storage subsystem chassis to pull the component securely into the chassis. The levers are locked in place by spring-loaded latches. The control components have the levers on the same side. The power supply and fan units and the interconnect-battery unit have the one lever mounted to the top of the component and one lever mounted to the bottom of the component. Figure 86 shows a component lever and the latch that secures the lever. The top view shows the lever in the closed and latched position. The bottom view shows the lever in the released position.

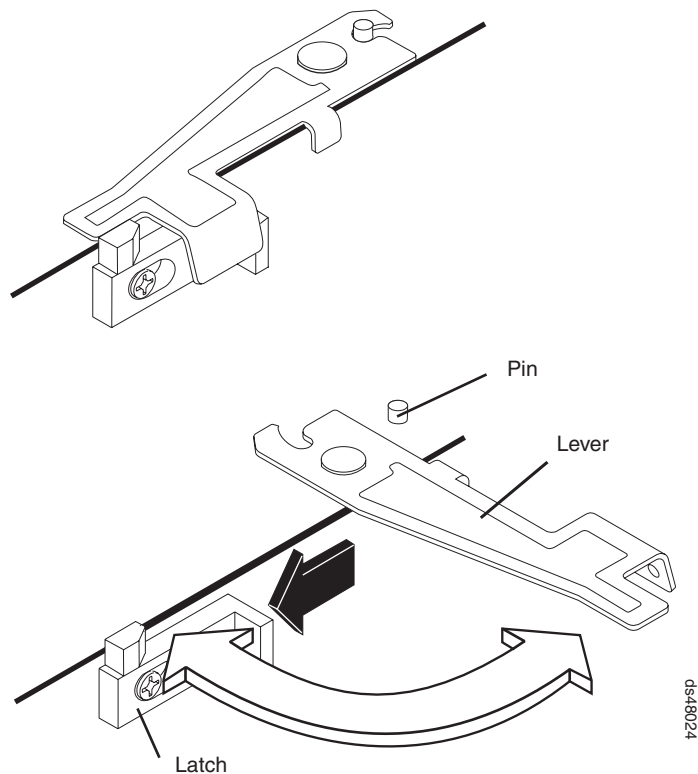


Figure 86. Component lever and latch

To release both latches on a component and remove the component, complete the following:

1. Push the latches to the side until the latches release the levers. Do not proceed with the next step until you have released both levers from the latches.
2. Rotate both levers out simultaneously. Ensure that the levers are completely free of the pins. Then place one hand under the component and use the levers to pull the component from the DS4800 Storage Subsystem.

To replace a component and lock the latches, complete the following:

1. With both levers rotated out perpendicular to the face of the component, slide the back of the component into the appropriate slot.

2. Push the component into the slot and, when the component is almost fully installed, verify that the notches in both levers are aligned with the pins on the storage subsystem. Verify this alignment to ensure that the component is pulled evenly into the storage subsystem, ensuring full electrical connection contact on all interface pins.
3. Press the component fully into the slot, engaging the pins on the storage subsystem.
4. Hold open both latches and rotate both levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers. This indicates that the component is locked in place.

Replacing a controller

Attention: Before you replace a RAID controller, verify the following:

- The replacement RAID controller part number matches the part number of the RAID controller to be replaced. To provide full functionality, the two controllers should have the same memory capacity. Although two controllers of different memories can be paired in a storage subsystem, the mismatch causes some functions to be disabled (for example, the cache mirroring function).
- Inserting a DS4800 model 80A/H controller into a non-model 80A/H DS4800 subsystems (that is, model 82A/H, model 84A/H, model 88A/H) will result in the controller to be held in lockdown state. Similarly, inserting a non-model 80 DS4800 controller into a DS4800 model 80 subsystem will cause it to be held in lock down state.
- Both power supply and fan units must be connected and powered on with no lighted Needs Attention LEDs. Ensure that the Power LEDs on each of the power supply and fan units are lit. If either of the power supply and fan units is not optimal, it is recommended that you replace that component before you proceed with the controller replacement procedure.
- If you are replacing an optimal controller, first make sure that the other RAID controller is optimal and that the fibre channel path from the hosts to the other RAID controller is also optimal.

Use the following procedure to replace a controller in an DS4800 Storage Subsystem.

Attention: If you are upgrading controllers you received through an upgrade kit, refer to “Upgrading controllers” on page 152 and use the instructions provided in the upgrade kit to replace the controllers instead of the instructions in this section.

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front.

1. Use the DS4000 Storage Manager client software to print a storage subsystem profile. Move logical drive ownership to the other controller. If the controller you are replacing has failed but is still operating, move the failed controller to an Offline state.

Attention: Never remove a controller unless the Service Action Allowed status LED is turned on. Doing so can result in a potential loss of data.

2. Locate the failed controller by checking the Needs Attention status LEDs on the controllers in the storage subsystem. (Figure 87 on page 148 shows the location of the Needs Attention LED on the back of a controller.)

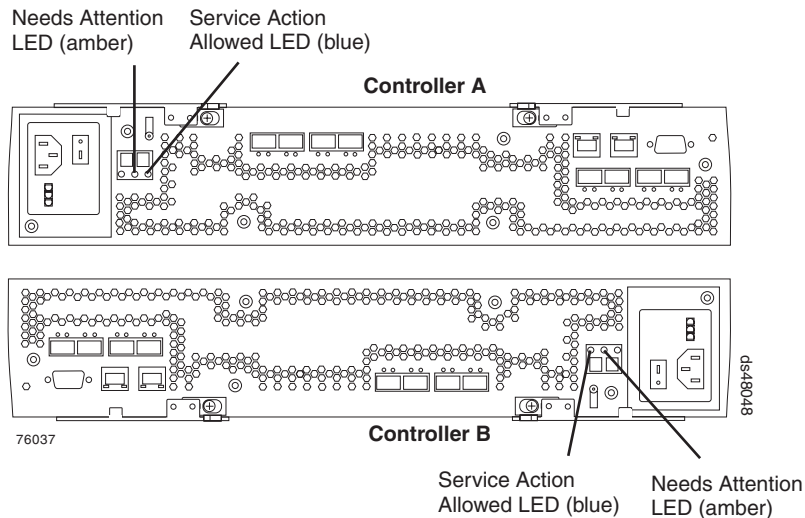


Figure 87. RAID controller Needs Attention and Service Action Allowed LEDs

3. Is the Service Action Allowed status LED turned on? (Figure 87 shows the location of the Service Action Allowed status LED on the back of a controller.)
 - Yes – Go to step 4.
 - No – Another component requires attention before you can remove the controller. Normally, this situation indicates that a power supply and fan unit is either powered off or failed. Ensure that both power supply and fan units are powered on and in an optimal state. If the Service Action Allowed status LED of the failed controller is unlit and both power supply and fan units are in an optimal state, contact your IBM support representative.

Electrostatic discharge can damage sensitive components. Touching the storage subsystem or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

4. Put on antistatic protection.
5. Unpack the new controller. Save all packing materials in the event you need to return the new controller.
6. Determine whether the replacement controller will serve as controller A or controller B. (Controller A is inserted in the top controller bay; controller B is inserted in the bottom controller bay.) Then apply the controller labels for host channels, drive channels, power inputs, and numeric display to the replacement controller. The controller labels and instructions are included with the replacement controller. Make sure that the labels are aligned properly and do not cover any ports or LEDs.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. For specific handling guidelines, see “Handling fibre-optic cables” on page 48.

7. Disconnect all attached interface cables from the failed controller, including the SFP modules. Ensure that you label each cable so that you can reconnect them correctly to the new controller. Figure 88 on page 149 shows the location of the connectors on the back of a controller.

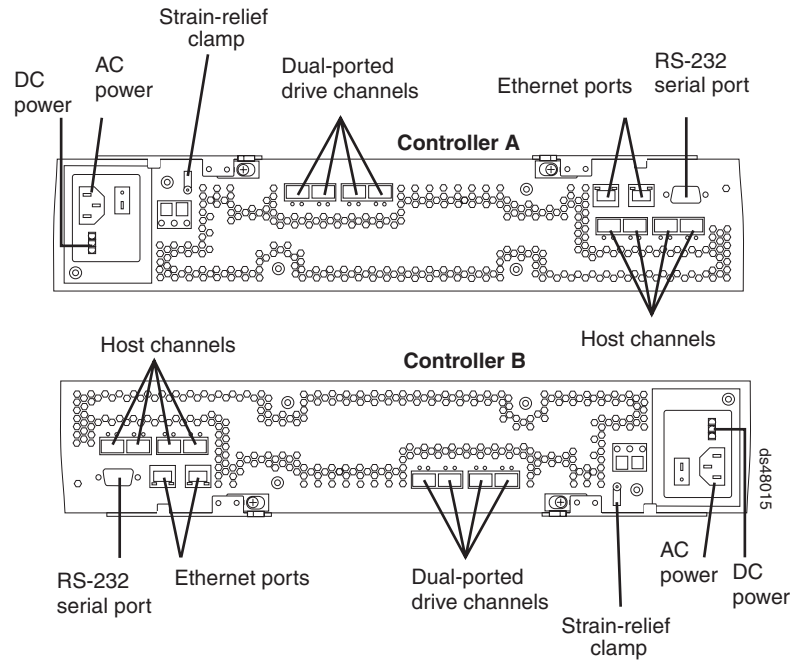


Figure 88. Connectors on the back of each controller

Use the following procedure to remove the SFPs from the RAID controller that has failed:

- a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see “Handling fibre-optic cables” on page 48.
- b. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 89.

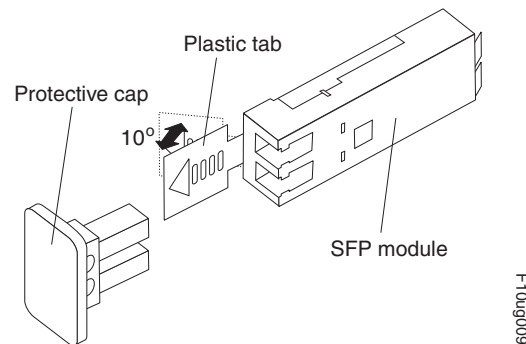


Figure 89. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 90 on page 150.

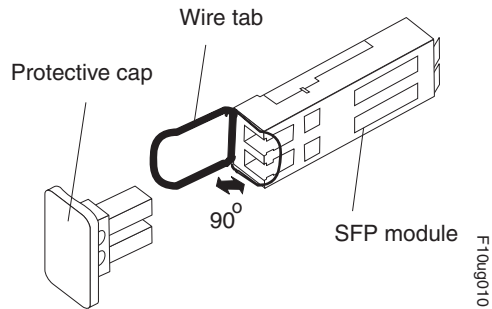


Figure 90. Unlocking the SFP module latch - wire variety

- c. With the SFP latch in the unlocked position, extract the SFP module.
 - For SFP modules that contain plastic tabs, slide the SFP module out of the port.
 - For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the minihub port.
- d. Replace the protective cap on the SFP module.
- e. Place the SFP module into a static-protective package.
- f. Replace the protective cap on the port.
8. Remove the strain-relief nut and cable strain-relief clamp from the RAID controller.
9. Unplug the power cord from the electrical outlet and then disconnect the power cord from the ac power connector on the controller.
10. Release the controller levers and remove the failed controller. Figure 91 shows the controller sliding from the storage subsystem chassis.

