IBM System Storage DS4000 EXP810
Storage Expansion Enclosure

# Installation, User's and Maintenance Guide

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> **Note:**
> Before using this information and the product it supports, be sure to read the general information in "Notices" on page 139.

**First Edition (February 2006)**

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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 EXP810 storage expansion enclosure. 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.

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: |
|---|---|
| 1. Turn everything OFF. | 1. Turn everything OFF. |
| 2. First, attach all cables to devices. | 2. First, remove power cords from outlet. |
| 3. Attach signal cables to connectors. | 3. Remove signal cables from connectors. |
| 4. Attach power cords to outlet. | 4. Remove all cables from devices. |
| 5. Turn device ON. | |

**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 Laserlaite
Apparell À Laser de Calsse 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.**
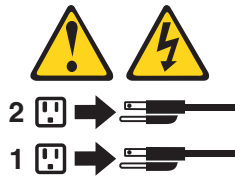
**Statement 8:**



**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.**

**Cable Warning:**

**WARNING:** 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.**

# About this document

This document provides instructions for installing and customizing the configuration of your IBM® System Storage® DS4000 EXP810 storage expansion enclosure. It also provides 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 EXP810 storage expansion enclosure. This chapter includes an inventory checklist and an overview of the storage expansion enclosure features, operating specifications, and components.

Chapter 2, "Installing the EXP810," on page 19 contains information on how to install the EXP810.

Chapter 3, "Cabling the EXP810," on page 37 contains information on how to cable the EXP810.

Chapter 4, "Operating the EXP810," on page 51 contains information on how to power on and off the storage expansion enclosure, recover from an overheated power supply-fan, troubleshoot the storage expansion enclosure, and interpret LEDs.

Chapter 5, "Installing and replacing devices," on page 69 contains step-by-step instructions about how to install or remove customer replaceable units (CRUs), such as hard disk drives, power supply-fans, environmental services modules (ESMs), midplane, and SFP modules.

Chapter 6, "Hardware maintenance," on page 95 describes problems and symptoms that are specific to your storage expansion enclosure. It also provides a parts list for the EXP810.

Appendix A, "Upgrading the DS4000 controller firmware," on page 101 contains instructions for how to upgrade the existing EXP810 ESM firmware.

Appendix B, "Records," on page 111 provides a table that you can use to record and update important information about your EXP810, including serial number and device records. Whenever you add options to your EXP810, be sure to update the information in this table.

Appendix C, "Rack mounting template," on page 115 provides the rack mounting templates for installation of the EXP810. 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 119 lists power cord information for the EXP810.

Appendix E, "Additional DS4000 documentation," on page 123 lists additional DS4000 documents.

Appendix F, "Accessibility," on page 131 details accessibility information.

Appendix G, "European Directive About Product Recycling and Disposal," on page 133 details the European directive about product recycling.

"Battery return program" on page 141 details the battery return program.

## 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.

**See also:** The *DS4000 Storage Server and Storage Expansion Enclosure Quick Start Guide* provides an excellent overview of the installation process.

*Table 1. Where to find DS4000 installation and configuration procedures*

| | Installation task | Where to find information or procedures |
|---|---|---|
| 1 | Plan the installation | • DS4000 Storage Manager Concepts Guide<br>• DS4000 Storage Manager Installation and Support Guide for AIX®, HP-UX, Solaris and Linux® on POWER™<br>• DS4000 Storage Manager Installation and Support Guide for Windows® 2000/Server 2003, NetWare, ESX Server, and Linux<br>• DS4100 Storage Server Installation, User's, and Maintenance Guide<br>• DS4300 Fibre Channel Storage Server Installation and User's Guide<br>• DS4400 Fibre Channel Storage Server Installation and Support Guide<br>• DS4500 Fibre Channel Storage Server Installation and Support Guide<br>• DS4800 Storage Subsystem Installation, User's, and Maintenance Guide |
| 2 | Mount the DS4000 storage subsystem in the rack | • DS4800 Installation, User's, and Maintenance Guide<br>• DS4400 and DS4500 Rack Mounting Instructions<br>• DS4300 Rack Mounting Instructions<br>• DS4100 Installation, User's and Maintenance Guide |
| 3 | Mount the DS4000 EXP storage expansion unit in the rack | • DS4000 EXP100 Storage Expansion Unit Installation, User's and Maintenance Guide<br>• DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide<br>• DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide<br>• FAStT EXP500 Installation and User's Guide |

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

| | Installation task | Where to find information or procedures |
|---|---|---|
| 4 | Route the storage expansion unit Fibre Channel cables | • DS4100 Fibre Channel Cabling Instructions<br>• DS4300 Fibre Channel Cabling Instructions<br>• DS4400 Fibre Channel Cabling Instructions<br>• DS4500 Fibre Channel Cabling Instructions<br>• DS4800 Installation, User's, and Maintenance Guide |
| 5 | Route the host server Fibre Channel cables | • DS4100 Fibre Channel Cabling Instructions<br>• DS4300 Fibre Channel Cabling Instructions<br>• DS4400 Fibre Channel Cabling Instructions<br>• DS4500 Fibre Channel Cabling Instructions<br>• DS4800 Installation, User's, and Maintenance Guide |
| 6 | Power up the subsystem | • DS4100 Storage Server Installation, User's, and Maintenance Guide<br>• DS4300 Fibre Channel Storage Server Installation and User's Guide<br>• DS4400 Fibre Channel Storage Server Installation and Support Guide<br>• DS4500 Fibre Channel Storage Server Installation and Support Guide<br>• DS4800 Storage Subsystem Installation, User's, and Maintenance Guide |
| 7 | Configure DS4000 network settings | • DS4100 Storage Server Installation, User's, and Maintenance Guide<br>• DS4300 Fibre Channel Storage Server Installation and User's Guide<br>• DS4400 Fibre Channel Storage Server Installation and Support Guide<br>• DS4500 Fibre Channel Storage Server Installation and Support Guide<br>• DS4800 Storage Subsystem Installation, User's, and Maintenance Guide<br>• DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER<br>• DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux<br>• DS4000 Storage Manager online help |
| 8 | Zone the fabric switch (SAN-attached only) | • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER<br>• DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux<br>• DS4000 Storage Manager Copy Services Guide (describes switch zoning for the Remote Mirror Option)<br>• 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 | • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER<br>• DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux<br>• 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 | • DS4100 Storage Server Installation, User's, and Maintenance Guide<br>• DS4300 Fibre Channel Storage Server Installation and User's Guide<br>• DS4400 Fibre Channel Storage Server Installation and Support Guide<br>• DS4500 Fibre Channel Storage Server Installation and Support Guide<br>• DS4800 Storage Subsystem Installation, User's, and Maintenance Guide |
| 15 | Enable DS4000 Storage Manager premium feature keys | **Copy Services premium features**<br>　　　DS4000 Storage Manager Copy Services Guide<br><br>**FC/SATA Intermix premium feature**<br>　　　DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview<br><br>**Storage Partitioning (and general premium features information)**<br>　　• DS4000 Storage Manager Concepts Guide<br>　　• DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER<br>　　• DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux |
| 16 | Configure arrays and logical drives | • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER<br>• DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux<br>• 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 IBM @server xSeries® or IntelliStation® system, and whom to call for service, if it is necessary.

## Before you call

Before you call, make sure that you have taken 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 following Web site:

  www.ibm.com/servers/storage/support/disk/
- 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 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 xSeries and IntelliStation systems, 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 the xSeries or IntelliStation system and preinstalled software, if any, is available in the documents that come with your system. This includes printed documents, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions on how to use the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software.

## Web sites

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/

  The support page has many sources of information and ways for you to solve problems, including:
  - Diagnosing problems using the IBM Online Assistant
  - Downloading the latest device drivers and updates for your products
  - Viewing frequently asked questions (FAQ)
  - Viewing hints and tips to help you solve problems
  - Participating in IBM discussion forums
  - Setting up e-mail notification of technical updates about your products

- You can order publications through the IBM Publications Ordering System at the following web site:

  www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi/
- For the latest information about IBM xSeries products, services, and support, go to the following Web site:

  www.ibm.com/eserver/xseries/
- For the latest information about IBM pSeries® products, services, and support, go to the following Web site: www.ibm.com/eserver/pseries/
- For the latest information about the IBM IntelliStation information, go to the following Web site:

  www-132.ibm.com/content/home/store_IBMPublicUSA/

  en_US/IntelliStation_workstations.html
- 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

## Software service and support

Through IBM Support Line, for a fee you can get telephone assistance with usage, configuration, and software problems with xSeries servers, IntelliStation workstations, and appliances. 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

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- Internet: starpubs@us.ibm.com
- IBMLink™ from U.S.A.: STARPUBS at SJEVM5
- IBMLink from Canada: STARPUBS at TORIBM
- IBM Mail Exchange: USIB3WD at IBMMAIL

You can also mail your comments by using the Reader Comment Form in the back of this manual or direct your mail to:

International Business Machines Corporation
Information Development
Dept. GZW
9000 South Rita Road
Tucson, AZ 85744–0001
U.S.A.

# Chapter 1. Introduction

This chapter describes the operating specifications, features, and components for the IBM System Storage EXP810 storage expansion enclosure (hereafter referred to as *EXP810* or *storage expansion enclosure*). This chapter also includes a list of hardware that comes with the storage expansion enclosure.

## Overview

The IBM System Storage DS4000 EXP810 storage expansion enclosure (Machine Type 1812, Models 81A and 81H) provides high-capacity, fibre channel disk storage. The storage expansion enclosure delivers fast, high-volume data transfer, retrieval, and storage functions for multiple drives to multiple hosts. The storage expansion enclosure provides continuous, reliable service, using hot-swap technology for easy replacement without shutting down the system and support redundant, dual-loop configurations. External cables and Small Form-Factor Pluggable (SFP) modules connect the DS4000 storage subsystem to the storage expansion enclosure.

The EXP810 is a rack-mountable enclosure that supports up to 16 2 Gbps fibre-channel 300 GB disk drive modules, offering up to 4.8 terabytes (TB) of capacity per enclosure. Coupled with a DS4000 storage subsystem such as the DS4800, you can configure RAID-protected storage solutions of up to 67.2 TB, providing economical and scalable storage for your rapidly growing application needs for limited access, data reference storage capacity.

The EXP810 uses the latest fibre channel technology and is designed with redundant 2 or 4 Gbps Fibre Channel connections to the DS4000 storage subsystem offering reliability and performance.

**Note:** The initial release of the EXP810 supports only 2 Gbps fibre channel hard drives or intermixing with EXP100 drive expansion enclosures in the same DS4000 storage subsystem configuration. Contact IBM Support for information about 4 Gbps fibre channel or SATA hard drive support in the future.

The EXP810 supports redundant, dual-loop configurations with the DS4000s and other EXP810 and EXP710 enclosures. External cables and small form-factor pluggable (SFP) modules connect the controller to the storage expansion enclosure. EXP810s attached to supported DS4000s can be used with storage area networks to satisfy the needs of various fixed content, data reference applications that require large amounts of storage capacity but do not have the high utilization and access characteristics satisfied by Fibre Channel disk drive storage. The storage expansion enclosure provides continuous, reliable service and uses hot-swap technology for easy replacement without the need to shut down the system. Up to seven EXP810 units can be connected together in a fibre-channel loop, providing connections to a maximum of 112 hard drives.

## Operating system support

Microsoft® Windows 2000 Server and Advance Server, Microsoft Windows 2003 Server and Enterprise Edition, Sun®Solaris, IBM AIX, RedHat Enterprise Linux Server, and SuSE Linux Enterprise Server are the supported operating systems for host servers that have mapped LUNs created in the DS4000 with EXP810 drive expansion enclosures. See the latest DS4000 Storage Manager host software

**1**

readme file and the IBM DS4000 series products interoperability matrix at the following Web site for additional host operating system support:

www.storage.ibm.com/disk/fastt/supserver.htm

# 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 devices can be supported, compared to 15 small computer system interface (SCSI) devices. The connection from the DS4000 to the EXP810 is a 2 Gbps fibre-channel device that supports data transfer rates up to 200 MBps half-duplex and 400 MBps full-duplex on optical interfaces.

# Inventory checklist

The EXP810 ships with the following items:
- Power cables (2 jumper line cords)
- One rack-mounting hardware kit, including:
  - Two rails (right and left assembly)
  - Twelve M5 black hex-head slotted screws
  - Eight washers
- 16 blank trays (your storage expansion enclosure might come with up to 16 hard disk drives)
- Box ID labels (used to label the enclosure IDs on the front of the EXP810)
- *DS4000 Storage Server Controller Firmware Version 6.16 Support for DS4000 EXP810 Fibre-Channel Storage Expansion Enclosure* CD

A rack mounting template and instructions for installing the support rails and the storage expansion enclosure are provided in this book in "Installing the support rails" on page 22.

To connect your EXP810 to other devices, use the following options:
- IBM SFP module
- IBM LC-LC fibre-channel cable

**Note:** You must order these options separately.

# EXP810 components

The EXP810 has the following removable components. These components, called customer replaceable units (CRUs), are accessible from the front or back of the EXP810.
- Up to 16 2 Gbps fibre channel hard disk drives
- Two environmental services modules (ESMs)
- Two power supply-fans

## Disk drives

This section shows the location of EXP810 hot-swap disk drives. The hot-swap features of the EXP810 enable you to remove and replace 2 Gbps fibre channel

hard disk drives, power supply-fans, and ESMs without turning off the storage expansion enclosure. You can maintain the availability of your system while a hot-swap device is removed, installed, or replaced.

The hot-swap drive bays that are accessible from the front of your storage expansion enclosure are shown in Figure 1.

Hot-swap drive bays



77033-10
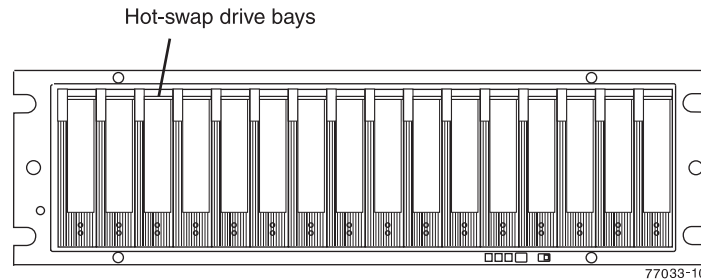
*Figure 1. EXP810 hot-swap drive bays*

The EXP810 supports up to 16 2 Gbps fibre channel hard disk drives, which come preinstalled in drive trays. Each drive and carrier assembly is called a drive CRU. Install drive CRUs in the 16 drive bays on the front of the storage expansion enclosure from the rightmost slot (slot 16) to the leftmost slot (slot 1).

There are no serviceable parts in a drive CRU. If it fails, it must be replaced in its entirety (drive, bezel, and tray). The EXP810 drive tray is not interchangeable with the drive tray of the DS4000 EXP700 or EXP710. When replacing a drive CRU, be sure to order and install the correct drive CRU.

**Attention:**
1. After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.
2. Never hot-swap a drive CRU when its associated green Activity LED is flashing. Hot-swap a drive CRU only when its associated amber Fault LED lights is not flashing or when the drive is inactive and its associated green Activity LED lights is not flashing.

**Note:** If the hard disk drive you want to remove is not in a failed or bypass state, always use the Storage Manager client program either to place the drive in a failed state or to place the array that is associated with the drive (or drives) in an offline state before you remove the drive from the enclosure.

## ESMs

The EXP810 has two hot-swappable and redundant ESM units. The ESMs are located at the back of the storage expansion enclosure. The left ESM is labeled ESM A, and the right ESM is labeled ESM B. One ESM will continue to operate if the other ESM fails.

The ESMs contain the storage expansion enclosure control logic, interface ports, and LEDs. Each ESM has four SFP module ports that you could use to connect the storage expansion enclosure to the controller. However, only the two ESM SFP ports (labeled 1A and 1B) near the center of the storage expansion enclosure are used. The SFP ports labeled 2A and 2B are reserved for future use.

The EXP810 ESMs support automatic ESM firmware synchronization. This function allows a new ESM with a different level of ESM firmware to be automatically synchronized with the ESM firmware version in the existing ESM in the EXP810 chassis. To enable automatic ESM firmware synchronization:

1. Verify that the Storage Manager Event Monitor is installed and running.
2. Verify that the DS4000 storage subsystem that the EXP810 is attached to is defined in the Enterprise Management window of the Storage Manager client (SMclient).

Although both ESM units (A and B) are identical, they are seated in the EXP810 chassis in opposite orientations. See Figure 2. If the ESM can not fully be inserted in the ESM bay, flip it 180 degrees and reinsert it.

### Connectors, switch, and enclosure ID

The ESMs support fiber optic interfaces for both the host channels and drive channels. The two interface ports located near the enclosure ID are reserved for future use. Do not plug any SFPs into these ports.

The dual seven-segment enclosure ID is located on the back of each ESM next to the ESM indicator lights. It provides a unique identifier for each module in the storage array. The storage management software automatically sets the enclosure ID number. You can only change the enclosure ID setting through the DS4000 storage management software. There are no switches on the EXP810 chassis to manually set the enclosure ID. Both ESM enclosure ID numbers will be identical under normal operating conditions.

Figure 2 shows the ESMs.
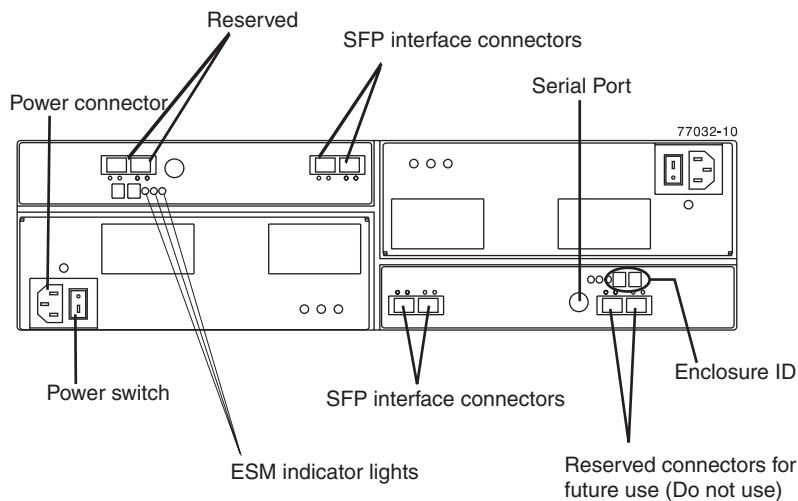


*Figure 2. Back view; power switch, enclosure ID, and connectors*

## Power supply-fans

The storage expansion enclosure has two removable power supply-fans. Each power supply-fan contains one power supply and two fans. The four fans pull air through the drive from front to back across the drives.

The fans provide redundant cooling, which means that if one of the fans in either fan housing fails, the remaining fans continue to provide sufficient cooling to

operate the storage expansion enclosure. The power supplies provide power to the internal components by converting incoming AC voltage to DC voltage. If one power supply is turned off or malfunctions, the other power supply maintains electrical power to the storage expansion enclosure. To preserve the optimal airflow, do not remove a failed power supply-fan CRU from the EXP810 chassis until you are ready to replace it with a new CRU.

Figure 3 shows a power supply-fan and the airflow through the storage expansion enclosure.

**Note:** Although both power supply-fan units (left and right) are identical, they are seated in the EXP810 chassis in opposite orientations. If the power supply-fan cannot fully be inserted in the power supply-fan bay, flip it 180 degree and reinsert it.
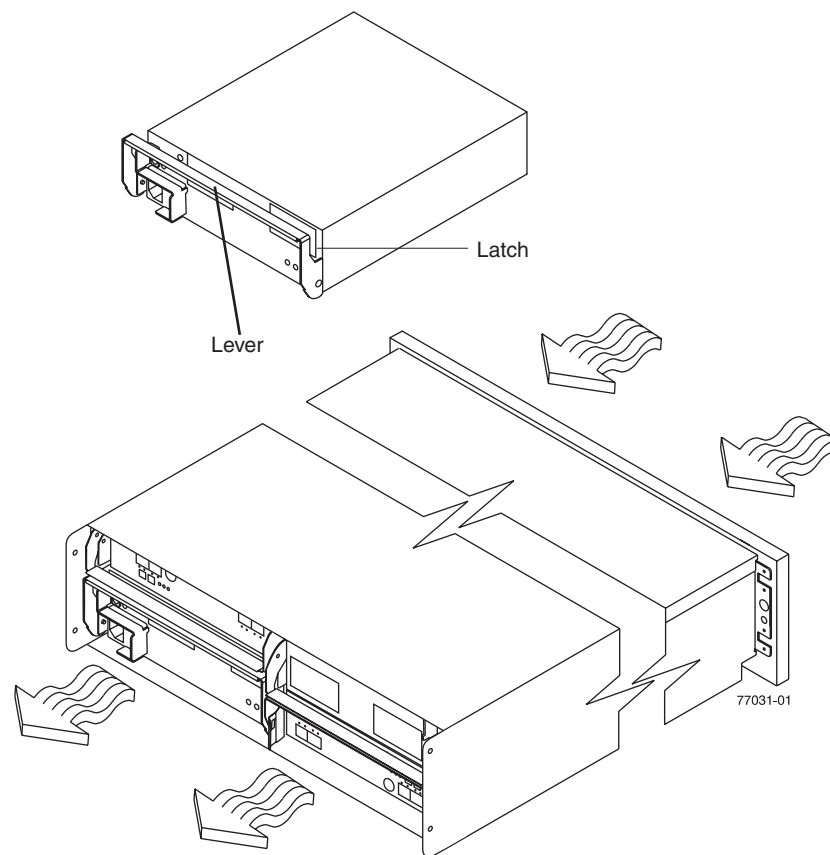


*Figure 3. Power supply-fan and airflow*

## Front controls and LEDs

This section shows the primary controls and LEDs on the front of the storage expansion enclosure. The locations of these primary controls are shown in Figure 4 on page 6.

The front view shows the following components:

• **Front Frame -** Metal cage frame containing global indicator lights and a link rate switch.

• **Drives -** Up to 16 removable drives, which are numbered 1 through 16 from left to right. When a drive is installed, the drive and tray slot designation is set automatically. The hardware addresses are based on the enclosure ID switch setting on the ESM and on the drive's physical location in the storage expansion enclosure.

**Note:** The drives in your storage expansion enclosure might differ slightly in appearance from those shown. The variation does not affect the function of the drives.
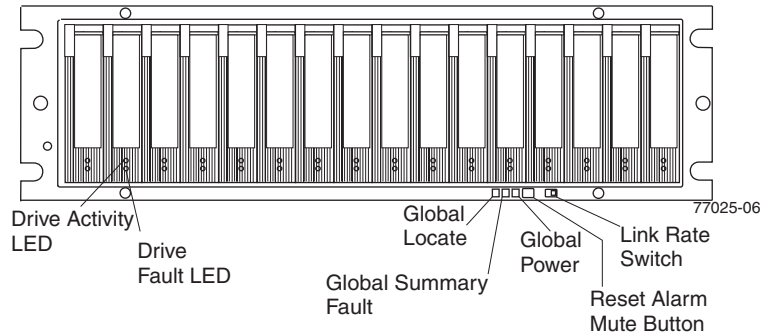


*Figure 4. Front controls and LEDs*

For a description of the front controls and LEDs, see "Front LEDs" on page 62.

# Rear controls, LEDs, and connectors

This section shows the primary controls, LEDs, and connectors on the rear of the storage expansion enclosure. The locations of these primary controls are shown in Figure 5 on page 7.

The back view shows the following components:

• **Fans and power supplies-** Two removable power supply-fan CRUs, each containing one power supply and two fans
• **ESMs -** Two removable environmental services monitors (ESMs)

Power Supply-Fan
CRU Fault

Power Supply-Fan
CRU
Direct Current Enabled

Power Supply-Fan CRU
Service Action Allowed

ESM Service Action Allowed
(OK to Remove)

ESM Service Action Allowed
(OK to Remove)

ESM Fault

ESM Fault

ESM Power

ESM Power

ESM Port 1
In Bypass

ESM Ports 1 & 2
(2 Gbps data rate)

ESM Port 2
In Bypass

ESM Port 3
In Bypass

ESM Ports 3 & 4
(2 Gbps data rate)

ESM Port 4
In Bypass

Power Supply-Fan
CRU Power

Power Supply-Fan
CRU Power

Power Supply-Fan CRU
Service Action Allowed

Power Supply-Fan
CRU Fault

Power Supply-Fan
CRU
Direct Current Enabled

ESM Port 1
In Bypass

ESM Port 2
In Bypass

ESM Ports 1 & 2
(2 Gbps data rate)

ESM Port 4
In Bypass

ESM Ports 3 & 4
(2 Gbps data rate)

ESM Port 3
In Bypass

Power Supply-Fan
CRU Power

77032-08

*Figure 5. Rear controls, LEDs, and connectors*

For a description of the rear controls, LEDs, and connectors, see "Rear LEDs" on page 63.

# SFP modules

The storage expansion enclosure supports fiber optic host interface cables. You must install a Small Form-factor Pluggable (SFP) module in each interface connector on the controller where a fiber optic cable is to be installed.

**Attention:** 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. Carefully check the SFP's IBM part number, option number, and FRU part number to identify its speed. There are no physical features that distinguish a 4 Gbps from a 2 Gbps SFP.

Figure 6 on page 8 shows an SFP module with fiber optic cable.

**Note:** The SFP module shown might look different from those shipped with your storage expansion enclosure. The differences does not affect transceiver performance.

SFP Module

Fiber-optic cable

77034-00
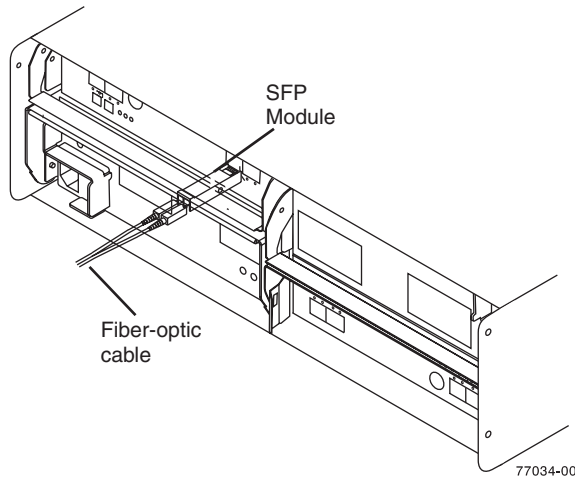
*Figure 6. SFP module and fiber optic cable*

# Software and hardware compatibility and upgrades

The latest DS4000 controller firmware and NVSRAM, the EXP810 drive enclosure ESM firmware, and the fibre channel drive CRUs firmware must be installed to ensure optimal functionality, manageability, and reliability.

# Software and firmware support code upgrades

To enable support for the EXP810, you *must* ensure that your system's software and firmware are at the levels shown in Table 2:

*Table 2. Software and firmware levels for the EXP810*

| Software/firmware | Level |
|---|---|
| DS4000 Storage Manager software | 9.16 |
| DS4000 controller firmware and NVSRAM | 06.16.xx.xx or later. This controller firmware does not support EXP100 attachment. |
| ESM firmware | 983x or later |
| Drive firmware | You can find the latest software and firmware at the IBM DS4000 TotalStorage Support Web site: www.ibm.com/servers/storage/support/disk/ |

These required EXP810 ESM and DS4000 storage subsystem controller firmware versions are included on the *DS4000 Storage Server Controller Firmware Version 6.16 Support for DS4000 EXP810 Fibre-Channel Storage Expansion Enclosure* CD that is shipped with the EXP810. To manage the DS4000 with controller firmware 06.16.xx.xx installed, the DS4000 Storage Manager version 9.16 software packages are included on the DS4000 Storage Manager host software for the appropriate OS CD or on the IBM Support Web site.

You can also find the latest software and firmware at the IBM DS4000 TotalStorage Support Web site:

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

See the *IBM TotalStorage DS4000 Storage Manager 9.16 Installation and Support Guide* for your operating system for instructions that describe how to install the DS4000 Storage Manager 9.16 host software.

The EXP810 requires that any connected DS4000s must be upgraded with DS4000 controller firmware version 6.16.xx.xx. See Appendix A, "Upgrading the DS4000 controller firmware," on page 101 for complete instructions on how to manually upgrade the controller firmware from firmware level 06.15.xx.xx or earlier. You can also refer to the online help in the Subsystem Management window of the DS4000 storage system or the instructions in the *IBM TotalStorage DS4000 Storage Manager 9.16 Installation and Support Guide* for your operating system.

If you need further assistance, please contact IBM technical support, your IBM reseller, or IBM representative to find out which controller firmware to use for EXP810 attachment.

For more information about the EXP810 ESM replacement procedure and problem troubleshooting, please refer to "Replacing an Environmental Services Monitor (ESM)" on page 89 and "Solving problems" on page 95.

## EXP810 hardware and software compatibility

Table 3 lists the EXP810 hardware and software compatibility. Currently, the only DS4000 storage subsystem that supports EXP810 attachment is the DS4800 Storage Subsystem. Please contact IBM resellers or representatives for other DS4000 storage subsystem support in the future.

