

IBM System Storage DS4800 Storage Subsystem



Installation, User's, and Maintenance Guide

IBM System Storage DS4800 Storage Subsystem



Installation, User's, and Maintenance Guide

Note:

Before using this information and the product it supports, be sure to read the general information in “Notices” on page 189.

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Safety

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

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

DANGER

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

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

Statement 1:



DANGER

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

To avoid a shock hazard:

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

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

Statement 2:



CAUTION:

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

Do not:

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

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

Statement 3:



CAUTION:

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

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



DANGER

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

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




Class 1 Laser statement

Class 1 Laser Product
Laser Klasse 1
Laser Klasse 1
Luokan 1 Laserlaitte
Appareil À Laser de Classe 1

IEC 825-11993 CENELEC EN 60 825

Statement 4:



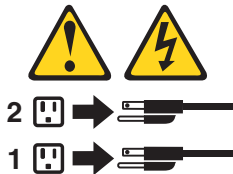
		
≥ 18 kg (39.7 lb)	≥ 32 kg (70.5 lb)	≥ 55 kg (121.2 lb)

CAUTION:
Use safe practices when lifting.

Statement 5:



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



Statement 6:



CAUTION:

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



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

Statement 7:



DANGER

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

Contents

Safety	iii
Figures	xiii
Tables	xv
About this document	xvii
FAST product renaming	xvii
Who should read this document	xvii
How this document is organized	xviii
Notices and statements used in this document.	xviii
Chapter 1. Introduction	1
Overview	1
Fibre channel defined	2
SATA defined	2
Features at a glance	2
Clustering support	3
Inventory checklist	3
Product updates	5
Best practices guidelines.	6
Storage server components.	7
Intermixing the EXP810 and EXP710 in the same drive channel.	10
Controllers	10
Controller cable connections	11
Controller memory	14
Power supply-fans	15
Interconnect-battery unit	16
SFP Modules	18
Specifications	19
Area requirements	19
Dimensions	19
Weight	19
Shipping dimensions	20
Environmental requirements and specifications	20
Temperature and humidity	20
Altitude	21
Airflow and Heat Dissipation	21
Acoustic Noise	22
Electrical requirements	23
Site wiring and power	23
AC power recovery	23
Power cords and receptacles.	24
Chapter 2. Installing the storage subsystem	25
Installation overview	25
Handling static-sensitive devices	27
Heat output, airflow, and cooling	28
Preparing for installation	29
Preparing the site	31
Preparing the rack cabinet.	31
Installing the support rails	32
Installing the DS4800	36

Releasing and locking a component lever	37
Removing the components	39
Installing the DS4800 on the support rails	41
Replacing the components	43
Chapter 3. Cabling the storage subsystem.	47
Working with SFPs and fiber-optic cables	47
Handling fiber-optic cables	48
Installing SFP modules	48
Removing SFP modules	50
Installing fiber-optic cables	51
Using LC-LC fibre-channel cables	52
Connecting an LC-LC cable to an SFP module	53
Removing an LC-LC fibre-channel cable	55
Using LC-SC fibre-channel cable adapters	55
Connecting an LC-SC cable adapter to a device	56
Removing an LC-LC cable from an LC-SC cable adapter	58
Connecting storage expansion enclosures to the DS4800	59
DS4800 Storage Subsystem drive cabling topologies	69
One DS4800 and one storage expansion enclosure	70
One DS4800 and two storage expansion enclosures	71
One DS4800 and four storage expansion enclosures	72
One DS4800 and eight storage expansion enclosures	73
One DS4800 and fourteen EXP810 storage expansion enclosures	74
One DS4800 and sixteen EXP710 storage expansion enclosures	75
One DS4800 to seven EXP810 and eight EXP710 storage expansion enclosures.	75
Cabling the storage expansion enclosures to a DS4800 storage subsystem	76
Storage expansion enclosure settings	77
Fibre channel loop and ID settings.	78
DS4000 storage expansion enclosure ID settings	78
Connecting hosts to the DS4800	79
Connecting secondary interface cables	81
Configuring the storage subsystem	82
Storage subsystem management methods.	82
Host-agent (in-band) management method.	82
Direct (out-of-band) management method	83
Fibre channel connections.	84
Fibre channel host loop configurations	84
Redundant host and drive loops	85
Installing the storage subsystem configuration	88
Connecting the power cables.	88
Chapter 4. Operating the storage subsystem.	93
Performing the DS4000 Health Check process	94
Web pages	95
Hardware responsibilities	95
Removing and replacing the front bezel	96
Turning the storage subsystem on and off	96
Turning on the storage subsystem	97
Turning off the storage subsystem	100
Restoring power after an unexpected shutdown	102
Performing an emergency shutdown	103
Restoring power after an emergency shutdown	103
Responding to the audible alarm	105
Installing the DS4000 Storage Manager client	106

Firmware requirements	106
Monitoring status through software	107
Firmware updates	109
Troubleshooting the storage subsystem	109
Checking the LEDs	111
Front bezel LEDs.	111
RAID controller LEDs	113
Numeric display LEDs	116
Power supply-fan LEDs	118
Interconnect-battery unit LEDs.	119
Recovering from an overheated power supply-fan	122
Resetting the controller circuit breakers	124
Cache memory and cache battery	129
Cache memory	129
Subsystem cache battery	130
Chapter 5. Replacing components	133
Handling static-sensitive devices	133
Service Action Allowed Status LED	134
Single component failures	134
Multiple component failures	135
Releasing a component lever	136
Replacing a controller	137
Upgrading controllers	142
Replacing a power supply-fan	144
Replacing the interconnect-battery unit.	148
Replacing a backup battery pack	152
Replacing an SFP module	155
Installing SFPs and fiber-optic cables	158
Chapter 6. Hardware maintenance	159
General checkout	159
Using the diagnostic hardware.	159
Solving problems	159
Parts list	166
Appendix A. Additional DS4000 documentation	169
DS4000 Storage Manager Version 9 library	169
DS4800 Storage Subsystem library	170
DS4700 Storage Subsystem library	171
DS4500 Fibre Channel Storage Server library	172
DS4400 Fibre Channel Storage Server library	173
DS4300 Fibre Channel Storage Server library	174
DS4100 SATA Storage Server library	175
DS4000 Storage Expansion Enclosure documents	176
Other DS4000 and DS4000-related documents	177
Appendix B. Records	179
Identification numbers	179
Appendix C. Rack mounting templates.	181
Appendix D. Power cords	185
Appendix E. Accessibility	187

Notices	189
Trademarks.	189
Important notes	190
Product recycling and disposal	191
Battery return program	191
Electronic emission notices	192
Federal Communications Commission (FCC) statement	192
Chinese class A compliance statement.	192
Industry Canada Class A emission compliance statement.	193
Australia and New Zealand Class A statement	193
European Union EMC Directive conformance statement	193
Taiwanese Class A warning statement	193
Japanese Voluntary Control Council for Interference (VCCI) statement	194
 Glossary	 195
 Index	 205

Figures

1. DS4800 Storage Subsystem	8
2. Location of components in the storage subsystem	9
3. Controllers in the storage subsystem	11
4. Controller connections	12
5. DS4800 configuration with 2-Gbps and 4-Gbps enclosures in different drive channel pairs	13
6. Power supply-fan.	16
7. Interconnect-battery unit	17
8. SFP module with fiber-optic cable	18
9. DS4800 Storage Subsystem dimensions	19
10. DS4800 Storage Subsystem airflow	22
11. Example of cold aisle/hot aisle rack cabinet configuration	29
12. DS4800 front rack mounting template	33
13. DS4800 rear rack mounting template	34
14. DS4800 support rail assembly	35
15. DS4800 Storage Subsystem front views and back view	37
16. Component lever and latch	38
17. Removing the power supply-fans	40
18. Removing the interconnect-battery unit.	40
19. Removing the controllers	41
20. Securing the DS4800 to the rack cabinet	42
21. Replacing the power supply-fans	43
22. Replacing the interconnect-battery unit.	44
23. Replacing the controllers	44
24. Removing the front bezel.	45
25. Small Form-Factor Pluggable (SFP) module	49
26. Replacing an SFP module	50
27. Unlocking the SFP module latch - plastic variety	51
28. Unlocking the SFP module latch - wire variety	51
29. Removing caps from fiber-optic cables	52
30. Connecting fiber-optic cable to SFP	52
31. LC-LC fibre-channel cable	53
32. Removing fiber-optic cable protective caps	54
33. Inserting an LC-LC fibre-channel cable into an SFP module	54
34. LC-LC fibre-channel cable lever and latches.	55
35. Removing the LC-LC fibre-channel cable	55
36. LC-SC fibre-channel cable adapter	56
37. Removing the LC-SC cable adapter protective caps	57
38. Connecting an LC-LC cable into the LC-SC cable adapter	57
39. LC-LC fibre-channel cable lever and latches.	58
40. Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter	58
41. Example 1 of redundant drive channel pairs	61
42. Example 2 of redundant drive channel pairs	62
43. EXP710/EXP100 port labels.	63
44. Connecting EXP710 or EXP100 enclosures to DS4800.	64
45. EXP810 port labels	65
46. Connecting EXP810 enclosures to DS4800	66
47. DS4800 Storage Subsystem ports and controllers.	70
48. One DS4800 and one storage expansion enclosure — Recommended cabling	71
49. View 1: One DS4800 and two storage expansion enclosures cabling — Recommended.	71
50. View 2: One DS4800 and two storage expansion enclosures cabling — Not recommended	72
51. One DS4800 and four storage expansion enclosures — Recommended cabling	73
52. One DS4800 and eight storage expansion enclosures — Recommended cabling	74
53. One DS4800 and fourteen EXP810 storage expansion enclosures — Recommended cabling	75

54. One DS4800 and sixteen EXP710 storage expansion enclosures — Recommended cabling	75
55. One DS4800 to seven EXP810 and eight EXP710 storage expansion enclosures — Recommended cabling	76
56. Installing an SFP module and LC-LC cable in a DS4800	77
57. Installing an SFP module and connecting an LC-LC cable to the storage expansion enclosures	77
58. Location of host cables on RAID controllers	80
59. Cabling diagram for four redundant host connections	80
60. Ethernet and serial port locations	81
61. Host-agent (in-band) managed storage subsystems	83
62. Direct (out-of-band) managed storage subsystems	84
63. Examples of redundant host direct attached fibre channel configurations	86
64. Example of a single SAN fabric configuration	87
65. Example of two storage subsystems in a dual SAN environment	87
66. Example of a two-cluster configuration	88
67. AC power switch and AC and DC power connectors	89
68. Redundant AC power connections to controllers and storage expansion enclosures	91
69. Installing the front bezel	96
70. AC power switches on the controllers	98
71. Front bezel LEDs	111
72. RAID controller LEDs	113
73. Numeric display LEDs	117
74. Power supply-fan LEDs	118
75. Interconnect-battery unit LEDs	120
76. Power supply-fan Needs Attention LEDs	125
77. RAID controller connections	126
78. Removing the controller from the storage subsystem	127
79. Circuit breaker access holes	127
80. Cache Active LEDs	130
81. Battery LEDs	131
82. Component lever and latch	136
83. RAID controller Needs Attention and Service Action Allowed LEDs	138
84. Connectors on the back of each controller	139
85. Unlocking the SFP module latch - plastic variety	139
86. Unlocking the SFP module latch - wire variety	140
87. Removing a controller from the DS4800	140
88. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel	145
89. Power supply-fan LEDs	146
90. Removing a power supply-fan from the DS4800	147
91. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel	149
92. Interconnect-battery unit Needs Attention and Service Action Allowed LEDs	150
93. Removing an interconnect-battery unit from the DS4800	151
94. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel	153
95. Battery access cover on the interconnect-battery unit	153
96. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel	156
97. Needs Attention and SFP Model Bypass LEDs	156
98. Replacing an SFP module	157
99. DS4800 parts list	167
100. Location of MAC address labels	179
101. DS4800 front rack mounting template	182
102. DS4800 rear rack mounting template	183

Tables

1. Mapping of FASTT names to DS4000 Series names.	xvii
2. Features at a glance	3
3. Maximum number of storage expansion enclosures	9
4. Supported EXP810 and EXP710 enclosure combinations per redundant drive channel pair	10
5. RAID controller specifications	15
6. DS4800 Storage Subsystem weights	19
7. DS4800 Storage Subsystem component weights	20
8. DS4800 Storage Subsystem shipping carton dimensions	20
9. Temperature and humidity requirements	20
10. DS4800 Storage Subsystem altitude ranges	21
11. DS4800 Storage Subsystem power and heat dissipation	22
12. DS4800 Storage Subsystem sound levels	22
13. IBM System Storage DS4800 AC power requirements	23
14. Different ways to connect four storage expansion enclosures to the DS4800	69
15. DS4800 Storage Subsystem drive ports and drive channels	70
16. Recommended enclosure ID settings scheme	78
17. Firmware requirements	106
18. Front bezel LEDs	111
19. RAID controller LEDs	113
20. Host and drive channel LED definitions	116
21. Numeric display diagnostic codes	118
22. Power supply-fan LEDs	119
23. Interconnect-battery unit LEDs	120
24. DS4800 Symptom-to-FRU index.	160
25. Parts list (System Storage DS4800 Storage Subsystem)	167
26. DS4000 Storage Manager Version 9.1 titles by user tasks	169
27. DS4800 Storage Subsystem document titles by user tasks	170
28. DS4700 Storage Subsystem document titles by user tasks	171
29. DS4500 Fibre Channel Storage Server document titles by user tasks	172
30. DS4400 Fibre Channel Storage Server document titles by user tasks	173
31. DS4300 Fibre Channel Storage Server document titles by user tasks	174
32. DS4100 SATA Storage Server document titles by user tasks	175
33. DS4000 Storage Expansion Enclosure document titles by user tasks	176
34. DS4000 and DS4000–related document titles by user tasks	177
35. DS4000 Storage Manager alternate keyboard operations	187

About this document

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

FAST product renaming

IBM has renamed some FAST family products. Table 1 identifies each DS4000 product name with its corresponding previous FAST product name. Note that this change of **product name only** indicates no change in functionality or warranty. All products listed below with new names are functionally-equivalent and fully-interoperable. Each DS4000 product retains full IBM service as outlined in service contracts issued for analogous FAST products.