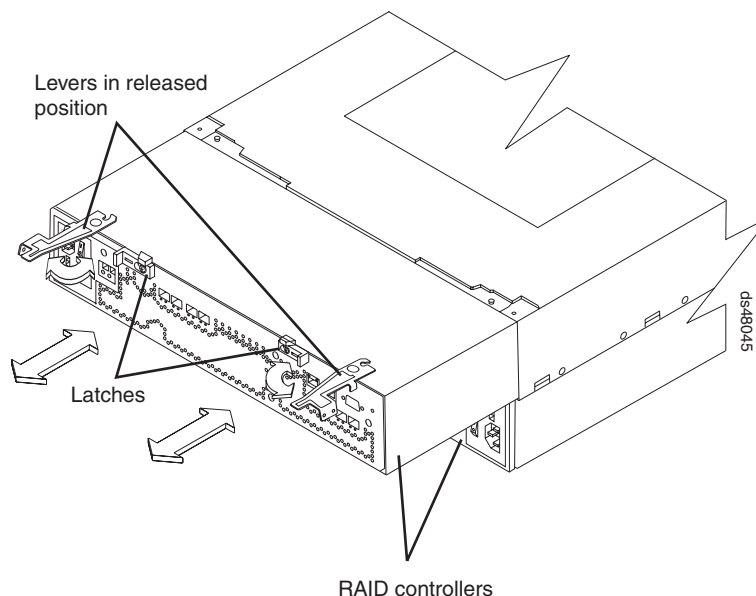


Figure 91. Removing a controller from the DS4800

11. Install the new controller by performing the following:
 - a. Carefully position the controller at the back of the storage subsystem chassis. Ensure that the controller can slide into the storage subsystem chassis without obstruction.

- b. With the left and right levers rotated out perpendicular to the face of the controller, slide the back of the controller into the appropriate slot.
 - c. Push on both sides of the controller so that it slides into the slot evenly. *Stop inserting the controller when it is about 1 inch from being fully inserted into the slot.* With the controller not fully inserted in the slot, attach all the SFPs and cables that you disconnected from the failed controller in step 7 on page 148.
 - 1) Replace the SFPs into the appropriate ports. See “Installing SFP modules” on page 49.
 - 2) Reconnect all cables, including all host and drive channel cables and secondary cables (such as Ethernet connections).
 - d. Holding both levers, slowly push the controller until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the controller is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on all interface pins.

Attention: Verify that the controller does not snag any other DS4800 cables when you slide it into the controller bay.
 - e. Press the controller fully into the slot, engaging the pins on the enclosure.
 - f. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the component is locked in place.
12. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the controller connection end. Leave some slack between the clamp and the controller end of the power cord. Replace the strain-relief nut and tighten it securely to secure the clamp to the controller unit.
 13. Connect the power cord to the new DS4800 controller ac power connector. Plug the power cord into a properly grounded electrical outlet.
 14. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new controller.
 15. Complete any remaining Recovery Guru procedures for controller replacement, if needed.
 16. Check the LEDs on the new controller to verify that the controller is fully operational. See “RAID controller LEDs” on page 122.
 17. Remove the antistatic protection.
 18. Use the DS4000 Storage Manager client Subsystem Management window to check the status of all components in the storage subsystem.
 - If the new controller is online and the DS4000 Storage Manager client Subsystem Management window indicates normal operation, go to step 21 on page 152.
 - If the new controller is online and the DS4000 Storage Manager client Subsystem Management window indicates a problem status, go to “Troubleshooting the storage subsystem” on page 119.
 - If the new controller is offline, go to step 19.
 19. If the newly inserted controller is in an offline state, see the DS4000 Storage Manager client online help for instructions on bringing the controller online. If necessary, open the DS4000 Storage Manager Subsystem Management window and place the controller online; select the offline controller and click **Advanced ► Recovery ► Place controller online**.
 20. Verify the state of the LEDs on the newly inserted controller. See “RAID controller LEDs” on page 122. You can also use the DS4800 Storage Manager

client Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?

- Yes – Select the Recovery Guru toolbar button in the Subsystem Management window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
- No – Go to step 21.

21. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Upgrading controllers

The IBM System Storage DS4800 Controller Cache Upgrade Kit enables you to upgrade the DS4800 controller memory cache either in the DS4800 storage subsystem models 82A/H to 4 GB of memory cache per controller or in the DS4800 storage subsystem models 82A/H and 84A/H to 8 GB of cache memory per controller. There are three DS4800 controller cache upgrade options that are available from IBM:

- DS4800 Model 82A/H Cache upgrade to 8 GB. This option upgrades the DS4800 controllers with 2 GB of cache memory per controller to DS4800 controllers with 4 GB of cache memory per controller.
- DS4800 Model 82A/H Cache upgrade to 16 GB. This option upgrades the DS4800 controllers with 2 GB of cache memory per controller to DS4800 controllers with 8 GB of cache memory per controller.
- DS4800 Model 84A/H Cache upgrade to 16 GB. This option upgrades the DS4800 controllers with 4 GB of cache memory per controller to DS4800 controllers with 8 GB of cache memory per controller.

Important:

- The machine type and model for the DS4800 are printed on the product label affixed to the DS4800 storage subsystem chassis. As a result, the label that identifies this information does not change when you perform a DS4800 controller upgrade. However, after you upgrade the controller cache, the DS4800 storage subsystem functions as and is treated as the DS4800 model with the cache memory to which you have upgraded. If you perform a future controller replacement, ensure that you identify the correct controller part number for your DS4800 and mention that you have previously upgraded the DS4800 storage subsystem controllers.
- Whenever you add options to your DS4800 storage subsystem, be sure to update the MAC information in Appendix B, "Records," on page 189.

Attention: Do not dispose of the DS4800 controller CRUs that you replace with the controller CRUs in this upgrade kit. If separate return processing instructions for the DS4800 controller CRUs you replace are included with this upgrade kit, follow the instructions to return the replaced controllers.

Upgrade preparations requirements

Before you upgrade the controller cache in your existing DS4800 storage subsystems, perform the following steps:

1. Save the DS4800 storage subsystem profile. Store the profile in a different location than the disks that are attached to the DS4800 storage subsystem to be upgraded. Also, save the configuration of the setup, including the topology and logical drives to logical unit number (LUN) mapping. Refer to the online help in the Subsystem Management window for instructions on how to save the subsystem profile and configuration information.
2. Perform a full system backup.
3. Upgrade the DS4000 drive expansion enclosure ESM firmware version of the existing DS4000 drive expansion enclosures to the latest levels that are posted on the DS4000 System Storage Disk Support Web site:
www.ibm.com/systems/support/storage/disk
You must perform the drive expansion enclosure ESM firmware version upgrade before you upgrade the controller firmware in the following step.
4. Upgrade the DS4000 Storage Manager client host software to the appropriate DS4000 Storage Manager version and the DS4800 storage subsystem controller firmware to the appropriate version. See “Software and hardware compatibility and upgrades” on page 19 for versions and compatibility.
5. Verify that both of the DS4800 storage subsystem power supply fan units are plugged in, powered on, and in optimal state. Use the DS4000 Storage Manager client host software to verify that the DS4800 storage subsystem is in optimal state. (This step is not required for cold upgrades.)
6. If the DS4800 host ports are connected to a FC switch, use the switch monitor tool to make sure that the DS4800 host ports and the server FC HBA ports are operating optimally. No unexpected port log-out and log-in events should be reported. If there are any, make sure that the cause or causes of these events are corrected before starting the DS4800 controller cache upgrade. (This step is not required for cold upgrades.)
7. Verify that the premium feature keys are available. Also, locate all premium feature and entitlement proofs of purchase and ensure that they can be accessed when needed.
8. Use the *DS4800 Installation, User's, and Maintenance Guide* for reference as needed. This upgrade procedure may refer to specific sections in the *DS4800 Installation, User's, and Maintenance Guide*. A hard copy of this guide was included in the original DS4800 shipment. Additional copies of this guide in pdf format are available on the DS4000 System Storage Disk Support Web site:
www.ibm.com/systems/support/storage/disk
9. If you use out-of-band (direct) management and assign IP addresses to the DS4800 controllers using Dynamic Host Configuration Protocol (DHCP) based on the DS4800 controller MAC addresses, you must upgrade your DHCP server with the new MAC addresses for the replacement DS4800 controllers in the upgrade kit.

The following two upgrade methods are possible when you perform the DS4800 controller cache upgrade:

- Hot-case upgrade procedure — The DS4800 storage subsystem remains powered on and receives I/Os during the controller cache upgrade. Because the DS4800 storage server controllers will be swapped during the upgrade, you should schedule the upgrade during a non-peak I/O (low-usage) period. Use the DS4800 Storage Manager performance monitor function to determine the non-peak I/O load time if required.
- Cold-case upgrade procedure — The DS4800 storage subsystem is powered down when controllers are upgraded.

Note: The cold-case controller upgrade procedure is recommended if your production environment allows the scheduling of downtime for maintenance purposes.

Refer to the IBM System Storage DS4800 Controller Upgrade Kit Instructions for step-by-step instructions for upgrading DS4800 controller cache.

Replacing a power supply and fan unit

The power supply and fan unit is a component that includes both a 400-W power supply unit and two fans. The power supply and fan units provide power and cooling for the DS4800 Storage Subsystem. The power supply and fan units are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported power supply and fan units for your specific storage subsystem.

Each power supply and fan unit has a built-in sensor that detects the following conditions:

- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. If the power remains off after the condition that causes it to go off, make sure that the environment is optimal (no overheating has occurred, all electrical outlets are working, and so on). For more information, see “Restoring power after an unexpected shutdown” on page 112.

The storage subsystem cooling system consists of two fans in each of the two power supply and fan units. The power supply and fan units circulate air from the front to the back of the unit.

If both power supply and fan units fail, or if the power supply and fan units cannot maintain an internal temperature below 70° C (158° F), the power supply and fan units in the unit will automatically shut down (an over-temperature condition). If this occurs, you must cool the unit and restart it. See “Restoring power after an unexpected shutdown” on page 112.

Attention: The fans in the power supply and fan units draw in fresh air and force out hot air. The power supply and fan units are hot-swappable and redundant; however, if the fans in one power supply and fan unit fail, you must replace the entire failed power supply and fan unit within 48 hours to maintain redundancy and optimum cooling. Do not remove the failed power supply and fan unit from the DS4800 chassis until you have the replacement power supply and fan unit. When you do remove the failed power supply and fan unit, be sure to install the second power supply and fan unit within 10 minutes to prevent any overheating due to the interruption to the air flow that cools the DS4800 chassis.

Do not run the storage subsystem without adequate ventilation and cooling, because it might cause damage to the internal components and circuitry.

Use the following procedure to replace a power supply and fan unit. Each power supply and fan unit contains a power supply, cooling fan, battery charger, and temperature sensor. If any of these components fail, you must replace power supply and fan unit. The power supply, fan, battery charger, and temperature sensor are not individually replaceable components within the power supply and fan unit.

Statement 8:



CAUTION:

Never remove the cover on a power supply and fan unit or any part that has the following label attached.