**Note:** For the latest information about supported servers and operating systems for the EXP810, refer to the interoperability matrix at this Web site:

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

*Table 3. EXP810 hardware and software compatibility*

| Storage server | Storage management software | Firmware |
|---|---|---|
| System Storage DS4800 Storage Subsystem | IBM DS4000 Storage Manager Version 9.16 | Controller firmware: version 06.16.xx.xx |

## Determining firmware levels

There are two different methods to determine the DS4000 storage subsystem and the EXP810 firmware versions. Each method uses the DS4000 Storage Manager client that manages the DS4000 storage subsystem with the attached EXP810 enclosure.

**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 to locate the following information.

**Note:** The Profile For Storage Subsystem 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

**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 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 firmware version:*
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.

**To obtain the drive enclosure component firmware version:**
1. Click the Drive Enclosure Component icon (which is the right most icon) in the Drive Enclosure frame in the Physical View pane of the Subsystem Management window. 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.

You must perform this step for each drive expansion enclosure.

# Product updates

> **Important**
>
> To keep your system up to date with the latest firmware and other product updates, use the information below to register and use the **My support** web site.

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.

To be notified of important product updates, you must first register at the IBM Support and Download Web site:

www-1.ibm.com/servers/storage/support/disk/index.html

In the **Additional Support** section of the Web page, click **My support**. On the next page, if you have not already done so, register to use the site by clicking **register now**.

Perform the following steps to receive product updates:

1. After you have registered, type your user ID and password to log into the site. The **My support** page opens.
2. Click **Add products**. A pull-down menu displays.
3. In the pull-down menu, select **Storage**. Another pull-down menu displays.
4. In the new pull-down menu, and in the subsequent pull-down menus that display, select the following topics:
   - **Computer Storage**
   - **Disk Storage Systems**
   - **TotalStorage DS4000 Midrange Disk Systems & FAStT Stor Srvrs**

   **Note:** During this process a check list displays. Do not check any of the items in the check list until you complete the selections in the pull-down menus.

5. When you finish selecting the menu topics, place a check in the box for the machine type of your DS4000 series product, as well as any other attached DS4000 series product(s) for which you would like to receive information, then click **Add products**. The **My support** page opens again.
6. On the **My support** page, click the **Edit profile** tab, then click **Subscribe to email**. A pull-down menu displays.
7. In the pull-down menu, select **Storage**. A check list displays.
8. Place a check in each of the following boxes:
   a. **Please send these documents by weekly email**
   b. **Downloads and drivers**
   c. **Flashes**

   and any other topics that you may be interested in, and then click **Update**.
9. Click **Sign out** to log out of My Support.

## 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 EXP810 right and left power supply-fan 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 subsystem that the EXP810 storage expansion enclosures are attached to should be plugged into the same two independent external power circuits as the EXP810s. This ensures that the

DS4000 storage subsystem 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 plugged into the same power circuit enables the DS4000 devices in the configuration to power on simultaneously during an unattended restoration of power. See Figure 33 on page 47 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 Table 9 on page 15 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), 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 in the logical drives created for the DS4800.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in "Turning the EXP810 on and off" on page 53. 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 the EXP810 on and off" on page 53 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 subsystems are not displayed in the DS4000 Storage Manager graphical user interface (GUI).
  - The storage subsystem logical drives and subsystems do not come online.
  - The storage subsystem logical drives and subsystems seem to be degraded.

## Specifications

This section provides site specifications for the EXP810 storage expansion enclosure. Before installing a storage expansion enclosure, 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 EXP810 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 7 shows the dimensions of the EXP810, which conforms to the 19-inch rack standard.
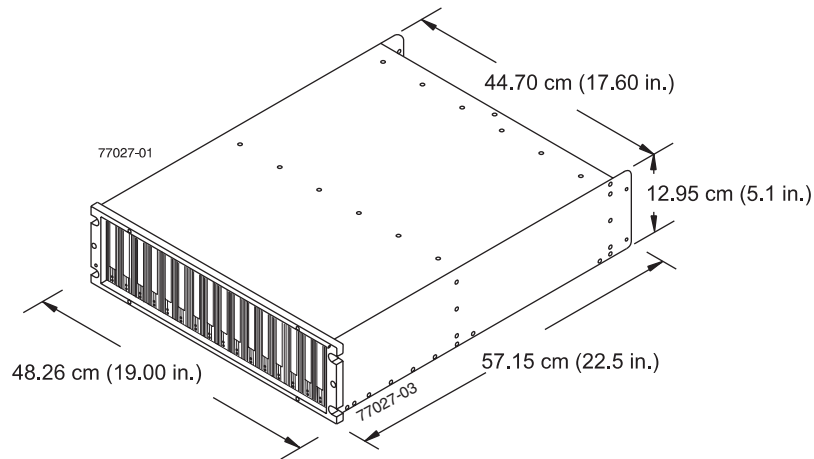


*Figure 7. EXP810 dimensions*

## Weight

The total weight of the storage expansion enclosure depends on the number of components installed. Table 4 lists the maximum, empty, and shipping weights for the storage subsystem in different configurations. Table 5 lists the weight of each component.

*Table 4. EXP810 weights*

| Unit | Weight | | |
| --- | --- | --- | --- |
| | Maximum [1] | Empty [2] | Shipping |
| EXP810 | 40 kg (88 lb) | 15.9 kg (35.0 lb) | 52.2 kg (115.0 lb) |

[1] Chassis with all CRUs and 16 drives.

[2] Chassis without CRUs and drives but with front cage frame and midplane.

*Table 5. EXP810 component weights*

| Unit | Weight |
| --- | --- |
| Drive | 0.75 kg (1.65 lb) |
| Power supply-fan | 3.60 kg (7.95 lb) |
| ESM | 1.88 kg (4.15 lb) |

## Shipping dimensions

Table 6 lists shipping carton dimensions. The height shown includes the height of the pallet.

*Table 6. EXP810 shipping carton dimensions*

| Height | Width | Depth |
| --- | --- | --- |
| 45.7 cm (18.0 in.) | 62.6 cm (24.5 in.) | 80.7 cm (31.75 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 storage expansion enclosure.

## Temperature and humidity

Table 7 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 7. 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 | -10° - 65° C (14° - 149° 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 90% |
| | Transit range | 5% to 95% |
| | Maximum dew point | 26° C (79° F) |
| | Maximum gradient | 10% per hour |

**Notes:**

1. The nonoperating 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 8 lists the acceptable altitudes for operating, storing, and shipping the EXP810.

*Table 8. EXP810 altitude ranges*

| Environment | Altitude |
|---|---|
| Operating | 30.5 m (100 ft.) below sea level to 3000 m (9842 ft.) above sea level |
| Storage | 30.5 m (100 ft.) below sea level to 3000 m (9842 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 8 shows the intended airflow for the EXP810. 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.
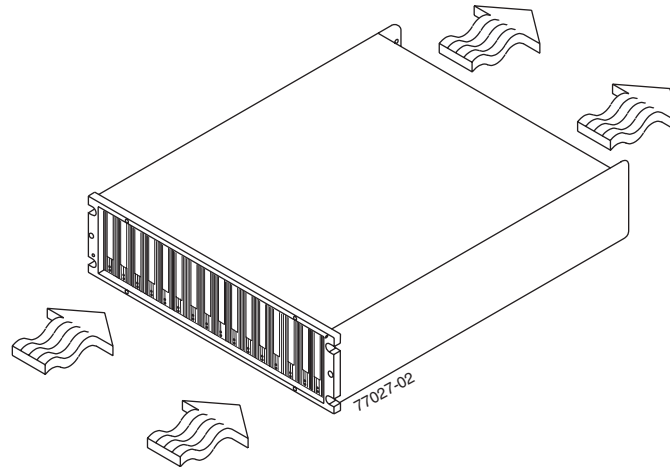


*Figure 8. EXP810 airflow*

Table 9 lists the KVA, watts, and Btu calculations. 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 9. EXP810 power and heat dissipation*

| Parameter | KVA | Watts (AC) | Btu per hour |
|-----------|-----|-----------|--------------|
| EXP810 | 0.454 | 443 | 1516 |

## Acoustic noise

Table 10 lists the maximum sound levels emitted by the storage subsystem.

*Table 10. EXP810 sound levels*

| Measurement | Level |
|-------------|-------|
| Sound power (normal operation) | 6.5 bels |
| Sound pressure (normal operation) | 65 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 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 11. EXP810 AC power requirements*

|  | Low Range | High Range |
|---|---|---|
| Nominal Voltage | 90 to 136 VAC | 180 to 264 VAC |
| Frequency (Hertz) | 50 to 60 Hz | 50 to 60 Hz |
| Idle Current | 3.86 A[a] | 2.05 A[b] |
| Maximum Operating Current | 4 A/4.54 A[a] | 2.12 A/2.41 A[b] |
| Maximum Surge Current | 5.04 A[a] | 2.67 A[b] |

[a.] Typical voltage: 115 V AC, 60 Hz, assumes 73% power-supply efficiency and 0.99 power factor

[b.] Typical voltage: 230 V AC, 60 Hz, assumes 73% power-supply efficiency and 0.99 power factor

### Site wiring and power

The storage expansion enclosure 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 EXP810 storage expansion enclosure are 6 amps at 100 VAC and 2.5 amps at 240 VAC. These are the overall maximum operating currents for this system.

### AC power recovery

After normal power is restored after a total AC power failure, the EXP810 storage expansion enclosure performs power-up recovery procedures automatically without operator intervention.

### Power cords and receptacles

The EXP810 ships with two jumper cords used to connect to the rack PDU. You must purchase the power cords that are appropriate for use in a typical outlet in the destination country. See Appendix D, "Power cords," on page 119 for more information.

## Heat output, airflow, and cooling

See "Airflow and heat dissipation" on page 15 for heat output, airflow, and cooling specifications.

**Note:** In general, disk subsystem reliability tends to decrease as the ambient temperature of the environment in which it is being used increases. The ambient temperature in the immediate area of the disk enclosure unit should be kept near 22° C (72° F), or lower, to provide better reliability.

When racks that contain many EXP810s are to be installed together, the following requirements must be met to ensure that the EXP810s are adequately cooled:

- Air enters at the front of the rack and leaves at the back. To prevent the air that is leaving the rack from entering the intake of another piece of equipment, you must position the racks in alternate rows, back-to-back and front-to-front. This arrangement is known as "cold aisle/hot aisle" and is shown in Figure 9.
- Where racks are in rows, each rack must touch the rack that is next to it to reduce the amount of hot air that can flow around from the back of the rack into the intakes of the storage expansion enclosures that are in that rack. You should use Suite Attach Kits to completely seal any gaps that remain between the racks. For details about Suite Attach Kits, contact your marketing representative.
- Where racks 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, the rack filler plates must be installed in unused positions. Also, all the gaps in the front of the racks must be sealed, including the gaps between the storage expansion enclosures.
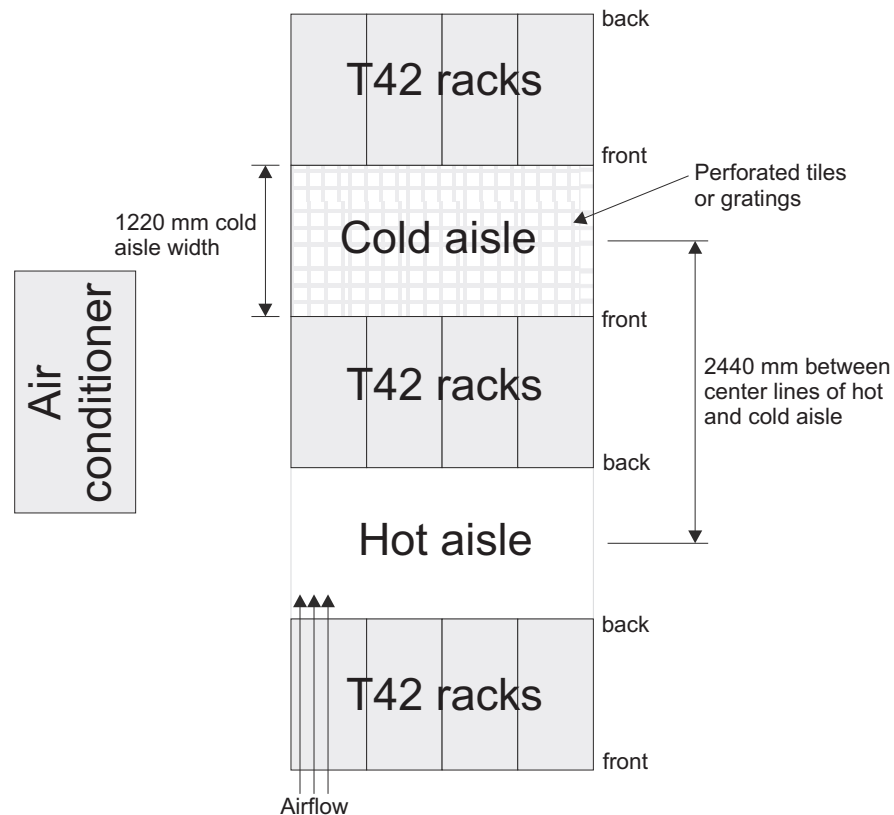


Figure 9. Example of cold aisle/hot aisle rack configuration

# Chapter 2. Installing the EXP810

This chapter provides the information that you need to prepare the EXP810 for installation into a rack cabinet.

Before you begin the installation, review the safety information in "Safety" on page xi.

"Installation overview" provides an overview of the EXP810 installation process. Read this overview before you begin the installation. This chapter also contains information about cabling, setting interface options, and installing optional cables.
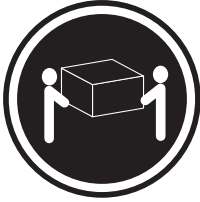
## Installation overview

The following sequence summarizes the installation steps you will perform in this chapter.

1. Prepare the installation site and the rack cabinet. Unpack the EXP810 and other hardware from the shipping box. See "Preparing for installation" on page 20.

   **Statement 4:**

   

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

   **CAUTION:**
   **Use safe practices when lifting.**

   **Attention:**   The EXP810 weighs up to 40 kg (88 lb). At least two other people should help you lift the EXP810 from the shipping box. If desired, open the sides of the shipping box and remove the CRUs from the EXP810 before you lift it from the shipping box in order to lighten the storage expansion enclosure. See "Removing the CRUs" on page 26.

2. Install the support rails in the rack. See "Installing the support rails" on page 22.

3. If necessary, remove the CRUs from the EXP810. See "Removing the CRUs" on page 26.

4. Install the EXP810. See "Installing the EXP810 into a rack" on page 30. If necessary, replace the CRUs in the EXP810. See "Replacing the EXP810 CRUs" on page 32.

5. Cable the EXP810 to other EXP810s or EXP710s or to a DS4000. See Chapter 3, "Cabling the EXP810," on page 37.

6. Install the DS4000 Storage Manager 9.16 host software. Refer to the *IBM TotalStorage DS4000 Storage Manager 9.16 Installation and Support Guide* for the appropriate operating system for instructions on how to install the DS4000 Storage Manager 9.16 host software.

7. If this is a new DS4000 storage subsystem configuration, or an existing DS4000 configuration that includes EXP710s, upgrade the controller firmware in the DS4000 Storage Subsystem to version 06.16.xx.xx or later.

   **Note:** If your DS4000 storage subsystem shipped preloaded with controller firmware 06.16.xx.xx, you do not need to upgrade the firmware, although it is still recommended that you upgrade to the latest version of the firmware for your specific storage subsystem model.

8. Turn on the EXP810 (if you have not done so already) after performing step 7. See "Turning the EXP810 on and off" on page 53.

9. Turn on the DS4000 Storage Subsystem if it is not already on after performing step 7 and use the DS4000 Storage Manager 9.16 host software to verify the configuration and upgrade the controller firmware if needed. If the controller firmware is not at version 06.16.xx.xx or later, the EXP810 enclosures will be shown in the DS4000 subsystem management window with empty drive slots and enclosure ID of 99.

## 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 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 EXP810, create a detailed plan of how this unit will be used in your storage configuration. The plan should include determining RAID levels, fallover requirements, operating systems to be used, and total storage capacity requirements.

Complete the following steps to prepare the EXP810 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 12.
2. Move the EXP810 to the site.

   **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 EXP810 from its shipping container and check the contents (see "Inventory checklist" on page 2). If any items are missing, contact your IBM reseller before proceeding.
4. Assemble the tools and equipment that you will need for installation. These might include:
   - The rack power jumper cords that are shipped with the EXP810
   - Number 2 Phillips and 5/16 (8 mm) hex nut driver
   - Antistatic protection (such as a grounding wrist strap)
   - Fibre Channel (FC) and Ethernet interface cables and cable straps
   - SFP modules
   - The rack-mounting hardware that ships with the EXP810
   - IBM DS4000 Storage Manager 9.16 software
   - DS4000 controller firmware that ships with the EXP810. You use this software to configure the storage subsystems.

   **Note:** Different models may have different firmware versions.

5. Read the *Storage System Product Release Notes for Version 9.16* for any updated information about hardware, software, or firmware products.
6. Continue with "Preparing the site."

# Preparing the site

This section lists the floor space requirements and weight information for the EXP810. For information on interface cables and connections, see Chapter 3, "Cabling the EXP810," on page 37.

**Floor space:** The floor area at the installation site must provide the following conditions:
- Enough stability to support the weight of the fully configured EXP810 and associated systems

- Sufficient space to install the EXP810

**Weight:** The EXP810 total weight depends on the number of fibre channel hard disk drives that are installed. A fully configured EXP810 with two power supply-fans, two ESMs, and up to 16 fibre channel hard disk drives installed weighs 40 kg (88 lbs).

**Other**: Consider these important preparation activities:
- Install uninterruptible power supply (UPS) devices.
- Install host bus adapters (HBAs), switches, or other devices, if applicable.
- Route interface cables from the hosts or switches to the installation area.
- Route main power cords to the installation area.

Continue with "Preparing the rack."

# Preparing the rack

**Important:** Before you install the EXP810 in a rack, keep in mind the following considerations:
- Review the documentation that comes with your rack enclosure for safety and cabling considerations.
- Install the EXP810 in a maximum 35° C (95° F) environment.
- To ensure proper airflow, do not block the air vents; 15 cm (6 in.) of air space is sufficient.
- 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 expansion enclosure to a properly grounded outlet.

Complete the following steps to prepare the rack before you install the EXP810:
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 EXP810" on page 26.

# Installing the support rails

**Attention:** Duplicate copies of the rack mounting templates are provided in Appendix C, "Rack mounting template," on page 115. If you want to tear out the templates from this document for easier use, use the copies in Appendix C, "Rack mounting template," on page 115 rather than the copies provided in this section.

Use the following templates (Figure 10 on page 23 and Figure 11 on page 24) to identify the proper locations for inserting M5 screws when mounting the support rails and EXP810 to a rack. The locations for the M5 screws are highlighted in the templates.

The EXP810 is 3 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 might be round, square, or threaded.
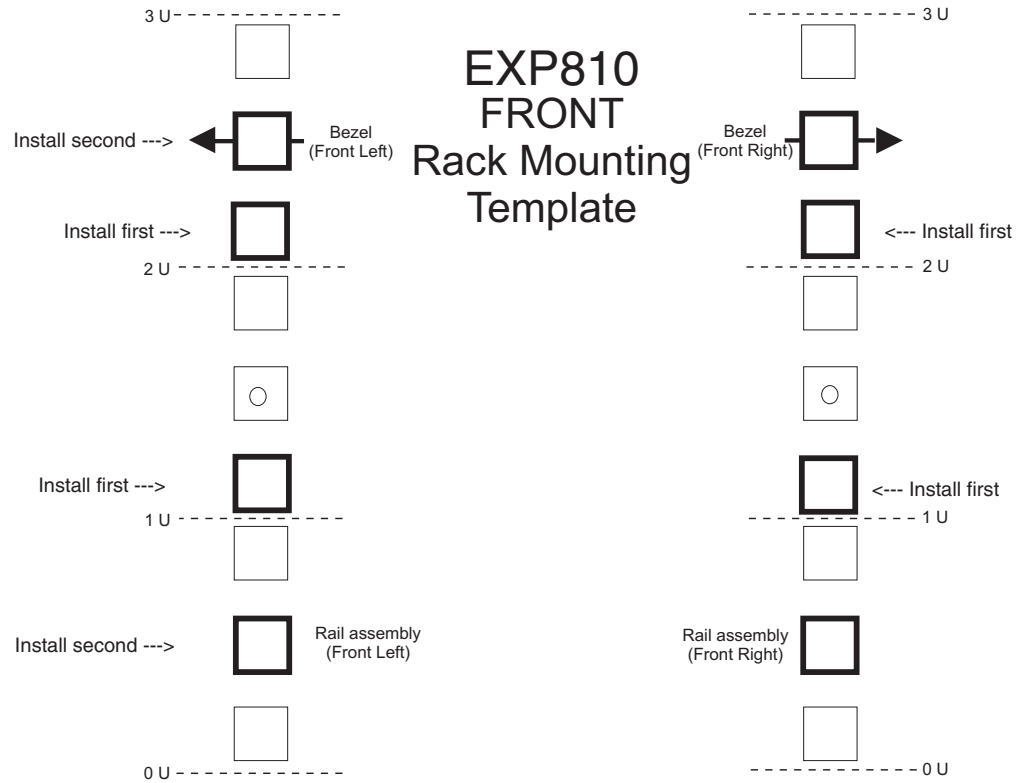


*Figure 10. Front rack mounting template*

EXP810
REAR
Rack Mounting
Template

3U

3U

Rail mounting guide

2U

2U

1U

1U

Rail assembly
(Rear Left)

Rail assembly
(Rear right)

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0U

0U
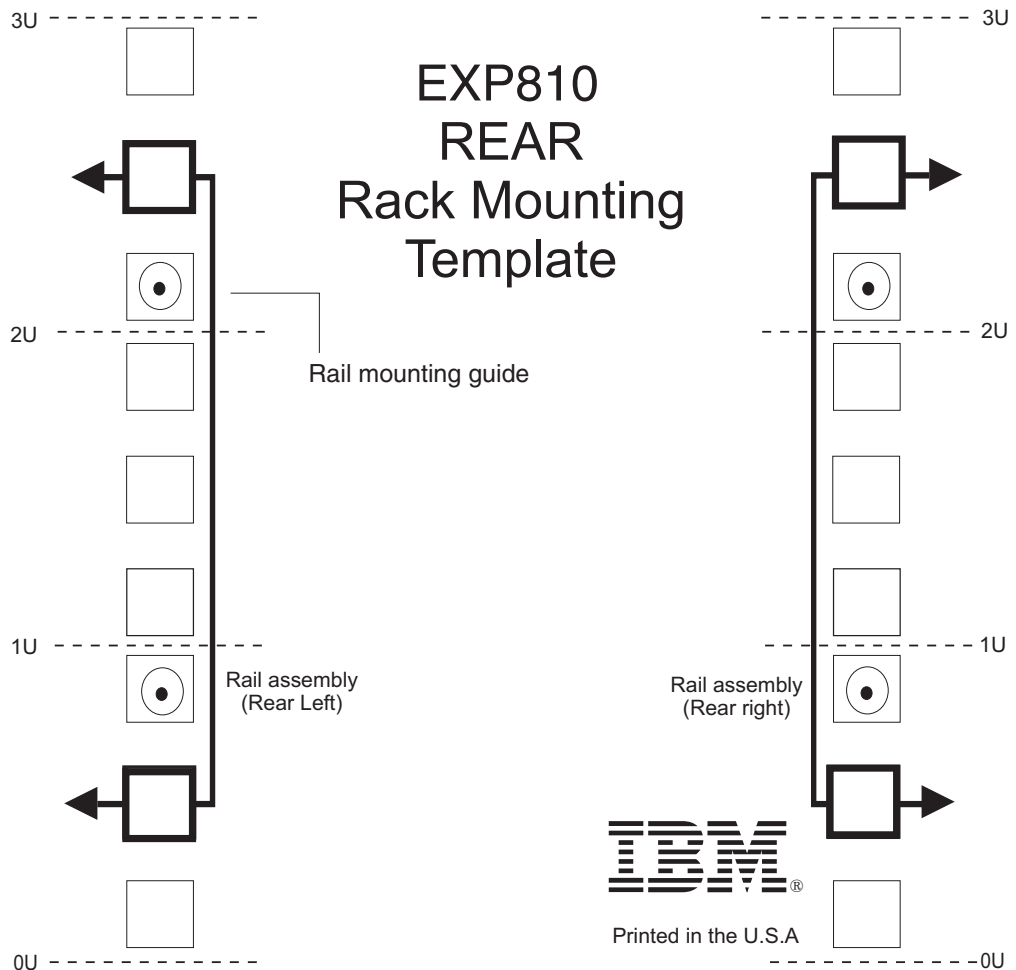
*Figure 11. Rear rack mounting template*

Before installing the EXP810 in a rack, you must install the rails and rack-mounting hardware that come with your storage expansion enclosure. The EXP810 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, is 60.96 cm (24 in.) minimum and 81.28 cm (32 in.) maximum. This rack conforms to the EIA standard. Where you place the support rails in the rack depends on where you intend to position the storage expansion enclosure.

Complete the following steps to install the support rails:

**Note:** Refer to Figure 12 on page 26 while performing these steps.

1. Ensure that the rack has already been installed.
2. Ensure that a stabilizer has been correctly attached to the bottom front of the rack to prevent the rack from tipping forward while the EXP810 is being installed.

   Refer to the installation and service guide, or equivalent, for the rack as required.
3. Locate the two support rails, eight of the twelve M5 screws, and eight washers that are supplied with the EXP810.

   **Note:** The M5 screws and washers may already be attached to the support rails. If so, remove them from the support rails.

4. The rack-mounted unit is three EIA units high. Decide accordingly where you are going to install the support rails.

   **Attention:** Use the rack mounting template provided in Figure 10 on page 23 and Figure 11 on page 24 to locate the proper rack mounting holes for installing the support rails into the rack.

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

   - If you are installing the EXP810 into an empty rack, install it into the lowest available position so that the rack does not become unstable.
   - If you are installing more than one EXP810 in the rack, start at the lowest available position, and work upward.
   - If appropriate, allow for possible later installation of other units.
   - If necessary, remove the rack power distribution unit before you install the support rails.
   - For procedures and more information, refer to the installation and service guide, or equivalent, for the rack.

5. Loosen the two screws on the left support rail that hold the two parts of the rail together ( **5** ).

   **Note:** The support rails are not marked as Left or Right. However, each rail can be correctly mounted on only one side of the rack cabinet. The rails should be mounted with the alignment pins at the back of the rack. Figure 12 on page 26 shows the installation of the left support rail.

6. Hold the back of the rail against the inside of the rack-mounting flange. Make sure the rail mounting guide pins are in the correct holes. See Figure 11 on page 24 for illustration.

7. Loosely tighten the two M5 screws ( **2** ).

   **Note:** Make sure you use a washer when installing an M5 screw through a *square* hole on the rack-mounting flange.

8. Extend the rail to the front of the rack until it makes contact with the front rack-mounting flange ( **3** ).

9. Loosely tighten the two M5 screws ( **1** ).

   **Note:** Be sure to install the screws labeled *install first* in Figure 10 on page 23.

10. Securely tighten all the M5 screws that you loosely tightened.

11. Repeat step 5 through step 10 for the right support rail.

Rear of Rack
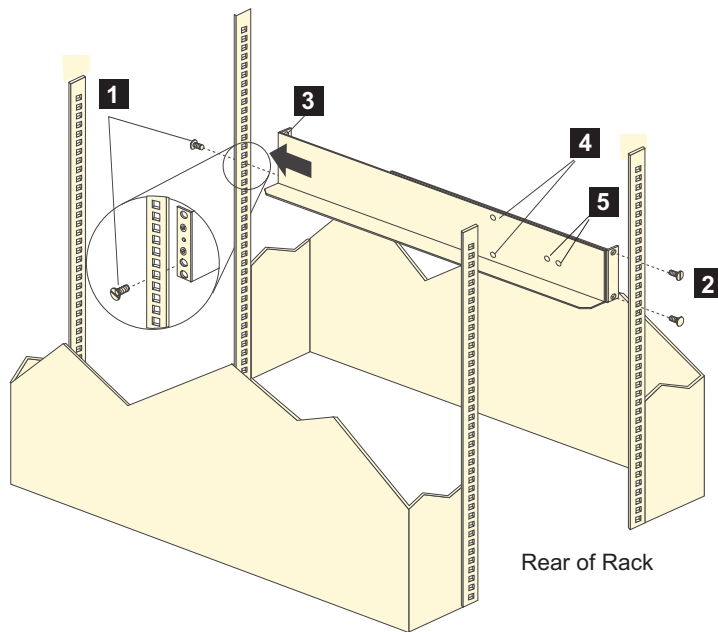
*Figure 12. Installing the support rails*

12. Continue with "Removing the CRUs."

# Installing the EXP810

This section provides instructions on installing the EXP810. The installation process includes:

- "Removing the CRUs"
- "Installing the EXP810 into a rack" on page 30
- "Replacing the EXP810 CRUs" on page 32

# Removing the CRUs

This section describes how to remove the CRUs in order to minimize the weight of the EXP810 before you install it in the rack. However, if you have three or more people available to lift and install the EXP810 in a rack, you might not find it necessary to remove the CRUs before you install the EXP810. If this is the case, you can skip the CRU removal instructions provided in this section. Instead, continue with "Installing the EXP810 into a rack" on page 30, and then skip the CRU replacement instructions provided in "Replacing the EXP810 CRUs" on page 32.