Table 1. Mapping of FAST names to DS4000 Series names

Previous FAST Product Name	Current DS4000 Product Name
IBM TotalStorage FAST Storage Server	IBM TotalStorage DS4000
FAST	DS4000
FAST Family	DS4000 Mid-range Disk System
FAST Storage Manager vX.Y (for example v9.10)	DS4000 Storage Manager vX.Y (for example v9.10)
FAST100	DS4100
FAST600	DS4300
FAST600 with Turbo Feature	DS4300 Turbo
FAST700	DS4400
FAST900	DS4500
EXP700	DS4000 EXP700
EXP710	DS4000 EXP710
EXP100	DS4000 EXP100
FAST FlashCopy	FlashCopy for DS4000
FAST VolumeCopy	VolumeCopy for DS4000
FAST Remote Mirror (RM)	Enhanced Remote Mirroring for DS4000
FAST Synchronous Mirroring	Metro Mirroring for DS4000
	Global Copy for DS4000 (New Feature = Asynchronous Mirroring without Consistency Group)
	Global Mirroring for DS4000 (New Feature = Asynchronous Mirroring with Consistency Group)

Who should read this document

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

How this document is organized

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

Chapter 2, “Installing the storage subsystem,” on page 25 contains instructions for installing the DS4800 Storage Subsystem in a standard rack cabinet and setting the interface options.

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

Chapter 4, “Operating the storage subsystem,” on page 93 contains instructions for powering the DS4800 Storage Subsystem on or off during either normal or emergency situations. It also contains information on how to check the LEDs on the front and back of the storage subsystem.

Chapter 5, “Replacing components,” on page 133 contains step-by-step instructions for how to install or remove customer replaceable units (CRUs), such as power-supply fans, RAID controllers, and interconnect-battery units.

Chapter 6, “Hardware maintenance,” on page 159 contains problems, symptoms, and error messages that are specific to the DS4800 Storage Subsystem. It also contains the parts listing for the DS4800 Storage Subsystem.

Appendix A, “Additional DS4000 documentation,” on page 169 provides references to other DS4000 publications.

Appendix B, “Records,” on page 179 provides a table that you can use to record and update important information about your DS4800, including serial number, model and machine type, and MAC addresses.

Appendix C, “Rack mounting templates,” on page 181 provides the rack mounting templates for installation of the DS4800. If you want to tear out the templates from the document for use during installation, use these copies of the templates.

Appendix D, “Power cords,” on page 185 lists power cord information for the DS4800.

Appendix E, “Accessibility,” on page 187 provides information about DS4000 Storage Manager accessibility features.

Notices and statements used in this document

The caution and danger statements used in this document also appear in the multilingual *Safety Information* document provided with your IBM DS4800. Each caution and danger statement is numbered for easy reference to the corresponding statements in the safety document.

The following types of notices and statements are used in this document:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.

- **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.
- **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.
- **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.

Chapter 1. Introduction

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

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

Overview

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

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

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

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

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

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

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

The DS4000 Storage Manager client is also available for the DS4800. This storage management software is designed to help centralize storage management, help simplify partitioning of the DS4000 series storage into as many as 64 virtual servers, and strategically allocate storage capacity to maximize storage space.

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

the DS4800 either ships with the 8-storage-partition premium feature or can be ordered with 8-, 16-, or 64-storage-partition premium features. The operating system host kit shipped with the DS4800 also depends on the model ordered. DS4800 models 80H, 82H, 84H, and 88H come with the Windows operating system and 8 storage partitions. Please contact your IBM sales representatives or reseller for information on the various DS4800 models and options.

Attention: DS4800 models 82, 84 and 88 will be shipped with controller firmware version 6.15.xx.xx. The DS4800 model 80 will be shipped with version 6.16.xx.xx and will not have support for versions 6.15.xx.xx or 6.14.xx.xx as will the other models.

Fibre channel defined

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

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

SATA defined

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

The Serial ATA Working Group introduced the first SATA specification, Serial ATA 1.0, in 2001 (<http://www.serialata.org>).

Features at a glance

Table 2 on page 3 summarizes the features of the storage subsystem. For a list of the operating specifications, such as weight, height, and heat output, see “Specifications” on page 19.

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

Table 2. Features at a glance

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

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

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

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

Inventory checklist

After you unpack the DS4800, verify that you have the following items. See “Storage server components” on page 7 for the locations of hardware components on the DS4800.

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

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

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

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

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

Attention: The DS4800 does not ship with region-specific power cords. You must obtain the IBM-approved power cords for your region. See Appendix D, “Power cords,” on page 185 for the IBM-approved power cords for your region.

- **Software and documentation**

- Host software attachment kit

Depending on the DS4800 model you order, your DS4800 will ship with either the Microsoft® Windows® host software attachment kit or with your choice of host software kits (Windows, AIX®, Linux®, Netware, SUN Solaris, HP-UX, Linux on POWER™, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4800. The kit includes a *DS4000 Storage Manager Version 9.16 Support* CD that has the appropriate IBM DS4000 Storage Manager host software. The CD also contains includes firmware, online help, and publications in Adobe Acrobat Portable Document Format (PDF). (For a list of available IBM DS4000 publications, see Appendix A, “Additional DS4000 documentation,” on page 169.)

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

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

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

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

If you have not already done so, record your storage subsystem serial number, machine type and model number, and RAID controller MAC addresses in Appendix B, “Records,” on page 179. The serial number, machine type, and model

number are located on top of the DS4800 subsystem. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 100 on page 179. You may not be able to easily access this information after you install the DS4800.

Rack mounting templates for installing the support rails are provided in this document in Appendix C, "Rack mounting templates," on page 181.

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

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

Note: You might need to order these options separately.

Product updates

Important

In order 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 server 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 Svrs**

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**
 - d. Any other topics that you may be interested in

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 DS4800 right and left RAID controller units into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4800 should be plugged into the same two independent external power circuits as the DS4800. This ensures that the DS4800 and all its attached storage expansion enclosures will have power in the event that only one power circuit is available. In addition, having all the right or all the left power cables plug into the same power circuit enables the DS4000 devices in the configuration to power on simultaneously during an unattended restoration of power. See Figure 68 on page 91 for an example of redundant power connections.

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

- Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), 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 on the storage subsystem" on page 97. Check that each component of the subsystem is powered-on in the proper order during this entire power-up procedure to ensure the controller will be able to optimally access all of your storage subsystems.

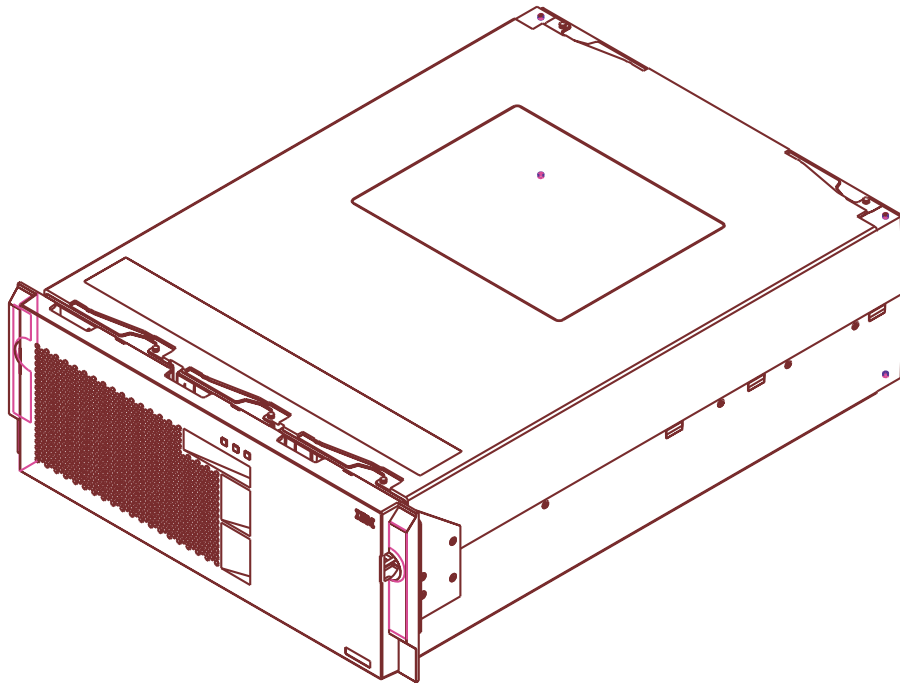
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in “Turning on the storage subsystem” on page 97 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and arrays are not displayed in the DS4000 Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and arrays do not come online.
 - The storage subsystem logical drives and arrays seem to be degraded.

Storage server components

The DS4800 directs and manages the I/O activity between a host and the drives in a RAID array. The storage subsystem has eight single-ported host channels (4 per controller) and can support up to 256 hosts with two FC connections to the DS4800 (one to controller A and one to controller B for redundancy). The storage subsystem has four dual-ported drive channels and can support up to 224 Fibre Channel or SATA drives with a maximum of 2048 addressable logical drives.

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

The DS4800 has Intel® Pentium® processors and RAID controllers with either 2, 4 or 8 GB of cache random access memory (RAM) (depending on the DS4800 model). Its host-side and drive-side fibre channel port can support fibre channel speeds of up to 4 Gb/s. Figure 1 on page 8 shows the DS4800 with front bezel in place.



ds4800p

Figure 1. DS4800 Storage Subsystem

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

- RAID controllers (two)
- Power supply-fans (two)
- Interconnect-battery unit (one)

The power supply-fans and interconnect-battery unit are located behind the front bezel. The controllers are located in the rear of the storage subsystem. All components are secured in the storage subsystem by quick release latches, enabling each component to be removed by disengaging the latch and sliding the component from the storage subsystem chassis. Figure 2 on page 9 shows the positions of the components in the DS4800.

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

Attention

Refer to the component replacement sections in Chapter 5, “Replacing components,” on page 133, or refer to the DS4000 Storage Manager Recovery Guru, for instructions and prerequisites before performing any CRU replacements. Failure to meet prerequisites or follow replacement instructions might result in a loss of data access.

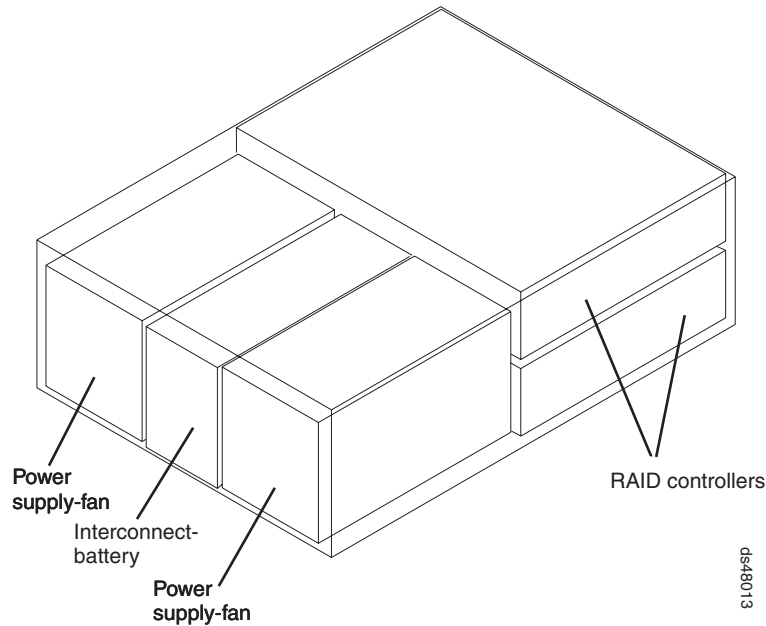


Figure 2. Location of components in the storage subsystem

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

- EXP100
- EXP710
- EXP810

The DS4800 storage subsystem models 80A/H support only the following DS4000 storage expansion enclosures:

- EXP710
- EXP810

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

Table 3. Maximum number of storage expansion enclosures

Enclosure type	Maximum number of enclosures in a redundant DS4800 drive channel pair	Maximum number of enclosures in a DS4800 subsystem
EXP100	8	16
EXP710	8	16
EXP710 and EXP100	8	16
EXP810	7	14

Table 3. Maximum number of storage expansion enclosures (continued)

Enclosure type	Maximum number of enclosures in a redundant DS4800 drive channel pair	Maximum number of enclosures in a DS4800 subsystem
EXP710 and EXP810	7 ¹	14 (or 15) ²
<p>¹ The intermix of EXP100 and EXP810 storage expansion enclosures behind a DS4800 subsystem is not currently supported. Please contact IBM reseller and representatives for such support in the future.</p> <p>² The value 15 assumed that one of the redundant DS4800 drive channel pairs must have only EXP710 enclosures attached.</p>		

Notes:

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

Intermixing the EXP810 and EXP710 in the same drive channel

You can intermix the EXP810 and EXP710 in the same drive channel, but the Link Rate switch for all storage expansion enclosures in the intermixed drive channel 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 4 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 4 assumes that a DS4000 storage subsystem is generally capable of addressing the maximum of 112 fibre channel hard drives for each redundant drive channel pair.