Hazardous voltage, current, and energy levels are present inside any component that has this label attached. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

1. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
2. Locate the storage subsystem that contains the failed power supply and fan unit by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 92 on page 156 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

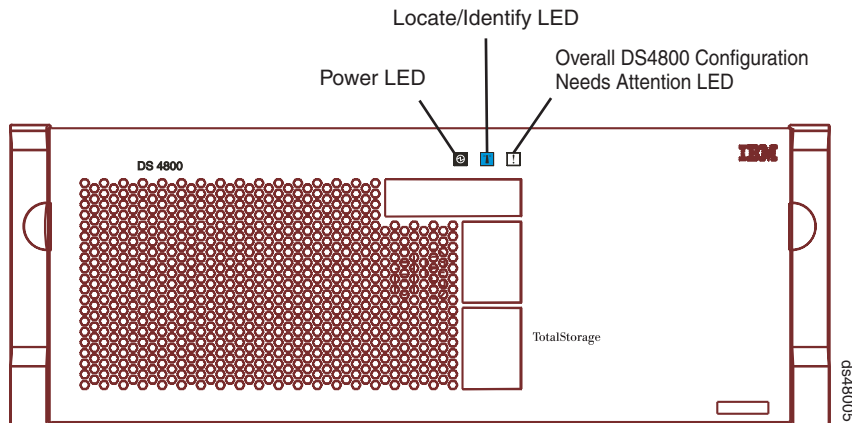


Figure 92. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

3. Remove the front bezel by grasping the sides and pulling the cover toward you.
4. Locate the failed power supply and fan unit by checking that the power supply and fan unit Needs Attention LED that is turned on. (Figure 93 shows the LEDs on the power supply and fan unit.)

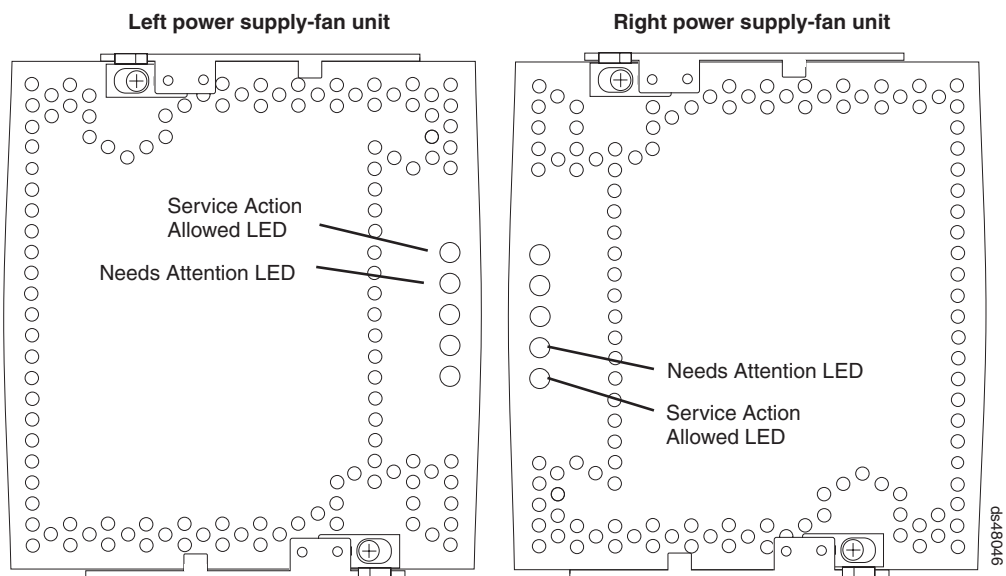


Figure 93. Power supply and fan unit LEDs

Attention: Never remove a power supply and fan unit unless the Service Action Allowed status LED is turned on.

5. Is the Service Action Allowed status LED turned on? (Figure 93 shows the location of the Service Action Allowed status LED on the power supply and fan unit.)
 - Yes – Go to step 6 on page 157.
 - No – Another component requires attention before you can remove the power supply and fan unit. Normally, this indicates that a RAID controller is either powered off or failed. Ensure that both DS4800 RAID controllers are

optimal. If the Service Action Allowed status LED of the failed power supply and fan unit is not lit when both RAID controllers are optimal, contact your IBM support representative.

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

6. Put on antistatic protection.
7. Unpack the new power supply and fan unit.
Save all packing materials in the event you need to return the new power supply and fan unit.
8. Apply the appropriate label to the LED column for the replacement power supply and fan unit. The labels and instructions are included with the replacement power supply and fan unit. Make sure that the labels are aligned properly and do not cover any LEDs.
9. Unlatch the top and bottom levers on the failed power supply and fan unit. Rotate both levers out simultaneously and remove the failed power supply and fan unit. (Figure 94 shows a power supply and fan unit sliding from the storage subsystem chassis.)

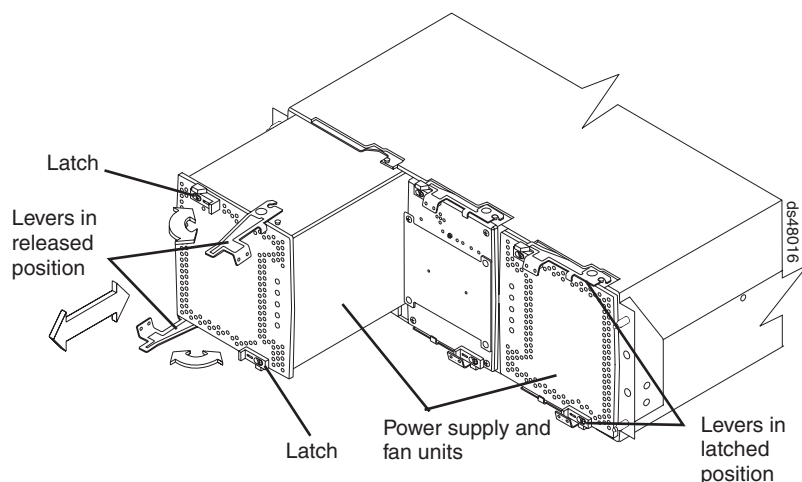


Figure 94. Removing a power supply and fan unit from the DS4800

10. Install the new power supply and fan unit.
 - a. Carefully position the power supply and fan unit in the storage subsystem chassis. The power supply and fan unit has a relief formed along one long edge of the component. The component relief fits onto a rail cast into the storage subsystem chassis. Ensure that the component relief fits onto the rail before attempting to slide the controller into the storage subsystem chassis.
 - b. With the left and right levers rotated out perpendicular to the face of the power supply and fan unit, slide the back of the power supply and fan unit into the appropriate slot.
 - c. Holding both levers, slowly push the power supply and fan unit until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the power supply and fan unit is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on all interface pins.

Attention: Verify that the power supply and fan unit does not snag any other DS4800 cables when you slide it into the bay.

- d. Press the power supply and fan unit fully into the slot, engaging the pins on the enclosure.
 - e. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the power supply and fan unit is locked in place.
11. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new power supply and fan unit.
 12. Complete any remaining Recovery Guru procedures for power supply and fan unit replacement, if needed.
 13. Did this correct the problem?
 - Yes – Go to step 14.
 - No – Verify the following:
 - Both power supply and fan unit switches on the back of the DS4800 are turned on.
 - The circuit breaker for the electrical outlet that DS4800 connects to has not been tripped.
 - The circuit breaker in the DS4800 RAID controller that the power supply and fan unit is linked to has not been tripped. (The right power supply and fan unit is linked to controller A; the left power supply and fan unit is linked to controller B.) See “Resetting the controller circuit breakers” on page 133.

If the problem persists after you have checked the above, contact your IBM service representative.

14. Remove the antistatic protection.
15. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover, and then press the cover toward the chassis until the pins snap into place.
16. Use the DS4000 Storage Manager Subsystem Management window to check the status of components in the storage subsystem.
17. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the Subsystem Management window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 18.
18. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Replacing the interconnect-battery unit

Use the following procedure to replace the interconnect-battery unit.

Attention:

Never remove the interconnect-battery unit unless directed to do so by an IBM service representative. In addition, do not replace the interconnect-battery unit in any of the following situations:

- The DS4800 controller A is not in optimal state.
- The FC paths from the hosts to the host ports in controller A are not optimal.

- The drive paths from controller A to the storage expansion enclosures are not optimal.
- The right power supply and fan unit is not powered on or not optimal.

The reason not to replace the interconnect-battery unit in any of the above situations is because controller A is the designated controller to receive all I/Os when the interconnect-battery unit is removed from the DS4800. Use the DS4000 Storage Manager client Subsystem Management window and the appropriate SAN monitoring tools to ensure that there are no problems with controller A or with the connection from the host to controller A.

Also note that LUN Failover between controllers is disabled during this procedure because controller B must be placed offline before the interconnect-battery unit is removed from the DS4800. It is recommended to perform the interconnect-battery unit replacement procedure during off-peak I/O traffic hours.

Before removing the interconnect-battery unit, you *must* use the DS4000 Storage Manager client to place controller B offline. Controller A must display Optimal status before removing the interconnect-battery unit. Do *not* remove the interconnect-battery unit if controller A does not display Optimal status.

Electrostatic discharge can damage sensitive components. Touching the storage subsystem or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

1. Locate the failed interconnect-battery unit by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 95 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

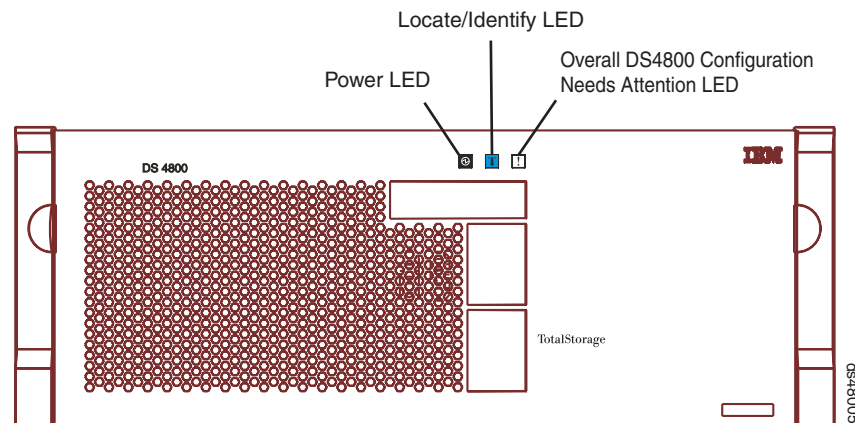


Figure 95. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

2. Use the DS4000 Storage Manager client to place controller B offline.
Attention: Controller A must display Optimal status before removing the interconnect-battery unit. Do *not* remove the interconnect-battery unit if controller A does not display Optimal status.
3. Remove the front bezel by grasping the sides and pulling the cover toward you.
Attention: Never remove a power supply and fan unit unless the Service Action Allowed status LED is turned on.

4. Is the Service Action Allowed status LED turned on? (Figure 96 shows the location of the Service Action Allowed status LED on the interconnect-battery unit.)

- Yes – Go to step 5.
- No – Make sure that the right power supply and fan unit is connected, powered on, and in optimal state.

If the right power supply and fan unit is connected, powered on, and in optimal state and Service Action Allowed status LED remains unlit, run the Recovery Guru to determine what other components might require attention. If the Recovery Guru does not indicate any other component problems, contact your IBM support representative.

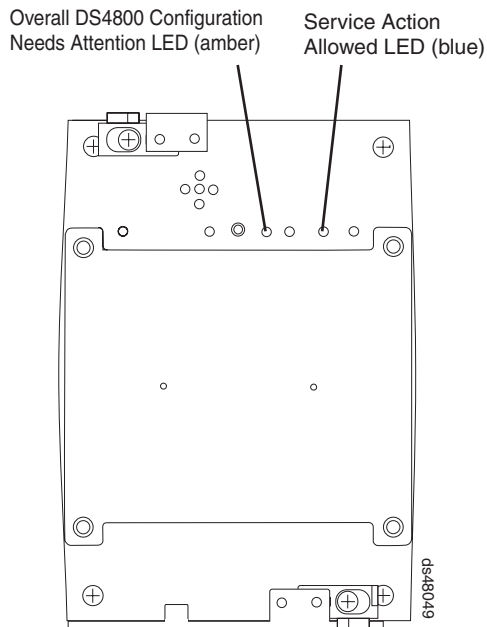


Figure 96. Interconnect-battery unit Needs Attention and Service Action Allowed LEDs

5. Put on antistatic protection.
6. Unpack the interconnect-battery unit.
Save all packing materials in the event you need to return the new interconnect-battery unit.
7. Unlatch both the top and bottom levers of the interconnect-battery unit and rotate both levers straight out simultaneously to remove the failed interconnect-battery unit. (Figure 97 on page 161 shows the interconnect-battery unit sliding from the storage subsystem chassis.)