Use the following procedures to remove the CRUs from the EXP810 before installation. Use these instructions after you have completed all applicable site, rack, and EXP810 preparations (as discussed in "Preparing for installation" on page 20) and installed the support rails (as discussed in "Installing the support rails" on page 22). Alternately, if necessary, you can use these instructions to lighten the EXP810 before removing it from the shipping box. The shipping box opens to provide access to the storage expansion enclosure CRUs.

The EXP810 comes with a rack-mounting hardware kit for installing it in a rack. It is easier to lift the EXP810 and install it in a rack cabinet if you remove all the CRUs first. You will need an antistatic wrist strap and a cart or level surface (to hold the CRUs). Observe the precautions listed in "Handling static-sensitive devices" on page 20
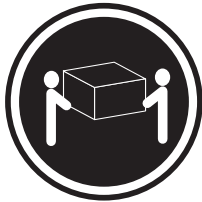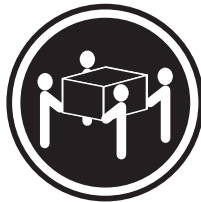
page 20. In the following procedure, you will remove the following CRUs from the storage expansion enclosure before you install it in the rack:

- ESMs
- Power supply-fans
- Hot-swap hard disk drives

You do not need to remove the blank trays.

**Statement 4:**

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

**CAUTION:**
**Use safe practices when lifting.**

**Attention:**  The storage expansion enclosure comes with a bezel that is attached to the front of the unit. The bezel protects the light pipes that are located above the drive trays. Leave the protective bezel in place until you are instructed to remove it.

## Removing an ESM
Complete the following steps to remove an ESM:

**Attention:**  After you remove an ESM, wait 70 seconds before reseating or replacing the ESM. Failure to do so may cause undesired events.

1.  Squeeze the ESM latch and pull the lever open 90° (so that the lever is horizontal) to release the ESM from the latch. The ESM latch is a coral colored tab on the lever.

    **Note:** The lever rotates upward or downward 90°, depending on whether the ESM you are removing is the right or left ESM CRU.

2.  Slowly pull the lever away from the chassis to remove the ESM from the bay, as shown in Figure 13 on page 28.
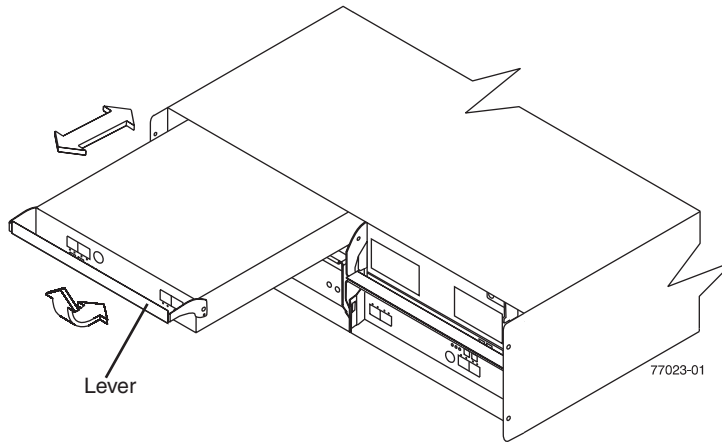
*Figure 13. Removing and replacing an Environmental Services Monitor (ESM)*

3. Place the ESM on a level surface.

4. Repeat step 1 through step 3 for the second ESM.

## Removing a power supply-fan

**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.**



**CAUTION:**
**Disconnect the power cord before removing the power supply-fan.**

Complete the following steps to remove a power supply:

1. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the power supply-fan from the latch. The latch is a coral colored tab on the lever.

2. Slowly pull the lever away from the chassis to remove the power supply-fan, as shown in Figure 14 on page 29.

   **Note:** The lever rotates upward or downward 90°, depending on whether the power supply-fan you are removing is in the left or right power supply-fan bay.

Lever
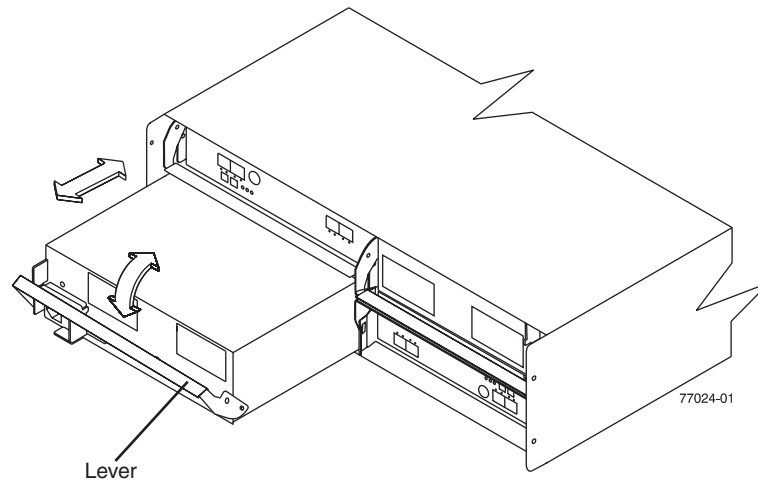
*Figure 14. Replacing a power supply-fan*

3. Place the power supply on a level surface.
4. Repeat step 1 through step 3 for the second power supply.

## Removing a hard disk drive

Complete the following steps to remove a hot-swap hard disk drive:

**Note:** The hard disk drive comes installed in a drive tray. Do not attempt to detach the drive from the tray.

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

1. Use Table 23 on page 114 to record the location and identify your hard disk drives. You must record this information to be able to replace the hard disk drives in their original order before they were removed.
2. Release the latch on the drive CRU by pressing on the inside of the bottom of the tray handle.
3. Lift the closed latch to its open position. (The latch is at a 90° angle to the front of the drive when open.)
4. Pull the drive out of the bay, as shown in Figure 15 on page 30.
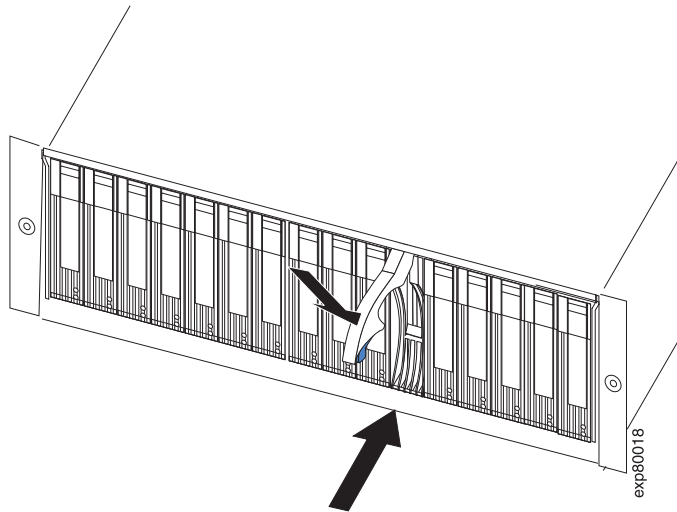
*Figure 15. Removing a drive CRU*

5.  Place the drive CRU horizontally on a level surface.

    **Attention:**  Do not stack drive CRUs on top of one another. Protect the drive CRUs from vibrations or sudden shocks.

6.  Repeat step 1 through step 4 for additional drive CRUs.

Continue with "Installing the EXP810 into a rack."

# Installing the EXP810 into a rack
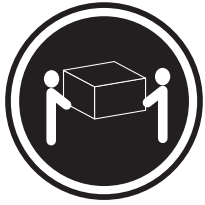
Complete the following steps to install the EXP810 in the rack.

**CAUTION:**
**Do not install modules 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 tip over. Always install hardware in the lowest available position in the cabinet.**

**Statement 4:**



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

**CAUTION:**
**Use safe practices when lifting.**

1.  Put on antistatic protection, and keep it on while performing all of the remaining procedures in this chapter.

2.  Remove the four screws from the rails (two screws in each rail). See **4** in Figure 12 on page 26. If you do not remove these screws, the storage expansion enclosure will not fit securely.

3.  Place the storage expansion enclosure in the rack.

    **Note:** If you have removed the CRUs from the EXP810, you should be able to lift the unit into the cabinet with the help of one other person. If you have not removed the CRUs before the installation, you should have at least two other people available to help you lift the unit into the rack.

    a.  Move the storage expansion enclosure to the front of the rackmount cabinet.

    b.  With help from another person, place the back of the storage expansion enclosure on the support rails, and then slide the unit into the rack as shown in Figure 16.



Front of Rack
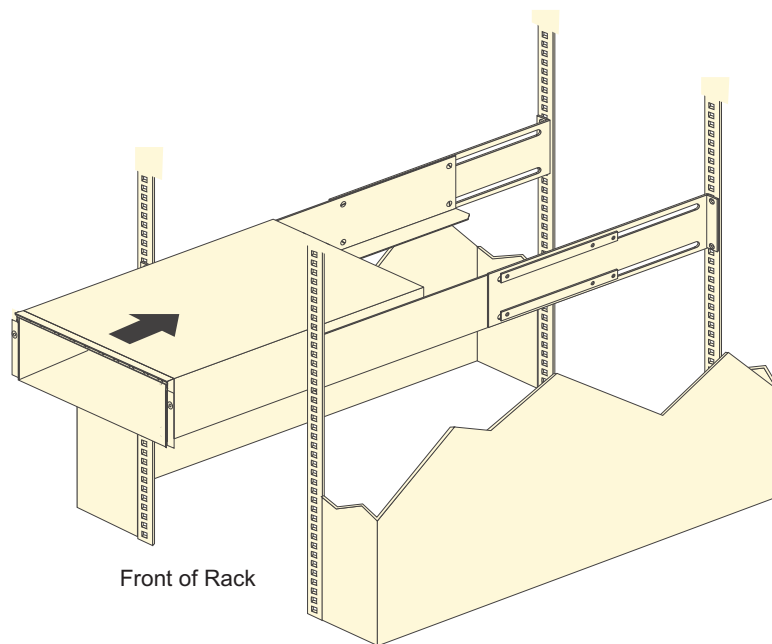
*Figure 16. Installing the EXP810*

4.  Secure the storage expansion enclosure. Figure 17 on page 32 shows how to secure the storage expansion enclosure to the rack.

    a.  Align the front mounting holes on each side of the storage expansion enclosure with the mounting holes on the front of the support rails.

    b.  Using the screws that you removed in step 2, secure the sides in the back of the EXP810 storage expansion enclosure to the rack rails.

    c.  Secure the front of the storage expansion enclosure using the four M5 screws as shown in Figure 17 on page 32.
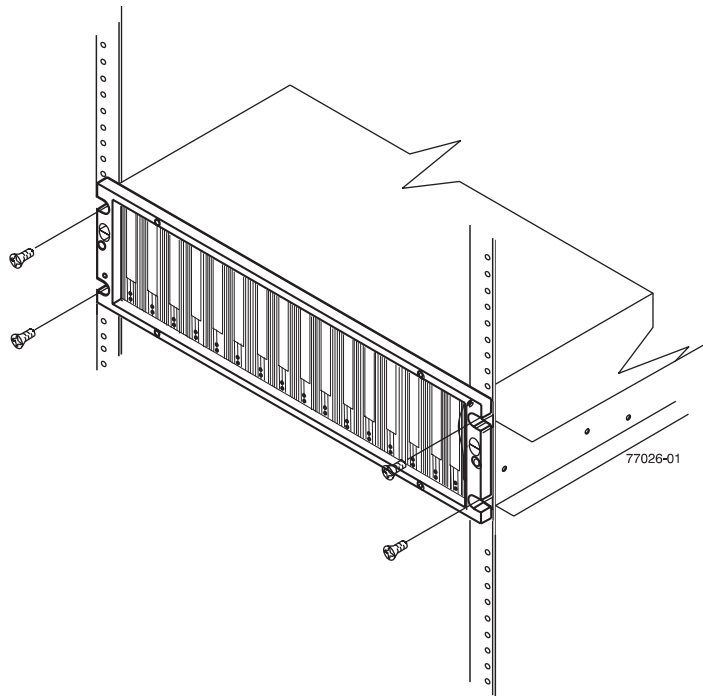
*Figure 17. Securing the storage expansion enclosure to the Rack*

5. Continue with one of the following actions:
   - If you did remove the EXP810 CRUs before installation (as described in "Removing the CRUs" on page 26), continue with "Replacing the EXP810 CRUs."
   - If you did not find it necessary to remove the EXP810 CRUs before installation, continue with "Cabling the EXP810" on page 37.

# Replacing the EXP810 CRUs

Use the following procedures to replace the CRUs in the EXP810 after the EXP810 is installed successfully in a rack.

## Replacing an ESM

Complete the following steps to replace the ESM that you removed before the installation:

**Attention:** After you remove an ESM, wait 70 seconds before reseating or replacing the ESM. Failure to do so may cause undesired events. The left and right ESMs are seated in the EXP810 chassis in opposite orientations. If you cannot fully insert the ESM into the ESM bay, flip it 180° and reinsert it.

1. Slide one ESM into the empty slot in the storage expansion enclosure. Be sure that the lever is pulled straight out as you slide the ESM in, as shown in Figure 18 on page 33.
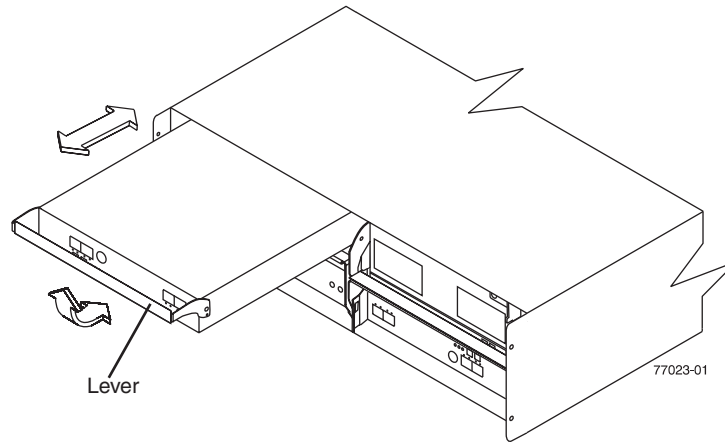
*Figure 18. Removing and replacing an Environmental Services Monitor (ESM)*

2. As you slide the ESM into the empty slot, make sure the guide pins on the side of the ESM fit into the notches. After the guide pins fit into the notches and ESM fits snugly into the bay, push the lever downward or upward 90°, depending on whether the ESM is inserted in the A or B ESM bay to fully latch it into place.

   **Attention:** Make sure that the levers lock into place in the storage expansion enclosure chassis.

3. Repeat step 1 and step 2 to replace the second ESM.

## Replacing a power supply-fan

**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.**



**CAUTION:**
**Disconnect the power cord before replacing the power supply-fan.**

Complete the following steps to replace the power supply-fans that you removed before the installation:

1. Slide one power supply-fan into the storage expansion enclosure. Be sure to replace the power supply-fans so that the lever on each power supply-fan opens toward the interior of the storage expansion enclosure, as shown in Figure 44 on page 88.

**Attention:** Be sure that the lever is pulled straight out as you slide the power supply-fan into the storage expansion enclosure, as shown in Figure 19. The left and right power supply-fan units are seated in the EXP810 chassis in opposite orientations. If you cannot fully insert the power supply-fan into the power supply-fan bay, flip it 180° and reinsert it.



Lever
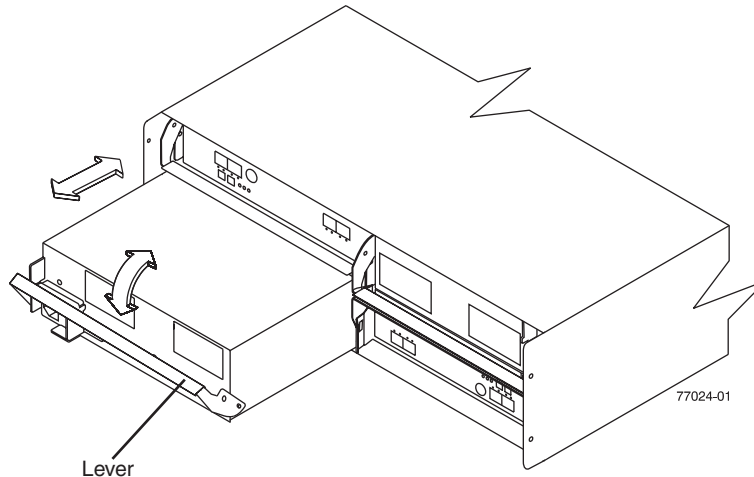
*Figure 19. Replacing a power supply-fan*

2. As you slide the power supply-fan into the empty slot, make sure the guide pins on the side of the power supply-fan fit into the notches along the sides of the power supply-fan bay. After the guide pins fit into the notches and power supply-fan fits snugly into the slot, push the lever upward or downward 90° depending on whether the power supply fan is inserted in the left or right bay to fully latch it into place. Then gently push the front of the power supply-fan to ensure that it is fully seated.

3. Repeat step 1 and step 2 to replace the second power supply-fan.

## Replacing a hard disk drive

Complete the following steps to replace the hot-swap hard disk drives that you removed before the installation.

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

**Note:** Use Table 23 on page 114 to verify the proper replacement locations of your fibre channel hard disk drives.

1. Lift up on the handle and gently push the drive CRU into the empty bay until the hinge of the tray handle latches beneath the storage expansion enclosure bezel, as show in Figure 20 on page 35.
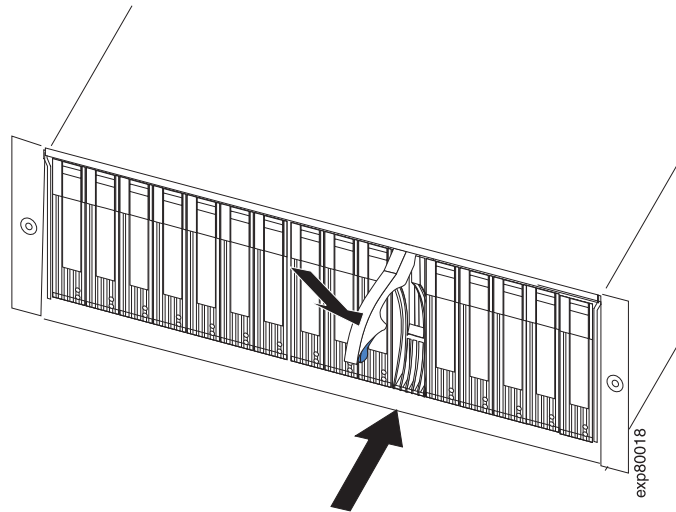
*Figure 20. Replacing a hard disk drive*

2. Push the tray handle down until the latch clicks into place.
3. Repeat step 1 and step 2 to replace additional drives.

# Chapter 3. Cabling the EXP810

After the storage expansion enclosure is installed in its permanent location, you must cable it to hosts and other storage devices, depending on your hardware configuration.

This chapter addresses the following cabling and configuration topics:

## Enclosure ID settings

The dual seven-segment enclosure ID is located on the back each ESM next to the indicator lights. It provides a unique identifier for each module in the storage subsystem.

The storage management software *automatically* sets the enclosure ID number. You can change the setting through the storage management software if necessary. Both ESM enclosure ID numbers are identical under normal operating conditions.

The allowable ranges for enclosure ID settings are 0-99. However, IBM recommends that you do not set the enclosure ID to 00 or any number greater than 80.

Figure 21 shows the enclosure ID.
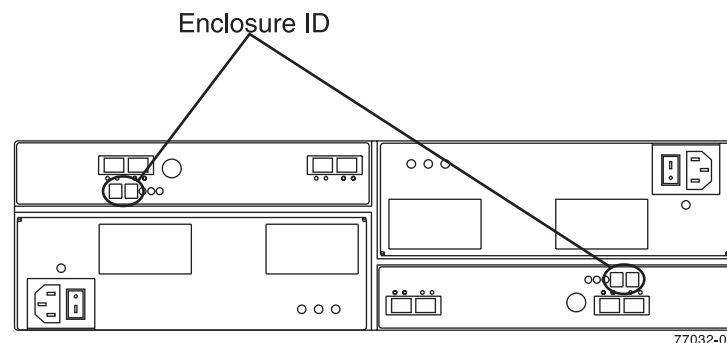


*Figure 21. Storage expansion enclosure seven-segment enclosure ID*

## 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.

## Cabling the EXP810

The EXP810 supports two redundant drive loops. A redundant EXP810 drive loop consists of one or more storage expansion enclosures that are connected to a storage subsystem using two sets of fibre-channel cables. If one fibre-channel drive loop fails, the storage subsystem uses the other drive loop to maintain input/output (I/O) to the EXP810 drives. Usually, there are two redundant array of independent disks (RAID) controllers in a storage subsystem. Use the *Fibre Channel Cabling*

*Instructions* that ships with your storage subsystem for the specific information about cabling the EXP810. Before cabling the storage expansion enclosure, read the following information:

- **Fibre-channel loop:** A fibre-channel loop consists of EXP810 drive expansion enclosures that are connected to each other and to one or more RAID controllers. A loop can support multiple RAID controllers, multiple EXP810 drive expansion enclosures, and other addressable entities such as system-management logic chips. Refer to your storage subsystem documentation for information about controller-dependent hardware configuration. Some controllers might have restrictions on the maximum number of disk drives that can be supported on a loop, cabling restrictions, and other requirements.
- **SFP module ports:** The EXP810 supports large, complex, and redundant disk drive loop configurations. Each ESM has two SFP module ports. Each SFP module has an input and output port. A loop is created by connecting one or more EXP810 storage expansion enclosures to one or more RAID controllers.
- **Fibre-channel cable restrictions:** RAID controllers use specific IBM fibre-channel options. Refer to the *IBM TotalStorage DS4000 Hardware Maintenance Manual, Problem Determination Guide,* or your IBM representatives or resellers for the cable option that is required for your configuration.
- **Power cabling:** The EXP810 uses two standard power cables. You can connect the power cables to a primary power unit inside the rack, such as a properly grounded ac distribution unit or uninterruptible power supply. You can also connect the power cable to an external source, such as a properly grounded electrical outlet.

   **Note:** To ensure maximum availability of power to your EXP810, do not connect both the left and right power supplies to the same power circuit or power source.

# Installing SFP modules

The EXP810 requires SFP modules. SFP modules convert electrical signals to optical signals that are required for Fibre Channel transmission to and from RAID controllers. After you install the SFP modules, you use fiber-optic cables to connect the EXP810 to a DS4000.

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

- Do not mix long-wave SFPs and short-wave SFPs on a single storage subsystem. Use either long-wave SFPs or short-wave SFPs. You can use the DS4000 Storage Manager client to view the Storage Subsystem Profile in order to verify that you are not mixing long-wave and short-wave SFPs.

   **Attention:**   In addition, do not use long-wave SFPs or GBICs in any of the FC ports in the FC drive loops. (Long-wave SFPs and GBICs are not supported for use in the drive ports of storage expansion enclosures. Long-wave SFPs and GBICs are only supported in the host ports of the DS4000 storage subsystem).
- The SFP module housing has an integral guide key that is designed to prevent you from inserting the SFP module improperly.
- Use minimal pressure when inserting an SFP module into an SFP port. Forcing the SFP module into a port could cause damage to the SFP module or to the port.
- You can insert or remove the SFP module while the port is powered on.
- The operational or redundant 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 port. Refer to "Removing SFP modules" on page 40 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.

   **Attention:**   Carefully check the SFP's IBM part number, option number, and FRU part number to identify its speed. There are no physical features that distinguish a 4 Gbps from a 2 Gbps SFP.

**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 20.

Complete the following steps to install an SFP module:

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 22 on page 40. Save the protective cap for future use.
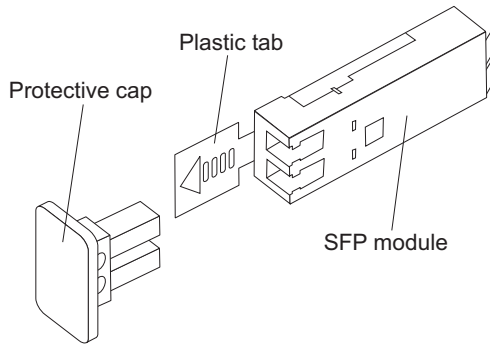
Figure 22. SFP module and protective cap

3. Remove the protective cap from the SFP port. Save the protective cap for future use.

4. Insert the SFP module into the host port until it clicks into place. See Figure 23.
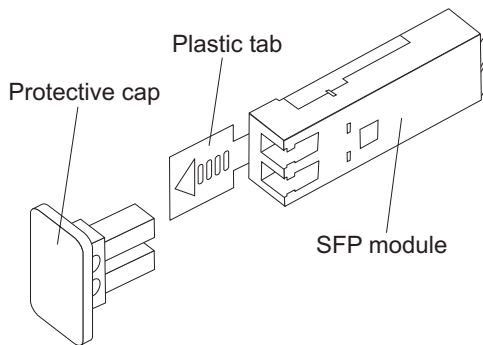


Figure 23. Installing an SFP module into the host port

5. Connect an LC-LC fibre-channel cable. For information about the LC-LC cable, see "Using LC-LC fibre-channel cables" on page 42.

## Removing SFP modules

Complete the following steps to remove the SFP module from the host port:

**Attention:** To avoid damage to the cable or to the SFP module, make sure that 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 fiber-optic cables" on page 41.

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 24 on page 41.
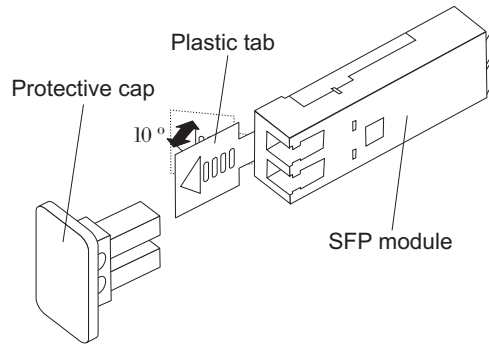
*Figure 24. Unlocking the SFP module latch - plastic variety*

  • For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 25.
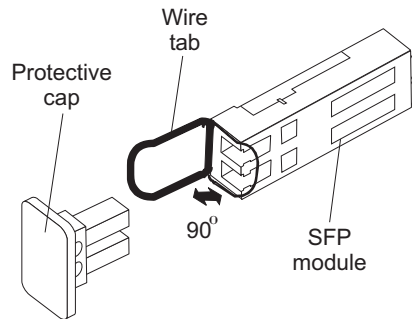


*Figure 25. Unlocking the SFP module latch - wire variety*

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 mini-hub 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 host port.

## Handling fiber-optic cables

**Attention:**  To avoid damage to your fiber-optic cables, follow these guidelines:
  • Do not route the cable along a folding cable-management arm.
  • When connecting cables to a device on slide rails, leave enough slack in the cable so that it does not bend to a radius of less than 38 mm (1.5 in.) when extended or become pinched when retracted.
  • Route the cable away from places where it can be snagged by other devices in the rack.
  • Do not overtighten the cable straps or bend the cables to a radius of less than 38 mm (1.5 inches).
  • Do not put excess weight on the cable at the connection point. Be sure that the cable is well supported.

# Using LC-LC fibre-channel cables

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

- An SFP module installed in an IBM EXP810 Storage Expansion Enclosure
- An SFP module installed in a DS4300 or DS4500 Fibre Channel Storage Server

See Figure 26 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.
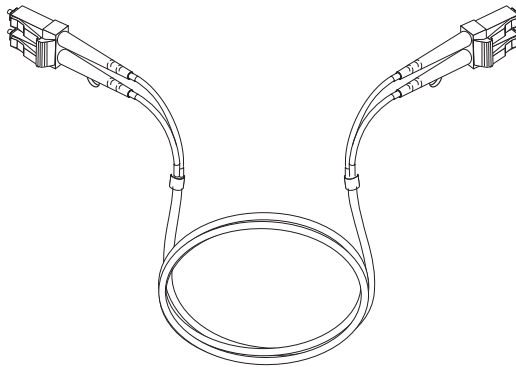


*Figure 26. LC-LC fibre-channel cable*

# 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 fiber-optic cables" on page 41.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 22 on page 40. 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 27. Save the protective caps for future use.
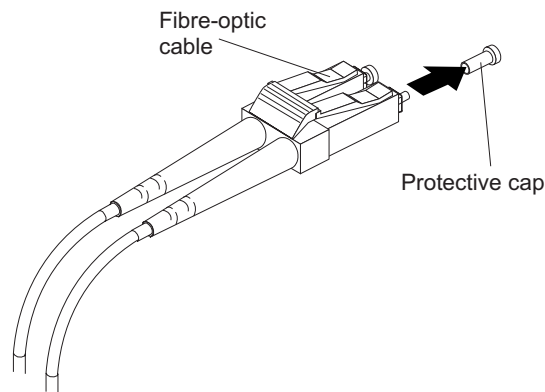


*Figure 27. Removing fiber-optic cable protective caps*

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the EXP810. 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 28.
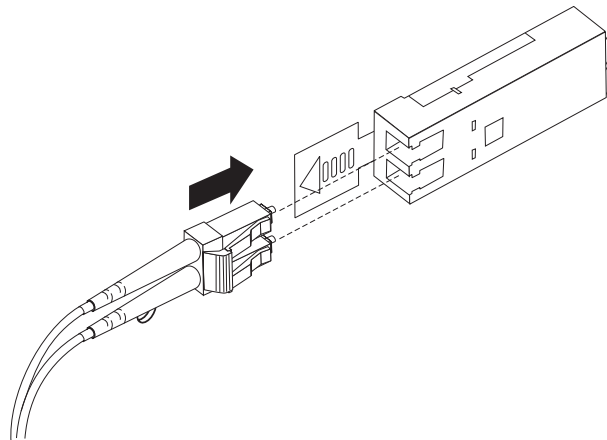


*Figure 28. Inserting an LC-LC fibre-channel cable into an SFP module*

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 one of the following devices:
   - An SFP module that is installed in a separate EXP810

- An SFP module that is installed in a DS4300 or DS4500

# Removing an LC-LC fibre-channel cable

Complete the following steps to remove 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.