Table 4. Supported EXP810 and EXP710 enclosure combinations per redundant drive channel 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 channel
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

Controllers

The DS4800 has two RAID controllers. Both controllers are identical and interchangeable. The controllers install from the rear of the storage subsystem. The

upper controller is controller A; the lower controller is controller B. All connections to the hosts and the drives in the storage configuration are through the controllers. Figure 3 shows the controllers in the DS4800.

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

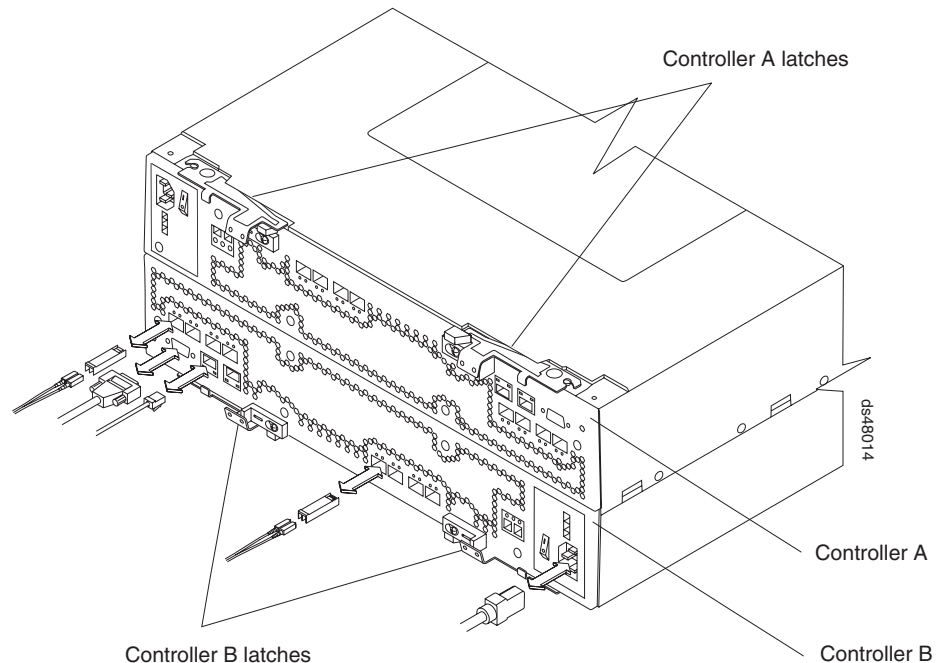


Figure 3. Controllers in the storage subsystem

Information about the condition of the controllers is conveyed by indicator LEDs on the back of each controller. (“RAID controller LEDs” on page 113 identifies the indicator LEDs on the RAID controller and explains the conditions that each LED indicates.)

Controller cable connections

Each controller provides the following connections:

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

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

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

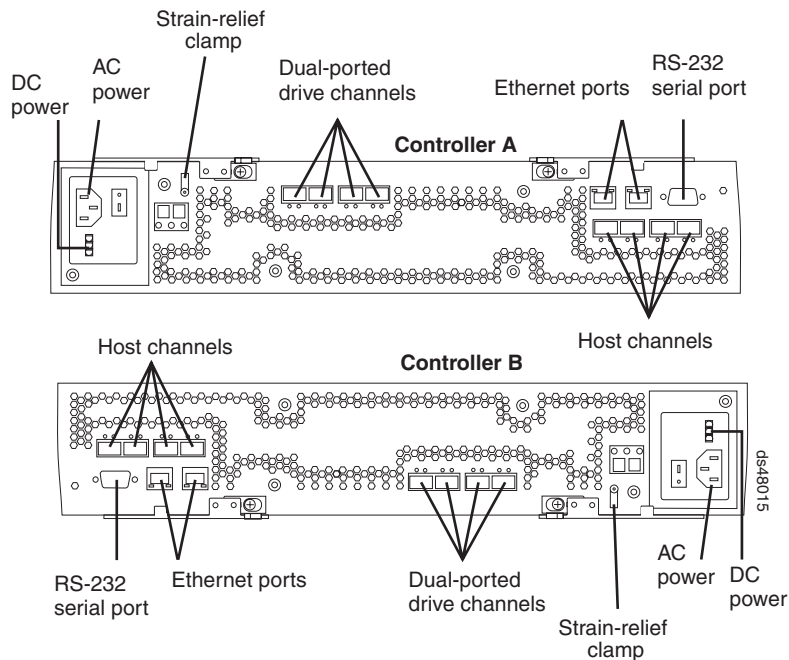


Figure 4. Controller connections

Dual-ported drive channels

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

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

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

Two drive channels (one from each controller) are used to form a redundant drive channel pair. Each drive channel pair supports up to a maximum of 112 drives in seven or eight IBM DS4000 storage expansion enclosures, depending on the enclosure types. (See Table 3 on page 9 for more information.)

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

However, if the 2 Gbps and the 4 Gbps DS4000 storage expansion enclosures are separated into different redundant drive channel pairs, the DS4800 (1) will support both 2 Gbps and the 4 Gbps DS4000 storage expansion enclosures at their own fibre channel speed (either 2 Gbps or 4 Gbps). For example, as shown in Figure 5 on page 13, the redundant drive

channel with EXP810s (**4**) operates at 4 Gbps, while at the same time the other redundant drive channel with EXP710s (**5**) operates at 2 Gbps. This is possible because all 4 Gbps EXP810s (**2**) are connected behind a given redundant drive channel pair, and all 2 Gbps EXP710s (**3**) are connected to a different redundant drive channel pair.



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

Host channels

Each DS4800 controller has four single-ported host Fibre Channel ports. The controllers perform link speed negotiation on each host channel Fibre Channel port (also referred to as auto-negotiation). Each host channel can operate at either 1, 2, or 4 Gbps fibre channel speeds. The controllers interact with the fibre channel host bus adapter ports in the host server or the fibre channel switch to determine the fastest compatible speed between the controllers and the host or switch. The fastest compatible speed becomes the operating speed of the link. If the host or switch on the other end of the link are either fixed-speed or not capable of negotiating, the controllers automatically detect the operating speed of the other host or switch and set the controller link speed accordingly. Link speed negotiation for a given host channel is limited to link speeds supported by the small form-factor pluggable (SFP) module on that channel.

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

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

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

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

Ethernet ports

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

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

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

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

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

RS-232 serial port

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

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

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

Controller memory

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

Table 5 lists the technical specifications for the RAID controllers.

Table 5. RAID controller specifications

Category	Criteria	Specification
Memory	Cache size	2 GB, 4 GB or 8 GB, depending on the model
Interface	Fibre Channel Host port	4 fiber-optic ports per controller 2 Ethernet ports per controller (for out-of-band management)
	Fibre Channel Drive expansion port	4 fiber-optic ports per controller Note: Each DS4800 controller drive channel has two ports. There are two drive channels per DS4800 controller.
Storage Expansion Enclosure Support	Redundant drive channel pairs	2 per controller
	Maximum number of drives per redundant drive channel pair	112 drives per redundant drive channel pair (either 8 storage expansion enclosures with 14 drives each or 7 storage expansion enclosures with 16 drives each). See Table 3 on page 9.
	Maximum number of drives supported by one DS4800	224 drives (2 redundant drive channel pairs with 112 drives in each drive channel pair)
Data transfer rates	Fibre Channel host	Up to 4 Gb/sec maximum. Support 1, 2 and 4 Gbps FC speeds.
	Fibre Channel drives	Up to 4 Gb/sec maximum (depends on storage expansion enclosure speed). Support 2 and 4 Gbps drives only. Does not support 1Gbps drives.
	Ethernet	10BASE-T 100BASE-T

Power supply-fans

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

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

Install the power supply-fans from the front of the storage subsystem. Figure 6 shows how a power supply-fan slides into the storage subsystem. The levers that secure the left power supply-fan into the storage subsystem are shown in the released position. The levers that secure the right power supply-fan into the storage subsystem are shown in the latched position.

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

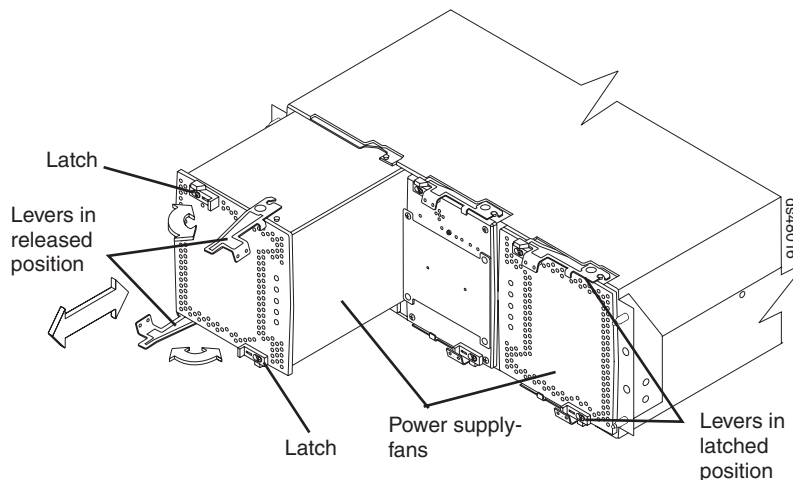


Figure 6. Power supply-fan

Information about the condition of the power supplies, fans, and battery charger is conveyed by indicator lights (LEDs) on the front of each of the power supply-fan units and on the interconnect-battery unit. You must remove the front bezel to see the LEDs. (“Power supply-fan LEDs” on page 118 identifies the indicator LEDs on a power supply-fan and explains the conditions that each LED indicates.)

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

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

Interconnect-battery unit

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

Attention: Because the interconnect-battery unit provides electrical signal connections between the controllers, removing the interconnect-battery unit interrupts the communications between the controller units in the DS4800, resulting in a loss of communication between controllers A and B. Data access is limited to only controller A when the interconnect-battery unit is removed. Controller B is in an off-line state while controller A performs all controller operations. *To prevent any problems as a result of this condition, controller B must be placed off-line before you remove the interconnect-battery unit.* See “Replacing the interconnect-battery unit” on page 148 for more information. Failure to observe the instructions and prerequisites described in “Replacing the interconnect-battery unit” on page 148 might result in a loss of data access.

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

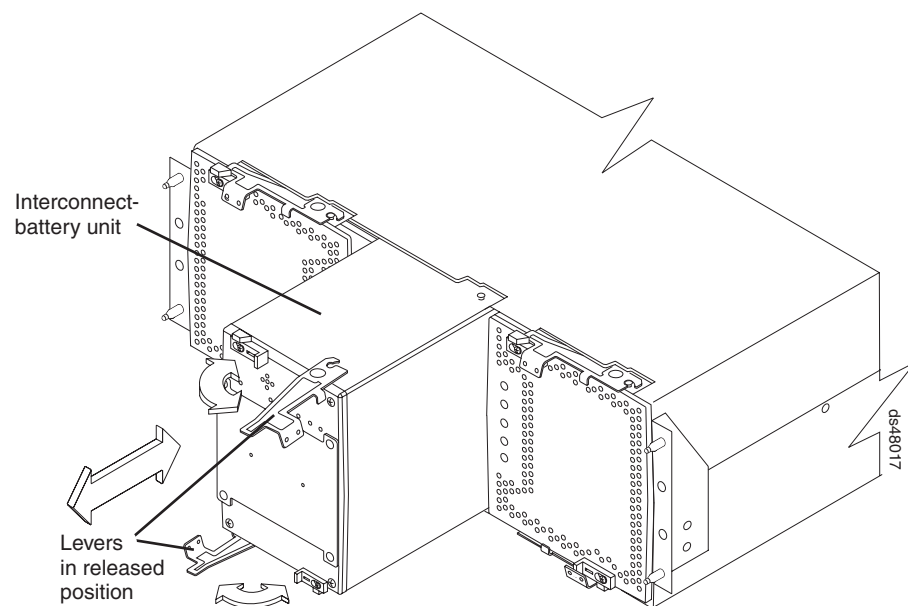


Figure 7. Interconnect-battery unit

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

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

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

Attention

Never remove the interconnect-battery unit unless directed to do so by an IBM support representative. Removing the interconnect-battery unit after a controller or a power supply-fan has already been removed results in a loss of data access. Refer to “Replacing the interconnect-battery unit” on page 148 for complete information about the conditions required for safe removal of the interconnect-battery unit. Do not replace the interconnect-battery unit without first meeting the requirements described in “Replacing the interconnect-battery unit” on page 148.

Information about the condition of the interconnect-battery unit is conveyed by indicator LEDs on the front of interconnect-battery unit. (“Interconnect-battery unit LEDs” on page 119 identifies the indicator LEDs on the interconnect-battery unit and explains the conditions that each LED indicates.)

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

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

Note: The displayed order of the Overall DS4800 Configuration Needs Attention and Locate/Identify LEDs on the interconnect-battery unit are reversed when the bezel is removed. See “Front bezel LEDs” on page 111 and “Interconnect-battery unit LEDs” on page 119.