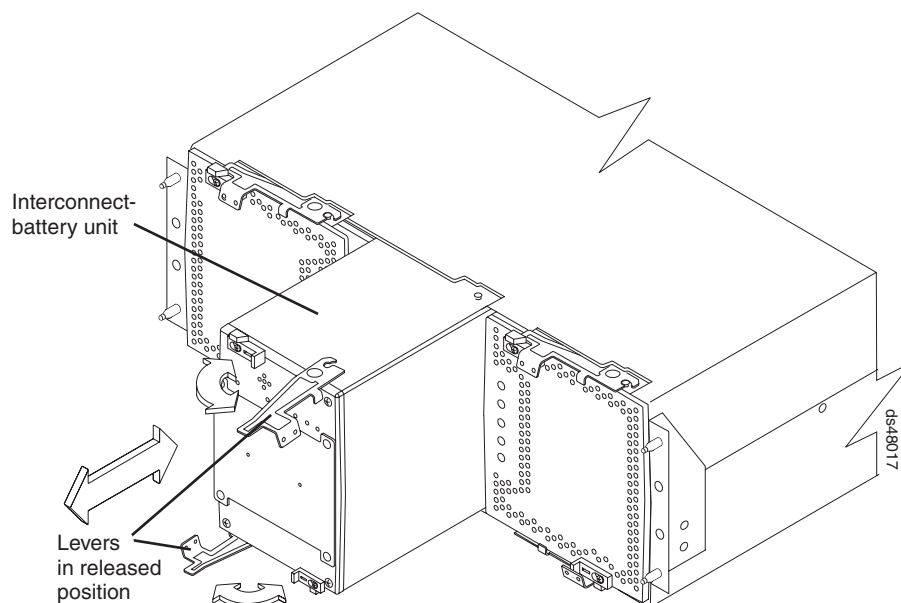


Figure 97. Removing an interconnect-battery unit from the DS4800

8. Remove both battery packs from the failed interconnect-battery unit and replace the battery packs in the replacement interconnect-battery unit. See “Replacing a backup battery pack” on page 162 for instructions on how to remove and replace the battery packs from an interconnect-battery unit.
9. Install the new interconnect-battery unit by performing the following steps:
 - a. Carefully position the interconnect-battery unit in the storage subsystem chassis.
 The interconnect-battery unit has a pin on the connector end of the component. The pin fits onto a relief cast into the storage subsystem chassis. (You can see the relief by peering into the slot for the interconnect-battery unit.) Ensure that the interconnect-battery unit pin is aligned with the relief in the storage subsystem chassis before attempting to slide the interconnect-battery unit into the storage subsystem chassis.
 - b. With the top and bottom levers rotated out perpendicular to the face of the interconnect-battery unit, slide the back of the unit into the appropriate slot.
 - c. Holding both levers, slowly push the interconnect-battery unit until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the interconnect-battery unit is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on the interface pin.
Attention: Verify that the interconnect-battery unit does not snag any other DS4800 cables when you slide it into the bay.
 - d. Press the interconnect-battery unit fully into the slot, engaging the pins on the enclosure.
 - e. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the interconnect-battery unit is locked in place.
10. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new interconnect-battery unit.

11. Use the DS4000 Storage Manager client to place controller B online.
12. Complete any remaining Recovery Guru procedures for interconnect-battery unit replacement, if needed.
13. Did this correct the problem?
 - Yes – Go to step 14.
 - No – If the problem has not been fixed, contact your IBM service representative.
14. Remove the antistatic protection.
15. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover and then press the cover toward the chassis until the pins snap into place.
16. Use the Subsystem Management window to check the status of all components in the storage subsystem.
17. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the DS4000 Storage Manager Subsystem Management window, and complete the recovery procedure. If the problem persists, contact your IBM support representative.
 - No – Go to step 18.
18. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Replacing a backup battery pack

Use the following procedure if the DS4000 Storage Manager client instructs you to replace the battery because the current battery has failed. You can also use the DS4000 Storage Manager client to check the status of the battery. Because write-caching is disabled when either one of the backup battery packs fail, IBM recommends that you replace the failed battery pack as soon as possible to minimize any impact due to the disabling of the write-caching function.

Replace only the battery pack that is indicated as failed by the LEDs. You do not need to replace both battery packs when the Battery LEDs indicate that only one battery pack has failed.

Note: Unlike the batteries for other DS4000 Storage Subsystems, the DS4800 Storage Subsystem battery packs do not have set expiration dates. Do not replace these batteries after a certain usage period.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 143.

Use the following procedure to replace a backup battery pack in the interconnect-battery unit:

1. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
2. Locate the storage subsystem that contains the interconnect-battery unit with the failed battery by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 98 on page 163 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

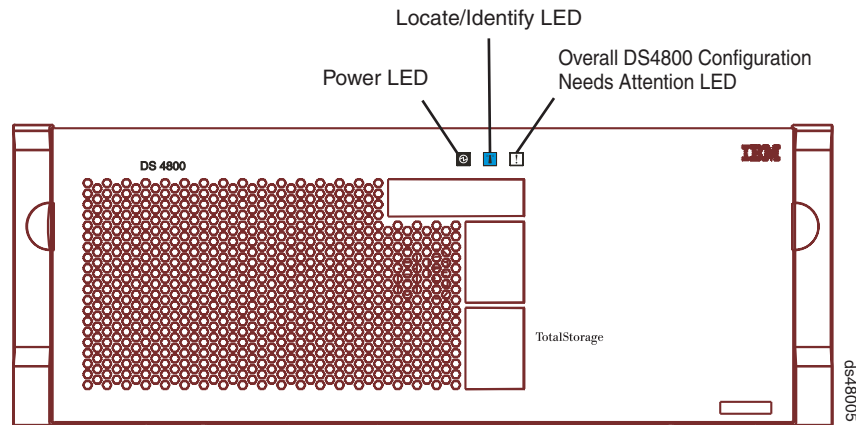


Figure 98. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

3. Remove the front bezel by grasping the sides and pulling the cover toward you.
4. Check the LEDs on the power supply and fan units to determine which of the two battery packs has failed. (See Figure 85 on page 141.) Replace only the battery pack that is indicated as failed by the LEDs.
5. Put on antistatic protection.
6. Unpack the new battery pack. Set the new battery pack on a dry, level surface. Save all packing materials in the event you need to return the new battery pack.
7. Remove the battery access cover from the front of the interconnect-battery unit by removing the thumb screws that secure the cover to the component. Figure 99 shows the access cover and mounting screws on the interconnect-battery unit.

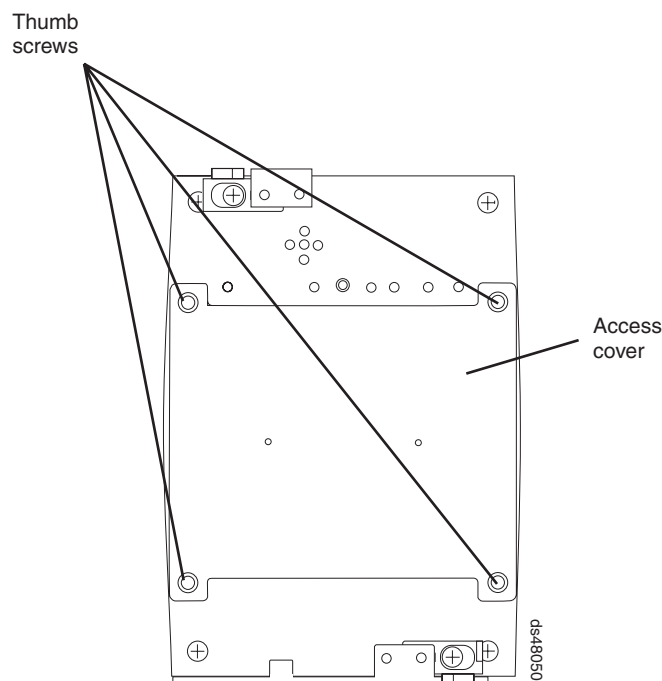
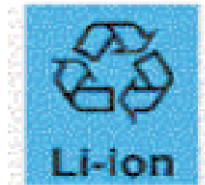


Figure 99. Battery access cover on the interconnect-battery unit

8. Remove the failed battery pack by sliding it out of the interconnect-battery unit.

Note: There are two battery packs in the interconnect-battery unit. The right and left Battery Needs Attention LEDs on the interconnect-battery unit correspond to each of the two battery packs. Be sure to remove the failed battery, as indicated by the lit amber Battery Needs Attention LED.

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



CAUTION:

This product contains a sealed Lithium Ion battery. Discharged Lithium and Lithium Ion batteries are currently designated to be disposed of in normal trash. However, users should contact their municipal waste disposal facility prior to discarding any used battery in normal trash. Alternatively, IBM recommends users may return Lithium, Lithium Ion and Lithium Ion battery packs to IBM for recycling.

In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM Lithium, Lithium Ion and Lithium Ion battery packs. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

For information on disposal of sealed Lithium Ion batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

9. Install the replacement battery pack. Carefully position the battery pack to ensure that the battery pack will slide correctly into the interconnect-battery unit. The flat side of the battery pack should face towards the outside of the chassis. Make sure that the battery bracket slides properly into the slots for the battery. Slide the battery pack into the interconnect-battery unit. Push the battery pack firmly into the interconnect-battery unit to ensure that the battery pack completely engages with the connectors in the interconnect-battery unit.
10. Reinstall the battery access cover onto the front of the interconnect-battery unit.
11. Once you have replaced the battery pack, you must reset the battery age through the DS4000 Storage Manager client, by performing these three steps:
 - First, you must select the **Controller enclosure components** icon in the Physical View of the Storage Manager client. The Controller enclosure components dialog will be displayed.
 - Next, you must select the **Batteries** icon, and then select **Reset**. You will be asked to Confirm Reset. Select **Yes** to confirm that you want to reset the battery age.

- Now, the battery age clock is reset to 0.
- 12. Remove the antistatic protection.
- 13. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover and then press the cover toward the chassis until the pins snap into place.
- 14. Use the Subsystem Management window to check the status of all components in the storage subsystem.
- 15. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the DS4000 Storage Manager Subsystem Management window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 16.
- 16. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Note: Note that it might take from 15 minutes to a few hours for a new battery to become fully charged. The DS4000 Storage Manager client will show the battery as charging until it is fully charged. Controller caching is automatically disabled until the new battery becomes fully charged.

- 17. After 24 hours, check the Needs Attention and Battery LEDs to ensure that the battery is working properly.
If the replacement battery indicates a fault, contact your IBM support representative.

Replacing an SFP module

Use the following procedure to replace an SFP module in a controller. The SFP module shown in this procedure might look different from those you are using, but the difference does not affect SFP module performance.

Electrostatic discharge can damage sensitive components. To prevent electrostatic discharge damage to the storage subsystem, use proper antistatic protection when handling the DS4800 components.

Attention: Removing an SFP module that has not failed can cause data loss. To prevent data loss, remove only the SFP module that has a Bypass LED on or that displays a failed status in the DS4000 Storage Manager client software.

1. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.
2. Locate the storage subsystem that has the failed SFP module by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 100 on page 166 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

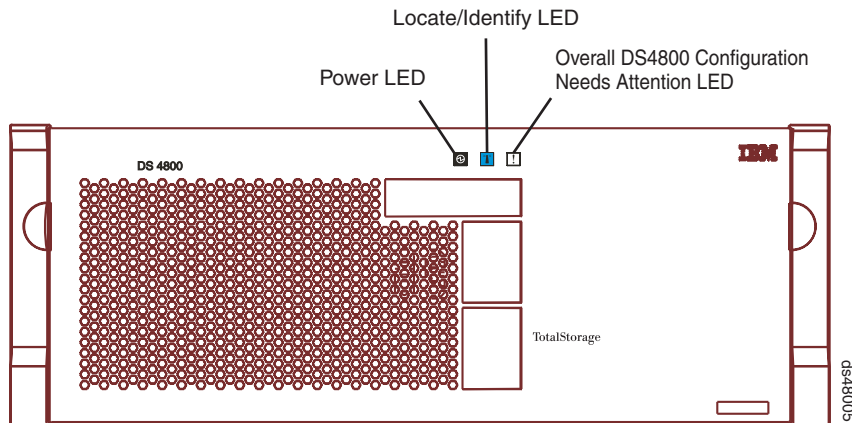


Figure 100. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

3. Locate the failed SFP module by checking the SFP Bypass LED and Needs Attention LED on the controllers. If a fault is detected, the LEDs are lit. Figure 101 shows the location of the controller SFP Bypass LED and Needs Attention LED on the controller.

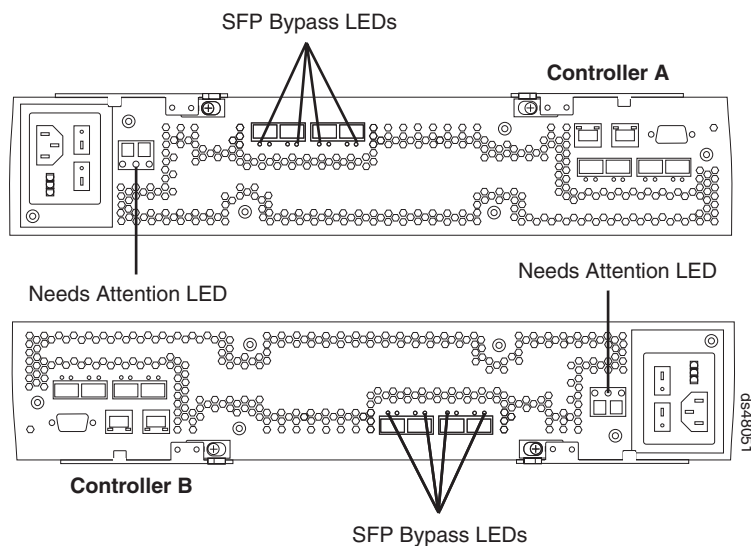


Figure 101. Needs Attention and SFP Model Bypass LEDs

4. Put on antistatic protection.
5. Unpack the new SFP module. Verify that it is the same type of module you are replacing. Save all packing materials in the event you might need to return the new SFP module.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. For specific handling guidelines, see “Handling fibre-optic cables” on page 48.

6. Disconnect the interface cable from the SFP module. (Figure 102 on page 167 shows the SFP module, interface cable, and the rear of a controller.)

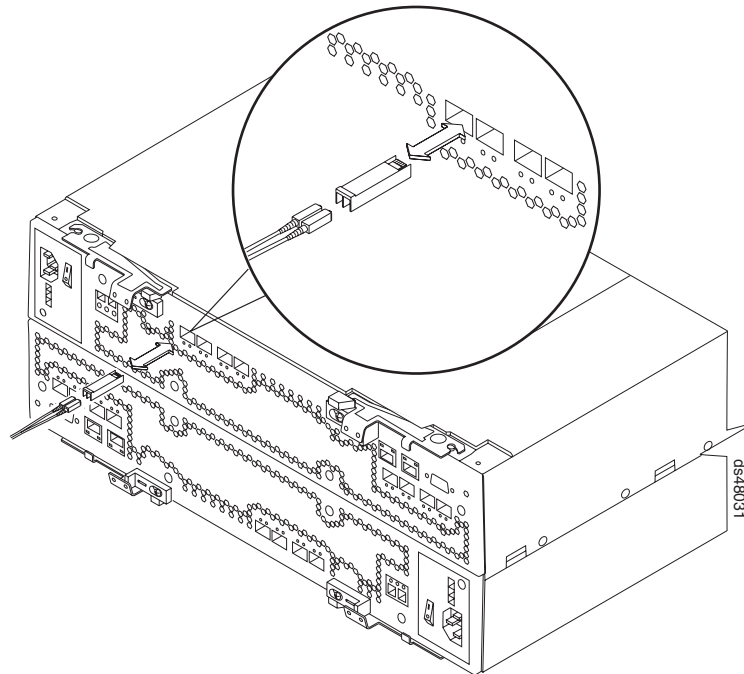


Figure 102. Replacing an SFP module

7. Remove the failed SFP module from the controller.
8. Install the new SFP module into the controller.
9. Reconnect the interface cable.
10. Check the Bypass and Needs Attention LEDs for the new SFP module.
Based on the status of the Bypass and Needs Attention LEDs, choose one of the following steps:
 - Bypass LED or Needs Attention LED is illuminated – The SFP module and cables might be installed incorrectly, or the cable might not be securely connected. Reinstall the SFP module and cable, check the cable connection, and then go to step 11.
 - Bypass LED and Needs Attention LED are off – Go to step 12.
11. Is the problem corrected?
 - Yes – Go to step 12.
 - No – Contact your IBM support representative.
12. Remove the antistatic protection.
13. Use the DS4000 Storage Manager Subsystem Management window to check the status of all components in the storage subsystem.
14. Do any storage subsystems have a Needs Attention (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the Subsystem Management window and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 15.
15. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Installing SFPs and fiber-optic cables

Each RAID controller unit has four single-ported host channels and two dual-ported drive channels. SFPs are inserted into the ports, and then fibre-channel cables are connected to the SFPs.

For information on installing SFPs and fiber-optic cables, see “Working with SFPs and fiber-optic cables” on page 47.

Chapter 6. Hardware maintenance

This chapter contains information to help you solve some of the simpler problems that you might have with your storage subsystem. It contains the problem indicators and error messages along with suggested actions to take to resolve the problem.

For instructions on how to obtain service and technical assistance for your storage subsystem and other IBM products, see “Getting information, help, and service” on page xxii.

General checkout

Use the status LEDs, Symptom-to-FRU index, and the DS4000 Storage Manager client software to diagnose problems. See “Solving problems.”

To diagnose a cluster system, use the cluster problem determination procedure in the *IBM System Storage DS4000 Problem Determination Guide*.

Note: If power was just applied to the storage subsystem, the green and amber LEDs might turn on and off intermittently. Wait up to five minutes for the storage subsystem to finish powering up before you begin to check for faults.

Using the diagnostic hardware

The DS4800 comes with an LC wrap-plug adapter and LC-LC coupler. The wrap-plug adapter and LC-LC coupler are used to perform the loopback test and to identify fibre path problems. See the *IBM System Storage DS4000 Problem Determination Guide* for more information.

The loopback test and the sendEcho test are described in the *IBM System Storage DS4000 Problem Determination Guide*. In the IBM System Storage SAN Integration Server configuration, a loopback adapter (P/N 17P6918) is included to identify path problems on the drive loop when using fibre channel 1.2 m copper cable (P/N 18P5237).

Solving problems

Always use the DS4000 Storage Manager client to diagnose storage subsystem problems and component failures. Also to find solutions to problems that have definite symptoms.

You can use the symptom-to-FRU index (Table 37 on page 170) as a guide for troubleshooting problems in addition to the DS4000 Storage Manager Recovery Guru in the Subsystem Management window. Do not depend solely on Table 37 on page 170 for FRU replacement decision.

See the problem determination maps in the *IBM System Storage DS4000 Problem Determination Guide* for more detailed procedures for problem isolation.

Attention: Do not remove any power supply and fan units, controllers, or interconnect-battery units from the storage subsystem unless the Service Action Allowed LED for the component is lit. Always use the appropriate procedure in Chapter 5, “Replacing components,” on page 143 to prevent an inadvertent shutdown of the DS4800 as a result of removing the DS4800 components in the wrong sequence.

Table 37. DS4800 Symptom-to-FRU index

Problem indicator	Component	Possible cause	Possible solutions
Amber Needs Attention LED on	RAID controller Needs Attention LED	RAID controller offline	<p>If you have placed the controller offline, use the DS4000 Storage Manager client software to place it online.</p> <p>If one controller has been placed offline by the other controller, contact IBM support. (This is the case if you use the DS4000 Storage Manager client software to make repeated attempts to bring an offline controller online, but the controller keeps reverting back to an offline state.)</p>
		RAID controller failure	<p>If the RAID controller Needs Attention LED is on and the Service Action Allowed LED for that RAID controller is lit, replace the RAID controller.</p> <p>If the Service Action Allowed LED for the RAID controller is not lit, perform additional diagnostics to identify other component failures. Replace the other failed components before replacing the RAID controller.</p>
	Drive bypass LED	Fibre-channel cable is not attached to the storage expansion enclosure.	Connect the fibre-channel cable to the enclosure port; check other connections.
		No incoming signal detected.	<p>Reattach the SFPs and fibre-channel cables.</p> <p>Verify that the fibre channel cables are in good condition. For specific handling guidelines, see “Handling fibre-optic cables” on page 48.</p> <p>Verify the SFPs are working properly. Use the wrap-plug coupler kit that ships with the DS4800 and the wrap-plug instructions in the <i>DS4000 Problem Determination Guide</i>.</p> <p>Replace input and output SFPs or cables as necessary.</p>
Amber Needs Attention LED on (continued)	Overall DS4800 Configuration Needs Attention LED (located on interconnect-battery unit)	General system error	Indicates that a Needs Attention LED somewhere in the DS4800 storage subsystem configuration, including all attached storage expansion enclosures, has turned on. (Check for amber LEDs on DS4800 components as well as all attached storage expansion enclosures.) Use the DS4000 Storage Manager software to diagnose server problems.
	Various DS4800 components	Multiple component failures	Do not randomly replace components in the DS4800. This might result in a subsystem shutdown, causing a loss of data availability. Use the DS4000 Storage Manager client program to identify the failed components. Identify and replace the failed power supply and fan unit components first before fixing any other failed components.

Table 37. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs off	All CRUs	Subsystem power is off.	Check that all power cords are plugged in and all power switches are on. If applicable, check that the main circuit breakers for the rack cabinet are turned on.
		AC power failure	Check the main circuit breaker and ac outlet.
		Both power supply and fan units have failed.	Replace the power supply and fan units.
		Both controller circuit breakers have tripped.	Reset the controller circuit breakers.