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 29.
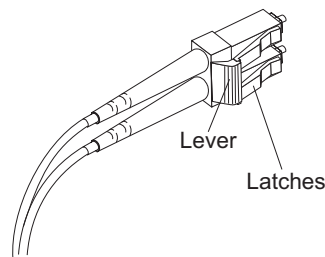


Lever

Latches

*Figure 29. 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 30.
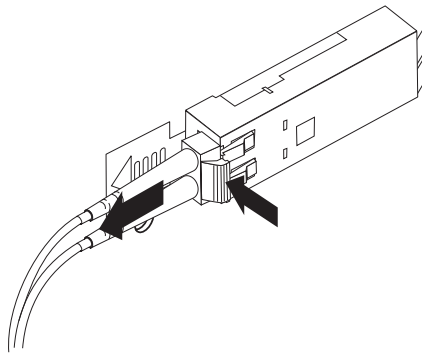


*Figure 30. Removing the LC-LC fibre-channel cable*

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

# Cabling the EXP810 to a DS4800 storage subsystem

In this release, you can cable the DS4000 EXP810 to a DS4800 Storage Subsystem only.

**Note:** Connections to other storage subsystems might be supported in the future. To verify your storage subsystems compatibility with the EXP810, check the

Installation, User's, and Maintenance Guide for your storage subsystem and the IBM DS4000 storage system support Web site: www.ibm.com/servers/storage/support/disk/

Complete the following steps to cable the EXP810 to a DS4800 Storage Subsystem:

1. Install an SFP module in the drive mini hub port on the back of a DS4800 Storage Subsystem.

2. Connect an LC-LC fiber-optic cable into the SFP module, as shown in Figure 31.
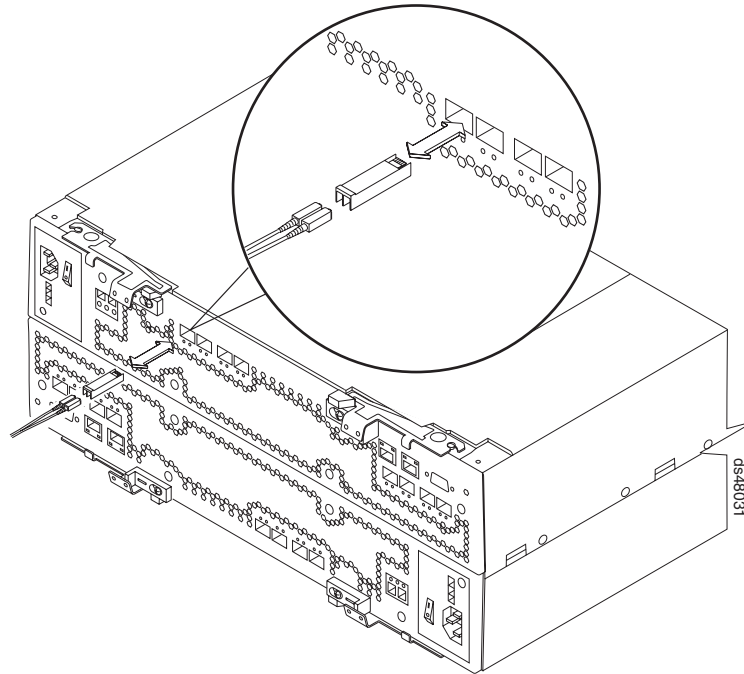


*Figure 31. Installing an SFP module and LC-LC cable in a DS4800*

3. Install an SFP module in the SFP port on the back of the EXP810; then, connect the other end of the LC-LC cable into the SFP module, as shown in Figure 32 on page 46.
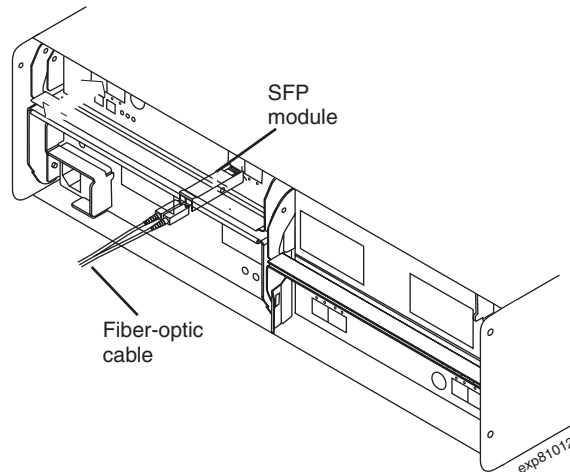
*Figure 32. Installing an SFP module and connecting an LC-LC cable to the EXP810*

# EXP810 loop redundancy

**Note:** The term *drive loop* or *drive loop* pair used in this publication might be referred to as a *drive channel* or *drive channel pair* when referring to a DS4800 Storage Subsystem in the *DS4800 Storage Subsystem Installation, User's and Maintenance Guide* and other DS4800 Storage Subsystem publications. The terms have identical meanings.

The EXP810 provides redundant loop support when the second ESM is configured, and when both loops (called A and B) are connected to a DS4000 that supports redundant loops. If a cable or SFP module fails on drive loop A, drive loop B provides redundancy, which is an alternate path to your disk drives.

**Notes:**

1. The EXP810 supports 2 GB fibre channel hard drives.
2. In the initial EXP810 release, the EXP810 can only be intermixed with EXP710s. Even though the storage expansion enclosures do not need to be grouped by drive enclosure type, IBM recommends that you group them by enclosure type in a redundant drive channel pair to simplify maintenance and troubleshooting. In addition, the EXP810 Link Rate switch must be set at 2 Gbps.

Figure 33 on page 47 shows a redundant drive loop that you might create with a DS4800 Storage Subsystem and four EXP810s. The numbers provided in Figure 33 on page 47 show the order in which cables should be attached.
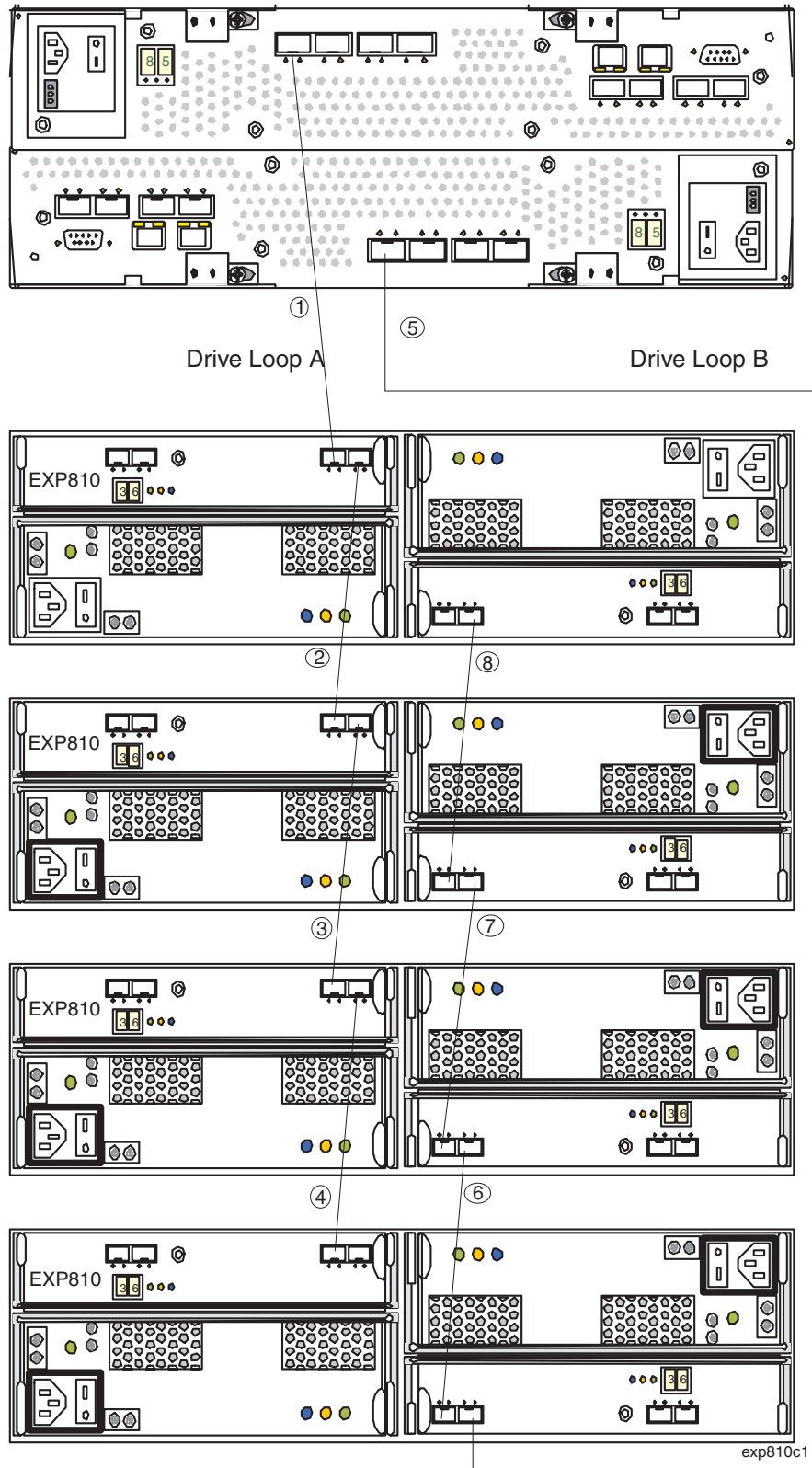
*Figure 33. EXP810 redundant drive loop configuration*

To create drive loop A (of the DS4800 redundant drive loop) shown in Figure 33, you would perform the following steps:

1. Make a fibre-channel connection from the *DS4800 Storage Subsystem* to the *first storage expansion enclosure* (connection 1).
2. Make a fibre-channel connection from the *first storage expansion enclosure* to the *second storage expansion enclosure* (connection 2).
3. Make a fibre-channel connection from the *second storage expansion enclosure* to the *third storage expansion enclosure* (connection 3).
4. Make a fibre-channel connection from the *third storage expansion enclosure* to the *fourth storage expansion enclosure* (connection 4).

To create drive loop B (of the DS4800 redundant drive loop) shown in Figure 33 on page 47, you would perform the following steps:
1. Make a fibre-channel connection from the *DS4800 Storage Subsystem* to the *last storage expansion enclosure* (connection 5).
2. Make a fibre-channel connection from the *last storage expansion enclosure* to the *third storage expansion enclosure* (connection 6).
3. Make a fibre-channel connection from the *third storage expansion enclosure* to the *second storage expansion enclosure* (connection 7).
4. Make a fibre-channel connection from the *second storage expansion enclosure* to the *first storage expansion enclosure* (connection 8).

# Intermixing the EXP810 and EXP710 in the same drive loop

In the initial EXP810 release, you can only intermix the EXP810 and EXP710. You can intermix the EXP810 and EXP710 in the same drive loop, but the Link Rate switch for all storage expansion enclosures in the intermixed drive loop must be set to 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 and EXP810 drive enclosure combinations. Table 12 lists the numbers of EXP710 and EXP810 storage expansion enclosures that you can combine for use in a single redundant drive channel/loop pair. Table 12 assumes that a DS4000 storage subsystem is generally capable of addressing the maximum of 112 fibre channel hard drives for each redundant drive channel/loop pair.

*Table 12. Supported EXP810 and EXP710 enclosure combinations per redundant drive channel/loop pair*

| Number of EXP810s | Number of EXP710s | Total number of drives in EXP810s | Total number of drives in EXP710s | | Total number of drives in a mixed EXP710 and EXP810 drive loop |
|---|---|---|---|---|---|
| 0 | 8 | 0 | 112 | = | 112 |
| 1 | 6 | 16 | 84 | = | 100 |
| 2 | 5 | 32 | 70 | = | 102 |
| 3 | 4 | 48 | 56 | = | 104 |
| 4 | 3 | 64 | 42 | = | 106 |
| 5 | 2 | 80 | 28 | = | 108 |
| 6 | 1 | 96 | 14 | = | 110 |
| 7 | 0 | 112 | 0 | = | 112 |

For more information, see the *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* or the*IBM TotalStorage DS4800 Storage Subsystem Installation, User's, and Maintenance Guide*.

# Cabling the power supply

Complete the following steps to connect the power supply cable:

1. Using the supplied strap, tie the power supply cord to the rail to provide strain relief for the power cord.

2. Attach the power supply nut and tighten it securely.

3. Connect the power cable to the power supply.

4. Plug the supply power cable into a properly grounded electrical outlet. For maximum protection against power loss, connect each of the two power supplies to a different power source.

5. Continue with "Turning the EXP810 on and off" on page 53 for the initial startup of the storage expansion enclosure.

# Chapter 4. Operating the EXP810

This chapter describes operating procedures for the EXP810.

To ensure optimal operation of your system, see "Best practices guidelines" on page 11

## 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 52 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 EXP810 storage configuration.

**Note:** You can find details on many of these inspection and maintenance responsibilities in the appropriate sections of this document.

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.

# Turning the EXP810 on and off

When you turn on and turn off the EXP810, be sure to use the startup sequence in this section.

**Attention:**  *Before* you first power on the DS4000 storage subsystem with a newly installed EXP810, you *must* perform the DS4000 controller firmware upgrade described in Appendix A, "Upgrading the DS4000 controller firmware," on page 101. In addition, you might have to regenerate the premium feature key files to re-enable the premium feature key that is enabled from the factory after the controller firmware upgrade.

# Turning on the EXP810

This section contains instructions for turning the EXP810 on and off under normal and emergency situations.

The following procedure covers two situations:
- The entire storage subsystem has been shut down (the main circuit breakers for the cabinet are off).
- Some storage expansion enclosures are being powered on while others remain online (the main circuit breakers for the cabinet are on). You might encounter this if you are adding an additional storage expansion enclosure to increase storage capacity.

**Attention:**

1. **Potential damage to drives** - Repeatedly turning the power off and on without waiting for the drives to spin down can damage the drives. Always wait at least 70 seconds from when you turn off the power until you turn it on again.

2.  If you are connecting a power cord to a storage expansion enclosure, turn off both of its power switches first. If the main circuit breaker is off, be sure both power switches are off on each storage expansion enclosure in the cabinet before turning on the main circuit breakers.

1. Are the main circuit breakers turned on?

   - **Yes -** Turn off **both** power switches on each storage expansion enclosure that you intend to connect to the power.

   - **No -** Turn off **both** power switches on **all** storage expansion enclosure in the storage subsystem.

2. Connect the power cords to the power supplies on each storage expansion enclosure.

3. If the main circuit breakers are turned off, turn them on.

4. Verify that the link rate setting on the front of the storage expansion enclosure matches the speed of the drives in the subsystem.

   **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 complete the startup process. If the controllers do not find any drives present during the initial power on sequence, the storage subsystem will not complete the startup process. This will prevent controllers from communicating with each other, and any factory-installed premium features will not be activated correctly.

5. Turn on both power switches on the back of each storage expansion enclosure. 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 storage subsystem drive port should be lit.

6. Turn on both power switches on the back of the DS4000 storage subsystem.

   Depending on the number of storage expansion enclosures in the configuration, the 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. A storage subsystem can take up to 10 seconds to power on and up to 15 minutes to complete its controller battery self-test. During this time, the indicator lights on the front and back of the module blink intermittently.

Power switch    Power connector



Power switch
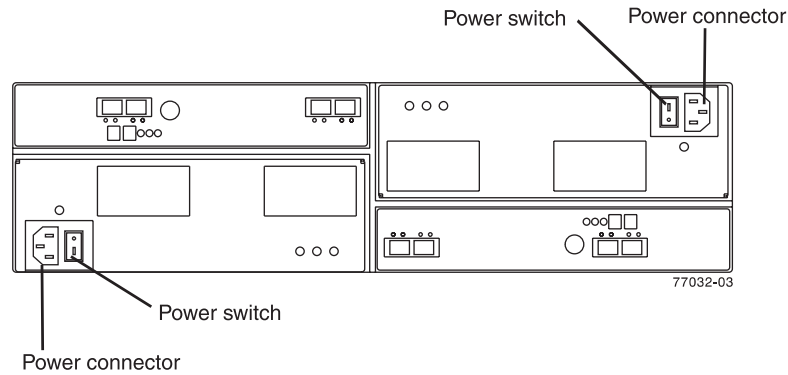
Power connector

*Figure 34. Power supply switches and connectors*

7. 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 "Checking the LEDs" on page 62 or 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 "Solving problems" on page 95.

   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.

8. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?

   • Yes — End of procedure.

   • No — Go to step 9.

9. 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 specific failed component. For troubleshooting procedures, see Chapter 6, "Hardware maintenance," on page 95.

   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 corrected.

   d. If the problem persists, contact your IBM service representative.

## Turning off the EXP810

Use the following procedure to turn off the power for the EXP810. Figure 34 shows the location of the power switches on a storage expansion enclosure.

**Attention:** Except in an emergency, never turn off the power if any 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 EXP810. All LEDs should be green on the front of the storage expansion enclosure. If they are not, use the DS4000 Storage Manager client to diagnose the problem. This ensures that the EXP810 will power up correctly later.

The EXP810 is designed to run continuously. After you turn on the EXP810, do not turn it off. Turn off the power only in the following situations:

- Instructions in a hardware or software procedure require that you turn off the power.
- An IBM technical support representative instructs you to turn off the power.
- A power outage or emergency situation occurs, see "Restoring power after an unexpected shutdown" on page 58.

**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.**
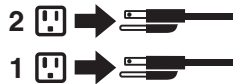


**Attention:** Turning off and turning on power without waiting for the storage expansion enclosure disk drives to spin down can damage the drives and might cause data loss. Always let at least 70 seconds elapse from when you turn off the power until you turn on the power again.

> **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 expansion enclosures for a planned shutdown. To turn off power for an unplanned shutdown, see "Restoring power after an unexpected shutdown" on page 58.

Before proceeding, use the 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 each storage expansion enclosure.
2. Remove the front cover from the storage expansion enclosure, if applicable.
3. Determine the status of all storage expansion enclosures 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.
   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.
4. Are the LEDs indicating normal operation, and is the status Optimal on all configuration components?
   - **Yes** - Go to step 6 on page 58.
   - **No** - Go to step 5.
5. 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 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.

6. Check the Cache Active LED, and verify that it 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.

7. 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.

8. Turn off the AC power switch on the back of each controller in the storage subsystem.

   **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.

9. Turn off both power switches on the back of each storage expansion enclosure in the configuration.

10. After you perform the necessary maintenance procedures, turn on the power using the procedure in "Turning on the EXP810" on page 53.

## Performing an emergency shutdown

**Attention:** 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 helps to safeguard your equipment from potential damage due to electrical surges when power is restored. If the EXP810 loses power unexpectedly, it might be due to a hardware failure in the power system or in the midplane of the EXP810.

Complete the following steps to shut down the system during an emergency:

1. If you have time, stop all I/O activity to the storage expansion enclosure.

2. Check the LEDs. 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, starting with the DS4000 storage subsystem first, and followed by the storage expansion enclosures. Then, unplug the power cables from the EXP810.

## Restoring power after an unexpected shutdown

Complete the following steps to restart the EXP810 if you turned off the power supply switches during an emergency shutdown, or if a power failure or power outage occurred:

1. After the emergency situation is over or power is restored, check the EXP810 for damage. If there is no visible damage, continue with step 2; otherwise, have your system serviced.

2. After you check the EXP810 for damage, ensure that the power switches are in the off position; then plug in the EXP810 power cables, if required.

3. Check the system documentation of the hardware devices that you want to turn on and determine the proper startup sequence.

> **Note:** Be sure to turn on all of the storage expansion enclosures and verify that there are not any ESM or power supply-fan fault LEDs lit before you turn on the DS4000.
>
> In addition, consider the following items:
> - The storage subsystem supports simultaneous power-up of the system components; however, you should always follow the power-up sequence listed in the "Turning on the storage subsystem section" of the appropriate *DS4000 Storage Subsystem Installation, User's, and Maintenance Guide* during any attended power-up procedure.
> - A storage subsystem in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, contact IBM technical support if any of the following conditions occur:
>   - The storage subsystem logical drives and subsystems do not display in the Storage Manager graphical user interface (GUI).
>   - The storage subsystem logical drives and subsystems do not come online.
>   - The storage subsystem logical drives and subsystems seem to be degraded.

4. Turn on the power to each device, based on the startup sequence.
5. Turn on both of the power supply switches on the EXP810. The green LEDs on the front and the back of the EXP810 should remain lit. If other amber Fault LEDs light, see "Solving problems" on page 95.

## Recovering from an overheated power supply-fan

Each EXP810 storage expansion enclosure contains two power supply-fans. Each power supply-fan contains a built-in temperature sensor designed to prevent it from overheating. Under normal operating conditions, with an ambient air temperature range of 10° C to 35° C (50° F to 95° F), the fans in the power supply-fan units maintain a proper operating temperature inside the module.

If the internal temperature reaches 65° C (149° F), the power supply shuts down automatically. If both power supplies shut down because of overheating, the module has no power, and all indicator lights are off.

The following factors can cause the power supplies to overheat.
- An unusually high room temperature
- Fan failures in the power supply-fan units
- Defective circuitry in the power supply
- Blocked air vents
- Failures in other devices in the configuration or cabinet

If a fan failure causes overheating, the Global Fault LED on the storage expansion enclosure turns on. The power-fan canister Fault LED on the back of the storage expansion enclosure also turns on. "Rear LEDs" on page 63 shows the location of these LEDs.

If the module temperature exceeds 45° C (113° F), the storage management software displays a Needs Attention icon in the Subsystem Management Window. If event monitoring is enabled, and event notification is configured, the software issues two critical problem notifications.

- If *one* power supply shuts down, the storage management software displays a Needs Attention status in the Subsystem Management Window.
- If *both* power supplies shut down, the module shuts down, and the storage management software displays a Not Responding status in the Array Management Window.

Use the following procedure to resume normal operation after a power supply shutdown. Figure 35 on page 61 shows the location of the power switches on the storage expansion enclosure.

**Attention:   Risk of damage from overheating** - The power supplies automatically shut down when the air temperature inside the cabinet reaches 65° C (149° F). If the power supplies shut down, immediately remove all cabinet panels to help cool the cabinet air temperature and to prevent damage to the DS4000 storage subsystem configuration components.

1. Remove the front cover.
2. If applicable, mute the alarm.
3. Did you use the procedure "Troubleshooting the storage expansion enclosure" on page 61 to identify an overheating problem?
   - **Yes** - Go to step 4.
   - **No** - Perform the procedure "Troubleshooting the storage expansion enclosure" on page 61 to verify that the power supplies have shut down because of an overheating problem, and then go to step 4.
4. Stop I/O activity to all attached storage expansion enclosures.
5. Take all or some of the following measures to alleviate the overheating problem:
   - Removing all panels from the cabinet immediately
   - Using external fans to cool the area
   - Shutting down the power to the storage expansion enclosure, using the procedure described in "Performing an emergency shutdown" on page 58.
6. Wait for the air temperature in and around the storage expansion enclosure to cool.

   After the temperature inside the power supplies cools to below 65° C (149° F), the storage expansion enclosure is capable of power-up recovery without operator intervention. After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers will reset and return to normal operation.
7. Did the power supplies restart automatically?
   - **Yes** - Go to step 9.
   - **No** - Go to step 8.
8. To cycle the power, turn off both power switches on the back of each storage expansion enclosure, wait two minutes, and turn on both power switches.

   While the storage expansion enclosure powers up, the LEDs on the front and the back of the module blink intermittently. Depending on your configuration, the storage expansion enclosure can take between 20 seconds and several minutes to power on.
9. Turn on both power switches on the back of the storage subsystem.

   A storage subsystem can take 10 seconds to power on and up to 15 minutes for the battery self-test to complete. During this time, the LEDs on the front and the back of the modules blink intermittently.

Power switch     Power connector



77032-03

Power switch

Power connector
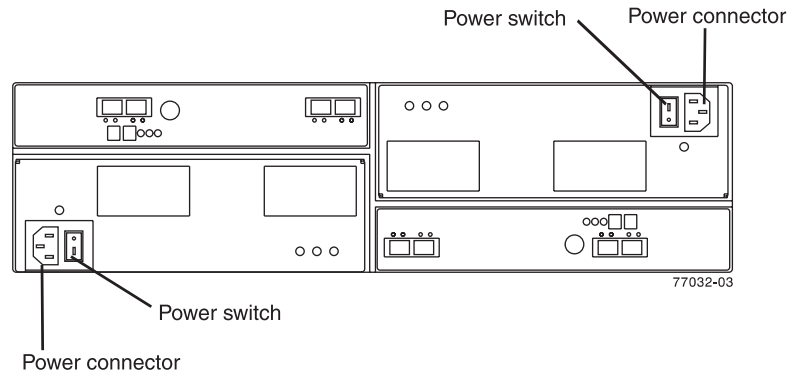
*Figure 35. Power supply switches*

10. Check the status of each storage expansion enclosure and its components.

   a. Note the status of the LEDs on the front and back of each module.

      A green LED indicates a normal status; amber LEDs indicate a hardware fault.

   b. Open the Subsystem Management Window for the storage array.

   c. Select the appropriate components button for each module in the Physical View of the Subsystem Management Window to view the status of its components.

      The status for each component is either Optimal or Needs Attention.

11. Does each module display green LEDs only, and is the status Optimal for each module component?

   • **Yes** - Go to step 13.

   • **No** - Go to step 12.

12. Diagnose and correct the fault.

   a. To run the Recovery Guru, select 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, locate and troubleshoot that component. See "Checking the LEDs" on page 62.

   c. When the procedure is completed, rerun the Recovery Guru to ensure that the problem has been corrected by selecting Recheck in the Recovery Guru.

   d. If the problem persists, contact IBM Customer and Technical Support.

13. Replace the bezel on the storage expansion enclosure, if applicable.

## Troubleshooting the storage expansion enclosure

The DS4000 Storage Manager is the best way to monitor the storage expansion enclosure, diagnose a problem, and recover from a hardware failure. You should run the DS4000 Storage Manager continuously, and check the status of the storage array frequently.

Use the following procedure to check the status of and identify a problem with the storage expansion enclosure.

1. Open the Subsystem Management Window.

2. Select the component button for each storage expansion enclosure in this storage subsystem, and view the status of each of the components.

The status for each component is either Optimal or Needs Attention.

3. Does any component have a Needs Attention status?
   - **Yes** - Go to step 4.
   - **No** - All components are Optimal. Go to step 6.
4. 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 5.

   **Attention:** If the fault requires you to power off an attached storage expansion enclosure, you might need to cycle the power on the DS4000 storage subsystem and all remaining storage expansion enclosures in the storage subsystem. Contact IBM Customer and Technical Support before powering off any attached storage expansion enclosures.
5. Mute the alarm, if needed.
6. Check the indicator LEDs on the front and the back of the storage expansion enclosure.

   A green LED denotes a normal status; an amber LED denotes a hardware fault.
7. Is an amber LED on?
   - **Yes** - Locate and troubleshoot the failed components. See "Checking the LEDs."
   - **No** - You are finished with this procedure. If you are still experiencing a problem with this storage subsystem, create, save, and print a storage subsystem profile. This information might be helpful when troubleshooting. Contact IBM Customer and Technical Support for assistance. When the recovery procedure is completed, select Recheck in the Recovery Guru to rerun the Recovery Guru and to ensure that the problem has been corrected.

## Checking the LEDs

The LEDs display the status of the storage expansion enclosure 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. The blue LED also indicates that the storage expansion enclosure is being identified or located.