SFP Modules

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

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

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

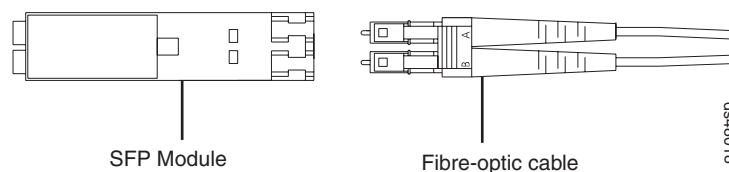


Figure 8. SFP module with fiber-optic cable

Specifications

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

Area requirements

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

Dimensions

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

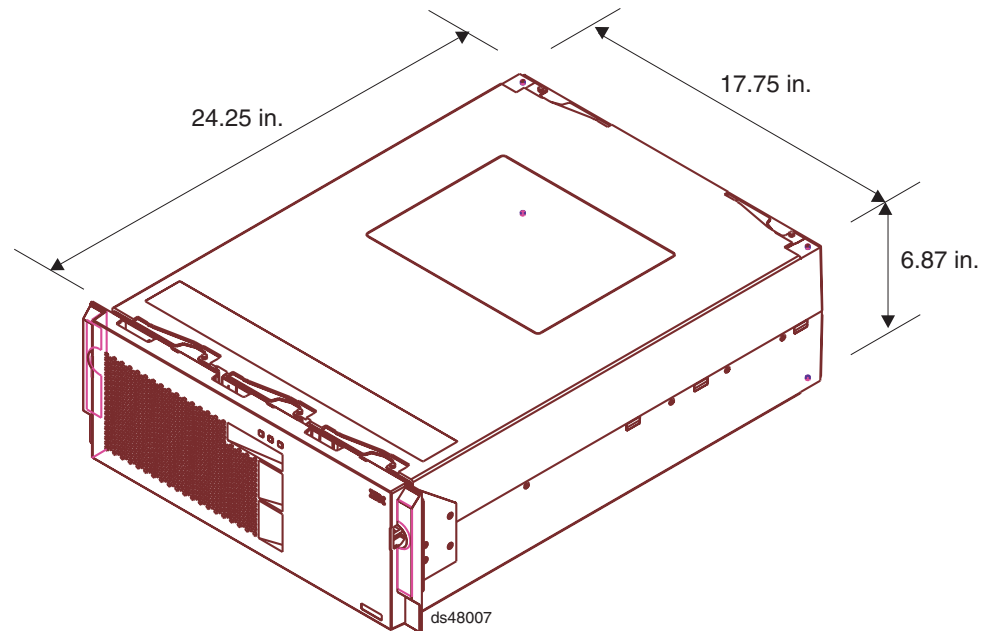


Figure 9. DS4800 Storage Subsystem dimensions

Weight

The total weight of the storage subsystem depends on the number of components installed. Table 6 lists the maximum, empty, and shipping weights for the storage subsystem in different configurations. Table 7 on page 20 lists the weight of each component.

Table 6. DS4800 Storage Subsystem weights

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

Table 6. DS4800 Storage Subsystem weights (continued)

Unit	Weight		
	Maximum ¹	Empty ²	Shipping ³

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

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

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

Table 7. DS4800 Storage Subsystem component weights

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

Shipping dimensions

Table 8 lists shipping carton dimensions. The height shown includes the height of the pallet.

Table 8. DS4800 Storage Subsystem shipping carton dimensions

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

Environmental requirements and specifications

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

Temperature and humidity

Table 9 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 9. Temperature and humidity requirements

Condition	Parameter	Requirement
Temperature ¹	Operating range	10° - 35° C (50° - 95° F)
	Maximum rate of change	10° C (18° F) per hour
	Storage range	1° - 60° C (33° - 140° F)
	Maximum rate of change	15° C (27° F) per hour
	Transit range	-40° C to 65° C (-40° F to 149° F)
	Maximum rate of change	20° C (36° F) per hour

Table 9. Temperature and humidity requirements (continued)

Condition	Parameter	Requirement
Relative humidity (no condensation)	Operating range	20% to 80%
	Storage range	10% to 93%
	Transit range	5% to 95%
	Maximum dew point	26° C (79° F)
	Maximum gradient	10% per hour

Notes:

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

Altitude

Table 10 lists the acceptable altitudes for operating, storing, and shipping the DS4800 Storage Subsystem.

Table 10. DS4800 Storage Subsystem altitude ranges

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

Airflow and Heat Dissipation

Figure 10 on page 22 shows the intended airflow for an DS4800 Storage Subsystem. Allow at least 30 inches in front of the storage subsystem and at least 24 inches behind the storage subsystem for service clearance, proper ventilation, and heat dissipation.

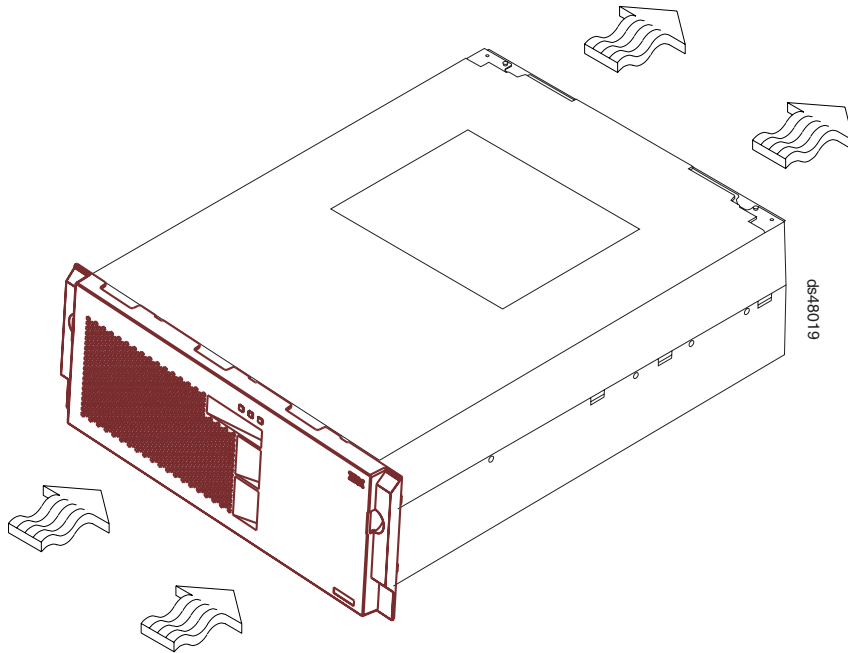


Figure 10. DS4800 Storage Subsystem airflow

Table 11 lists the KVA, watts, and Btu calculations for the DS4800 Storage Subsystem. These values assume the power supplies have a 73 percent efficiency and a power factor of 0.99. These tabulated power and heat dissipation values are typical for the storage subsystem. Maximum configuration units are typically operated at higher data rates, have larger random access memory (RAM) capacities, or have different host interface boards.

Table 11. DS4800 Storage Subsystem power and heat dissipation

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

Acoustic Noise

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

Table 12. DS4800 Storage Subsystem sound levels

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

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

Electrical requirements

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

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

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

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

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

Table 13. IBM System Storage DS4800 AC power requirements

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

^a. Typical voltage: 120 V AC, 60 Hz, assumes 75% power-supply efficiency and 0.99 power factor

^b. Typical voltage: 240 V AC, 60 Hz, assumes 75% power-supply efficiency and 0.99 power factor

Site wiring and power

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

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

AC power recovery

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

Power cords and receptacles

The DS4800 ships with the line jumper cords used to connect the DS4800 to rack power distribution units (PDUs). If you need the AC power cords to connect the DS4800 to wall receptacle outlets, you must purchase the appropriate power cords for your country or region as described in Appendix D, "Power cords," on page 185.

Chapter 2. Installing the storage subsystem

This chapter provides the information that you need to install the DS4800 into a rack cabinet.




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

Chapter 2, “Installing the storage subsystem” provides an overview of the entire DS4800 installation process. Read this overview before you begin the installation.

Installation overview

Statement 4:



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

CAUTION:

Use safe practices when lifting.

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

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

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

6. Record the serial number, machine type and model number, and RAID controller MAC addresses for your DS4800 Storage Subsystem in Appendix B, “Records,” on page 179.

The serial number, machine type, and model number are located on top of each the DS4800 subsystem unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 100 on page 179. You may not be able to easily access this information after you install the DS4800.

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

Attention

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

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

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

10. Use SFP modules and fibre channel cables to cable the DS4800 to the DS4000 storage expansion enclosure or enclosures. See “Connecting storage expansion enclosures to the DS4800” on page 59.
11. Set the enclosure IDs for all EXP100 and EXP710 storage expansion enclosures in the configuration to unique values. The EXP810 drive expansion enclosures automatically adjust the enclosure IDs to ensure unique enclosure IDs among themselves. See “Storage expansion enclosure settings” on page 77.
12. Perform one of the following cabling tasks to enable management of the DS4800 configuration:
 - If you are using out-of-band management, cable the DS4800 Ethernet ports to either the management workstation or the host. See “Connecting secondary interface cables” on page 81.
 - If you are using in-band management, cable the DS4800 host channels to the fibre channel host bus adapters (HBAs) in either the hosts or the fibre channel switch that connects to the host HBAs. See “Connecting hosts to the DS4800” on page 79.

13. Connect the power cables for the DS4800. See “Connecting the power cables” on page 88.
14. Power on the attached storage expansion enclosures and the DS4800 Storage Subsystem using the procedure described in “Turning on the storage subsystem” on page 97.
15. Install the DS4000 Storage Manager 9.16 host software on the management workstation (for out-of-band management) or on the host (for in-band management). Refer to the *IBM System Storage DS4000 Storage Manager 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.
16. If the EXP810 is the type of attached DS4000 storage expansion enclosure, you will need to upgrade the controller firmware to version 06.16.xx.xx to enable the attachment of the EXP810 storage expansion enclosures if your controller firmware version is 6.15.xx.xx and earlier.

Note: You must first upgrade the controller firmware using the controller firmware version 6.16.xx.xx files in the IBM Documentation Controller Firmware and Storage Server DS4000 Version 6.16 Support for DS4000 EXP810 Fibre Channel Storage Expansion Enclosure, which is shipped with each of the EXP810 enclosures, before upgrading the controller with a newer version of 6.16.xx.xx firmware that is posted in the IBM DS4000 support Web site.

Attention: This version of controller firmware does not support the attachment of EXP100 enclosures. Do not load the controller firmware version 6.16.xx.xx to DS4800 controllers that have EXP100 expansion enclosures attached.

17. Use the DS4000 Storage Manager 9.16 host software to verify the configuration.
18. Review and perform the procedures described in “Performing the DS4000 Health Check process” on page 94.

Handling static-sensitive devices

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

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

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

on a metal table. Take additional care when handling devices during cold weather because heating reduces indoor humidity and increases static electricity.

Heat output, airflow, and cooling

The maximum heat output of the DS4800 is 235 watts (803.7 BTU/hr). Each DS4800 rack-mounted unit requires an airflow of 2.5 m³ (87 ft.³) per minute. The input air temperature to all rack cabinets should be in the range 10° C - 35° C (50° F - 95° F). The recommended operating temperature is 22° C (72° F).

When rack cabinets that contain many DS4800s are to be installed together, the following requirements must be met to ensure that the DS4800s are adequately cooled:

- Air enters at the front of the rack cabinet and leaves at the back. To prevent the air that is leaving the rack cabinet from entering the intake of another piece of equipment, you must position the rack cabinets in alternate rows, back-to-back and front-to-front. This arrangement is known as “cold aisle/hot aisle” and is shown in Figure 11 on page 29.
- Where rack cabinets are in rows, each rack cabinet must touch the rack cabinet that is next to it. This reduces the amount of hot air that can flow around from the back of the rack into the intakes of the storage subsystems that are in that rack cabinet. You should use Suite Attach Kits to completely seal any gaps that remain between the rack cabinets. For details about Suite Attach Kits, contact your marketing representative.
- Where rack cabinets are in rows front-to-front or back-to-back, a gap of at least 1220 mm (48 in.) must separate the rows across the cold aisle.
- To ensure correct airflow in each rack cabinet, the rack filler plates must be installed in unused positions. Also, all the gaps in the front of the rack cabinets must be sealed, including the gaps between the storage subsystems.

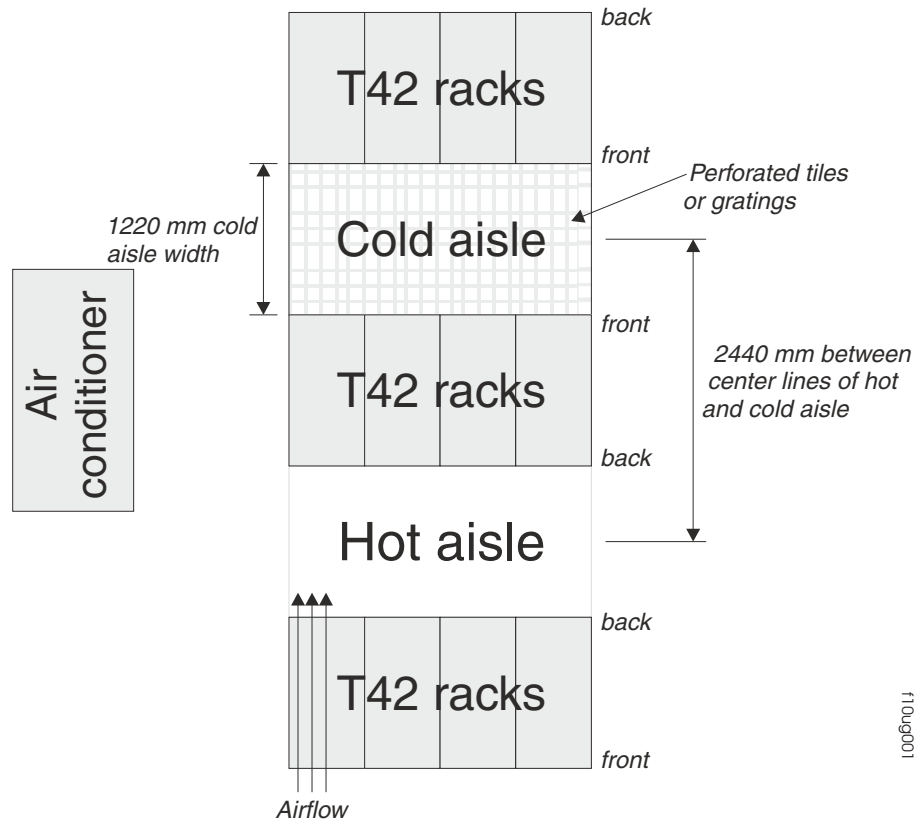


Figure 11. Example of cold aisle/hot aisle rack cabinet configuration

Preparing for installation

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




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

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Specifications” on page 19.
2. Move the shipping box that contains the DS4800 to the site.