Table 37. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is on, green LED is off, blue LED is off, and Overall DS4800 Storage Subsystem Needs Attention LED is on	Power supply and fan unit <ul style="list-style-type: none"> Amber Needs Attention LED on Blue Service Action Allowed LED off Green Power LED off 	<ul style="list-style-type: none"> Power switch on a power supply and fan unit is turned off. An electrical outlet circuit breaker has been tripped. There has been an ac power failure. The circuit breaker in the RAID controller associated with this PSF has been tripped. 	<p>Check the power supply and fan unit power switches, circuit breakers, and ac power source.</p> <p>If none of these sources are the cause of the fault, then do not replace the failed power supply and fan unit until you have performed additional diagnostics to determine why the Service Action Allowed LED on the power supply and fan unit is not lit. Call IBM Support if needed.</p>
	Interconnect-battery unit <ul style="list-style-type: none"> Amber Battery Needs Attention LED on the interconnect-battery unit is on Green Battery LED on the power supply and fan unit is off 	Battery failure	Verify the failure using DS4000 Storage Manager Client and replace the failing battery.
	Interconnect-battery unit <ul style="list-style-type: none"> Green Power LED on interconnect-battery unit is off Amber Battery Needs Attention LED on the interconnect-battery unit is on 	Interconnect-battery unit failure or midplane failure	Call IBM support.
	RAID controller <ul style="list-style-type: none"> Amber Controller Needs Attention LED is on. 	Controller failure or controller placed offline	Use DS4000 Storage Manager client software to place the controller online. If the failure persists, do <i>not</i> replace the controller unit. Instead, perform additional diagnostics (such as checking the power supply and fan unit components) to determine what additional failures have caused the associated Service Action Allowed LED on the controller not to light.

Table 37. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is on and blue LED is on, and Overall DS4800 Storage Subsystem Needs Attention LED is on	Power supply and fan unit <ul style="list-style-type: none"> Amber Needs Attention LED on. Blue Service Action Allowed LED on. 	Power supply and fan unit failure or power supply failure	Use DS4000 Storage Manager client software to verify the failure and replace the power supply and fan unit.
	RAID controller <ul style="list-style-type: none"> Amber Controller Needs Attention LED is on. Blue Controller Service Action Allowed LED is on. 	RAID controller offline	<p>If you have placed the controller offline, use the DS4000 Storage Manager client software to place it online.</p> <p>If one controller has been placed offline by the other controller, contact IBM support. (This is the case if you use the DS4000 Storage Manager client software to make repeated attempts to bring an offline controller online, but the controller keeps reverting back to an offline state.)</p>
		RAID controller failure	<p>If the RAID controller Needs Attention LED is on and the Service Action Allowed LED for that RAID controller is lit, replace the RAID controller.</p> <p>If the Service Action Allowed LED for the RAID controller is not lit, perform additional diagnostics to identify other component failures. Replace the other failed components before replacing the RAID controller.</p>
	Interconnect-battery unit <ul style="list-style-type: none"> Amber Needs Attention LED is on. Blue Service Action Allowed LED is on. 	Interconnect-battery unit failure	Contact IBM Support.

Table 37. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more Green LEDs off	Controller Cache LED off	<p>Caching is not enabled or was disabled because:</p> <ul style="list-style-type: none"> The cache memory in controllers A and B is mismatched. The battery is charging or performing a diagnostic test. One of the cache backup battery packs has failed. <p>Or, there are no I/Os being sent to the DS4800.</p>	<p>Enable write-caching using the DS4000 Storage Manager client program.</p> <p>Or:</p> <ul style="list-style-type: none"> Use the DS4000 storage manager client program to verify the cache memory for both controllers. The DS4800 performs battery diagnostic tests and recharges every 25 hours. Write caching is disabled during the test and will be enabled automatically after the test completes. The test duration time varies depending on the recharging requirement, but the duration should be less than 15 minutes. Replace the failing battery. <p>If there are no I/Os being sent to the DS4800, generate I/Os to send to the DS4800.</p>
	Battery LED off and power supply and fan unit Power LED off	The battery is missing.	Verify that the battery is missing. All DS4800s are shipped with both cache battery packs installed. Call IBM support if a cache battery pack is missing and you did not remove any of the cache battery packs from the DS4800.
	L1 and L2 (Link Speed) LEDs for a host port	Fibre channel cable is not attached to the DS4800 host port or the FC device that should be connected to this DS4800 host port.	Connect the fibre channel cable to the enclosure port; check other connections.
		No FC signal detected.	<p>Reattach the SFPs and fibre-channel cables.</p> <p>Verify that the fibre channel cables are in good condition and that there are no cable management issues. For specific handling guidelines, see "Handling fibre-optic cables" on page 48.</p> <p>Verify the SFPs are working properly. Use the wrap-plug coupler kit that ships with the DS4800 and the wrap-plug instructions in the <i>DS4000 Problem Determination Guide</i>.</p> <p>Replace input and output SFPs or cables as necessary.</p>
	L1 and L2 (Link Speed) LEDs of drive port	SFP module failure or SFP module not seated properly.	<p>Reseat the SFP.</p> <p>Verify the SFPs are working properly. Use the wrap-plug coupler kit that ships with the DS4800 and the wrap-plug instructions in the <i>DS4000 Problem Determination Guide</i>.</p> <p>Replace SFPs as necessary.</p>

Table 37. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Only one Blue Service Action Allowed LED is lit with no other amber Needs Attention LEDs lit	Interconnect-battery unit	A command from the DS4800 Subsystem Management window placed the interconnect-battery unit in Identify/Locate mode.	Stop the Identify/Locate action in the DS4800 Subsystem Management window.
Only one Blue Service Action Allowed LED is lit and the amber Needs Attention LED for the same component is lit	Power supply and fan unit, controller, or interconnect-battery unit	The component indicated by both the blue (Service Action Allowed) LED and the amber (Needs Attention) LED has failed and can be replaced.	
Unable to access drives	Expansion drive channel	Fibre-channel cabling has failed.	Ensure that the fibre-channel cables are undamaged and properly connected. For specific handling guidelines, see “Handling fibre-optic cables” on page 48.
		RAID controller has failed.	Replace the RAID controller.
		An SFP module has failed.	Ensure the SFP module is seated properly; replace the SFP module.
		You have connected more than eight expansion enclosures to the ports of the drive channel. Even though the drive channel is dual-ported, the DS4800 currently does not support more than 112 drives per drive channel.	Power down the DS4800 and its storage expansion enclosures. Recable the expansion enclosures with a maximum of eight expansion enclosures per drive channel.

Table 37. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
The DS4000 Storage Manager client Enterprise Management window sees each storage subsystem controller as an independent storage subsystem or a partially managed device.	Controller	If this condition occurs after you have replaced a controller, the controller firmware for the replacement controller probably failed to synchronize with the firmware on the existing controller.	To recover, perform the following steps: <ol style="list-style-type: none"> 1. Remove and reinsert the controller blade. 2. Wait 5 minutes. 3. Delete the controller entry with the incorrect firmware version from the DS4000 Storage Manager Enterprise Management window. 4. Add the controller back to the DS4000 Storage Manager Enterprise Management window using the Add Device menu option in the Enterprise Management window. 5. If the DS4000 Storage Manager client Enterprise Management window still shows each storage subsystem controller as an independent storage subsystem or a partially managed device, contact IBM support for instructions on how to force firmware synchronization in the replacement controller.
		The DS4800 has been powered on without a connection to at least one storage expansion enclosure populated with at least two drives.	If this is the case, power off the DS4800 and connect at least one storage expansion enclosure populated with at least two drives.
		The attached storage expansion enclosures and/or drives in the attached storage expansion enclosures are not certified or not supported by the DS4800.	The DS4800 will not recognize non-IBM storage expansion enclosures and drive models. If you are positive that storage expansion enclosures and drives are of IBM models, obtain the DS4800 Subsystem Profile and call IBM support.
Random errors	Subsystem	Midplane has failed	Contact IBM Support.

Note: If you cannot find the problem in the Symptom-to-FRU index, test the entire system.

Parts list

Figure 103 on page 177 and the following table provide a parts list for the DS4800.

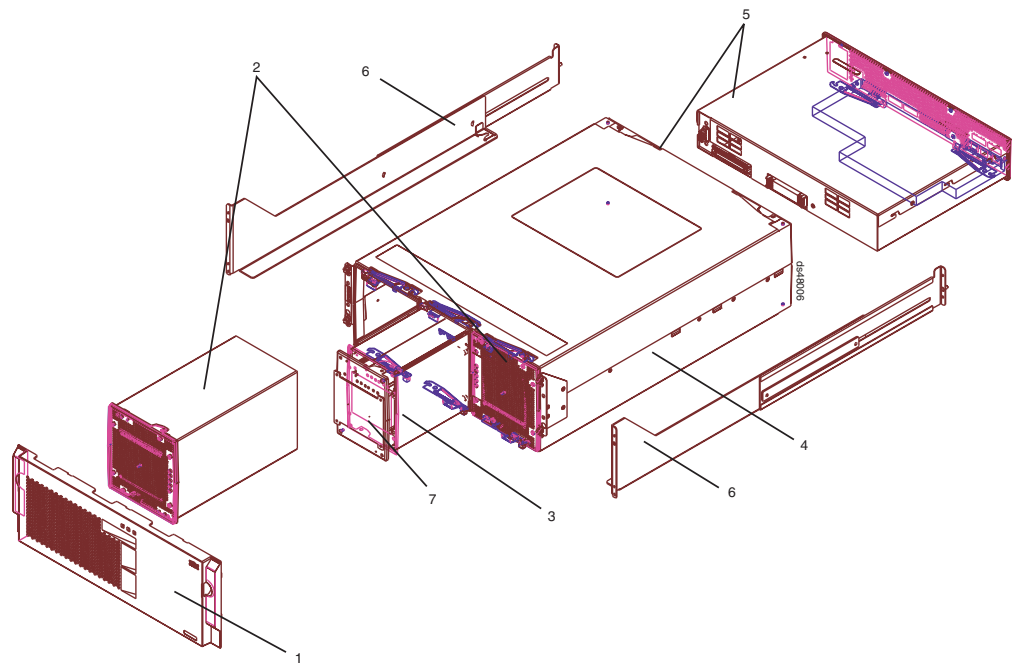


Figure 103. DS4800 parts list

Table 38. Parts list (System Storage DS4800 Storage Subsystem)

Index	DS4800 Storage Subsystem	FRU P/N
1	DS4800 bezel assembly	22R4271
2	DS4800 power supply and fan unit	23R1496
3	DS4800 interconnect-battery unit (with plate and without batteries)	23R0532
4	DS4800 chassis	23R1980 (Model 80H) 23R1982 (Model 80A Non Korea) 23R1981 (Model 80A Korea) 22R4272 (Model 82H) 22R4491 (Model 84H) 22R4493 (Model 82A Non Korea) 22R4494 (Model 82A Korea) 22R4495 (Model 84H Non Korea) 22R4496 (Model 84H Korea) 23R0531 (Model 88H) 23R0529 (Model 88A Non Korea) 23R0530 (Model 88A Korea)

Table 38. Parts list (System Storage DS4800 Storage Subsystem) (continued)

Index	DS4800 Storage Subsystem	FRU P/N
5	DS4800 RAID controller, 2 GB memory, Model 80A/H	23R1983
	DS4800 RAID controller, 2 GB memory, Model 82A/H	23R0535
	DS4800 RAID controller, 4 GB memory, Model 84A/H	23R0536
	DS4800 RAID controller, 8 GB memory, Model 88A/H	23R0537
6	DS4800 mounting rail assembly	22R4839
7	DS4800 battery cover/plate with 4 screws	22R4874
	DS4800 battery	22R4875
	LC wrap plug assembly	24P0950
	LC-SC fibre channel cable adapter	19K1268
	Power cord, 2.8-meter (9-ft.)	6952300
	Power cord, line jumper, high voltage	36L8886
	4-Gbps SFP module	77P2964
	Cable, 1-meter fiber-optic	19K1265
	Cable, 5-meter fiber-optic	19K1266
	Cable, 25-meter fiber-optic	19K1267

Appendix A. Additional DS4000 documentation

The following tables present an overview of the IBM System Storage DS4000 Storage Manager, Storage Subsystem, and Storage Expansion Enclosure product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address.