It is important to check all the LEDs on the front and back of the storage expansion enclosure when you turn on the power. During power up, the indicator LEDs blink intermittently as the storage expansion enclosure and components complete the power-up process. 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 LEDs

This section describes the primary LEDs and controls on the front of the storage expansion enclosure.
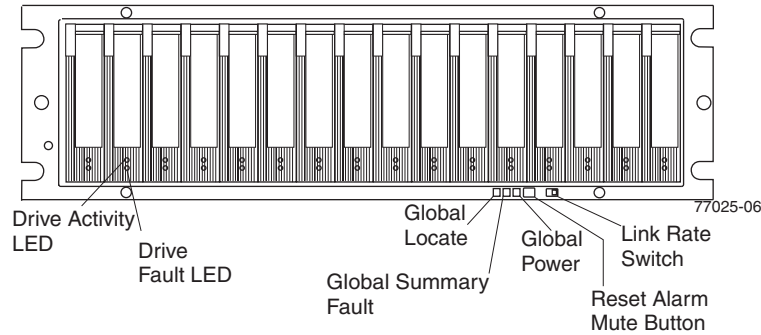
Figure 36. Front LEDs

Table 13. Front LEDs and controls

| LED | Normal Status | Problem Status |
|---|---|---|
| Drive Activity LED | On (not blinking) - No data is being processed<br><br>Blinking - data is being processed | Off |
| Drive Fault LED | Off<br><br>Blinking - Drive, volume, or storage array locate function | On (not blinking)<br>**Note:** In certain ESM firmware versions, the Drive Fault LED is lit when no drive is inserted in the drive slot. |
| Global Locate | On | N/A |
| Global Summary Fault | Off | On |
| Global Power | On | Off |
| Reset Alarm Mute Button | N/A | N/A |
| Link Rate Switch | In the initial EXP810 release, the Link Rate switch should be set only to the 2 Gbps position. | N/A |

## Rear LEDs

This section describes the primary LEDs, controls, and connectors on the rear of the storage expansion enclosure.
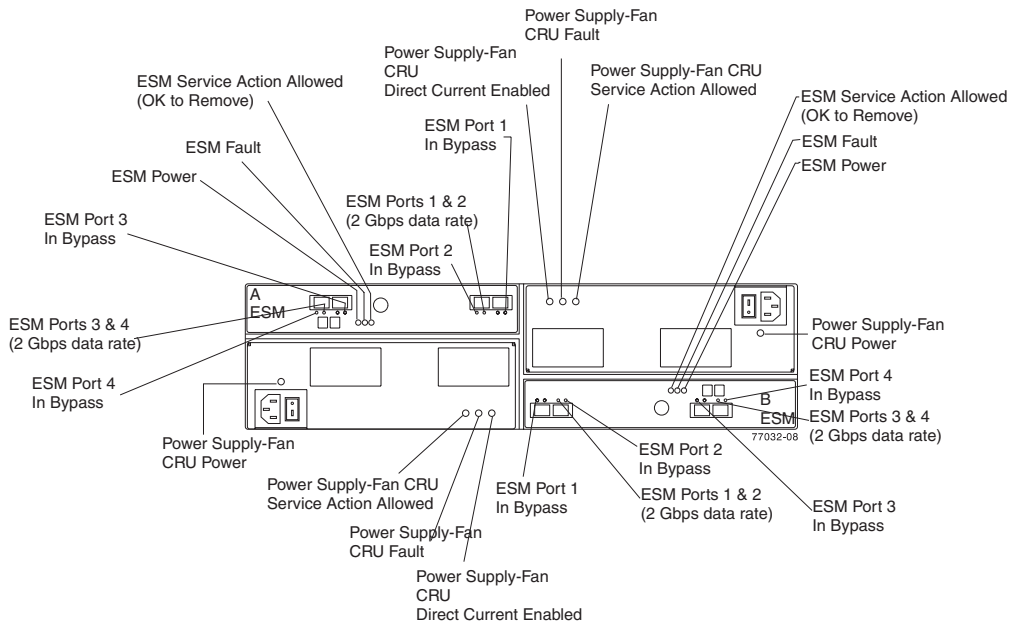
*Figure 37. Rear LEDs, controls, and connectors*

*Table 14. Rear LEDs, controls, and connectors*

| LED | Normal Status | Problem Status |
|---|---|---|
| Power supply-fan CRU Power | On | Off |
| Power supply-fan CRU Service Action Allowed (OK to Remove) | Off | On |
| Power supply-fan CRU Fault | Off | On |
| Power supply-fan CRU Direct Current Enabled | On | Off |
| ESM Port 1 In Bypass (This port is labeled 1A) | Off - Cable connected<br>On - No cable connected | On, blinking for 30 seconds |
| ESM Ports 1 & 2 2 Gbps Data Rate | One LED is lit if 2 Gbps<br>Both LEDs are lit if 4 Gbps | N/A |
| ESM Port 2 In Bypass (This port is labeled 1A) | Off - Cable connected<br>On - No cable connected | On, blinking for 30 seconds |
| ESM Port 3 In Bypass (This port is labeled 2A) | Off - Cable connected<br>On - No cable connected | On, blinking for 30 seconds |

*Table 14. Rear LEDs, controls, and connectors  (continued)*

| LED | Normal Status | Problem Status |
|---|---|---|
| ESM Ports 3 & 4<br><br>(2 Gbps data rate) | On if 2 GB | N/A |
| ESM Port 4 In Bypass<br><br>(This port is labeled 2B) | Off - Cable connected<br><br>On - No cable connected | On, blinking for 30 seconds |
| ESM Power | On | Off |
| ESM Fault | Off | On |
| ESM Service Action Allowed (OK to Remove) | Off | On |

# Seven-segment numeric display

The numeric display consists of two seven-segment LEDs that provide information about enclosure identification and diagnostics. Figure 38 shows the numeric display and the diagnostic LED.



Seven-segment display

Diagnostic LED
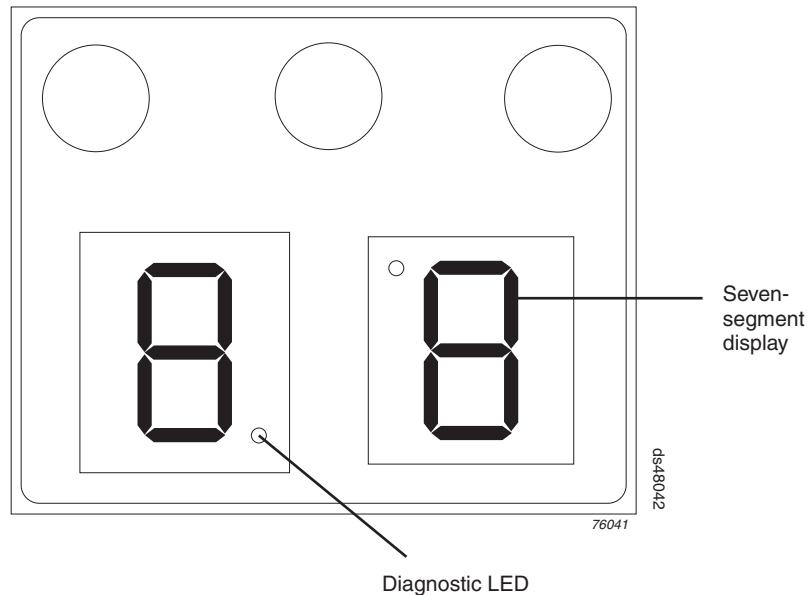
*Figure 38. Numeric display LEDs*

When you power on the storage expansion enclosures, the seven-segment LEDs show 88 before the boot firmware starts to run. After the boot code starts, - - is displayed.

When the application code starts, the ESMs display either aa or bb depending on whether it is ESM A or B.

When the storage expansion enclosure is operating normally, the numeric display shows the enclosure identification (enclosure ID) of the storage expansion enclosure.

If an error has occurred and the 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 tuns off when the numeric display shows the storage subsystem enclosure ID. The numeric display shows various diagnostic codes as the enclosures 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 or Hx, where x is a hexadecimal digit, indicate storage expansion enclosure state information. In general, these codes are displayed only when the storage expansion enclosure is in a non-operational state. The storage expansion enclosure might be non-operational due to a configuration problem (such as mismatched types), or it might be non-operational due to hardware faults. If the storage expansion enclosure is non-operational due to system configuration, the storage expansion enclosure Needs Attention LED is off. If the storage expansion enclosure is non-operational due to a hardware fault, the storage expansion enclosure Needs Attention LED is on. The definitions for Lx diagnostic codes are listed in Table 15.

*Table 15. Numeric display diagnostic codes*

| Value | Storage expansion enclosure State | Description | SANtricity View |
|-------|-----------------------------------|-------------|-----------------|
| L0 | Suspend | Mismatched ESM types | Needs Attention condition for board type mismatch |
| L2 | Suspend | Persistent memory errors | Needs Attention condition for offline ESM |
| L3 | Suspend | Persistent hardware errors | Needs Attention condition for offline ESM |
| L9 | Suspend | Over temperature | |
| H0 | Suspend | SOC Fibre Channel Interface Failure | |
| H1 | Suspend | SFP Speed Mismatch | |
| H2 | Suspend | Invalid/Incomplete Configuration | Needs Attention condition for offline ESM |
| H3 | Suspend | Maximum Reboot Attempts Exceeded | Needs Attention condition for offline ESM |
| H4 | Suspend | Cannot Communicate with other ESM | Needs Attention condition for offline ESM |
| H5 | Suspend | Midplane Harness Failure | Needs Attention condition for offline ESM |

*Table 15. Numeric display diagnostic codes (continued)*

| Value | Storage expansion enclosure State | Description | SANtricity View |
|-------|-----------------------------------|-------------|-----------------|
| H6 | Suspend | Firmware Failure | Needs Attention condition for offline ESM |
| 88 | Reset | ESM is held in reset by the other ESMs | |

# Chapter 5. Installing and replacing devices

This chapter contains information about installing and replacing the drive CRU, power supply-fan CRU, ESM CRU, SFP module, and midplane.

## 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 ESM and power supply-fan 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 EXP810 component unless the component's Service Action Allowed status LED is lit.

---
**Attention**

Never remove an ESM or power supply-fan unless the Service Action Allowed status LED is turned on. Doing so can result in a potential loss of data availability. 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 in this chapter 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.

# Adding the EXP810 to an existing and configured drive loop

**Note:** The term *drive loop or drive loop pair* used in this publication might be referred to as a *drive channel or drive channel pair* when referring to a DS4800 Storage Subsystem in the *DS4800 Storage Subsystem Installation, User's and Maintenance Guide* and other DS4800 Storage Subsystem publications. The terms have identical meanings.

You can add up to seven EXP810s to a redundant fibre-channel loop pair. Some DS4000 storage subsystems, like the DS4800s, support up to two redundant drive loop pairs. Before you cable your EXP810 to a drive loop, refer to the *Fibre Channel Cabling Instructions* that came with your storage subsystem for specific instructions.

---
**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.

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Figure 39 on page 71 shows an example of a DS4000 storage subsystem configured with redundant drive loop pairs.
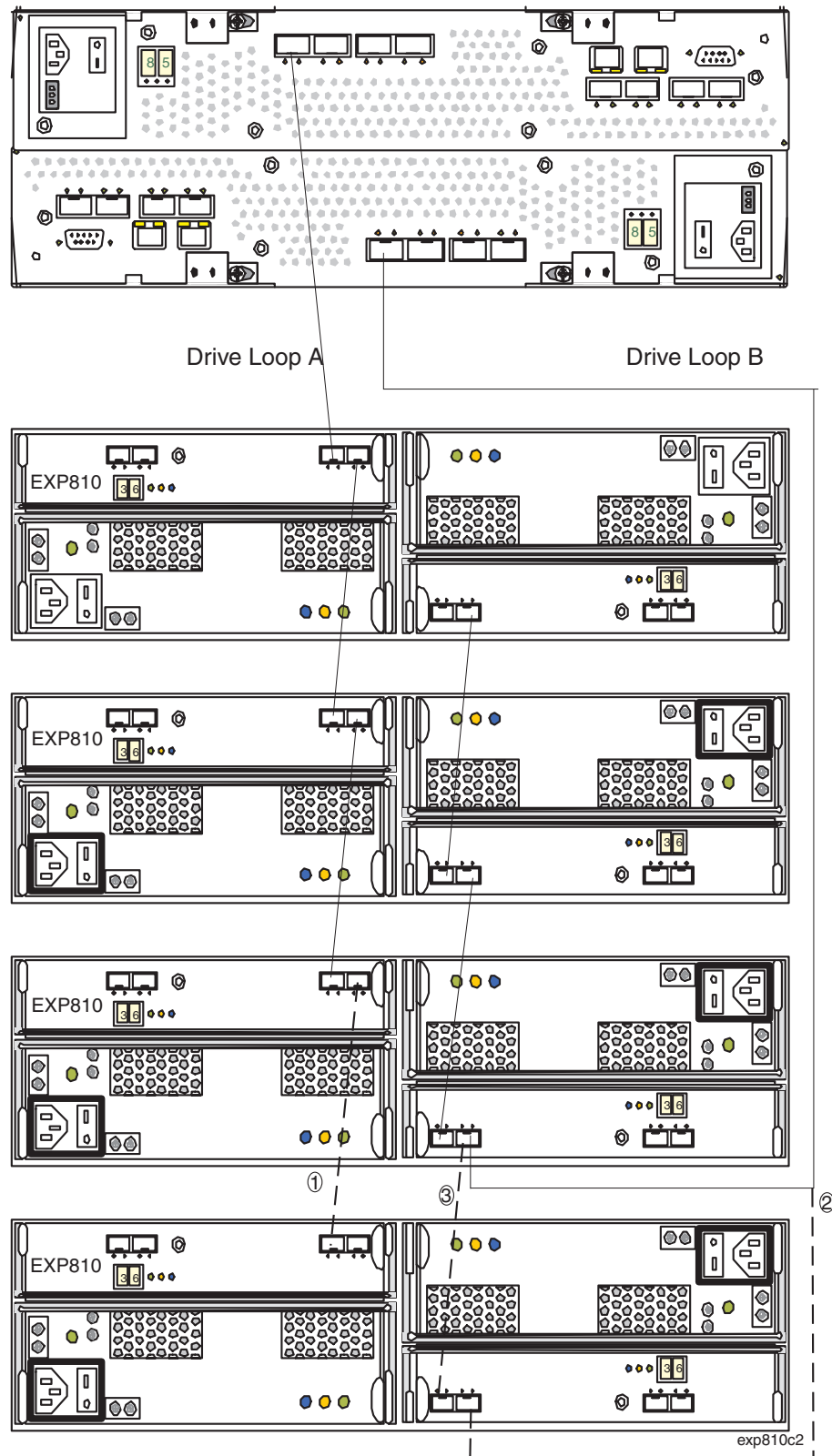
*Figure 39. Cabling the EXP810 to an existing and configured drive loop*

The dashed lines in Figure 39 show how to add a new EXP810 to an existing DS4800 configuration with EXP810s. To add the new EXP810 shown in Figure 39, perform the following steps:

1. Unpack and install the EXP810 drive expansion enclosure. Do not insert any drive CRUs into the enclosure drive slots.
2. Verify that the Link Rate speed is at the correct setting. You cannot add storage expansion enclosures with different Link Rate speed settings in the same redundant drive loop.
3. Power on the EXP810 storage expansion enclosure.
4. Make the fibre-channel connection marked *1* in Figure 39 on page 71 (drive loop A). Then verify that it is recognized by the Storage Manager software GUI.
5. Move the existing fibre-channel connection marked *2* in Figure 39 on page 71 from the existing EXP810 enclosure ESM port to the new EXP810 enclosure ESM port.
6. Make the fibre-channel connection marked *3* in Figure 39 on page 71 (drive loop B).
7. You can use either the Storage Subsystem Profile information or the Drive Enclosure Component icon in the Physical View of the Subsystem Management window to verify the EXP810 ESM firmware.

   **Attention:** For error-free operations, the ESM firmware in the EXP810 ESM modules must be at the same level.
8. Insert the drives into the drive slots two at a time. Wait until the drives have spun up and been recognized by the DS4000 before inserting the next two drives from the Physical View of the Subsystem Management window.
9. Repeat step1 to step 8 for each drive expansion enclosure that you want to add.

**Note:** Always add a new EXP810 to the *end* of a drive loop. Always add new drive expansion enclosures to the existing drive loop one at a time while the DS4000 storage subsystem is running and in an optimal state. See the *DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* for more information.

# Working with hot-swap hard disk drives

This section explains how you can increase the storage expansion enclosure capacity by adding more hard disk drives or by replacing existing drives with ones that have a larger capacity.

Before you begin, complete the following tasks:
- Read the safety and handling guidelines in "Safety" on page xi and in "Handling static-sensitive devices" on page 20.
- Ensure that your current system configuration is working properly.
- Back up all important data before you make changes to data storage devices.

Before you install or remove drive CRUs, review the following information:
- **Blank trays:** A storage expansion enclosure without a full set of drives (16) contains blank trays in the unused drive bays. Before installing new drives, you must remove these empty trays. Save the empty trays for future use. Each of the 16 bays must always contain either a blank tray or a hot-swap hard disk drive.

  For proper cooling and EMC protection, do not leave a drive slot open without either a drive blank or a drive CRU inserted.
- **Drive CRUs:**

- In the initial EXP810 release, only 2 Gbps fibre channel hard disk drives are supported. The Link Rate setting speed must be set accordingly. See "Verifying the Link Rate setting" on page 82 for more information.
- IBM recommends that when adding drive CRUs, if you are not installing all 16 drive CRUs into the EXP810, install the drive CRUs from left to right consecutively.
- For optimum performance, never insert a drive into a storage expansion enclosure without first confirming the drive firmware level. Contact IBM Support for information on supported drive firmware levels.
- Use of non-supported drives in the drive modules can cause the storage expansion enclosure to fail.
- In configurations with mixed modules, all modules on a fibre loop must be operating at the same interface speed. Refer to the *Storage System Product Release Notes for Version 9.1x* for model- specific restrictions.
- Ensure that the speed of the drive CRU you are adding is supported in the storage expansion enclosure. For example, do not install a 2 Gbps drive CRU in a storage expansion enclosure that supports only 4 Gbps drives.
- Drive CRUs are not interchangeable between EXP710s and EXP810s.
- After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

---

**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.

---

- **Drive CRU labels:** A label is provided on the front of each hard disk drive. Use this label to record the location information for each drive before you remove it. Ensure that you keep track of the drives and their corresponding bays. Also, record the location information in Table 23 on page 114. If you install a drive in the wrong bay, you might lose data.
- **Drive LEDs:** Each drive CRU tray has two associated LEDs, a green Activity LED and an amber Fault LED. These LEDs indicate the status for that drive. See Table 16 on page 74 for the drive LED states and descriptions.
- Drive CRUs are not interchangeable between the EXP810 and other DS4000 storage expansion enclosures such as EXP710s.

*Table 16. Drive LED activity*

| LED | LED state | Descriptions |
|---|---|---|
| Activity LED | Flashing green | The green LED flashes to indicate fibre-channel activity to the drive. |
| Activity LED | Steady green | The green LED lights to indicate that the drive is properly installed and is spun up by the DS4000 controller. |
| Fault LED | Flashing amber | The amber LED flashes to indicate that a drive has been identified by the software. |
| Fault LED | Steady amber | The amber LED lights to indicate a drive failure. The green activity LED will be flashing one every 2 seconds. |
| Activity and Fault LEDs | All unlit | Check for and resolve one of the following situations:<br>• EXP810 is turned off<br>• EXP810 enclosure speed is not set correctly |
| Activity LED | Flashing once every 2 seconds | Check for and resolve one of the following situations:<br>• EXP810 is not connected to the DS4000<br>• DS4000 storage subsystem controller firmware is not 06.16.xx.xx and higher |
| Activity and Fault LEDs | Flashing together in a certain pattern | Drive failure due to the incorrect EXP810 enclosure speed setting or internal drive hardware failures. |

- **Fibre-channel loop IDs:** When you install a hard disk drive in the storage expansion enclosure, the drive tray connects into a printed circuit board called the *midplane*. The midplane sets the fibre-channel loop ID automatically, based on the setting of the enclosure ID switch and the physical location (bay) of the drive CRU.
- **Hot-swap hardware:** The EXP810 contains hardware that enables you to replace a failed hard disk drive without turning off the storage expansion enclosure. You can continue to operate your system while a hard disk drive is removed or installed. These drives are known as hot-swap hard disk drives.

# Installing hot-swap hard disk drives

With the exception of the DS4000 storage subsystem initial power up, IBM recommends that you add hard disk drives while the storage expansion enclosure is turned on and running. Complete the following steps to install hot-swap hard disk drives in the storage expansion enclosure:

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

1. Read the documentation that comes with the hard disk drive.
2. Check for Fault LEDs shown in Figure 40 on page 75. If any amber LEDs are lit, see "Solving problems" on page 95.
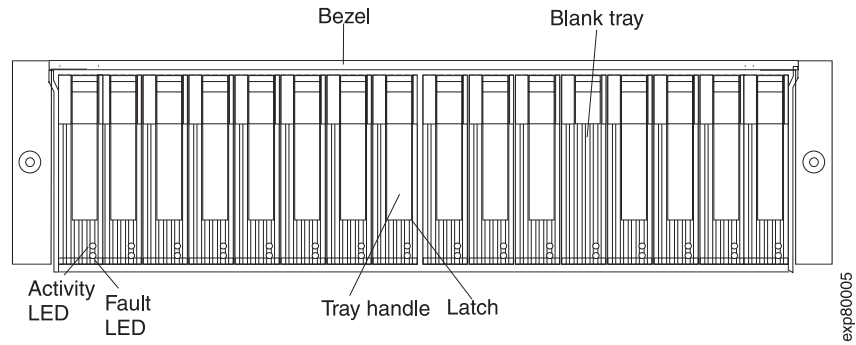
Figure 40. Hot-swap hard disk drive LEDs

3. Determine the bay into which you want to install the drive.

4. Remove the blank tray:

   a. Release the latch on the drive CRU by pressing on the inside of the bottom of the tray handle.

   b. Lift the closed latch to its open position. (The latch is at a 90° angle to the front of the drive when open.)

   c. Pull the blank tray out of the bay.

   d. Save the blank tray for later use.

5. Install the hard disk drive:

   **Note:** The hard disk drive comes installed in a drive tray. Do not attempt to detach the drive from the tray.

   a. Release the latch on the drive CRU by pressing on the inside of the bottom of the tray handle.

   b. Pull the handle on the tray out so that it is in the open position, as shown in Figure 41.
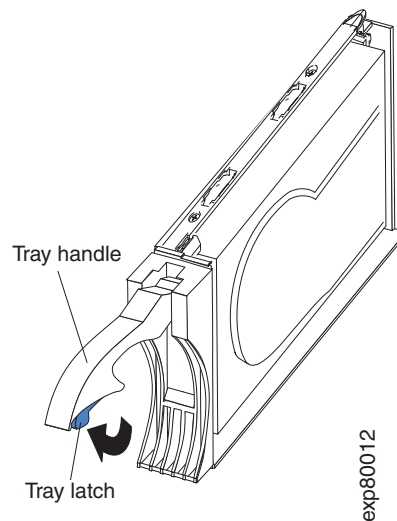


Figure 41. Drive CRU handle

   c. Slide the drive CRU into the empty bay until the hinge of the tray handle latches beneath the storage expansion enclosure bezel or the adjacent drive CRU bezel.

**Note:** Make sure that the EMC gasket does not snag on the bezel.

    d. Push the tray handle down until it latches into place.

# Replacing hot-swap hard disk drives

Drive problems include any malfunctions that delay, interrupt, or prevent successful I/O activity between the hosts and the hard disk drives in the storage expansion enclosure. This includes transmission problems between the host controllers, the ESMs, and the drives. This section explains how to replace a failed hard disk drive.

**Note:** If you want to remove a hard disk drive that is not in a failed or bypass state, always use the Storage Manager client program either to place the drive in a failed state or to place the array that is associated with the drive (or drives) in an offline state before you remove the drive from the enclosure.

**Attention:** Failure to replace the hard disk drives in their correct bays might result in loss of data. If you are replacing a hard disk drive that is part of a configured array and logical drive, ensure that you install the replacement hard disk drive in the correct bay. Check the hardware and software documentation that is provided with your DS4000 to see if there are restrictions regarding hard disk drive configurations.

Complete the following steps to replace a hot-swap hard disk drive:

1. Use the DS4000 Storage Management client software to print a new storage system profile.
2. Determine the location of the drive that you want to remove.

   **Attention:** Never hot-swap a drive CRU when its associated green Activity LED is flashing. Hot-swap a drive CRU only when its associated amber Fault LED is lit and not flashing.
3. Put on antistatic protection.
4. Remove the drive CRU:

   a. Release the latch on the drive CRU by pressing on the inside of the bottom of the tray handle, as shown by the arrow in Figure 41 on page 75.

   b. Pull the tray handle out into the open position.

   c. Pull the drive CRU about 1/2 inch out of the bay and wait 70 seconds to allow the drive to properly spin down and the storage subsystem controller to properly recognize that a drive is removed from the configuration. .

   d. Verify that there is proper identification (such as a label) on the drive CRU, and then slide it completely out of the storage expansion enclosure.
5. Unpack the new drive. Save all packing material in case you need to return the drive.
6. Install the new drive CRU:

   a. Gently push the drive CRU into the empty bay until the hinge of the tray handle latches beneath the storage expansion enclosure bezel.

   b. Push the tray handle down into the closed (latched) position.
7. Check the drive LEDs:

   • When a drive is ready for use, the green Activity LED lights and the amber Fault LED is off.

   • If the amber Fault LED lights and is not flashing, remove the drive from the unit and wait 70 seconds; then, install the drive again.

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

8. Use the DS4000 Storage Manager subsystem management window to verify that the drive is shown in the Storage Subsystem Management window.

## Replacing multiple drives

This section provides guidelines for upgrading the drives in the storage expansion enclosure. Read the software documentation and this entire section to determine if you should use this procedure, use a modified version of this procedure, or use a different procedure that is provided by your operating system.

**Note:** Instructions that are provided with your software should supersede anything stated in this document.

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

There are two methods for upgrading drives:

- **Replacing all the drives at the same time**

  This method requires that you back up the data on the affected drives and then turn off the EXP810 and the DS4000.

  **Attention:** Turn off the DS4000 storage subsystem before you turn off the EXP810.

  After replacing all the drives, you must reconfigure the new drives and restore data from backup. See the procedure in "Replacing all drives at the same time" on page 78.

  This is the safest way to exchange drives without losing data. However, this method might take a long time to complete because of the backup, reconfiguration, and restoration processes. In addition, other users are not able to use the storage subsystem (or any storage expansion enclosures attached to the storage subsystem) until you finish the procedure. You must use this method on RAID 0 logical drives.

- **Replacing the drives one at a time**

  In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before installing the next drive. After you install the new drives, you can configure them to make the additional drive space available. See the procedure in "Replacing the drives one at a time" on page 80.

  Using this method, you can replace the drives while the EXP810 and the DS4000 are running, eliminating the down time that is required if you replace all the drives at once. However, this method is more risky because you can lose data if the drive restoration or storage subsystem reconfiguration process fails. In addition, the reconstruction process might take a long time. This method works only on redundant logical drives (RAID 1, 3, or 5). You cannot use this method with any drives containing RAID 0 logical drives.

  Consider backing up your data if you use this method. This safeguards your data if the restoration and reconfiguration process fails or the new drive malfunctions.

The method you use depends on the following considerations:

- Which method most closely matches the recommended drive upgrade procedure that is provided in the operating system or the storage-management software documentation

- Which RAID level is used on the affected drives (RAID 0 requires you to replace all the drives at the same time)
- How much downtime is acceptable as you swap the drives
- The number of drives in an array. Replacing drives one at a time is better suited for arrays consisting of 3 to 5 drives. If you have more than 10 drives, consider replacing all drives at the same time.
- How much risk of losing data is acceptable. Because the array will be in a degraded state during the RAID array reconstruction and copyback process as result of replacing a drive in the array, any new drive failure will cause the array to fail (causing a loss of data availability and even a loss of data). The duration of the reconstruction and copyback process can be quite long, depending on the size of the RAID array.
- How extensive will the data be changed while the array is in a degraded state during the RAID array reconstruction and copyback process as result of replacing a drive in the array. The more extensive the data changes, the more work that will need to be performed to restore the data in the event that the array failed because of an addition drive failed while the array is in degraded state.

## Replacing all drives at the same time

Use this procedure to replace all drives at the same time. You must use this method if you are upgrading drives containing RAID 0 logical drives. All the data currently on the drives is lost when you replace the drives; therefore, you must back up all data that is currently on the drives. This procedure also requires you to turn off the EXP810 and the DS4000, which makes the storage subsystem (and any attached storage expansion enclosures) inaccessible to other users.

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

To replace all the drives at the same time, perform the following steps:

1. Read the following information:
   - The information in "Replacing multiple drives" on page 77, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
   - The information in your software documentation regarding drive upgrades and installation
   - The documentation that comes with the new drives

     Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.
2. Use the DS4000 Storage Manager software to check the status of the DS4000. Correct any problems that are reported.
3. Perform a complete backup of the drives that you are replacing.

   You need the backup to restore data on the drives later in this procedure.

   **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 20.
4. Unpack the new drives.

Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the drives.

5. Perform the following steps:

   a. Stop all I/O activity to the storage subsystem and attached storage expansion enclosures. Make sure that:

      1) All of the green Drive activity LEDs on the front of the storage subsystem (and on all attached EXP810s) are not flashing.

      2) The green Cache active LEDs are off. Refer to the *IBM TotalStorage DS4800 Storage Subsystem Installation, User's, and Maintenance Guide* for the location of the Cache active LEDs.

   b. If applicable, use the operating system software to disconnect the storage subsystem logical drives from the host before you power off the storage subsystem.

   **Attention:** To turn off all power to the storage subsystem, you must turn off both power-supply switches and disconnect both power cords. Use the procedure in step 6 for the proper shutdown sequence.

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

   a. Turn off power to the host before you turn off power to 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.

   b. Turn off power to the storage subsystem before you turn off power to the EXP810. Turn off both power supply switches on the back of the storage subsystem.

   c. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).

7. Use the procedures in "Replacing hot-swap hard disk drives" on page 76 to remove the drives that you want to replace. Use the procedures in "Installing hot-swap hard disk drives" on page 74 to install the new drives into the EXP810.