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

Statement 4:



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

CAUTION:

Use safe practices when lifting.

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

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

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

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

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

The kit includes a *DS4000 Storage Manager Version 9.16 Support CD* that has the appropriate IBM DS4000 Storage Manager host software. If you order more than one host software kit, the additional kits may also be shipped in the DS4800 shipping box.

The CD also includes the DS4000 Storage Subsystem controller firmware 06.15. Controller firmware version 6.16.xx.xx files, which are required to enable the attachment of EXP810 enclosures, is in the DS4000 Storage Subsystem Controller Firmware and IBM documentation Version 6.16 Support for DS4000 EXP810 Fibre Channel Storage Expansion Enclosure that is shipped with each of the EXP810 enclosures. You must upgrade the controller to this version before upgrading the controller with a newer version

of 6.16.xx.xx firmware that is posted in the IBM DS4000 support Web site. For the latest controller firmware, check the IBM support Web site for DS4000 storage products:

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

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

5. Continue with “Preparing the site.”

Preparing the site

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

- Sufficient space to install the DS4800
- Enough stability to support the weight of the fully configured DS4800 and associated systems. A fully configured DS4800 weighs 36.52 kg (80.7 lb).

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

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

For information on interface cables and connections, see Chapter 3, “Cabling the storage subsystem,” on page 47.

Continue with “Preparing the rack cabinet.”

Preparing the rack cabinet

Important: Before you install the DS4800 in a rack cabinet, keep in mind the following considerations:

- Review the documentation that comes with your rack cabinet for safety and cabling considerations.
- Install the DS4800 in a recommended 22° C (72° F) environment.
- To ensure proper airflow, do not block the air vents; at least 15 cm (6 in.) of air space is required. Review the important information in “Heat output, airflow, and cooling” on page 28.
- To ensure rack stability, load the rack cabinet starting at the bottom.
- If you install multiple components in the rack cabinet, do not overload the power outlets.
- Always connect the storage subsystem to a properly grounded outlet.
- Always connect the IBM-certified rack power distribution units (PDUs) to at least two independent power circuits or sources.

Complete the following steps to prepare the rack cabinet before you install the DS4800:

1. Move, unpack, and level the rack cabinet 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 cabinet.
4. If necessary, turn off all storage expansion enclosure and rack cabinet power. Disconnect existing power, network, and other external cables.
5. Install any additional interface cables and power cables.

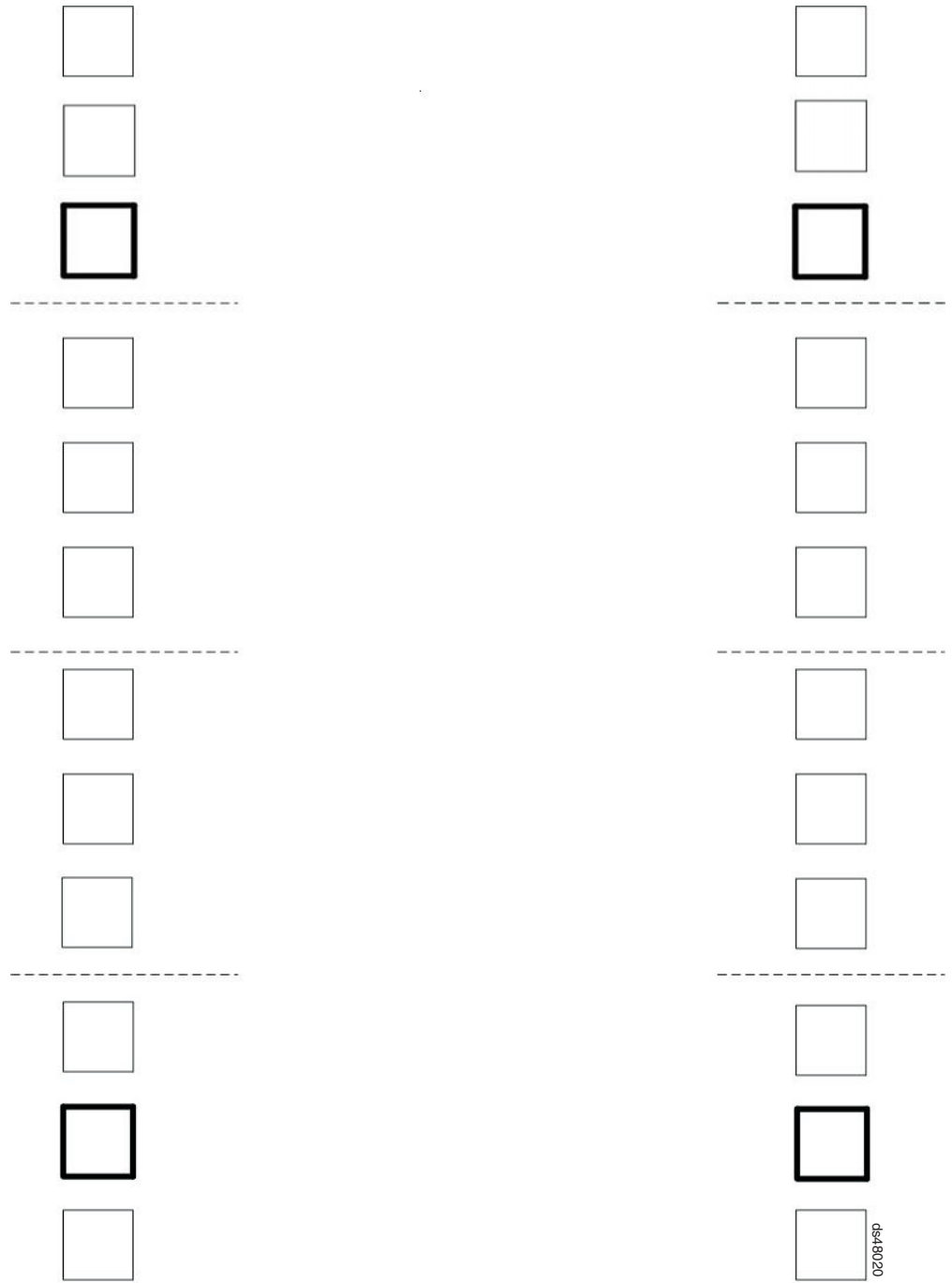
After you have completed these steps, continue with “Installing the support rails.”

Installing the support rails

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

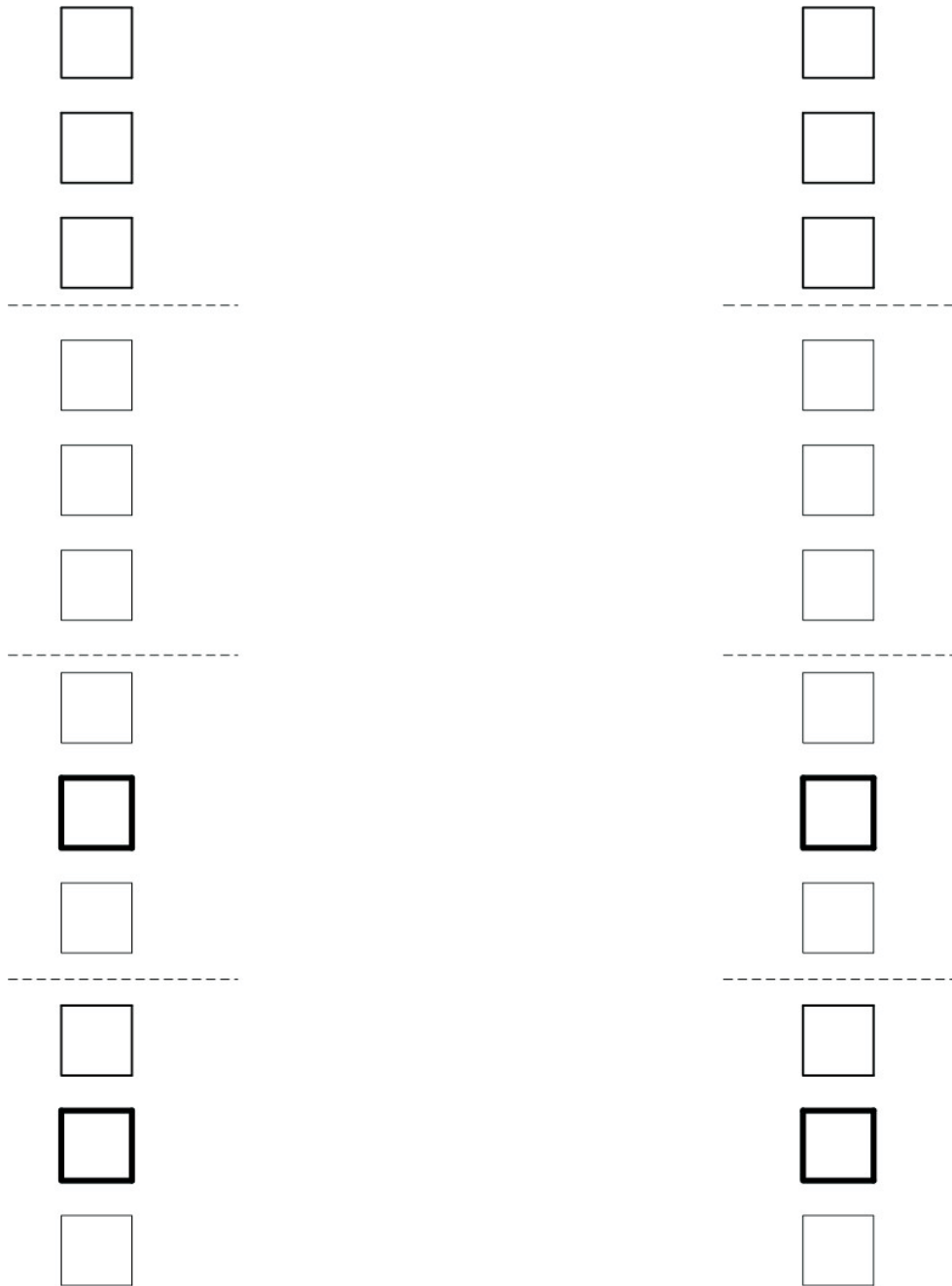
Hold the appropriate template up to each side of the rack cabinet at the 4-U section where you will install the DS4800. The highlighted squares on each side of the template mark the positions where you will thread the M5 screws that secure the rails and the DS4800 to the front and rear of the cabinet.

Note: If you want to tear out the templates from this document for easier use, use the copies provided in Appendix C, “Rack mounting templates,” on page 181.



Front

Figure 12. DS4800 front rack mounting template



Back

ds48021

Figure 13. DS4800 rear rack mounting template

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

Figure 14 shows the support rail assembly for the DS4800.

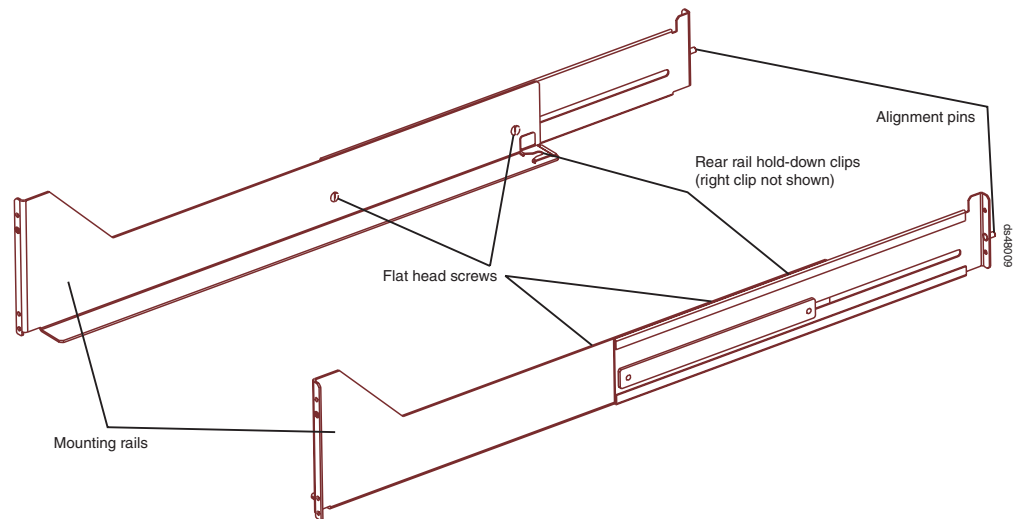


Figure 14. DS4800 support rail assembly

Complete the following steps to install the support rails:

Note: Refer to Figure 14 while performing these steps.

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

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

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

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

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

Attention: Use the rack mounting templates in this chapter or in Appendix C, “Rack mounting templates,” on page 181 to locate the proper rack mounting holes for installing the support rails into the rack cabinet.

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

- Plan the installation so that each DS4800 subsystem and its associated storage expansion enclosures are mounted together in the same rack, or in adjacent racks if necessary.