You can access the documents listed in these tables at both of the following Web sites:

www.ibm.com/servers/storage/support/disk/

www.ibm.com/shop/publications/order/

DS4000 Storage Manager Version 10 library

Table 39 associates each document in the DS4000 Version 10 Storage Manager library with its related common user tasks.

Table 39. DS4000 Storage Manager Version 10 titles by user tasks

Title	User tasks					
	Planning	Hardware installation	Software installation	Configuration	Operation and administration	Diagnosis and maintenance
<i>IBM System Storage DS4000 Storage Manager Installation and Host Support Guide for Windows 2000/Server 2003/2008, NetWare, VMWare ESX Server, and Linux</i>	✓		✓	✓		
<i>IBM System Storage DS4000 Storage Manager Installation and Host Support Guide for AIX, UNIX, Solaris, and Linux on POWER</i>	✓		✓	✓		
<i>IBM System Storage DS4000 Storage Manager Copy Services User's Guide</i>	✓		✓	✓	✓	
<i>IBM System Storage DS4000 Storage Manager Concepts Guide</i>	✓	✓	✓	✓	✓	✓

Table 39. DS4000 Storage Manager Version 10 titles by user tasks (continued)

Title	User tasks					
	Planning	Hardware installation	Software installation	Configuration	Operation and administration	Diagnosis and maintenance
IBM System Storage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview	✓	✓	✓	✓		

DS4800 Storage Subsystem library

Table 40 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 40. DS4800 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM System Storage DS4800 Storage Subsystem Installation, User's and Maintenance Guide	✓	✓		✓	✓	✓
IBM System Storage Quick start guide, Quick reference for the DS4800		✓	✓	✓		
IBM TotalStorage DS4800 Controller Cache Upgrade Kit Instructions	✓	✓		✓		

DS4700 Storage Subsystem library

Table 41 associates each document in the DS4700 Storage Subsystem library with its related common user tasks.

Table 41. DS4700 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4700 Storage Subsystem Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage Quick start guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i>		✓	✓	✓		

DS4500 Storage Subsystem library

Table 42 associates each document in the DS4500 (previously FASiT900) Storage Subsystem library with its related common user tasks.

Table 42. DS4500 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4500 Storage Subsystem Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4500 Storage Subsystem Cabling Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4500 Rack Mounting Instructions</i>	✓	✓				

DS4400 Storage Subsystem library

Table 43 associates each document in the DS4400 (previously FAStT700) Storage Subsystem library with its related common user tasks.

Table 43. DS4400 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4400 Fibre Channel Storage Server User's Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4400 Fibre Channel Storage Server Installation and Support Guide</i>	✓	✓		✓	✓	
<i>IBM TotalStorage DS4400 Fibre Channel Cabling Instructions</i>	✓	✓				

DS4300 Storage Subsystem library

Table 44 associates each document in the DS4300 (previously FASiT600) Storage Subsystem library with its related common user tasks.

Table 44. DS4300 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4300 Storage Subsystem Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4300 Rack Mounting Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4300 Storage Subsystem Cabling Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4300 SCU Base Upgrade Kit</i>		✓	✓			
<i>IBM TotalStorage DS4300 SCU Turbo Upgrade Kit</i>		✓	✓			
<i>IBM TotalStorage DS4300 Turbo Models 6LU/6LX Upgrade Kit</i>		✓	✓			

DS4200 Express Storage Subsystem library

Table 45 associates each document in the DS4200 Express Storage Subsystem library with its related common user tasks.

Table 45. DS4200 Express Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4200 Express Storage Subsystem Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage Quick start guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i>		✓	✓	✓		

DS4100 Storage Subsystem library

Table 46 associates each document in the DS4100 (previously FASiT100) Storage Subsystem library with its related common user tasks.

Table 46. DS4100 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4100 Storage Server Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4100 Storage Server Cabling Guide</i>		✓				

DS4000 Storage Expansion Enclosure documents

Table 47 associates each of the following documents with its related common user tasks.

Table 47. DS4000 Storage Expansion Enclosure document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4000 EXP810 Storage Expansion Enclosure Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage Quick start guide, Quick reference for the DS4700 and DS4200, Sections 2, 3, and 4 also for installing the EXP810 and EXP420</i>		✓	✓	✓		
<i>IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM DS4000 EXP500 Installation and User's Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4000 EXP420 Storage Expansion Enclosure Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide</i>	✓	✓				

Other DS4000 and DS4000-related documents

Table 48 associates each of the following documents with its related common user tasks.

Table 48. DS4000 and DS4000-related document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM Safety Information</i>					✓	
<i>IBM TotalStorage DS4000 Hardware Maintenance Manual</i> ¹						✓
<i>IBM System Storage DS4000 Problem Determination Guide</i>						✓
<i>IBM Fibre Channel Planning and Integration: User's Guide and Service Information</i>	✓	✓			✓	✓
<i>IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide</i>		✓			✓	
<i>IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide</i>		✓			✓	
<i>IBM Netfinity® Fibre Channel Cabling Instructions</i>		✓				
<i>IBM Fibre Channel SAN Configuration Setup Guide</i>	✓		✓	✓	✓	

Notes:

1. The *IBM TotalStorage DS4000 Hardware Maintenance Manual* does not contain maintenance information for the IBM System Storage DS4100, DS4200, DS4300, DS4500, DS4700, or DS4800 storage subsystems. You can find maintenance information for these products in the *IBM System Storage DSx000 Storage Subsystem Installation, User's, and Maintenance Guide* for the particular subsystem.

Appendix B. Records

Whenever you add options to your DS4800, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other options and provide needed data whenever you contact your IBM technical support representative.

Identification numbers

Record and retain the following information. The machine type, model number, and serial number are located on top of each RAID controller unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 104.

Product name:	IBM System Storage DS4800 Storage Subsystem
Machine type:	1815
Model number:	
Serial number:	
RAID controller MAC addresses:	
Controller firmware version:	

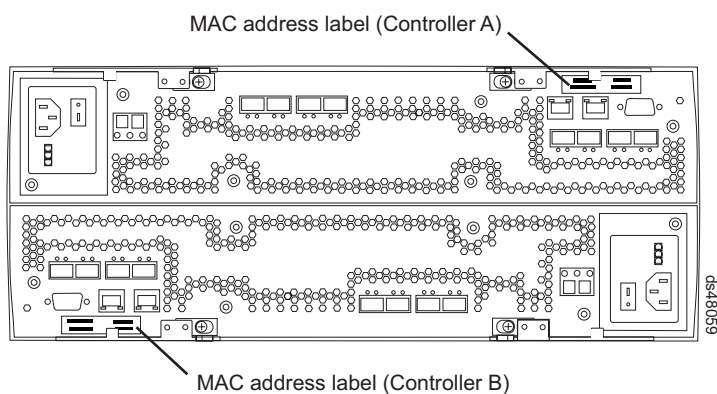


Figure 104. Location of MAC address labels

Appendix C. Rack mounting templates

This appendix provides duplicate copies of the rack mounting templates. If you want to tear out the templates from this document for easier use, use these copies rather than those provided in “Installing the support rails” on page 32.

Use the following templates (Figure 105 on page 192 and Figure 106 on page 193) to identify the proper locations for inserting M5 screws when mounting the support rails and DS4800 in a rack cabinet. The locations for the M5 screws are highlighted in the templates.

The DS4800 is 4 U high. Align the template with the rack at a U boundary. U boundaries are shown as horizontal dashed lines in the rack mounting templates.

Note: The mounting holes that are shown in the following templates are square. The holes in your rack cabinet might be round or square.

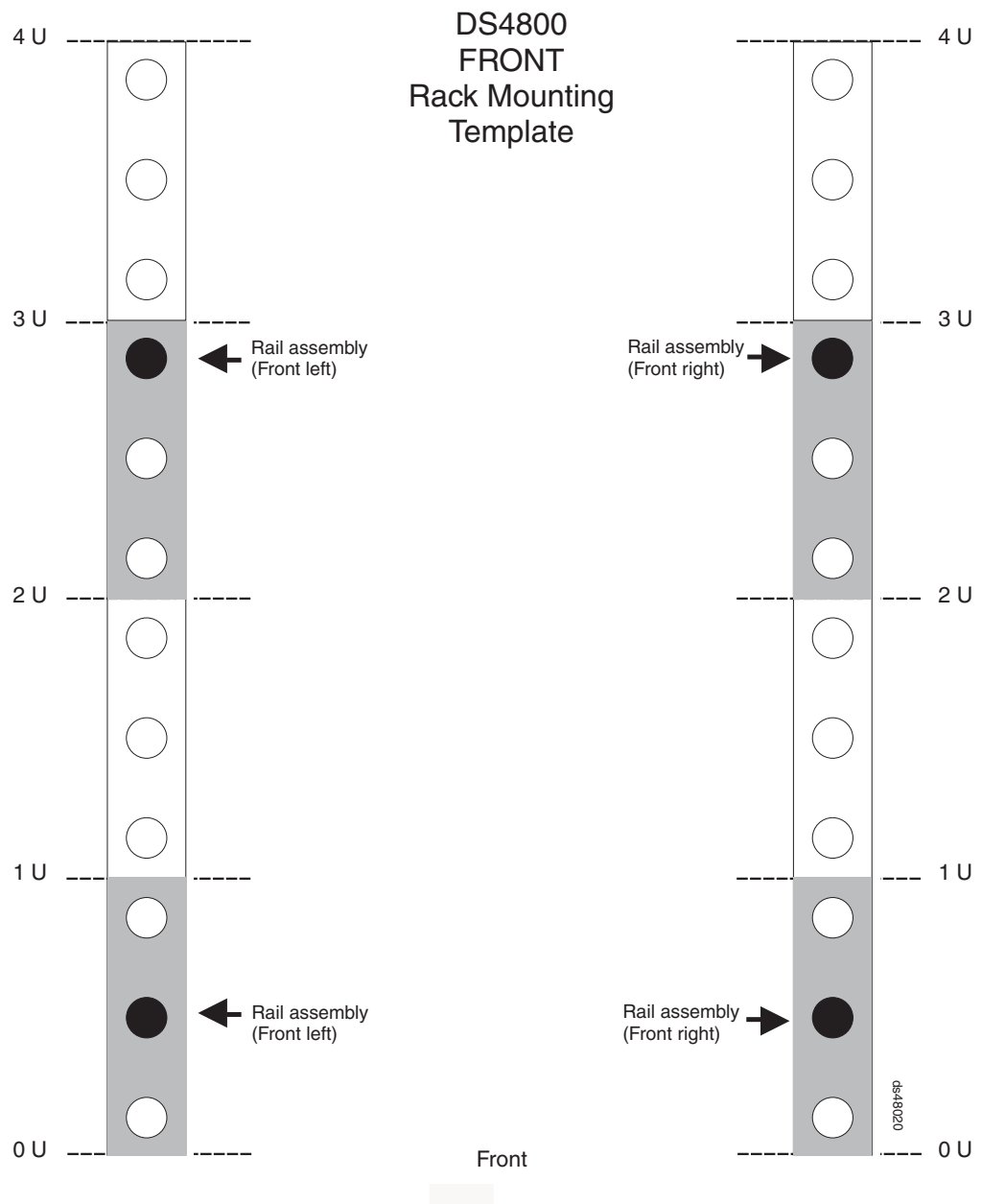


Figure 105. DS4800 front rack mounting template

Appendix D. Power cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet.

IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country or region are usually available only in that country or region.

IBM power cord part number	Cord specifics	Used in these countries or regions
13F9940	250V/10A 2.8M	Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea
39Y7917	250V/10A 2.8M	Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Democratic Republic of), Congo (Republic of), Cote D'Ivoire (Ivory Coast), Croatia (Republic of), Czech Rep, Dahomey, Djibouti, Egypt, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, French Guyana, French Polynesia, Gabon, Georgia, Germany, Greece, Guadeloupe, Guinea, Guinea Bissau, Hungary, Iceland, Indonesia, Iran, Kazakhstan, Kyrgyzstan, Laos (Peoples Democratic Republic of), Latvia, Lebanon, Lithuania, Luxembourg, Macedonia (former Yugoslav Republic of), Madagascar, Mali, Martinique, Mauritania, Mauritius, Mayotte, Moldova (Republic of), Monaco, Mongolia, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Reunion, Romania, Russian Federation Rwanda, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia (Republic of), Somalia, Spain, Suriname, Sweden, Syrian Arab Replublic, Tajikistan, Tahiti, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Upper Volta, Uzbekistan, Vanuatu, Vietnam, Wallis and Futuna, Yugoslavia (Federal Republic of), Zaire
39Y7918	250V/10A 2.8M	Denmark

IBM power cord part number	Cord specifics	Used in these countries or regions
39Y7922	250V/10A 2.8M	Bangladesh, Lesotho, Macao, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda
39Y7923	250V/10A 2.8M	Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, Cyprus, Dominica, Gambia, Ghana, Grenada, Guyana, Hong Kong S.A.R. of China, Iraq, Ireland, Jordan, Kenya, Kuwait, Liberia, Malawi, Malaysia, Malta, Myanmar (Burma), Nigeria, Oman, Qatar, Saint Kitts & Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, Sudan, Tanzania (United Republic of), Trinidad & Tobago, United Arab Emirates (Dubai), United Kingdom, Yemen, Zambia, Zimbabwe
39Y7919	250V/10A 2.8M	Liechtenstein, Switzerland
39Y7921	250V/10A 2.8M	Chile, Italy, Libyan Arab Jamahiriya
39Y7920	250V/10A 2.8M	Israel
39Y7931	250V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Caicos Islands, Canada, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Taiwan, United States, Venezuela
36L8880	250V/10A 2.8M	Argentina, Paraguay, Uruguay
02K0546	250V/6A 2.8M	PRC (China)
6952300	125V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Taiwan, Thailand, Turks and Caicos Islands, United States, Venezuela
6952301	125V/10A 1.8M	

Appendix E. Accessibility

This section provides information about alternate keyboard navigation, which is a DS4000 Storage Manager accessibility feature. Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

By using the alternate keyboard operations that are described in this section, you can use keys or key combinations to perform Storage Manager tasks and initiate many menu actions that can also be done with a mouse.

Note: In addition to the keyboard operations that are described in this section, the DS4000 Storage Manager version 9.14 - 10.10 (and later) software installation packages for Windows include a screen reader software interface.

To enable the screen reader, select Custom Installation when using the installation wizard to install Storage Manager 9.14 - 10.10 (or later) on a Windows host/management station. Then, in the Select Product Features window, select Java Access Bridge in addition to the other required host software components.

Table 49 defines the keyboard operations that enable you to navigate, select, or activate user interface components. The following terms are used in the table:

- *Navigate* means to move the input focus from one user interface component to another.
- *Select* means to choose one or more components, typically for a subsequent action.
- *Activate* means to carry out the action of a particular component.

Note: In general, navigation between components requires the following keys:

- **Tab** - Moves keyboard focus to the next component or to the first member of the next group of components
- **Shift-Tab** - Moves keyboard focus to the previous component or to the first component in the previous group of components
- **Arrow keys** - Move keyboard focus within the individual components of a group of components

Table 49. DS4000 Storage Manager alternate keyboard operations

Short cut	Action
F1	Open the Help.
F10	Move keyboard focus to main menu bar and post first menu; use the arrow keys to navigate through the available options.
Alt+F4	Close the management window.
Alt+F6	Move keyboard focus between dialogs (non-modal) and between management windows.

Table 49. DS4000 Storage Manager alternate keyboard operations (continued)

Short cut	Action
Alt+ underlined letter	<p>Access menu items, buttons, and other interface components by using the keys associated with the underlined letters.</p> <p>For the menu options, select the Alt + underlined letter combination to access a main menu, and then select the underlined letter to access the individual menu item.</p> <p>For other interface components, use the Alt + underlined letter combination.</p>
Ctrl+F1	Display or conceal a tool tip when keyboard focus is on the toolbar.
Spacebar	Select an item or activate a hyperlink.
Ctrl+Spacebar (Contiguous/Non-contiguous) AMW Logical/Physical View	<p>Select multiple drives in the Physical View.</p> <p>To select multiple drives, select one drive by pressing Spacebar, and then press Tab to switch focus to the next drive you want to select; press Ctrl+Spacebar to select the drive.</p> <p>If you press Spacebar alone when multiple drives are selected then all selections are removed.</p> <p>Use the Ctrl+Spacebar combination to deselect a drive when multiple drives are selected.</p> <p>This behavior is the same for contiguous and non-contiguous selection of drives.</p>
End, Page Down	Move keyboard focus to the last item in the list.
Esc	Close the current dialog (does not require keyboard focus).
Home, Page Up	Move keyboard focus to the first item in the list.
Shift+Tab	Move keyboard focus through components in the reverse direction.
Ctrl+Tab	Move keyboard focus from a table to the next user interface component.
Tab	Navigate keyboard focus between components or select a hyperlink.
Down arrow	Move keyboard focus down one item in the list.
Left arrow	Move keyboard focus to the left.
Right arrow	Move keyboard focus to the right.
Up arrow	Move keyboard focus up one item in the list.

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Processor speeds indicate the internal clock speed of the microprocessor; other factors also affect application performance.

CD-ROM drive speeds list the variable read rate. Actual speeds vary and are often less than the maximum possible.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for approximately 1000 bytes, MB stands for approximately 1 000 000 bytes, and GB stands for approximately 1 000 000 000 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity may vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives available from IBM.

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Battery return program

This product may contain a sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, see <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and battery packs from IBM equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Have the IBM part number listed on the battery available prior to your call.

In the Netherlands, the following applies.



For Taiwan: Please recycle batteries.



廢電池請回收

Electronic emission notices

This section gives the electronic emission notices or statements for the United States and other countries or regions.

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, 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 user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Chinese class A compliance statement

Attention: This is a class A statement. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

中华人民共和国“A类”警告声明

声明

此为A级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，可能需要用户对其干扰采取切实可行的措施。

Industry Canada Class A emission compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A statement

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

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to CISPR 22/European Standard EN 55022. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

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

Taiwanese Class A warning statement

警告使用者：
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。

Japanese Voluntary Control Council for Interference (VCCI) 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。

Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM TotalStorage DS4000 publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following Web site:

www.ibm.com/ibm/terminology

This glossary also includes terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- *IBM Glossary of Computing Terms*. New York: McGraw-Hill, 1994.

The following cross-reference conventions are used in this glossary:

See Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also

Refers you to a related term.

Abstract Windowing Toolkit (AWT). A Java graphical user interface (GUI).

accelerated graphics port (AGP). A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access volume. A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter. A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the

host system and the external fibre-channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture. A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent. A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP. See *accelerated graphics port*.

AL_PA. See *arbitrated loop physical address*.

arbitrated loop. One of three existing fibre-channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA). An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array. A collection of fibre-channel or SATA hard drives that are logically grouped together. All the drives in the array are assigned the same RAID level. An array is sometimes referred to as a "RAID set." See also *redundant array of independent disks (RAID)*, *RAID level*.

asynchronous write mode. In remote mirroring, an option that allows the primary controller to return a write I/O request completion to the host server before data has been successfully written by the secondary controller. See also *synchronous write mode*, *remote mirroring*, *Global Copy*, *Global Mirroring*.

AT. See *advanced technology (AT) bus architecture*.

ATA. See *AT-attached*.

AT-attached. Peripheral devices that are compatible with the original IBM AT computer standard in which signals on a 40-pin AT-attached (ATA) ribbon cable followed the timings and constraints of the Industry Standard Architecture (ISA) system bus on the IBM PC AT computer. Equivalent to integrated drive electronics (IDE).

auto-volume transfer/auto-disk transfer (AVT/ADT).

A function that provides automatic failover in case of controller failure on a storage subsystem.

AVT/ADT. See *auto-volume transfer/auto-disk transfer*.

AWT. See *Abstract Windowing Toolkit*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

bootstrap protocol (BOOTP). In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge. A storage area network (SAN) device that provides physical and transport conversion, such as Fibre Channel to small computer system interface (SCSI) bridge.

bridge group. A bridge and the collection of devices connected to it.

broadcast. The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT). A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client. A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command. A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string. The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download. A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

customer replaceable unit (CRU). An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC). (1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type. Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the Fibre Channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

drive channels. The DS4200, DS4700, and DS4800 subsystems use dual-port drive channels that, from the physical point of view, are connected in the same way as two drive loops. However, from the point of view of the number of drives and enclosures, they are treated as a single drive loop instead of two different drive loops. A group of storage expansion enclosures are connected to the DS4000 storage subsystems using a drive channel from each controller. This pair of drive channels is referred to as a redundant drive channel pair.

drive loops. A drive loop consists of one channel from each controller combined to form one pair of redundant drive channels or a redundant drive loop. Each drive loop is associated with two ports. (There are two drive channels and four associated ports per controller.) For the DS4800, drive loops are more commonly referred to as drive channels. See *drive channels*.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister. A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

error correction coding (ECC). A method for encoding data so that transmission errors can be detected and corrected by examining the data on the

receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

automatic ESM firmware synchronization. When you install a new ESM into an existing storage expansion enclosure in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, the firmware in the new ESM is automatically synchronized with the firmware in the existing ESM.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N_ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FC. See *Fibre Channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

Fibre Channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel

(FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as "Asynchronous Mirroring without Consistency Group." Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode*, *Global Mirroring*, *remote mirroring*, *Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as "Asynchronous Mirroring with Consistency Group." Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode*, *Global Copy*, *remote mirroring*, *Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface*.

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

heterogeneous host environment. A host system in which multiple host servers, which use different operating systems with their own unique disk storage subsystem settings, connect to the same DS4000 storage subsystem at the same time. See also *host*.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all

logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC). In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring. This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB. See *management information base*.

micro channel architecture (MCA). Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS). MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub. An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant Fibre Channel connections from the host computers, either directly or through a Fibre Channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port*, *gigabit interface converter (GBIC)*, *small form-factor pluggable (SFP)*.

mirroring. A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

parity check. (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry

Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks (RAID)*.

RAID level. An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array*, *redundant array of independent disks (RAID)*.

RAID set. See *array*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array*, *parity check*, *mirroring*, *RAID level*, *striping*.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring*, *Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, AIX, HP-UX, Solaris, and Linux on POWER host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and storage expansion enclosures in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, AIX, HP-UX, Solaris, and Linux on POWER host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

small computer system interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between

optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP. See *Simple Network Management Protocol* and *SNMPv1*.

SNMP trap event. (1) (2) An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1. The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

static random access memory (SRAM). Random access memory based on the logic circuit known as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP). A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological

elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping. Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

WORM. See *write-once read-many*.

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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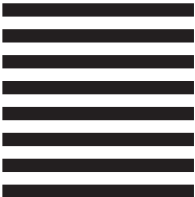
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