8. After you install all the new drives, 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:

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

   b. You must turn on the storage expansion enclosures before the storage subsystem. The controllers might not recognize the correct configuration if the drives are powered up after the storage subsystem. For instructions on powering up the storage subsystem, see the storage subsystem documentation.

   c. Turn on the power to the storage subsystem; then restart or turn on the power to the host.

9. Turn on the power to each device, based on the power-on sequence in step 8. To turn on power to the storage subsystem and the EXP810s, turn on the power-supply switches on the back of the storage subsystem. You must turn on both power-supply switches to take advantage of the redundant power supplies.

10. Check the green Drive activity LEDs and the amber Drive fault LEDs above the new drive CRUs.

Make sure that the Drive activity LEDs are on and the Drive fault LEDs are off.

**Note:** The Drive fault LEDs might flash intermittently while the drives spin up.
- If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.
- If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the DS4000 Storage Manager software for problem determination.

11. Use the DS4000 Storage Manager software to configure the new drives. See the DS4000 Storage Manager software online Help for detailed instructions.
12. Restore the data from backup to all the drives.

## Replacing the drives one at a time

Use this procedure to replace all the drives one at a time. You cannot use this procedure on RAID 0 logical drives (use the procedure in "Replacing all drives at the same time" on page 78).

**Note:** If your storage subsystem has hot spares assigned, you might want to unassign the hot spares while you perform this procedure. If you do not, reconstruction might start on the hot spare before you insert the new drive. The data on the new drive is still rebuilt, but the process takes longer for each drive. Remember to reassign the hot spares when you are finished with this procedure.

**Attention:** After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

To replace the drives one at a time, perform the following steps:
1. Read the following information:
   - "Replacing multiple drives" on page 77, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
   - Your software documentation regarding drive upgrades and installation
   - The documentation that comes with the new drives

     Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.
2. Use the DS4000 Storage Manager software to check the status of the unit. Correct any problems that are reported.
3. Back up the data in the arrays and logical drives that are configured using the drives that you are replacing.

   **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 20.
4. Unpack the new drives.

   Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the drives.
5. Use the DS4000 Storage Manager software to ensure that the array that was defined using these drives is in optimal (not degraded) state before manually

failing the first drive you want to replace. If the array is in degraded state, use the recovery procedures to bring the array into the optimal state.

Make sure that:

- You fail only one drive
- The software status display shows a failed status for the appropriate drive
- The amber Drive fault LED (on the front bezel below the drive) is on

**Attention:** Removing the wrong drive can cause data loss. Make sure that you remove only the failed drive CRU. The Drive fault LED below the failed drive CRU should be on.

If you remove an active drive accidentally, wait at least 30 seconds and then reinstall it. Because you failed two drives in a RAID array, the array might be marked failed by the controller. This array will not be available to the host for I/O. See the DS4000 Storage Manager software for further recovery instructions. Do not attempt to replace any drives until the array is brought back to optimal state.

6. Use the procedures in "Replacing hot-swap hard disk drives" on page 76 to remove the failed drive. Use the procedures in "Installing hot-swap hard disk drives" on page 74 to install the new drives into the EXP810.

   The new drive automatically reconstructs the data after you install it in the drive slot.

   During data reconstruction, the amber Drive fault LED might come on for a few minutes, then turn off when the green Drive activity LED begins flashing. A flashing Drive activity LED indicates that data reconstruction is in progress.

   **Note:** If your storage subsystem has active hot spares, data might not start copying to the new drive until the data is reconstructed on the hot spare. This increases the time that is required to complete the procedure.

7. Check the green Drive activity LED and the amber Drive fault LED above the new drive CRUs.

   Make sure that the Drive activity LEDs are on and the Drive fault LEDs are off.

   **Note:** The Drive fault LEDs might flash intermittently while the drives spin up.

   - If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.
   - If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the DS4000 Storage Manager software for problem determination.

8. Use the DS4000 Storage Manager software to monitor the status of the new drive and the progress of the data reconstruction. Wait for data reconstruction to finish (the Drive activity LED stops flashing).

   **Note:** The Drive activity LED will continue to flash after reconstruction is finished if there is I/O activity to that drive. In that case, use the host software to determine if the data reconstruction is finished.

9. When reconstruction is finished on the new drive, repeat step 5 on page 80 through step 8 for each additional drive that you want to install.

10. Use the DS4000 Storage Manager software to configure the additional space on the new drives.

# Verifying the Link Rate setting

If a link rate problem is indicated, use the following procedure to verify the Link Rate setting.

A Link Rate switch is located on the front of the storage expansion enclosure as shown in Figure 43 on page 83. The Link Rate indicator LEDs are located on the back of the storage expansion enclosure. The Link Rate switch enables you to select the data transfer rate between the ESMs and the drives to either 2 Gbps or 4 Gbps. The Link Rate switch is only read when the storage expansion enclosure is powered up.

**Notes:**

1. The initial release of the EXP810 supports 2 Gbps. Contact IBM Support for information about 4 Gbps support in the future.
2. Do not mix storage expansion enclosures with different Link Rate speed settings in the same drive loop.

Table 17 shows the data transfer rates for drives of different configurations.

**CAUTION:**
**Do not change the Link Rate setting while the storage subsystem is running. Changing the Link Rate setting while the storage subsystem is running could cause drives to fail. You must power down the storage subsystem and storage expansion enclosures before changing the Link Rate setting.**

*Table 17. Data transfer rates for drive modules*

| Link Rate Switch Setting | Storage Expansion Enclosures with 2 GB Drives |
|---|---|
| 2 Gbps | Drives function in 2 Gbps mode |
| 4 Gbps | Drives do not come online |

Use the following procedure to check the current setting of the data transfer rate and change it, if necessary.

**Attention:**   All devices on the loop must have the same data transfer rate, which means that you must set the link rate on the storage expansion enclosure to the same rate as the storage subsystem to which it is connected. Information about supported DS4000 storage subsystems can be obtained from the certified Compatibility Matrix, which can be found at the following Internet location:

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

1. Power down the DS4000 storage subsystem.
2. Locate the Link Rate indicator LEDs. Figure 42 on page 83 shows the location of the Link Rate indicator lights on the back of the storage expansion enclosure.

Link
Rate
LEDs
Two on = 4 Gbps
One on = 2 Gbps

77032-05
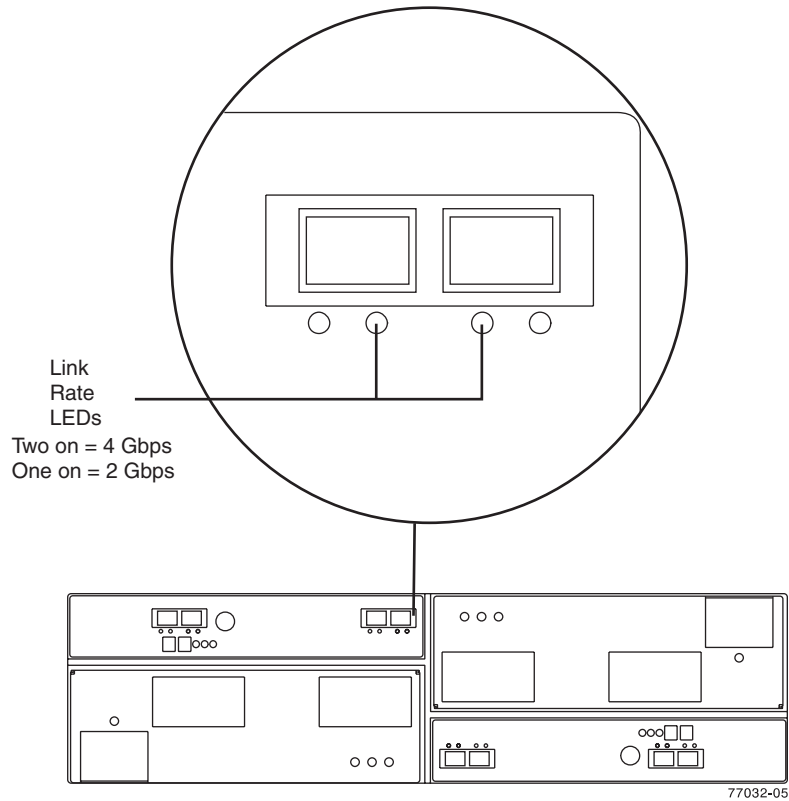
*Figure 42. Link rate LEDs*

If both Link Rate indicator LEDs are on, the data transfer rate is set for 4 Gbps. If one Link Rate indicator light is on, the data transfer rate is set for 2 Gbps.

3. Is the data transfer rate set correctly?
   - **Yes** - Go to step 9 on page 84.
   - **No** - Go to step 5 to change the setting.

   **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 20.

4. Locate the Link Rate switch. Figure 42 shows the location of the Link Rate indicator light on the front of the command module.



77025-01

Link Rate switch
(2 Gbs or 4 Gbs)
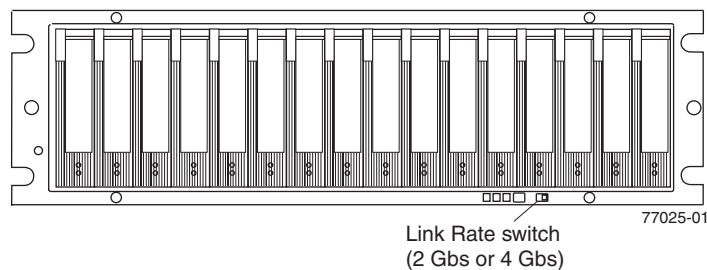
*Figure 43. Link rate switch*

5. Change the Link Rate switch setting.
   a. Put on antistatic protection.

b. Use a small screwdriver or the tip of a ball point pen to slide the Link Rate switch to the left or right to set the desired fibre channel operating speed.

   **Attention:** Although the Link Rate LED indicates the correct speed setting, the link rate speed does not change until after you cycle power to the storage expansion enclosure.

6. Repeat step 1 on page 82 through step 5 on page 83 for all of the EXP810 enclosures in the DS4000 configuration.

7. Power on the DS4000 storage subsystem.

8. To cycle power to the storage expansion enclosure, turn off both power switches on the storage expansion enclosure power supply; then turn on both switches on the storage expansion enclosure power supply.

9. Check the indicator lights on the front and back of all of the storage subsystem and expansion drive modules. All the green indicator LEDs should be on, and the amber indicator LEDs should be off. (No LEDs are displayed on blank drives.)

10. Are **only** the green indicator LEDs on?
    - **Yes** - The drive is working correctly.
    - **No** - If an amber Fault indicator LED is on, go to 11.

11. Diagnose and correct the fault.
    a. To run the Recovery Guru, select the Recovery Guru toolbar button in the Subsystem Management Window.
    b. Complete the recovery procedure.
    c. When the procedure is completed, rerun the Recovery Guru to ensure that the problem has been corrected by selecting Recheck in the Recovery Guru.

12. If the problem persists, contact IBM Customer and Technical Support.

## Replacing a power supply-fan

**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.**
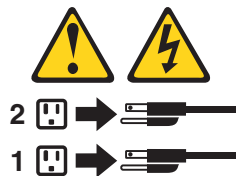


**CAUTION:**
**Disconnect the power cord before replacing the power supply-fan.**

The power supply-fan is a component that includes both a 600-W power supply unit and two fans. The power supply-fans provide power and cooling for the EXP810.

The power supply-fans are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported power supply-fan units for your specific storage subsystem.

Each power supply-fan 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 58.

The storage subsystem cooling system consists of two fans in each of the two power supply-fan CRUs. The power supply-fans circulate air from the front to the back of the unit.

If both power supply-fans fail, or if the power supply-fans cannot maintain an internal temperature below 70° C (158° F), the power supply-fans 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 58.

**Attention:** The fans in the power supply-fan units draw in fresh air and force out hot air. The power supply-fan units are hot-swappable and redundant; however, if the fans in one power supply-fan unit fail, you must replace the entire failed power supply-fan unit within 72 hours to maintain redundancy and optimum cooling. Do not remove the failed power-supply fan unit until you have the replacement power supply-fan unit. When you do remove the failed power supply-fan, be sure to install the second power supply-fan within 10 minutes to prevent any overheating due to the interruption to the air flow that cools the storage expansion enclosure.

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-fan. Figure 44 on page 88 illustrates removing and inserting a unit.

**Attention:** **Potential damage to a component -** To prevent damage from overheating, replace a failed power supply-fan CRU within 15 minutes of removal. If replacing it will take longer than 15 minutes, stop all I/O activity to the storage expansion enclosure and turn off the power until you complete the replacement.

**Statement 8:**

**CAUTION:**
**Never remove the cover on a power supply-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. If needed, use the DS4000 Storage Manager client software to print a storage system profile.
2. Did the Recovery Guru direct you to replace a failed power-fan canister?
   - **Yes** - Go to step 3.
   - **No** - Run the Recovery Guru to identify the failed component, and then go to step 3.
3. Put on antistatic protection.
4. Unpack the new power supply-fan. Save all packing material in case you need to return the failed power supply-fan CRU.

   **Note:** The new power supply-fan CRU comes with an instruction sheet and label sheet. The instruction sheet provides instructions on placing the appropriate labels on the power supply-fan CRU to mark the LEDs correctly. The label sheet contains the peel-off labels that you actually place on the power supply-fan CRU.

5. Using the information provided on the instruction sheet, place the labels on the power supply-fan CRU to correctly mark the LEDs.
6. Turn off the power switch on the new unit.
7. Check the Fault LED to locate the failed power supply-fan. If a fault is detected, the amber Fault LED is on.
8. Verify that the Service Action Allowed LED is on. Do not remove the power supply-fan if the LED is off. For more information on the Service Action Allowed LED, see "Service Action Allowed Status LED" on page 69.

   **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: |
| --- | --- |
| 1. Turn everything OFF. | 1. Turn everything OFF. |
| 2. First, attach all cables to devices. | 2. First, remove power cords from outlet. |
| 3. Attach signal cables to connectors. | 3. Remove signal cables from connectors. |
| 4. Attach power cords to outlet. | 4. Remove all cables from devices. |
| 5. Turn device ON. | |

9. Turn off the power switch, and unplug the power cord from the failed power supply-fan.
10. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the power supply-fan from the latch. The latch is a coral colored tab on the lever.
11. Slowly pull the lever away from the chassis to remove the power supply-fan, as shown in Figure 44 on page 88.

   **Note:** The lever rotates upward or downward 90°, depending on whether the power supply-fan you are removing is in the right or left power supply-fan bay.

12. Slide the new unit into the empty slot. As you slide the power supply-fan into the empty slot, make sure the guide pins on the side of the power supply-fan fit into the notches. After the guide pins fit into the notches and power supply-fan fits snugly into the slot, push the lever downward or upward 90° to fully latch the power supply-fan into place, depending on whether you are inserting the power supply-fan into the right or left power supply-fan bay. Then gently push the front of the power supply-fan to ensure that it is fully seated.

**Attention:** The left and right power supply-fan units are seated in the EXP810 chassis in opposite orientations. If you cannot fully insert the power supply-fan into the power supply-fan bay, flip it 180° and reinsert it. Make sure that the levers lock into place in the storage expansion enclosure chassis.

13. Plug in the power cord and turn on the power.
14. Check the Power and Fault LEDs on the new unit.



Lever

77024-01
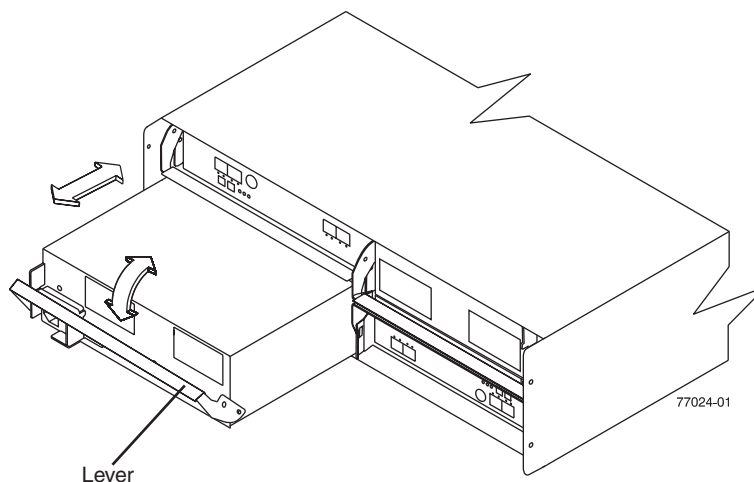
*Figure 44. Replacing a power supply-fan*

15. Based on the status of the Power and Fault LEDs, choose one of the following steps:
    - **Fault LED is on and AC and DC power LED are off** - The new unit might be installed incorrectly. The power supply-fan switch may not be turned on. The power cord plug may not be fully inserted into the power outlet or the power supply-fan AC socket. There is not any power to the outlet that the power supply-unit is connected to. The power cord may be faulty. Go to step 16.
    - **Fault and AC power LED is on but the DC power LED is off** - The power supply-fan is faulty. Turn the supply-fan power switch to off and contact IBM Customer and Technical Support for another power supply-fan.
    - **AC and DC Power LED is on and Fault LED is off** - Go to step 17.
16. Perform the following task or task(s) to resolve the problem:
    - Ensure that the power switch is turned to the on position.
    - Ensure that there is power at the AC outlet and no circuit breaker has tripped.
    - Ensure that the power cord is working and fully seated into the electrical outlet and the power supply-fan AC socket.
    - Reinstall the power supply-fan unit.

      If the above tasks do not resolve the problem, contact IBM Customer and Technical Support
17. Complete any remaining Recovery Guru procedures, if needed.
18. Check the status of each storage expansion enclosure in the storage subsystem.
19. Do any components have a Needs Attention LED?

- **Yes** - Select the Recovery Guru toolbar button in the Subsystem Management Window and complete the recovery procedure. If a problem is still indicated, contact IBM Customer and Technical Support.
- **No** - Go to step 20.
20. Create, save, and print a new storage subsystem profile.

## Replacing an Environmental Services Monitor (ESM)

This section describes the removal and replacement procedure for a failed hot-swap ESM. Complete the following steps to remove a failed ESM:

The EXP810 storage expansion enclosures support the ESM auto code synchronization functionality. When a new ESM is installed into an existing storage expansion enclosure in a DS4000 storage subsystem that supports ESM auto code synchronization, firmware is automatically synchronized in the new ESM with the firmware in the existing ESM. This function requires that the DS4000 storage subsystem be defined in the Enterprise Management window of the DS4000 Storage Manager client program installed in a management station. Additionally, the DS4000 Storage Manager client program must be opened and running, or the IBM DS4000 Storage Manager 9 Event Monitor service must be running when the new ESM is inserted.

Refer to the *DS4000 Storage Manager 9.1 Installation and Support Guide* for your operating system for more information on how to start this service. Do not perform to the following steps until you have installed the DS4000 Storage Manager client program, defined the affected DS4000 storage subsystem in the Enterprise Management window, and either have the DS4000 Storage Manager client program running or the Event Monitor service started.

**Attention:** After you remove an ESM, wait at least 70 seconds before reseating or replacing the ESM so that the DS4000 storage subsystem controller properly recognizes that an ESM is removed from the configuration. Failure to do so may cause undesired events.

1. Start the DS4000 Storage Manager client program. In the Enterprise Management window, open the Subsystem Management window for the DS4000 storage subsystem that includes the EXP810 enclosure that requires the ESM replacement.
2. Check the DS4000 Storage Manager online help for ESM failure-recovery procedures. Follow the steps provided in the failure-recovery procedures before continuing to step 3.
3. Save the DS4000 profile by performing the following steps:
   a. In the Subsystem Management Menu, select **Storage Subsystem → View → Profile**. The Storage Subsystem Profile window opens.
   b. In the Storage Subsystem Profile window, click **Save As**. The Save Profile window opens.
   c. In the Save Profile window, select or enter the file directory and file name. Click **Save** to save the profile. The Save Profile window closes.

      **Important:** Do not store DS4000 profiles in the same location as the logical drives that are defined on your DS4000 configuration. If you do, and the logical drives fail, you will lose data.
   d. Click **Close** to close the Storage Subsystem Profile window.
4. Label each cable to ensure that all cables are properly connected to the new ESM.

5. Label the SFP modules when you remove them. You must install the SFP modules in the same positions on the new ESM.

6. Remove the SFP modules and the fibre-channel cables from the failed ESM.

   **Attention:** Be careful not to bend the fibre-channel cables at a sharp angle or pinch them with objects. This can decrease the performance or cause data loss.

7. Squeeze the ESM latch. The ESM latch is a coral colored tab on the lever.

8. While squeezing the latch, pull the lever open 90° (so that the lever is horizontal). Pull the lever away from the chassis to remove the ESM from the EXP810 midplane, as shown in Figure 45.

   **Note:** The lever rotates upward or downward 90°, depending on whether the ESM you are removing is in the right or left ESM bay.
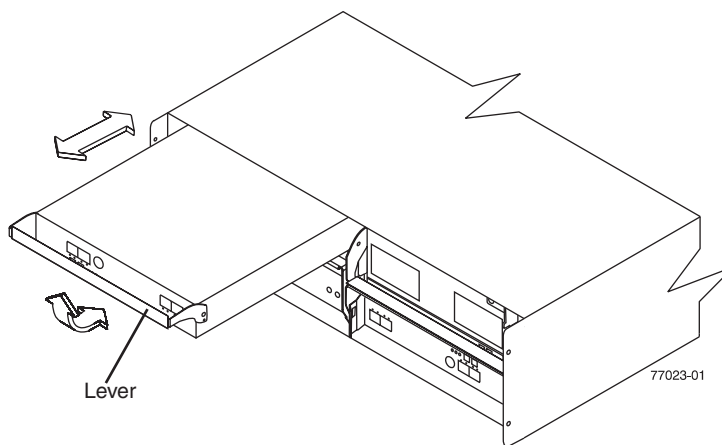


*Figure 45. Removing and replacing an Environmental Services Monitor (ESM)*

9. Unpack the new ESM CRU. Save all packing material in case you need to return the failed ESM CRU.

   **Note:** The new ESM CRU comes with an instruction sheet and label sheet. The instruction sheet provides instructions on placing the appropriate labels on the ESM CRU to correctly mark the LEDs and SFP ports. The label sheet contains the peel-off labels that you actually place on the ESM CRU.

10. Using the information provided on the instruction sheet, place the labels on the ESM CRU to correctly mark the LEDs and SFP ports.

11. Install the new ESM by sliding it into the empty slot. Be sure that the levers are pulled straight out as you slide the ESM into the storage expansion enclosure. As you slide the ESM into the empty slot, make sure the guide pins on the side of the ESM fit into the notches on the sides of the ESM bay. After the guide pins fit into the notches and ESM fits snugly into the bay, push the lever upward or downward 90° to fully latch the ESM into place, depending on whether you are inserting the ESM into the right or left ESM bay.

    **Attention:** The left and right ESMs are seated in the EXP810 chassis in opposite orientations. If you cannot fully insert the ESM into the ESM bay, flip it 180° and reinsert it. Make sure that the levers lock into place in the storage expansion enclosure chassis.

12. Reinsert the SFP modules and reconnect the fibre-channel cables to their original locations.

13. Check the Power and Fault LEDs on the new ESM:
    - If the Power LED is off, the ESM might not be inserted correctly.
    - If the Fault LED is lit, if the Power LED is off, or if any other Fault LEDs are lit, see "Solving problems" on page 95 or call IBM Support.
14. Check the input and output bypass LEDs at both ends of the reconnected cables. If the input and output bypass LEDs are lit, reconnect the cables and SFP modules.
15. Use the DS4000 Storage Manager 9 Client to open a Subsystem Management window to the DS4000 on which the EXP810 ESM was replaced. Click on the **Recovery Guru** or the **Environment Status** icon of the drive expansion enclosure on which you replaced the ESM.

    If there is an ESM firmware mismatch, wait up to 15 minutes for the DS4000 Client program to perform ESM code synchronization.

    **Note:** The ESM firmware download will take up to 5 minutes in typical workload condition.
    If there is no ESM firmware mismatch, the upgrade process is complete.
16. If there is an ESM firmware mismatch, you must make corrections to match the ESM firmware by using the ESM firmware download function in the DS4000 Storage Manager Client Subsystem Management window.

## Replacing an SFP module

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.

**Attention:** Refer to the FRU option P/N on the SFP to identify the maximum operating speed of the SFP and to request the correct FRU replacement.

Use the following procedure to replace a Small Form-factor Pluggable (SFP) module on the storage expansion enclosure. The SFP module shown in this procedure might look different from those you are using, but the difference will not affect functionality. Figure 46 on page 92 illustrates installing an SFP module.

Electrostatic discharge can damage sensitive components. To prevent electrostatic discharge damage to the storage expansion enclosure, use proper antistatic protection when handling components.

1. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.
2. Using the Recovery Guru, identify the failed component that needs to be replaced.
3. Check the Fault LEDs to locate the failed SFP module. If a fault is detected, the amber Fault LED is on.
   **Attention:** **Potential loss of data access** - To prevent loss of access to data, remove only the SFP module that has a failed status in the storage management software and has Port Bypass LED lit.
4. Put on antistatic protection.
5. Unpack the new SFP module. Verify that it is the same type of module you are replacing. If it is not, contact IBM Customer and Technical Support.

**Attention:** 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.

**Attention:** Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. When working with fiber-optic cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 inches).

6. Disconnect the interface cables from the 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.
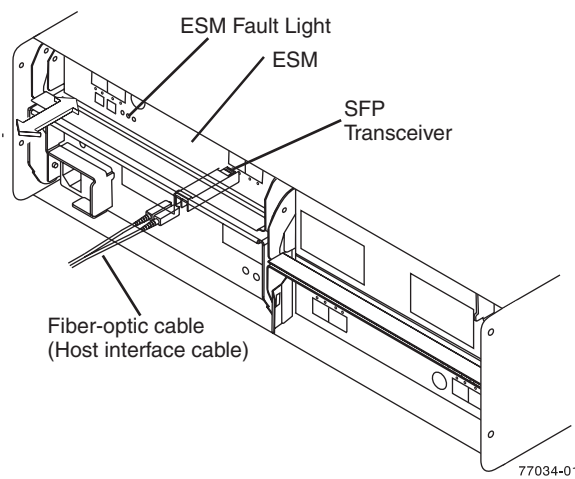


*Figure 46. Replacing an SFP module*

10. Check the Bypass and Fault LEDs for the new SFP module.
11. Based on the status of the Bypass and Fault LEDs, choose one of the following steps:
    - **Bypass LED** *or* **Fault LED is on** - Reinstall the SFP module and cables, and verify that the SFP module and cables are securely connected. Use the fibre channel loopback and the LC-LC connector to perform path diagnostics to ensure that the FC cable is good and the SFP on the other end of the fibre channel connection is working properly. When finished, go to step 12.
    - **Bypass LED and Fault LED are off** - Go to step 12.
12. Is the problem corrected?
    - **Yes** - Go to step 13.
    - **No -** Contact IBM Support.
13. Complete any remaining Recovery Guru procedures, if needed.
14. Use the DS4000 Storage Manager Subsystem Management Window to check the status the status of all components in the storage subsystem.
15. Remove the antistatic protection.
16. Does any component have a 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 IBM Support.

- **No** - Go to step 17.

17. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

## Replacing a midplane

Perform the following steps to replace a midplane:

1. Power down the EXP810. See "Turning off the EXP810" on page 55 for details.
2. Power down the DS4000 storage subsystem.
3. Power off the EXP810 storage expansion enclosure that will have its midplane replaced.
4. Remove the power cords from the power supply-fans of the EXP810 storage expansion enclosure.
5. Label the fibre channel cables that are attached to the rear of the ESMs. Labeling the cables simplifies the re-cabling process.
6. Remove the fibre channel cables that are attached to the rear of the ESMs.
7. Remove both ESMs. To remove them:
   a. Squeeze the ESM latch and pull the lever open 90° (so that the lever is horizontal) to release the ESM from the latch. The ESM latch is a coral colored tab on the lever.

      **Note:** The lever rotates upward or downward 90°, depending on whether the ESM you are removing is the right or left ESM CRU.

   b. Slowly pull the lever away from the EXP810 chassis to remove the ESM from the ESM bay, as shown in Figure 13 on page 28. (You do not have to actually remove them from the ESM bays.)
   c. Repeat steps 7a and 7b for the other ESM.
8. Remove both power supply-fans. To remove them:
   a. Squeeze the latch and pull the lever open 90° (so that the lever is horizontal) to release the power supply-fan from the latch. The latch is a coral colored tab on the lever.
   b. Slowly pull the lever away from the chassis to remove the power supply-fan, as shown in Figure 14 on page 29. (You do not have to actually remove them from the power supply-fan bays.)

      **Note:** The lever rotates upward or downward 90°, depending on whether the power supply-fan you are removing is in the right or left power supply-fan bay.

   c. Repeat steps 8a and 8b for the other power supply-fan.
9. Label the drive CRUs so you know their physical location in the midplane.
10. Remove the drive CRUs. See "Removing a hard disk drive" on page 29 for instructions.