- When you install the DS4800 and associated storage expansion enclosures into a rack cabinet, install each device in the lowest available position and work upwards so that the rack does not become unstable.
- Note:** If you are installing more than one DS4800 Storage Subsystem, it is recommended that you install each DS4800 and its associated storage expansion enclosures in a separate rack cabinet.
- If appropriate, allow for possible later installation of other units.
 - If necessary, remove the rack power distribution units (PDUs) before you install the support rails.
 - For procedures and more information, refer to the installation and service guide, or equivalent, for the rack cabinet.
6. Starting with the left rail, use a medium flat-blade screwdriver to loosen the two flat-head rail adjustment screws. See Figure 14 on page 35.
 7. Hold the front of the left rail against the inside of the front rack-mounting flange, and then extend the rear of the support rail until it makes contact with the rear rack mounting flange. The alignment pins at the rear of the rail should slide into the holes at the rear of the rack.
 8. From the front of the rack, use the 5/16 (8 mm) hex nut driver to thread and loosely tighten the lower M5 screw only. Use the front rack mounting template in this chapter (or use the copy in Appendix C, “Rack mounting templates,” on page 181) to locate the proper rack mounting hole for installing this screw.

Attention: Do not completely tighten the screw until you have installed the DS4800 in the rack cabinet.
 9. From the rear of the rack, thread and loosely tighten two M5 screws using the 5/16 (8 mm) hex nut driver. Use the rear rack mounting template in this chapter (or use the copy in Appendix C, “Rack mounting templates,” on page 181) to locate the proper rack mounting holes for installing these screws. Do not completely tighten the screws until you have installed the DS4800 in the rack cabinet.

When you are finished installing the left rail, the rail should be attached to the cabinet using one M5 screw in the front and two M5 screws at the back. All three M5 screws should be loosely tightened.
 10. Repeat step 6 through step 9 for the right rail.
 11. Tighten the rail adjustment screws on both rails.
 12. Continue with “Installing the DS4800.”

Installing the DS4800

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

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

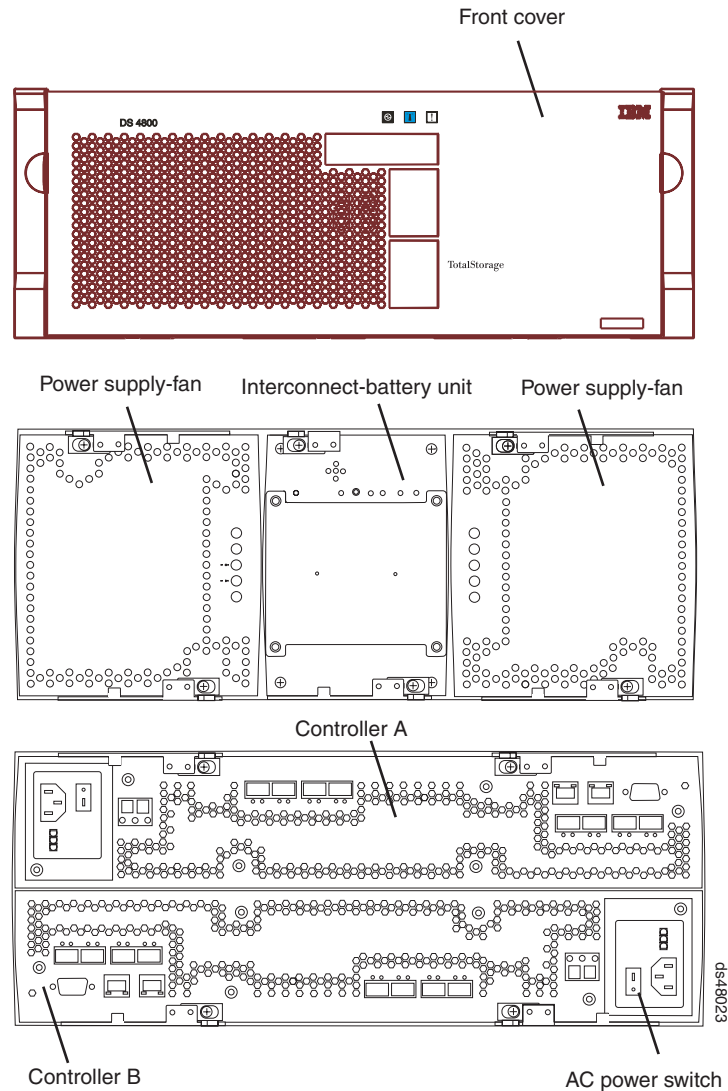


Figure 15. DS4800 Storage Subsystem front views and back view

Assemble these items before proceeding with the installation.

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

Releasing and locking a component lever

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

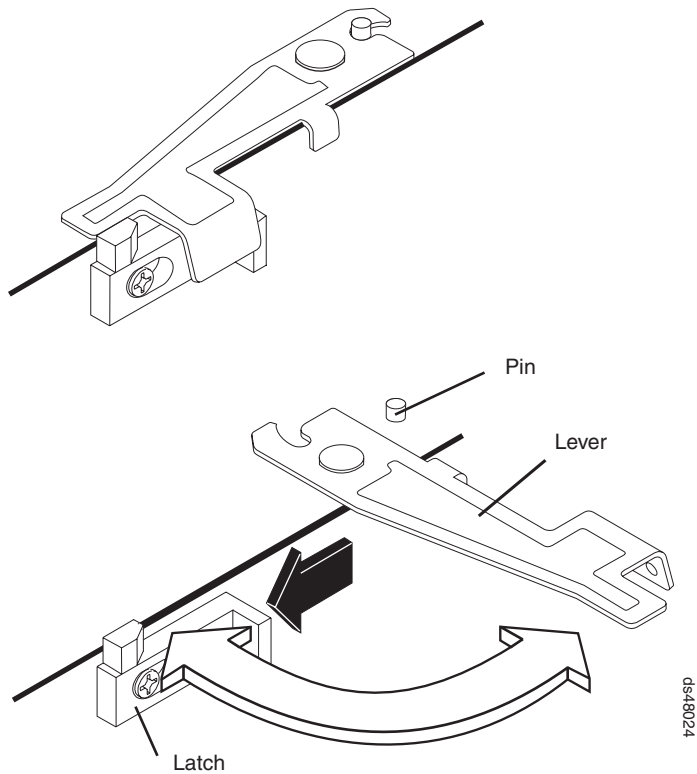


Figure 16. Component lever and latch

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

To release both latches on a component and remove the component:

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

Note: See Table 6 on page 19 for a listing of the weights of each DS4800 Storage Subsystem component.

To replace a component and lock the latches:

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

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

3. Holding the levers, press the component fully into the slot, engaging the pins on the enclosure.
4. Hold open both latches and rotate both levers simultaneously to the closed position. Release the latches. When you release the latches, you should see both latches slide over the levers, indicating that the component is locked in place.

Removing the components

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




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

You will need an antistatic wrist strap and a cart or level surface (to hold the components). Observe the precautions listed in “Handling static-sensitive devices” on page 27. In the following procedure, you will remove the following components from the storage subsystem before you install it in the rack cabinet:

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

Statement 4:



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

CAUTION:

Use safe practices when lifting.

Attention: A fully-populated DS4800 Storage Subsystem weighs 36.52 kg (80.7 lb). Do not attempt to lift the DS4800 Storage Subsystem from the shipping box or install the unit in the rack cabinet unless all of the components have been removed. If you choose to lift the DS4800 Storage Subsystem from the shipping box or install the unit in the rack without removing all of the components first, you do so at your own risk. For more information on the weights of the individual DS4800 Storage Subsystem components, see “Specifications” on page 19.

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

1. Open the two long sides of the shipping box, if you have not done so already. Opening the long sides of the box to a horizontal position provides access to the storage subsystem components.

2. Put on antistatic protection, and keep it on while performing all of the remaining procedures in this section.
3. Remove both power supply-fan units. Figure 17 shows the locations of the power supply-fans and the power supply-fan levers.

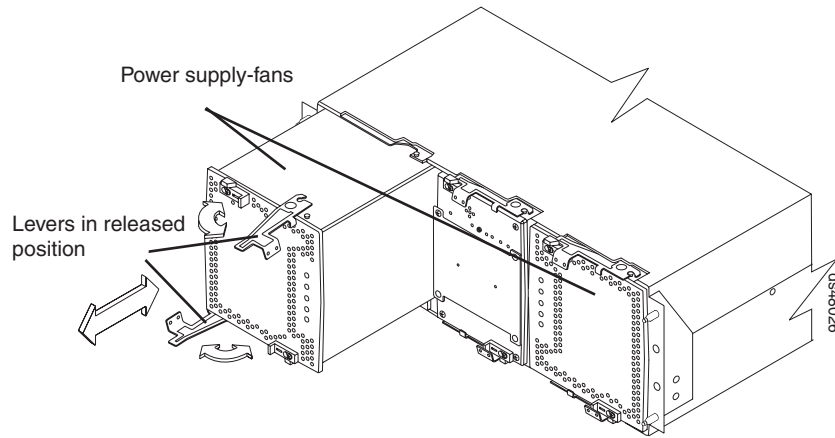


Figure 17. Removing the power supply-fans

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

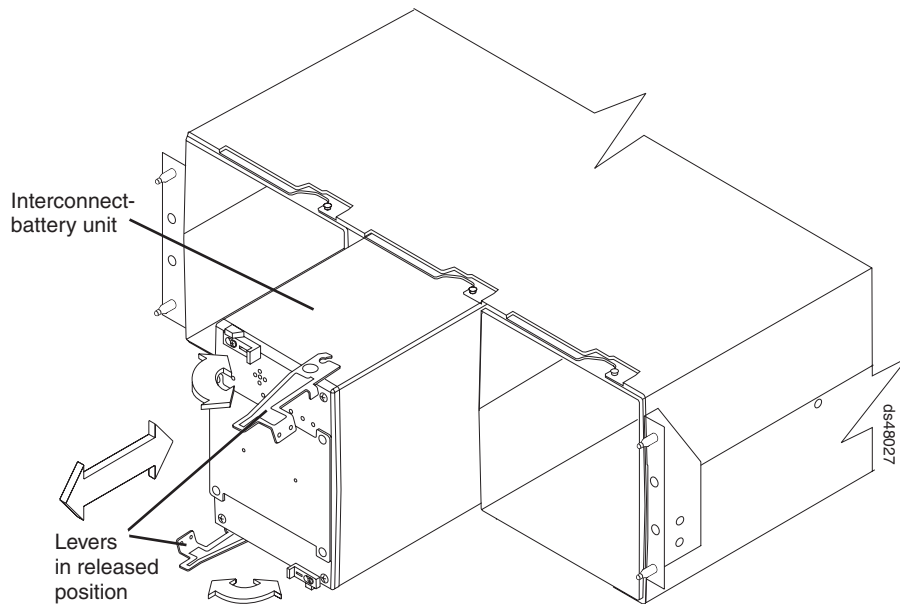


Figure 18. Removing the interconnect-battery unit

5. At the back of the DS4800 Storage Subsystem, use an adhesive note to label each of the controllers. Controller A is in the upper slot; controller B is in the lower slot. Figure 19 on page 41 shows the locations of the controllers and controller levers.

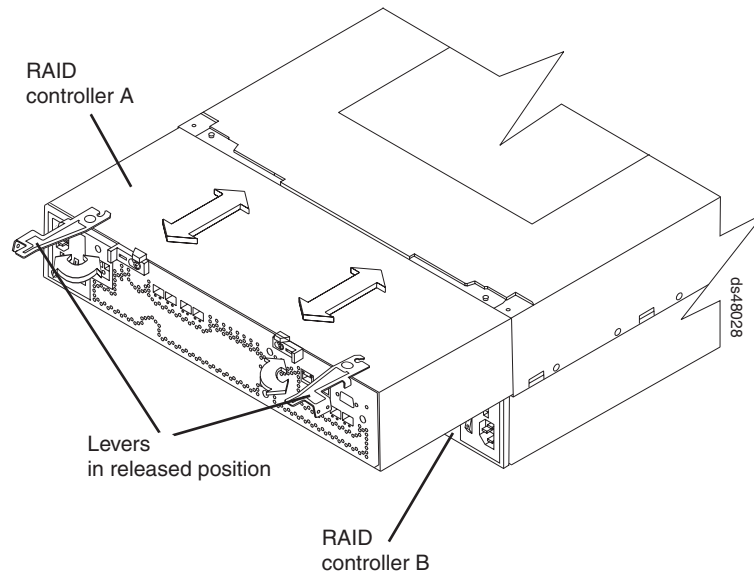


Figure 19. Removing the controllers

6. Remove the controllers. Figure 19 shows the controller locations and the controller levers.
7. After you have removed the components, record the serial number, machine type and model number, and MAC addresses for your DS4800 Storage Subsystem in Appendix B, “Records,” on page 179. The serial number, machine type, and model number are located on top of each RAID controller unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 100 on page 179. You may not be able to easily access this information after you install the DS4800.
8. Go to “Installing the DS4800 on the support rails.”

Installing the DS4800 on the support rails

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

Attention: If you have not yet done so, record the serial number, machine type and model number, and MAC addresses for your DS4800 Storage Subsystem in Appendix B, “Records,” on page 179, as described in step 7.

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

CAUTION:

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

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

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

1. Remove the empty DS4800 Storage Subsystem from the shipping box and set the storage subsystem in the cabinet. Figure 20 shows the correct orientation of the empty storage subsystem to the cabinet and support rail.
 - a. If you have installed a screw in the upper mounting hole at the front of each support rail, remove the upper screws. These two screws are used later to secure the front of the storage subsystem to the rack.
 - b. Move the empty storage subsystem from the shipping box and to the front of the cabinet.
 - c. With help from another person, place the back of the storage subsystem on the support rails, and then slide the storage subsystem into the cabinet.

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

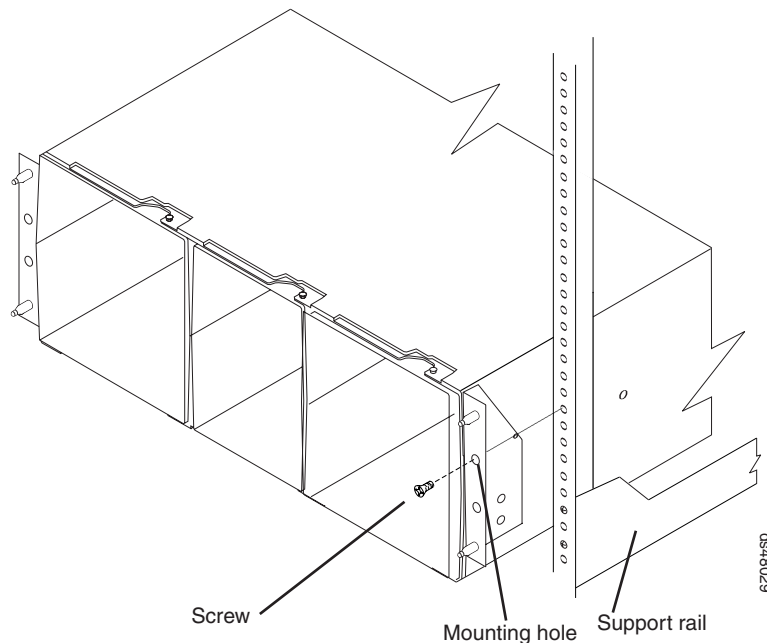


Figure 20. Securing the DS4800 to the rack cabinet

2. Secure the storage subsystem to the cabinet. Figure 20 shows how to secure the DS4800 to the vertical members of the cabinet.
 - a. Align the front mounting holes on the storage subsystem flanges with the mounting holes on the cabinet.

- b. Using the 5/16 (8 mm) hex nut driver, insert one M5 screw into the hole on each flange, and tighten the screws completely to secure the front of the storage subsystem to the cabinet.
3. At the front and the rear of the rack cabinet, use the 5/16 (8 mm) hex nut driver to finish tightening the other three M5 screws for each rail.
4. Continue with “Replacing the components.”

Replacing the components

Complete this procedure to replace the components in the storage subsystem.

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

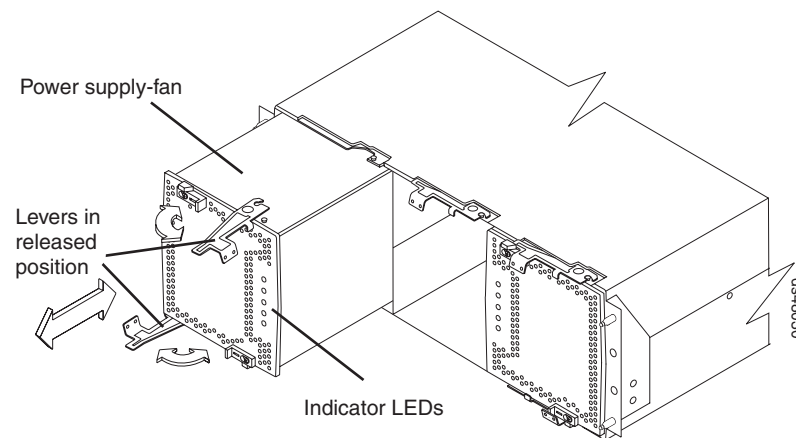


Figure 21. Replacing the power supply-fans

2. Replace the interconnect-battery unit. Figure 22 on page 44 shows the location of the interconnect-battery unit and the interconnect-battery unit levers. The interconnect-battery unit is keyed to always fit into the enclosure in the proper orientation. A large pin located on the back of the component prevents the component from being installed incorrectly. Before installing the component, turn the component so that the LEDs are near the top of the component.

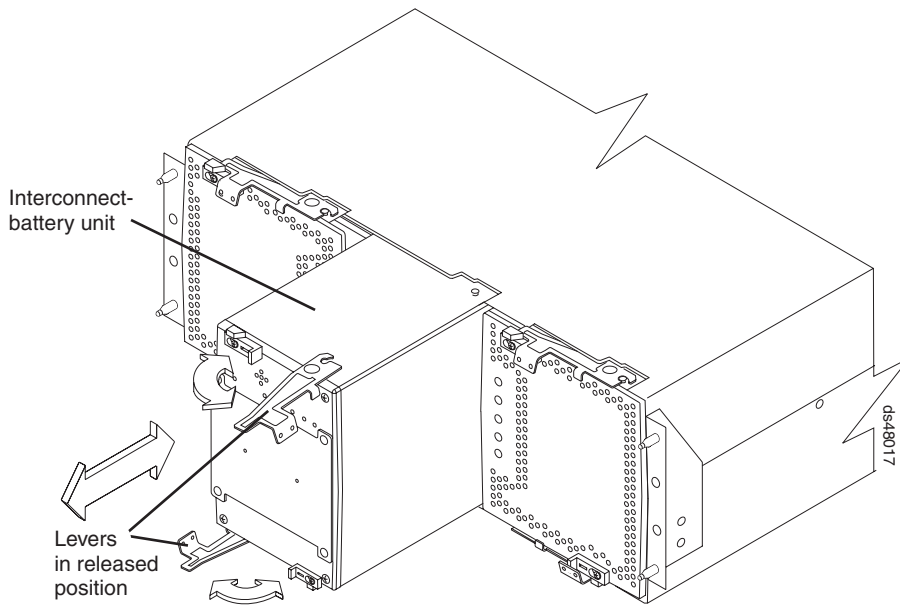


Figure 22. Replacing the interconnect-battery unit

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

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

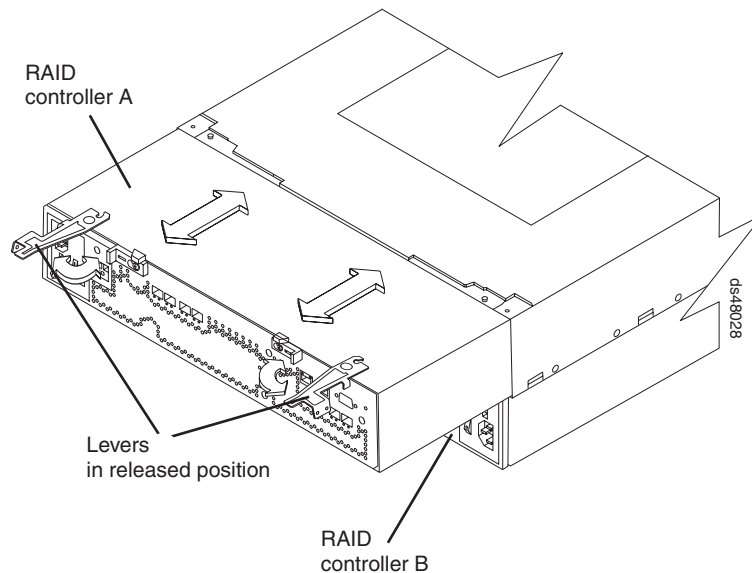


Figure 23. Replacing the controllers

4. Attach the DS4800 front bezel. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover, and then

press the cover toward the chassis until the pins snap into place. Figure 24 shows how to install the front bezel in the storage subsystem.

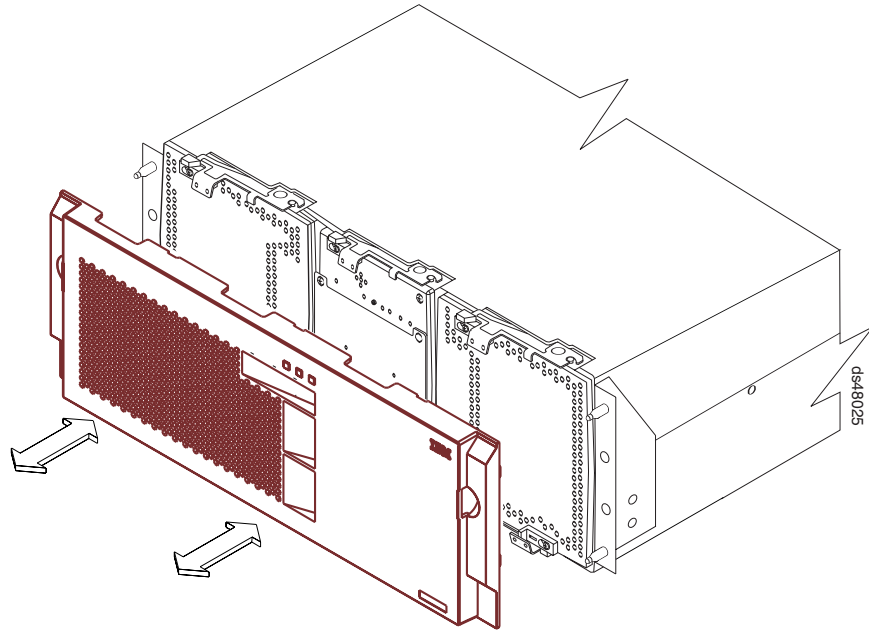


Figure 24. Removing the front bezel

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

Chapter 3. Cabling the storage subsystem

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

This chapter addresses the following cabling and configuration topics:

- “Working with SFPs and fiber-optic cables”
- “Connecting storage expansion enclosures to the DS4800” on page 59
- “Connecting hosts to the DS4800” on page 79
- “Connecting secondary interface cables” on page 81
- “Configuring the storage subsystem” on page 82
- “Installing the storage subsystem configuration” on page 88
- “Connecting the power cables” on page 88

Working with SFPs and fiber-optic cables

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

Statement 3



CAUTION:

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

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



Danger

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

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

Handling fiber-optic cables

Before you use fiber-optic cables, read the following precautions.

Attention: To avoid damage to the fiber-optic cables, follow these guidelines:

- Do not route the cable along a folding cable-management arm.
- When attaching 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 cabinet.
- Do not overtighten the cable straps or bend the cables to a radius of less than 38 mm (1.5 in.).
- Do not put excess weight on the cable at the connection point. Be sure that the cable is well supported.

Installing SFP modules

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

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

- Use only short-wave/multimode SFPs in DS4800 host or drive ports. In DS4800 configurations, you may use long-wave SFPs only in fibre channel switches that connect DS4800s over long distances.
- The SFP module housing has an integral guide key designed to prevent you from inserting the SFP module improperly.
- Use minimal pressure when you insert the SFP module into a port. Forcing the SFP module into a port could cause damage to the SFP module or the port.
- You can insert or remove the SFP module while the port is powered on.
- The operational loop performance is not affected when you install or remove an SFP module.
- You must insert the SFP module into a port before you connect the fiber-optic cable.
- You must remove the fiber-optic cable from the SFP module before you remove the SFP module from the fibre channel port. See “Removing SFP modules” on page 50 for more information.
- The speed of the SFP module determines the maximum operating speed of the fibre channel port in which the SFP is installed. For example, a 2-Gbps SFP that is plugged into a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps.
- The only label that identifies whether an SFP module can be operated at 2 Gbps only, or at both 2 Gbps and 4 Gbps, is the SFP part number that is printed on the manufacturing label attached to the SFP. Verify that you use SFPs with the correct speed requirements in your environment.

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

To install an SFP module, complete the following steps.

Statement 3:



CAUTION:

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

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



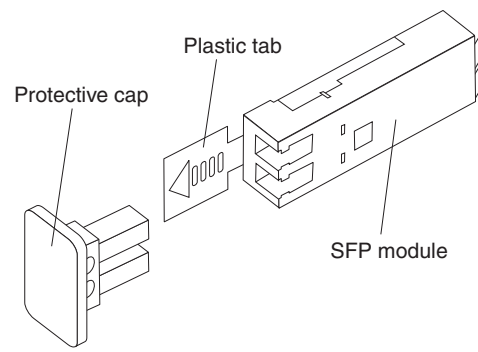
DANGER

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

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

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 27.

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 25. Save the protective cap for future use.



F10ug014

Figure 25. Small Form-Factor Pluggable (SFP) module

3. Remove the protective cap from the fibre channel port. Save the protective cap for future use.
4. Insert the SFP module into the fibre channel port until it clicks into place. See Figure 26.

Note: The alignment of the fibre channel ports on controller A are opposite those of controller B. Before inserting an SFP module into a port, verify that the SFP module is rotated correctly to match the alignment of the port on the RAID controller. Do not force-fit. For fibre channel ports in controller A, SFPs should be inserted with the exposed printed circuit facing up (as shown in Figure 26). For fibre channel ports in controller B, SFPs should be inserted with the exposed printed circuit facing down.

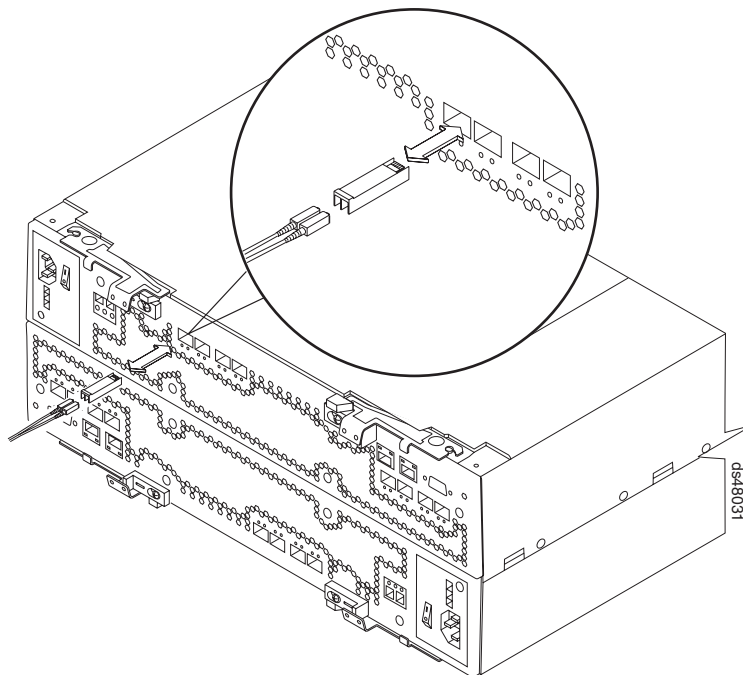


Figure 26. Replacing an SFP module

5. Connect a fibre channel cable.

Removing SFP modules

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

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

1. Remove the LC-LC fibre channel cable from the SFP module. For more information, see “Handling fiber-optic cables” on page 48.
2. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 27 on page 51.