    **Attention:** Do not stack drive CRUs on top of each other. Protect the drive CRUs from vibrations or sudden shocks.
11. Use a Phillips Number 1 screw driver to loosen the four front cage frame screws on the midplane, as shown in Figure 47 on page 94.
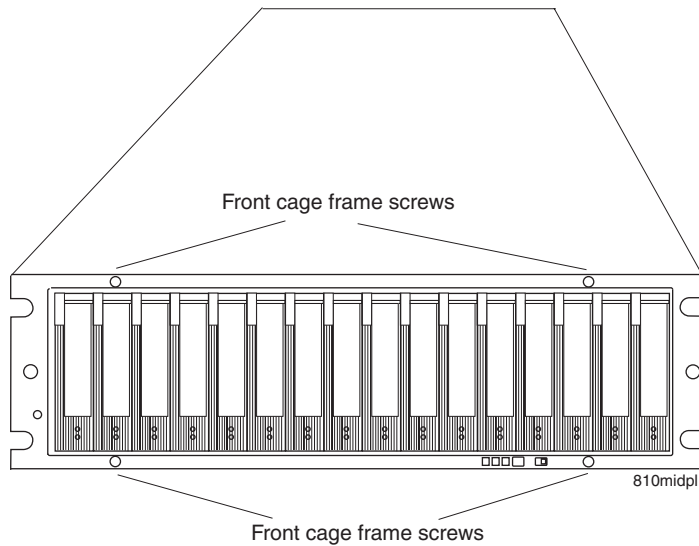
Figure 47. Replacing a midplane

12. Grab the blue handle in the center of the front cage frame and pull it outward to slide the front cage frame out approximately two inches. Grab the two sides of the front cage frame and remove it from the chassis.

13. Unpack the new front cage frame with the midplane. Save the packaging materials in case you need to return it.

14. Insert the new midplane by aligning it with the EXP810 front opening and slowly sliding it into the EXP810 chassis. Make sure that the front cage frame EMC gaskets do not snag between the frame and chassis.

15. Tighten the four front cage frame screws.

16. Insert the hard drive CRUs. Be sure you insert them in the correct slots. Use the labels you put on them before you removed them to guide you.

17. Re-insert the ESMs and reconnect the fibre channel cables.

18. Re-insert the power supply-fans and reconnect the power supply cords.

19. Power on the EXP810.

20. Wait at least 3 minutes and then power on the DS4000 storage subsystem. Verify the status of the configuration using LEDs and the DS4000 Storage Manager client program.

# 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 xxi.

## General checkout

Use the indicator lights, the diagnostics and test information, the symptom-to-FRU index, and the connected server HMM to diagnose problems.

The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

## Solving problems

This section contains information to help you solve some of the problems you might have with your storage expansion enclosure. Table 18 on page 96 contains the problem symptoms and error messages, along with suggested actions to take to resolve problems.

Always use the DS4000 Storage Manager client to diagnose storage subsystem problems and component failures and find solutions to problems that have definite symptoms.

You can use Table 18 on page 96, which contains the problem symptoms and error messages, along with suggested actions as a guide for troubleshooting problems in addition to the DS4000 Storage Manager Recovery Guru in the Subsystem Management window. Do not depend solely Table 18 on page 96 for a FRU replacement decision.

See the problem determination maps in the *DS4000 Problem Determination Guide* for more detailed procedures for problem isolation.

*Table 18. Symptom-to-FRU index*

| Problem indicator | Component | Possible cause | Possible solutions |
|---|---|---|---|
| Amber LED is lit | Drive CRU (Drive Fault LED) | Drive failure | Replace the failed drive. **Note:** The amber LED on the drive is also lit if the drive slot has a blank drive tray inserted. |
| | ESM (Fault LED) | ESM failure | Replace the ESM. See your controller documentation for more information. See Chapter 5, "Installing and replacing devices," on page 69 for more information. |
| | ESM (Port Bypass LED) | No incoming signal detected | Reconnect the SFP modules and the fibre-channel cables. Verify the input and output SFP using the path failure determination instruction in the *DS4000 Problem Determination Guide* and the FC loopback and female-female LC connector. Replace either input or output SFP modules or fibre channel cables as necessary. |
| | | Incorrect enclosure speed setting | When connecting the EXP810 to the existing operating redundant drive loop with a different speed setting, the port goes into bypass mode because mixing different speed enclosures within the same redundant drive loop/channel is not supported. |
| | | ESM failure | If the ESM Fault LED is lit, also replace the ESM. |
| | Front panel (Global Summary Fault LED) | General machine fault | A Fault LED is lit somewhere on the storage expansion enclosure (check for Amber LEDs on CRUs). |
| | | Fibre-channel connection failure | Check that the CRUs are properly installed. If none of the amber LEDs are lit on any of the CRUs, this indicates an SFP module transmission fault in the storage expansion enclosure. Replace the failed SFP module. See the DS4000 Storage Manager software documentation for more information. |
| Amber LED is lit and green LED is off | Power supply CRU (Fault and Power LEDs lit; Direct Current® Enable LED is not lit) | The power switch is turned off or there is an ac power failure. | Replace the failed power supply or turn on all power supply switches. |

*Table 18. Symptom-to-FRU index  (continued)*

| Problem indicator | Component | Possible cause | Possible solutions |
|---|---|---|---|
| Amber and green LEDs are lit | Power supply CRU<br><br>(Fault and Power LEDs lit; Direct Current Enable LED is not lit) | Power supply failure | Replace the failed power supply. |
| All amber and green LEDs are slowly flashing | All drive CRUs<br><br>(Activity and Fault LEDs are not lit) | Check for and resolve one of the following situations:<br>• EXP810 is not connected to the DS4000<br>• DS4000 does not have the correct firmware version | |
| All green LEDs are off | All CRUs | Subsystem power is off | Check that all storage expansion enclosure power cables are plugged in and the power switches are on. If applicable, check that the main circuit breakers for the rack are powered on. |
| | | AC power failure | Check the main circuit breaker and ac outlet. |
| | | Power supply failure | Replace the power supply. |
| Amber LED is flashing | Drive CRUs (Fault LED lit) | Drive identity is in process | No corrective action needed. |
| | ESM port bypass | An FC loop initialization process (LIP) is being generated in the drive loop due to a faulty component. | Use the Read Link Status window in the Storage Manager Client Subsystem Management window and the storage subsystem event logs to isolate the faulty component. |

*Table 18. Symptom-to-FRU index (continued)*

| Problem indicator | Component | Possible cause | Possible solutions |
|---|---|---|---|
| One or more green LEDs are off | Power supply CRUs | Power cable is unplugged or switches are turned off | Make sure that the power cable is plugged in and that the switches are turned on. |
| | All drive CRUs | Midplane failure | Replace the midplane. Contact an IBM technical support representative. |
| | Several CRUs | Hardware failure | Replace the affected CRUs. If this does not correct the problem, replace the ESMs, followed by the midplane. Contact an IBM technical support representative. |
| | | The DS4000 was not powered on, or all fibre-channel connections between the EXP810 and the storage subsystem failed. | Perform one of the following actions:<br>• Power on the storage subsystem.<br>• Verify that the fibre-channel connections between the EXP810 and the storage subsystem are made. |
| | Front panel | Power supply problem | Make sure that the power cables are plugged in and that the power supplies are turned on. |
| | | Hardware failure | If any other LEDs are lit, replace the midplane. Contact an IBM technical support representative. |
| Green LED slowly flashing one per 2 seconds | Drive CRUs | The DS4000 was not powered on, or all fibre-channel connections between the EXP810 and the DS4000 storage subsystem failed | Perform one of the following actions:<br>• Power on the storage subsystem.<br>• Verify that the fibre-channel connections between the EXP810 and the storage subsystem are made.<br>• Ensure that all the EXP810s in the same redundant drive loop/channel pair have the same enclosure speed setting. |
| Intermittent or sporadic power loss to the storage expansion enclosure | Some or all CRUs | Defective ac power source or improperly connected power cable | Check the ac power source. Reseat all installed power cables and power supplies. If applicable, check the power components (power units or universal power supply). Replace defective power cables. |
| | | Power supply failure | Check the power supply Fault LED on the power supply. If the LED is lit, replace the failed CRU. |
| | | Midplane failure | Have the midplane replaced. Contact an IBM technical support representative. |

*Table 18. Symptom-to-FRU index  (continued)*

| Problem indicator | Component | Possible cause | Possible solutions |
|---|---|---|---|
| Unable to access drives | Drives and fibre-channel loop | Incorrect storage expansion enclosure ID settings | Ensure that the fibre-channel optical cables are undamaged and properly connected. Check the storage expansion enclosure ID settings. **Note:** Change the switch position only when your storage expansion enclosure is powered off. |
| | | ESM failure | Replace one or both ESMs. Contact an IBM technical support representative. |
| | | Drive or drives failed | Replace failed drive or drives. |
| Random errors | Subsystem | Midplane failure | Have the midplane replaced. Contact an IBM technical support representative. |
| Hard disk drive not visible in RAID management software | Several CRUs | Drive or drives failed | Replace failed drive or drives. |
| | | FC cable failed | Replace FC cable. |
| | | SFP failed | Replace SFP. |
| | | ESM failure | Replace ESM. |
| | | Midplane failure | Have the midplane replaced. Contact an IBM technical support representative. |
| | | Drive CRU is not signed correctly | The drive and the interposer card in the drive CRU must be digitally signed together. |
| | | Incorrect firmware version | Verify that the DS4000 storage subsystem has been upgraded to the correct firmware version. Refer to Table 20 on page 101. |

# Parts listing

Figure 48 on page 100 and the following table provide a parts listing for the EXP810.
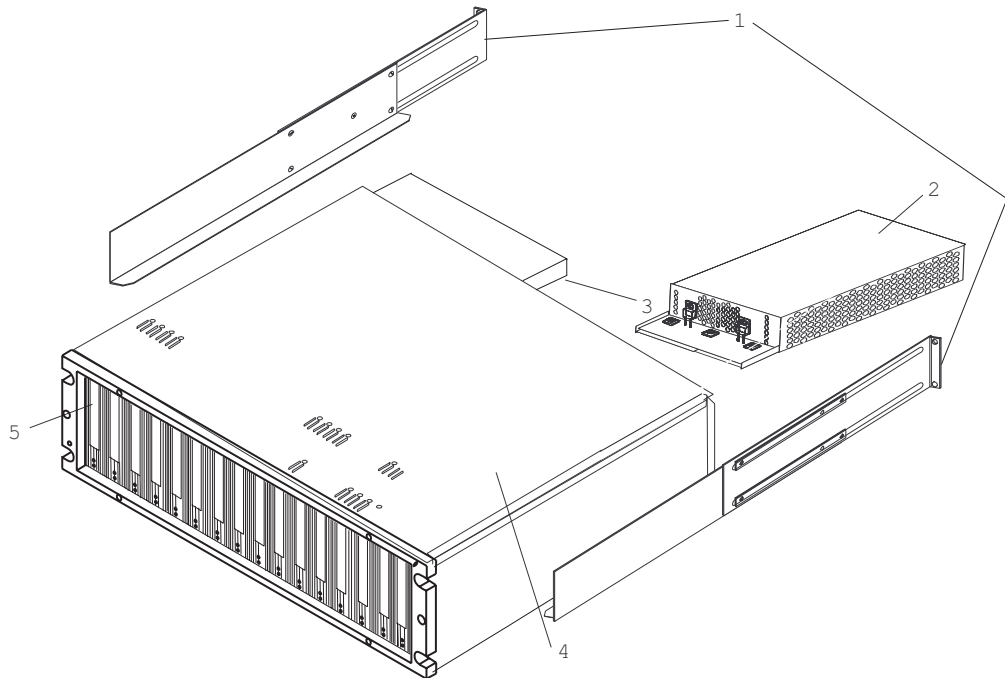
*Figure 48. EXP810 storage expansion enclosure parts list*

*Table 19. Parts listing (EXP810 storage expansion enclosure)*

| Index | EXP810 storage expansion enclosure | FRU P/N |
|---|---|---|
| 1 | rail kit | 41Y5152 |
| 2 | power supply FRU, 600 W | 39M5906 |
| 3 | ESM | 41Y5151 |
| 4 | Frame, Midplane | 41Y5150 |
| 5 | 2 Gbps FC, 73.4 GB/10K drive module | 39M4589 |
|  | 2 Gbps FC, 146.8 GB/10K drive module | 39M4593 |
|  | 2 Gbps FC, 300 GB/10K drive module | 39M4597 |
|  | 2 Gbps FC, 36.4 GB/15K drive module | 40K6803 |
|  | 2 Gbps FC, 73.4 GB/15K drive module | 40K6807 |
|  | 2 Gbps FC, 146.8 GB 15K drive module | 40K6811 |
|  | cable, FRU-1M | 39M5699 |
|  | cable, FRU-5M | 39M5700 |
|  | cable, FRU-25M | 39M5701 |
|  | FRU, SFP LC (shortwave) 4 Gbps | 39M5705 |
|  | power cord, 2.8M | 39M5081 |
|  | power cord, jumper | 39M5377 |

# Appendix A. Upgrading the DS4000 controller firmware

EXP810 storage expansion enclosures require DS4000 controller firmware version 06.16.xx.xx so that the DS4000 storage subsystem recognizes them. DS4000 controller firmware 06.16.xx.xx is shipped with the EXP810 on the *DS4000 Storage Server Controller Firmware Version 06.16.xx.xx Support for DS4000 EXP810 Storage Expansion Enclosure* CD.

To download the latest DS4000 Storage Manager host software to manage the DS4000 storage subsystem with controller code 06.16.xx.xx installed, go to the following Web site:

http://www-1.ibm.com/servers/storage/support/disk/

For controller firmware version names and numbers, see Table 20.

**Note:** Currently the only DS4000 storage subsystem that supports the EXP810 is the DS4800 storage subsystem.

*Table 20. Firmware versions*

|  | Controller | EXP810 |
|---|---|---|
| DS4800 | 06.16.xx.xx | 9837 |

If you are connecting an EXP810 to a DS4000 storage subsystem that is already connected to EXP710 drive enclosures only or has a combination of EXP100s (or EXP700) drive enclosures and EXP710 drive enclosures, use the steps in "Upgrading controller firmware for an existing DS4000 EXP710 configuration to support EXP810" on page 108 to upgrade the controller firmware to 06.16.xx.xx.

Otherwise, complete the following procedures for upgrading a DS4000 with firmware version 06.15.xx.xx or earlier:

- "Upgrading the firmware" on page 102
- "Downloading the firmware to controller B" on page 103
- "Powering up the DS4000 with EXP810 drive enclosures attached" on page 105
- "Adding and synchronizing the firmware for controller A with the firmware for controller B" on page 106
- "Completing the firmware upgrade procedure" on page 107

**Note:** Refer to the *DS4000 Storage Manager 9 Installation and Support Guide* for your operating system for more information on this upgrade procedure and any system requirements.

# Upgrading the firmware

**Attention:** The firmware upgrade procedure requires the out-of-band (Ethernet) management connections to both controllers in the connected DS4000. You can define the controller TCP/IP addresses in the following three ways:

- By default (to 192.168.128.101 and 192.168.128.102 for Controllers A and B respectively)
- By a DHCP/BootP server
- By static definition. existing DS4000 controllers have stored TCP/IP addresses that can be used for static definition.

  **Attention:** All of the enabled DS4000 premium features will be out-of-compliance after the controller firmware upgrade. Retrieve the necessary premium feature key files or premium feature entitlement card (to regenerate the necessary premium feature key file) for re-enabling the premium features after the controllers have been successfully upgraded to version 6.16.xx.xx.

Use the following procedures to upgrade a DS4000 storage subsystem manually to controller firmware level 06.16.xx.xx:

1. If this DS4000 is part of an existing configuration with EXP100s and EXP700s or both, the EXP100s and EXP700s must be removed from the configuration. Perform the appropriate steps to backup the data from the EXP100s and EXP700s before you remove them from the DS4000 configuration.

   **Note:** Always unmount the mapped logical drives before you power down the DS4000 configuration and disconnect or remove the drives to ensure that the all of the data in the server cache was flushed to the disk.

2. Power off the DS4000 configuration and the EXP810s, if applicable.

3. With the DS4000 and the EXP810s powered off, establish all fibre-channel cabling connections and management Ethernet connections. Refer to Chapter 3, "Cabling the EXP810," on page 37.

   **Note:** Do not power on any units yet.

4. Install DS4000 Storage Manager client software version 9.16 in the management station.

   Refer to the *DS4000 Storage Manager 9 Installation and Support Guide* for your operating system for more information on this upgrade procedure and any system requirements.

   **Attention:** The management station must have an Ethernet connection to the same network as the two controllers in the DS4000.

5. Remove Controller A from the DS4000 storage subsystem.

   **Important:** If you do not remove Controller A from the DS4000 storage subsystem, the new firmware may not be downloaded correctly on both controllers and the controllers will not recognize the EXP810 storage expansion enclosure.

   Refer to the appropriate DS4000 guide for the location and the instructions on how to remove the controller in a DS4000 storage subsystem.

   **Note:** For the DS4800 storage subsystem, Controller A is the top controller when looking at the front of the unit. Observe handling static-sensitive device precautions stated on "Handling static-sensitive devices" on page 20 when removing the DS4000 controller.

6. Power on the DS4000 storage subsystem only. Both power supplies must be powered on for maximum protection against power loss.

7. Open a DS4000 Storage Manger Client Enterprise Management window to manage the DS4000 for which you are upgrading the firmware. Refer to the *IBM TotalStorage DS4000 Storage Manager Installation and Support Guide* for the host operating system of your DS4000 management station for more information.

8. Add the TCP/IP address for Controller B to the Enterprise Management window of the DS4000 Storage Manager client program.

   a. In the Enterprise Management Window, click **Edit → Add Device**.

   b. The Add Device window opens. Enter the TCP/IP address of Controller B in the Host name or IP address field and click **Add** to add the DS4000 in the DS4000 Storage Manager client management domain.

   c. Click **Close** to close the Add Device window.

   **Note:** If this is an upgrade from an existing DS4000 storage subsystem with 06.15.xx.xx. firmware or earlier and there is an entry for this DS4000 in the DS4000 Storage Manager Client Enterprise Management window, delete this entry before you add controller B to the Enterprise Management window.

   To delete the entry, right-click the entry and select **Remove Device** from the pull-down menu. Click **Yes** when the Remove Device confirmation window opens.

When you are done, continue to "Downloading the firmware to controller B."

## Downloading the firmware to controller B

Perform the following steps to download the firmware and NVSRAM to controller B of the DS4000:

1. In the Enterprise Management window, right click the DS4000 storage subsystem name and select **Manage Device** to open the Subsystem Management window.

   **Note:** A Partially Managed Notice window might open, warning that the storage subsystem that you are trying to manage has a controller that has not yet been added to the Enterprise Management window. Click **Yes** to launch the Subsystem Management window for this DS4000 controller anyway.

2. In the Subsystem Management window, click **Advanced → Maintenance → Download → Controller NVSRAM** to load the NVSRAM file to Controller B. The NVSRAM Download window opens.

3. Select the directory that contains the NVSRAM file, then select the name of the NVSRAM file. Click **OK** to close the window and continue.

   The NVSRAM files are located in the appropriate DS4000 storage subsystem directory in the \NVSRAM directory of the *DS4000 Storage Server Controller Firmware Version 06.16.xx.xx Support for DS4000 EXP810 Storage Expansion Enclosure* CD that is shipped with the EXP810.

4. Click **Yes** when the Confirm Download window opens. The Confirm Download window closes and the Downloading window opens and shows the status of the firmware download.

5. One of two windows displays:

- If you receive the message `NVSRAM download successful` displayed in the Downloading window, click **Done** to close the Downloading window and then continue with step 6.
- If you see an error window displaying a `Controller Download Timeout` error, power off and then power on the DS4000. Then verify that the NVSRAM was downloaded correctly to Controller B of the storage subsystem.

  To verify that the correct NVSRAM version was downloaded, click **Storage Subsystem → View → Profile**. In the Storage Subsystem Profile window, look for the correct NVSRAM file version under the All tab.
  - If the NVSRAM was downloaded correctly, continue with step 6.
  - If the NVSRAM was not downloaded correctly, try the NVSRAM download again. If the problem persists after the second NVSRAM file download, call your IBM technical support representative.

6. Click **Done** to close the Downloading window.
7. Click **Advanced → Maintenance → Download → Controller Firmware**. The Firmware Download window opens.

   **Note:** The firmware version must be 06.16.xx.xx or higher. The firmware files are located in the appropriate DS4000 storage subsystem directory in the \FIRMWARE directory of the *DS4000 Storage Server Controller Firmware Version 06.16.xx.xx Support for DS4000 EXP810 Storage Expansion Enclosure* CD that is shipped with the EXP810 unit. You must upgrade the controller B firmware to the version on the CD and synchronize the firmware with controller A before you can download the newer version of the controller firmware on the DS4000 Support Web site:

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

8. Select the directory that contains the controller firmware file, then select the name of the controller firmware file. Click **OK** to close the window an continue.
9. Click **Yes** when the Confirm Download window opens. The Confirm Download window closes and the Downloading window opens and shows the status of the firmware download.
10. One of two windows displays:
    - If you receive the message `Firmware download is successful` in the Downloading window and the New Firmware Detected window displays, then continue with step 11 on page 105.
    - If you see an error window displaying a `Controller Download Timeout` error, power off and then power on the DS4000. Verify that the firmware was downloaded correctly to Controller B of the storage subsystem.

      To verify that the correct firmware version was downloaded, perform the following steps:
      a. Right-click the Controller B icon in the Physical pane of the Subsystem Management window and select **Properties**.
      b. Look for the entries starting with ″Appware version″ and ″Bootware version″ when the Controller Properties window opens.
         - If the firmware was downloaded correctly, continue with step 12 on page 105.
         - If the firmware was not downloaded correctly, try the firmware download again. If the problem persists after the second controller firmware download, call your IBM technical support representative.

11. Click **OK** to close the New Firmware Detected window and the Subsystem Management window.

12. Close the Subsystem Management window. In the Enterprise Management window, remove the Controller B entry from the Directly-Managed Storage Subsystem list. To delete the entry, perform the following steps:

    a.  Right-click the entry and select **Remove Device** from the pull-down menu.

    b.  Click **Yes** when the Remove Device confirmation window opens.

13. Power off the DS4000.

14.  If you have not connected the EXP810 drive storage expansion enclosures to the DS4000 storage subsystem, make appropriate fibre-channel cable connections between the EXP810 storage expansion enclosures and the DS4000 storage subsystem.

    **Attention:**  Do not re-insert Controller A to the DS4000 yet.

When you are done, continue to "Powering up the DS4000 with EXP810 drive enclosures attached."

## Powering up the DS4000 with EXP810 drive enclosures attached

Perform the following steps to power up the DS4000 with controller B only inserted and attached to the EXP810 storage expansion enclosures.

1.  Verify that the EXP810 storage expansion enclosures are correctly cabled to the DS4000 storage subsystem.

    For more information on cabling the EXP810, see Chapter 3, "Cabling the EXP810," on page 37.

2.  Power on all of the EXP810 storage expansion enclosures. The green Global Power, ESM Power, and the Power Supply-Fan Power LEDs will be lit.

3.  Wait for the green drive Activity LEDs on the drives in the EXP810 enclosures to start flashing once every two seconds and the EXP810 ESM Fault LED to change from amber to unlit.

    Verify that the port ByPass LEDs for all of the fibre-channel interconnect ports of the EXP810 storage expansion enclosures are not lit. The Port Bypass LED of the ports that are connected to the DS4000 storage subsystem drive ports will be lit.

4.  Power on the DS4000 storage subsystem.

    Wait at least four minutes after all of the drives in the EXP810 storage expansion enclosures have spun up by the DS4000 storage subsystem controllers. The drives will show solidly lit or rapidly flashing green drive Activity LEDs. Verify that the Port Bypass LED of the controller B drive port is not lit. Also verify that the Bypass LEDs on the EXP810 fibre channel ports that are connected to DS4000 storage subsystem controller drive ports are not lit.

5.  Add the TCP/IP address for Controller B to the Enterprise Management window of the DS4000 Storage Manager client program. Perform the following steps to add the TCP/IP address for Controller B.

    a.  In the Enterprise Management Window, click **Edit → Add Device**.

    b.  Enter the TCP/IP address of Controller B.

    c.  Click **Add** when the Add Device window opens.

    d.  If the Connection Problem window displays, continue with 5e. Otherwise, continue with 5g on page 106.

    e.  Click **No** to close the window and return to the Add Device window.

f. Wait a few minutes and click **Add** to try to add Controller B to the Enterprise Management window again.

   If the problem persists, power off the DS4000 storage subsystem and repeat steps 2 on page 105 through 5 on page 105. Otherwise, continue with step 5g.

g. Click **Close** to close the Add Device window.

   **Note:** A Partially Managed Notice window might open, warning that the storage subsystem that you are trying to manage has a controller that has not yet been added to the Enterprise Management window. Click **Yes** to launch the Subsystem Management window for this DS4000 storage subsystem controller anyway.

6. In the Enterprise Management window, right-click the entry for Controller B (which you just added) and select **Manage Device** from the pop-up menu.

7. A Subsystem Management window opens. Verify that all of the EXP810 drive expansion enclosures and drives are shown in the Subsystem Management window.

8. Close the Controller B Subsystem Management window.

When you are done, continue with "Adding and synchronizing the firmware for controller A with the firmware for controller B."

## Adding and synchronizing the firmware for controller A with the firmware for controller B

Perform the following steps to add Controller A and synchronize its firmware with the version loaded into controller B.

1. While the DS4000 is powered on, Hot-add the controller A CRU into the DS4000 server chassis.

   **Note:** The DS4000 storage subsystem supports hot additions of CRUs like controllers, power supplies, and so forth. This controller will be started up and its firmware and NVSRAM will synchronize automatically with the controller firmware and NVSRAM in Controller B. This process might take several minutes, depending on the number of EXP810 enclosures and drives in the DS4000 storage subsystem configuration. Wait at least five minutes (or 10 minutes in a large configuration; for example, one with 112 or more drives).

2. Perform the following steps to add Controller A to the Enterprise Management window using the TCP/IP address for Controller A.

   a. To add Controller A, click **Edit → Add Device**. The Add Device window opens.

   b. Enter the TCP/IP address of Controller A and click **Add**.

   c. If the Connection Problem window opens, click **No** to close the window and return to the Add Device window.

      Wait a few more minutes and click **Add** to try to add Controller A to the Enterprise Management window again. If the problem persists after a few attempts, call your IBM technical support representative.

When you are done, continue with "Completing the firmware upgrade procedure" on page 107.

# Completing the firmware upgrade procedure

Perform the following steps to complete the firmware upgrade procedure:

- If Controller A starts up successfully after synchronizing with the firmware and NVSRAM in Controller B, Controller A and Controller B will be displayed as a single entry under the Directly-Managed Storage Subsystem tree in the Enterprise Management window as Figure 49 shows. Right-click the entry for Controller B and select **Manage Device**. A Subsystem Management window should open without being preceded by the Partially Manage Device window.
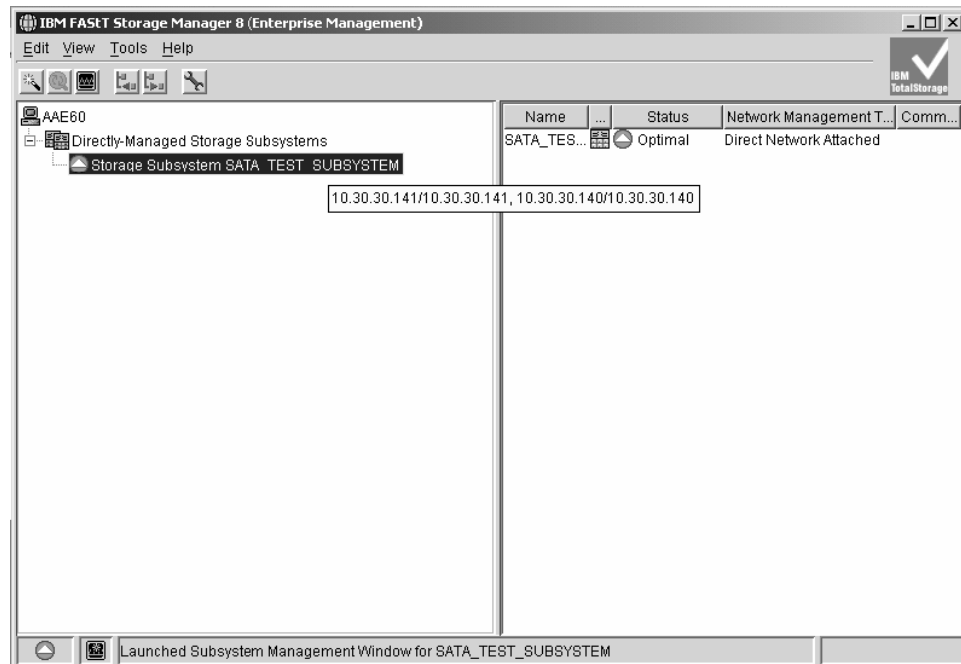


*Figure 49. Only one entry appears in the Directly-Managed Storage Subsystem tree*

When the Subsystem Management window opens, you can proceed with the other DS4000 storage subsystem management tasks, such as creating arrays, mapping logical drives to host partitions, and so on. Refer to the DS4000 Storage Subsystem Management online help for instructions. If you had any enabled premium features, re-enable them using the premium feature key files.

**Attention:** After you successfully upgrade the controller firmware, check whether new versions of the ESM firmware for the EXP810 and fibre channel drive firmware exist on the IBM DS4000 Storage Subsystem Web site:

http://www-1.ibm.com/servers/storage/support/disk/

Refer to the Storage Subsystem online help or the *Storage Manager 9 Installation and Support Guide* for your operating system or the *IBM TotalStorage DS4000 Storage Manager Concepts Guide* for more information on how to download the drive enclosure ESM firmware and drive firmware.

- If Controller A is added as a separate entry in the Enterprise Management window as shown in Figure 50 on page 108, perform the following steps:
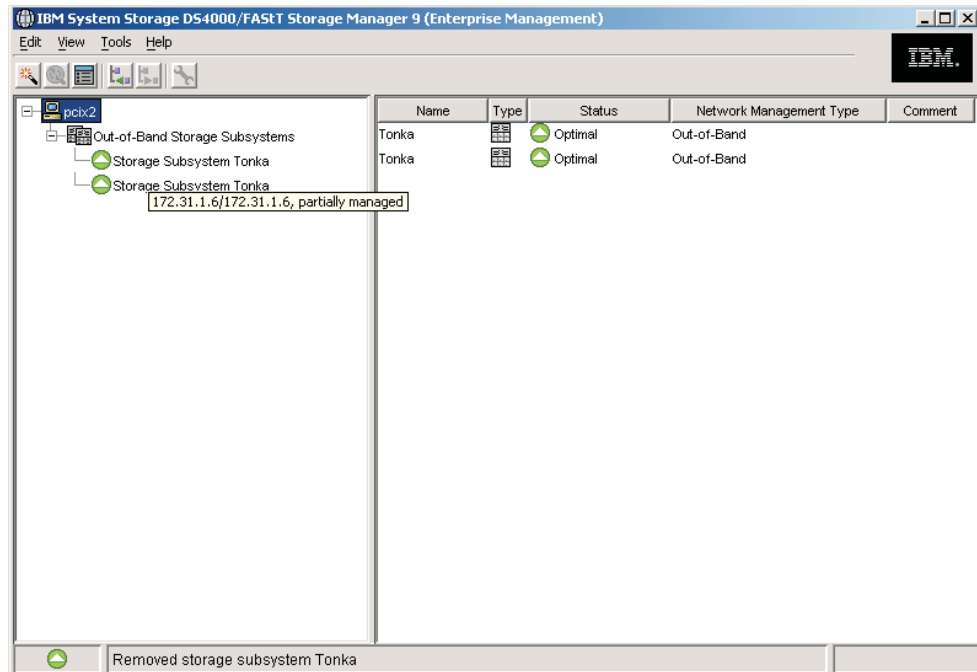
*Figure 50. Dual entries appear in the Directly-Managed Storage Subsystem tree*

    1. Close the Add Device window and delete the Controller A entry from the Enterprise Management window.

    2. Wait a few minutes and try to add Controller A again. (The problem might have been caused by Controller A not having had enough time to complete the sync-up with Controller B.)

- If Controller A is added as a separate entry in the Enterprise Management window again, perform the following steps:

    1. Close the Add Device window and delete the Controller A entry from the Enterprise Management window.

    2. Remove Controller A from the storage subsystem chassis, wait a minute or so, and repeat step 2 on page 106.

If the problem persists, call your IBM technical support representative.

## Upgrading controller firmware for an existing DS4000 EXP710 configuration to support EXP810

**Note:** After you upgrade the controller firmware, see the *DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* for information about adding new storage expansion enclosures.

The required controller firmware for the DS4000 storage subsystem that supports the EXP810 also supports the EXP710. For an existing DS4000 configuration that contains EXP710s, perform the following steps to upgrade the controller firmware to support EXP810s.

    1. If this DS4000 storage subsystem is part of an existing configuration with EXP100s or EXP700s, the EXP100s and EXP700s must be removed from the configuration. After the controller firmware upgrade, these enclosures will not

be recognized by the controllers. Perform the appropriate steps to backup the data from the EXP100s and EXP700s before you remove them from the DS4000 configuration.

2. Install DS4000 Storage Manager client software version 9.16 in the management station. Refer to the *DS4000 Storage Manager 9 Installation and Support Guide* for your operating system for more information on this upgrade procedure and any system requirements.

3. Do not make any fibre channel connections between the EXP810s and the DS4000 configuration. Power on the DS4000 configuration by:

   a. Powering on all of the EXP710 storage expansion enclosures.

   b. Powering on the DS4000 storage subsystem after verifying that the EXP710s are powered on and do not have any Bypass LEDs lit (on the EXP710 ports that are used for EXP710 interconnection.)

   Wait at least five minutes for the DS4000 storage subsystem boot process to complete.

   **Attention:** This upgrade procedure requires that the DS4000 storage subsystem and its attached EXP710 storage expansion enclosures are powered up and running optimally.

4. Open a DS4000 Storage Manger Client Enterprise Management window to manage the DS4000 storage subsystem for which you are upgrading the firmware. You can make either in-band or out-of-band management connections to the controller. IBM recommends making out-of-band management connections.

   Refer to the *DS4000 Storage Manager 9 Installation and Support Guide* for your operating system for more information on this upgrade procedure and any system requirements.

5. In the Enterprise Management window, right click the DS4000 name and select **Manage Device** to open the Subsystem Management window.

6. In the Subsystem Management window, verify that the subsystem is in optimal state. Perform appropriate recovery procedure to get the subsystem into optimal state before proceeding to the next step.

7. In the Subsystem Management window, click **Advanced → Maintenance → Download → Controller NVSRAM** to load the NVSRAM file to Controller B. The NVSRAM Download window opens.

8. Select the directory that contains the NVSRAM file, then select the name of the NVSRAM file. Click **OK** to close the window and continue.

   The NVSRAM files are located in the appropriate DS4000 storage subsystem directory in the \NVSRAM directory of the *DS4000 Storage Server Controller Firmware Version 06.16.xx.xx Support for DS4000 EXP810 Storage Expansion Enclosure* CD that is shipped with the EXP810.

   One of two windows displays:

   - If you receive the message `NVSRAM download successful` displayed in the Downloading window, click **Done** to close the Downloading window and then continue with step 9 on page 110.

   - If you see an error window displaying a `Controller Download Timeout` error, power off and then power on the DS4000. Then verify that the NVSRAM was downloaded correctly to Controller B of the storage subsystem.

     To verify that the correct NVSRAM version was downloaded, click **Storage Subsystem → View Profile**. In the Storage Subsystem Profile window, look for the correct NVSRAM file version under the All tab.

- If the NVSRAM was downloaded correctly, continue with step 9.
- If the NVSRAM was not downloaded correctly, try the NVSRAM download again. If the problem persists after the second storage subsystem power-cycle, call your IBM technical support representative.

9. Click **Done** to close the Downloading window.

10. Click **Advanced → Maintenance → Download → Controller Firmware**. The Firmware Download window opens.

11. Select the storage subsystem directory on the *DS4000 Storage Server Controller Firmware Version 06.16.xx.xx Support for DS4000 EXP810 Storage Expansion Enclosure CD* that contains the controller firmware file, then select the name of the controller firmware file. Click **OK** to close the window an continue.

12. One of two windows displays:
    - If you receive the message `Firmware download is successful` in the Downloading window and the New Firmware Detected window displays, then continue with step 13.
    - If you see an error window displaying a `Controller Download Timeout` error, power off and then power on the DS4000. Verify that the firmware was downloaded correctly to Controller B of the storage subsystem.

      To verify that the correct firmware version was downloaded, perform the following steps:
      a. Right-click the Controller B icon in the Physical pane of the Subsystem Management window and select **Properties**.
      b. Look for the entries starting with ″Appware version″ and ″Bootware version″ when the Controller Properties window opens.
         - If the firmware was downloaded correctly, continue with step 13.
         - If the firmware was not downloaded correctly, try the firmware download again. If the problem persists after the second storage subsystem power-cycle, call your IBM technical support representative.

13. Click **OK** to close the New Firmware Detected window and the Subsystem Management window.

14. Power on the EXP810 storage expansion enclosure and add it to the DS4000 controller redundant drive channel/loop pair one at a time. See Adding expansion enclosures containing new hard drives in the *DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* for details.

# Appendix B. Records

Whenever you add options to your EXP810, 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.

| | |
|---|---|
| Product name: | IBM System Storage DS4000 EXP810 Storage Expansion Enclosure |
| Machine type: | 1812 |
| Model number: | 81A, 81H |
| Serial number: | |

The serial number is located on the bottom inside surface at the rear and on the bottom right at the front of the EXP810.

# Storage subsystem and controller information record

Table 21 provides a data sheet for recording storage subsystem names, management types, Ethernet hardware addresses, and IP addresses. Make a copy of this table and complete the information for your storage subsystems and controllers. Use the information to set up the BOOTP table for the network server and the host or Domain Name System (DNS) table. The information is also helpful if you add storage subsystems after initial installation. Refer to your Storage Manager documentation for detailed instructions about how to obtain the information. For a sample information record, see Table 22 on page 113.

*Table 21. Storage subsystem and controller information record*

| Storage subsystem name | Management method | Controllers-Ethernet and IP addresses, and host name | | Host-IP address and host name |
|---|---|---|---|---|
| | | | | |
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# Sample information record

Table 22 shows a sample information record. This network contains storage subsystems that are managed by using both the direct-management and host-agent-management method.

*Table 22. Sample information record*

| Storage subsystem name | Management method | Controllers-Ethernet and IP addresses, and host name | | Host-IP address and host name |
|---|---|---|---|---|
| | | **Controller A** | **Controller B** | |
| Finance | Direct | Hardware Ethernet address = 00a0b8020420 | Hardware Ethernet address = 00a0b80000d8 | |
| | | IP address = 192.168.128.101 | IP address = 192.168.128.102 | |
| | | Host = Denver_a | Host = Denver_b | |
| Engineering | Host-agent | | | IP address = 192.168.2.22 |
| | | | | Host = Atlanta |

# Installed device records

Use the following table to record the number of the hard disk drives that you replaced and the corresponding bay number.

**Attention:** If you replace a hard disk drive in the wrong drive bay it might cause a loss of data.

*Table 23. Hard disk drive record*

| Bay Number | Hard disk drive serial number | Replaced hard disk drive serial number |
|---|---|---|
|  |  |  |
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# Appendix C. Rack mounting template

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 22.

Use the following templates (Figure 51 on page 116 and Figure 52 on page 117) to identify the proper locations for inserting M5 screws when mounting the support rails and EXP810 to a rack. The locations for the M5 screws are highlighted in the templates.

The EXP810 is 3 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 might be round or square.

3 U - - - - - - - - - - - -

EXP810
FRONT
Rack Mounting
Template

Install second --->  Bezel (Front Left)

Install first --->

2 U - - - - - - - - - - - -

Install first --->

1 U - - - - - - - - - - - -

Install second --->  Rail assembly (Front Left)

0 U - - - - - - - - - - - -

- - - - - - - - - - - - 3 U

Bezel (Front Right)

<--- Install first

- - - - - - - - - - - - 2 U

<--- Install first

- - - - - - - - - - - - 1 U

Rail assembly (Front Right)

- - - - - - - - - - - - 0 U
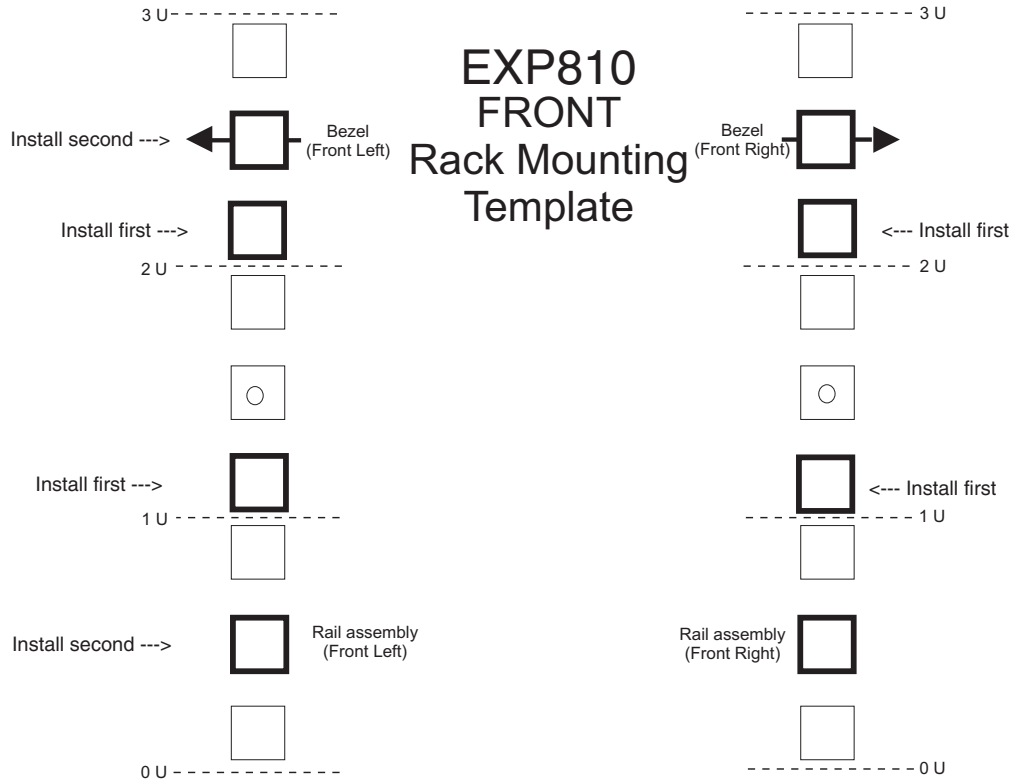
*Figure 51. Front rack mounting template*

EXP810
REAR
Rack Mounting
Template

3U

2U

Rail mounting guide

1U

Rail assembly
(Rear Left)

0U

3U

2U

1U

Rail assembly
(Rear right)

IBM®

Printed in the U.S.A

0U
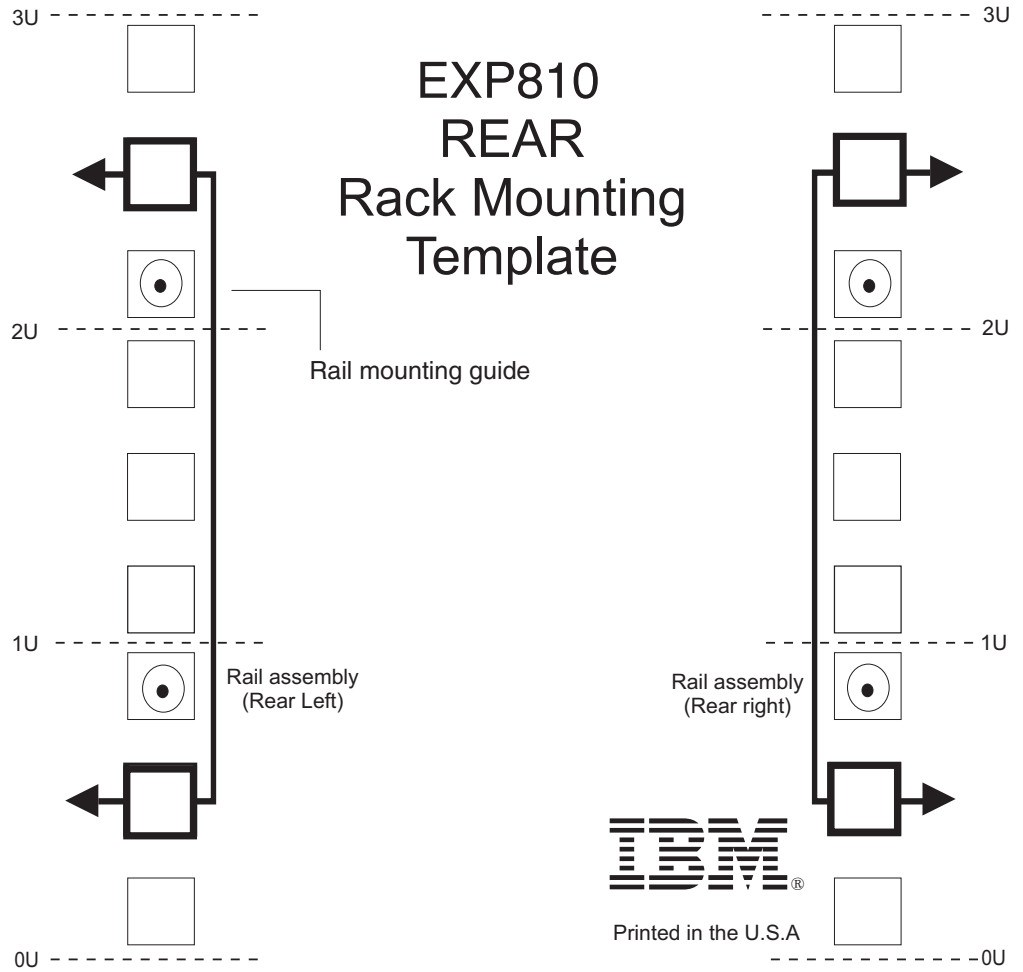
*Figure 52. Rear rack mounting template*

# 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.

*Table 24. IBM power cords*

| IBM power cord part number | Feature code | Description | Used in these countries or regions |
|---|---|---|---|
| 39Y7931 | 9800 | Power Cord (125v, 10A, 4.3m) | 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, Thailand, Turks and Caicos Islands, United States, Venezuela |

*Table 24. IBM power cords  (continued)*

| IBM power cord part number | Feature code | Description | Used in these countries or regions |
|---|---|---|---|
| 39Y7917 | 9820 | Power Cord (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, SSyrian Arab Replublic, Tajikistan, Tahiti, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Upper Volta, Uzbekistan, Vanuatu, Vietnam, Wallis and Futuna, Yugoslavia (Federal Republic of), Zaire |
| 39Y7918 | 9821 | Power Cord (250v, 10A, 2.8m) | Denmark |

*Table 24. IBM power cords  (continued)*

| IBM power cord part number | Feature code | Description | Used in these countries or regions |
|---|---|---|---|
| 39Y7923 | 9825 | Power Cord (250v, 10A, 2.8m) | Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, Cyprus, Dominica, Gambia, Ghana, Grenada, Guyana, Hong Kong, 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 |
| 39Y7920 | 9827 | Power Cord (250v, 10A, 2.8m) | Israel |
| 39Y7919 | 9828 | Power Cord (250v, 10A, 2.8m) | Liechtenstein, Switzerland |
| 39Y7922 | 9829 | Power Cord (250v, 10A, 2.8m) | Bangladesh, Lesotho, Maceo, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda |
| 39Y7925 | 9845 | Power Cord (250v, 12A, 2.8m) | Korea (Democratic Peoples Republic of) |
| 39Y7921 | 9830 | Power Cord (250v, 10A, 2.8m) | Chile, Italy, Libyan Arab Jamahiriya |
| 39M7924 | 9831 | Power Cord (250v, 10A, 2.8m) | Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea |
| 39Y7930 | 9834 | Power Cord (250v, 10A, 2.8m) | Argentina, Paraguay, Uruguay |
| 39Y7928 | 9840 | Power Cord (250v, 10A, 2.8m) | China |
| 39M2830 | 9841 | Power Cord 1.8m long | Taiwan |
| 39Y7929 | 9842 | Power Cord (125v, 10A, 2.8m) | Brazil |
| 39Y7927 | 9843 | Power Cord (250v, 10A, 2.8m) | India |
| 39Y7926 | 9844 | Power Cord (125v, 10A, 4.3m) | Japan |
| N/A | 9986 | Power Cord (125v, 10A, 1.8m) - US/Chicago | |

# Appendix E. Additional DS4000 documentation

The following tables present an overview of the IBM TotalStorage DS4000 Storage Manager and DS4000 Storage Subsystem 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 one of the following Web sites:

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

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

## DS4000 Storage Manager Version 9 library

Table 25 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

*Table 25. TotalStorage DS4000 Storage Manager Version 9.1 titles by user tasks*

| Title | User tasks | | | | | |
|---|---|---|---|---|---|---|
| | Planning | Hardware installation | Software installation | Configuration | Operation and administration | Diagnosis and maintenance |
| *IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux,* GC26-7706 | ✔ | | ✔ | ✔ | | |
| *IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for AIX, UNIX®, Solaris and Linux on Power,* GC26-7705 | ✔ | | ✔ | ✔ | | |
| *IBM TotalStorage DS4000 Storage Manager Version 9 Copy Services User's Guide,* GC26-7707 | ✔ | | ✔ | ✔ | ✔ | |
| *IBM TotalStorage DS4000 Storage Manager Version 9 Concepts Guide,* GC26-7734 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |

# DS4500 Fibre Channel Storage Server library

Table 26 associates each document in the DS4500 (previously FAStT900) Fibre Channel Storage Server library with its related common user tasks.

*Table 26. TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM TotalStorage DS4500 Installation and Support Guide*, GC26-7727 | ✔ | ✔ | | ✔ | | |
| *IBM TotalStorage DS4500 Fibre Channel Cabling Instructions*, GC26-7729 | ✔ | ✔ | | | | |
| *IBM TotalStorage DS4500 Storage Server User's Guide*, GC26-7726 | | | | ✔ | ✔ | ✔ |
| *IBM TotalStorage DS4500 Rack Mounting Instructions*, GC26-7728 | ✔ | ✔ | | | | |

# DS4400 Fibre Channel Storage Server library

Table 27 associates each document in the DS4400 (previously FAStT700) Fibre Channel Storage Server library with its related common user tasks.

*Table 27. TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM DS4400 Fibre Channel Storage Server User's Guide*, GC26-7730 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| *IBM DS4400 Fibre Channel Storage Server Installation and Support Guide*, GC26-7731 | ✔ | ✔ | | ✔ | ✔ | |
| *IBM DS4400 Fibre Channel Cabling Instructions*, GC26-7732 | ✔ | ✔ | | | | |

# DS4300 Fibre Channel Storage Server library

Table 28 associates each document in the DS4300 (previously FAStT600) Fibre Channel Storage Server library with its related common user tasks.

*Table 28. TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM TotalStorage DS4300 Fibre Channel Storage Server Installation and User's Guide*, GC26-7722 | ✔ | ✔ | | ✔ | | |
| *IBM TotalStorage DS4300 Rack Mounting Instructions*, GC26-7724 | ✔ | ✔ | | | | |
| *IBM TotalStorage DS4300 Fibre Channel Cabling Instructions*, GC26-7725 | ✔ | ✔ | | | | |
| *IBM TotalStorage DS4300 SCU Base Upgrade Kit*, GC26-7740 | | ✔ | ✔ | | | |
| *IBM TotalStorage DS4300 SCU Turbo Upgrade Kit*, GC26-7741 | | ✔ | ✔ | | | |
| *IBM TotalStorage DS4300 Turbo Models 6LU/6LX Upgrade Kit*, GC26-7723 | | ✔ | ✔ | | | |

# DS4100 SATA Storage Server library

Table 29 associates each document in the DS4100 (previously FAStT100) SATA Storage Server library with its related common user tasks.

*Table 29. TotalStorage DS4100 SATA Storage Server document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM TotalStorage DS4100 Installation, User's and Maintenance Guide,* GC26-7733 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| *IBM TotalStorage DS4100 Cabling Guide,* 24P8973 | | ✔ | | | | |

# DS4800 Storage Subsystem library

Table 30 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

*Table 30. TotalStorage DS4800 Storage Subsystem document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM TotalStorage DS4800 Installation, User's and Maintenance Guide*, GC26-7748 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| *IBM TotalStorage DS4800 Installation and Cabling Overview*, 22R4738 | | ✔ | | | | |

# Other DS4000 and DS4000-related documents

Table 31 associates each of the following documents with its related common user tasks.

*Table 31. TotalStorage DS4000 and DS4000–related document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM Safety Information*, 33P2406 | | | | | ✔ | |
| *IBM TotalStorage DS4000 Quick Start Guide,* GC26-7738 | ✔ | ✔ | | | | |
| *IBM TotalStorage DS4000 Hardware Maintenance Manual,* GC26-7702 | | | | | | ✔ |
| *IBM TotalStorage DS4000 Problem Determination Guide*, GC26-7703 | | | | | | ✔ |
| *IBM Fibre Channel Planning and Integration: User's Guide and Service Information*, SC23-4329 | ✔ | ✔ | | | ✔ | ✔ |
| *IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide*, GC26-7736 | | ✔ | | | ✔ | |
| *IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide*, GC26-7737 | | ✔ | | | ✔ | |
| *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview* GC26-7713 | ✔ | ✔ | ✔ | ✔ | | |
| *Fibre Channel Solutions - IBM DS4000 EXP500 Installation and User's Guide*, 59P5637 | ✔ | ✔ | | ✔ | ✔ | ✔ |

*Table 31. TotalStorage DS4000 and DS4000–related document titles by user tasks  (continued)*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| *IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide*, GC26-7735 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| *IBM TotalStorage DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide*, GC26-7798 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide*, GC26-7704 | ✔ | ✔ | | | | |
| *IBM DS4000 Management Suite Java™ User's Guide*, 32P0081 | | | | | ✔ | ✔ |
| *IBM Netfinity® Fibre Channel Cabling Instructions*, 19K0906 | | ✔ | | | | |
| *IBM Fibre Channel SAN Configuration Setup Guide*, 25P2509 | ✔ | | ✔ | ✔ | ✔ | |

# Appendix F. 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 9.14 software installation package for Windows includes a screen reader software interface. To enable the screen reader, select Custom Installation when using the installation wizard to install Storage Manager 9.14 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 32 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 32. 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 32. DS4000 Storage Manager alternate keyboard operations (continued)*

| Short cut | Action |
|-----------|--------|
| Alt+ underlined letter | Access menu items, buttons, and other interface components by using the keys associated with the underlined letters.<br><br>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.<br><br>For other interface components, use the Alt + underlined letter combination. |
| 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 | Select multiple drives in the Physical View.<br><br>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.<br><br>If you press Spacebar alone when multiple drives are selected then all selections are removed.<br><br>Use the Ctrl+Spacebar combination to deselect a drive when multiple drives are selected.<br><br>This behavior is the same for contiguous and non-contiguous selection of drives. |
| 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. |

# Appendix G. European Directive About Product Recycling and Disposal

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet site at `http://www.ibm.com/ibm/environment/products/prp.shtml`.
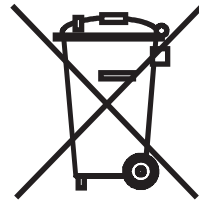


**Notice:** This mark applies only to countries within the European Union (EU) and Norway.

This appliance is labelled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

注意: このマークは EU 諸国およびノルウェーにおいてのみ適用されます。

この機器には、EU 諸国に対する廃電気電子機器指令 2002/96/EC(WEEE) のラベルが貼られています。この指令は、EU 諸国に適用する使用済み機器の回収とリサイクルの骨子を定めています。このラベルは、使用済みになった時に指令に従って適正な処理をする必要があることを知らせるために種々の製品に貼られています。

Remarque : Cette marque s'applique uniquement aux pays de l'Union Européenne et à la Norvège.

L'étiquette du système respecte la Directive européenne 2002/96/EC en matière de Déchets des Equipements Electriques et Electroniques (DEEE), qui détermine les dispositions de retour et de recyclage applicables aux systèmes utilisés à travers l'Union européenne. Conformément à la directive, ladite étiquette précise que le produit sur lequel elle est apposée ne doit pas être jeté mais être récupéré en fin de vie.

# Appendix H. Battery Return Program

This product may contain 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, go to 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 other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

In Taiwan, the following applies:



Please recycle batteries.

廢 電 池 請 回 收

# Appendix I. Cable Warning

**WARNING:** 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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## Important notes

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.

Maximum memory may require replacement of the standard memory with an optional memory module.

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## 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. 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.

## Product recycling and disposal

This unit contains materials such as circuit boards, cables, electromagnetic compatibility gaskets, and connectors which may contain lead and copper/beryllium alloys that require special handling and disposal at end of life. Before this unit is disposed of, these materials must be removed and recycled or discarded according to applicable regulations. IBM offers product-return programs in several countries. Information on product recycling offerings can be found on IBM's Internet site at www.ibm.com/ibm/environment/products/prp.shtml.

IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of programs and services to assist equipment owners in recycling their IT products. Information on product recycling offerings can be found on IBM's Internet site at www.ibm.com/ibm/environment/products/prp.shtml.



**Notice:** This mark applies only to countries within the European Union (EU) and Norway.

Appliances are labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

## 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.



# 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.

## United Kingdom telecommunications safety requirement

### Notice to Customers

This apparatus is approved under approval number NS/G/1234/J/100003 for indirect connection to public telecommunication systems in the United Kingdom.

## 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.

## Taiwan Class A warning statement

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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
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## Japanese Voluntary Control Council for Interference (VCCI) statement

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# 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.

**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*.

**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*.

**FAStT MSJ.**  See *FAStT Management Suite Java*.

**FAStT Management Suite Java (FAStT MSJ).**  A diagnostic and configuration utility that can be used on Linux, Microsoft Windows, and Novell NetWare host systems. In Linux, it is also used with the QLRemote agent to define preferred and non-preferred paths for logical drives.

**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.

**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, HP-UX, and Solaris 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 subsystems 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, HP-UX, and Solaris 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 know 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 subsystem. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage subsystems 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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**Installation, User's and Maintenance Guide**

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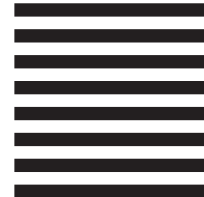
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