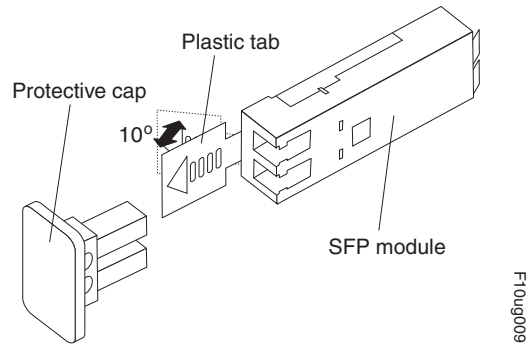


Figure 27. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 28.

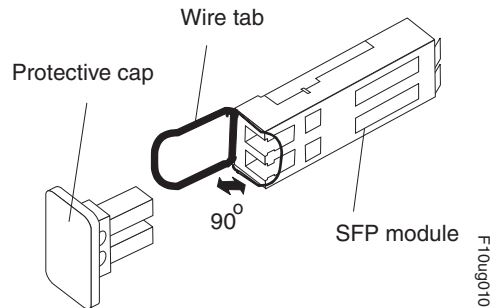


Figure 28. Unlocking the SFP module latch - wire variety

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

Installing fiber-optic cables

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

1. Remove the protective cap from the fiber-optic cable. See Figure 29 on page 52.

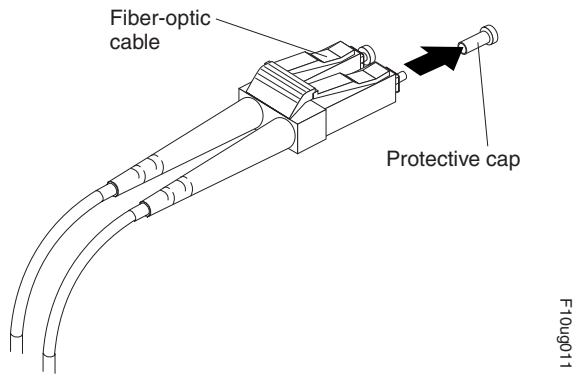


Figure 29. Removing caps from fiber-optic cables

2. Connect the fiber-optic cable to the installed SFP, as shown in Figure 30.

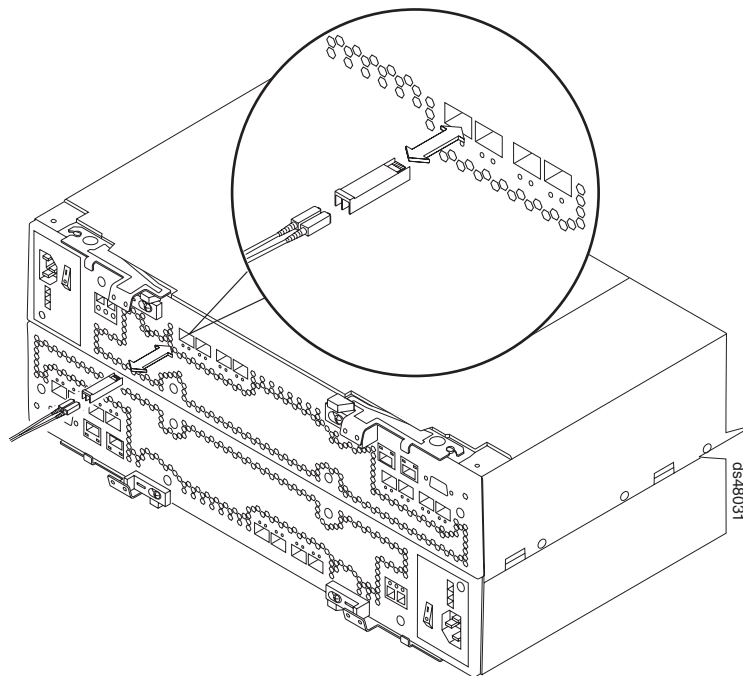


Figure 30. Connecting fiber-optic cable to SFP

3. Check the LEDs on the RAID controller. When the RAID controller is operating properly, the amber Needs Attention LED is off. For information about the status of the RAID controller LEDs, see “RAID controller LEDs” on page 113.
4. To remove the fiber-optic cables, gently pull the fiber-optic cable from the SFP; then replace the protective caps.

Using LC-LC fibre-channel cables

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

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

See Figure 31 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.

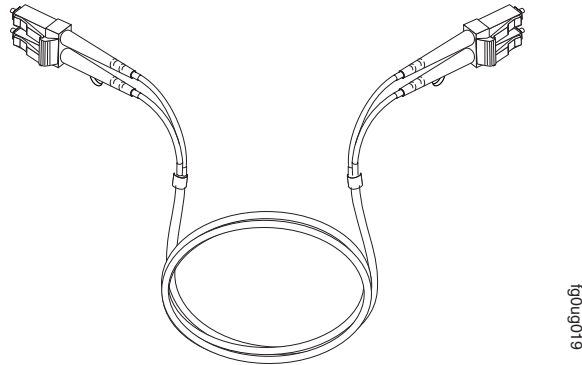


Figure 31. LC-LC fibre-channel cable

Note: If you are connecting the DS4800 Storage Subsystem host ports to a 1 Gbps device (such as a 1 Gbps fibre channel switch), you must also use an LC-SC fibre-channel cable adapter. For more information about using an LC-SC fibre-channel cable adapter, see “Using LC-SC fibre-channel cable adapters” on page 55.

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 48.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 32. 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 32. Save the protective caps for future use.

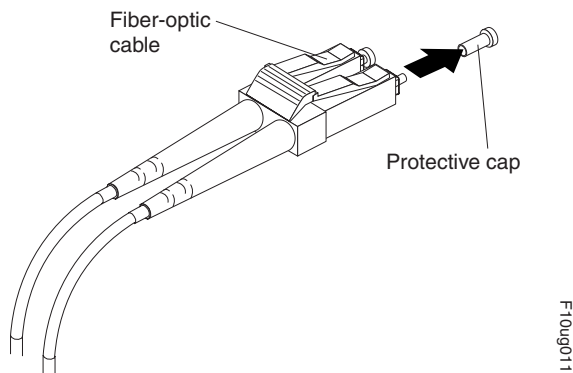


Figure 32. Removing fiber-optic cable protective caps

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the DS4800. The cable connector is keyed to ensure it is inserted into the SFP module correctly. Holding the connector, push in the cable until it clicks into place, as shown in Figure 33.

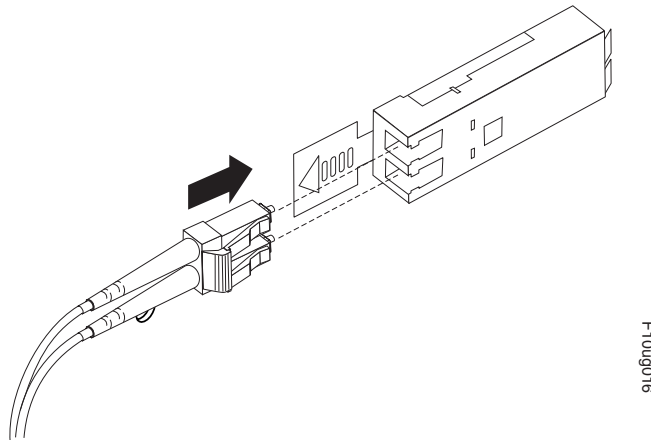


Figure 33. Inserting an LC-LC fibre-channel cable into an SFP module

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

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

Removing an LC-LC fibre-channel cable

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 34.

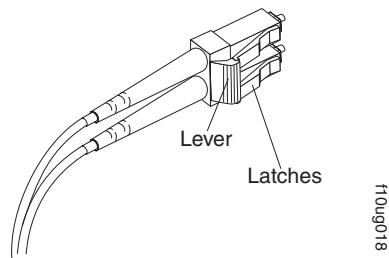


Figure 34. LC-LC fibre-channel cable lever and latches

2. Carefully pull on the connector to remove the cable from the SFP module, as shown in Figure 35.

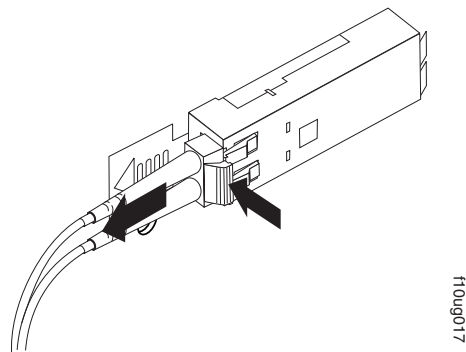


Figure 35. Removing the LC-LC fibre-channel cable

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

Using LC-SC fibre-channel cable adapters

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

- 1-Gbps fibre channel switch

- Fibre channel host bus adapter

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

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

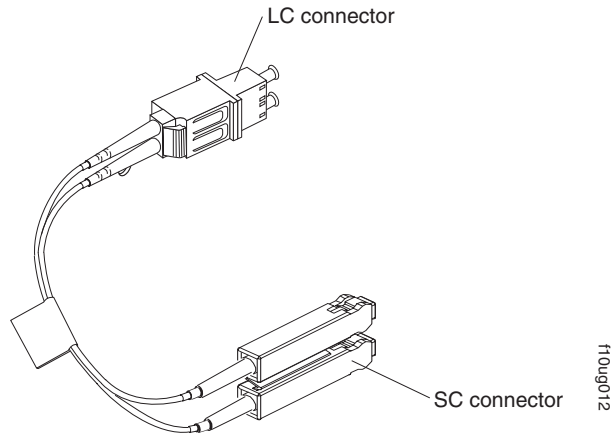


Figure 36. LC-SC fibre-channel cable adapter

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

Connecting an LC-SC cable adapter to a device

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

Statement 3:



CAUTION:

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

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



DANGER

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

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

1. Read the information in “Handling fiber-optic cables” on page 48.
2. Connect one end of an LC-LC cable to an SFP module in the DS4800. For instructions, see “Using LC-LC fibre-channel cables” on page 52.
3. Remove the two protective caps from the LC connector end of the LC-SC cable adapter as shown in Figure 37. Save the protective caps for future use.

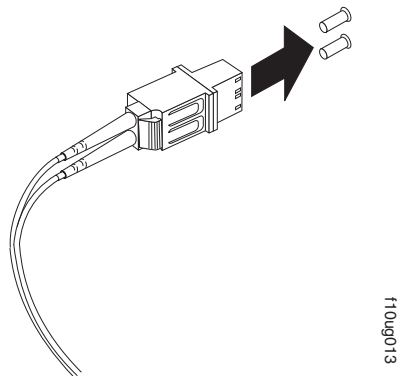


Figure 37. Removing the LC-SC cable adapter protective caps

4. Carefully insert the other end of the LC-LC cable into the LC connector end of the LC-SC cable adapter as shown in Figure 38. Push in the connector until it clicks into place.

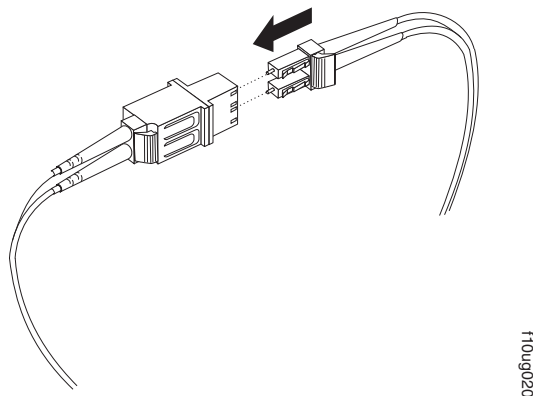


Figure 38. Connecting an LC-LC cable into the LC-SC cable adapter

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

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

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

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

1. On the end of the cable that connects into the LC connector end of the LC-SC cable adapter, press down and hold the lever to release the latches. Figure 39 shows the location of the lever and latches.

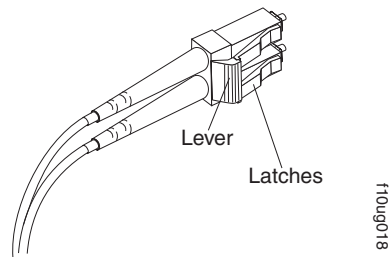


Figure 39. LC-LC fibre-channel cable lever and latches

2. Carefully pull on the connector to remove it. Make sure you grasp the connector and not the cable when removing the LC-LC cable from the LC-SC cable adapter as shown in Figure 40.

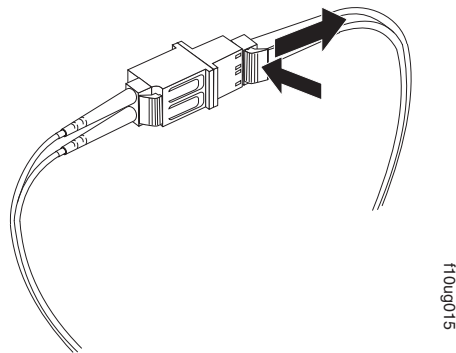


Figure 40. Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter

3. Replace the protective caps on the cable ends.

Connecting storage expansion enclosures to the DS4800

Attention

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

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

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

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

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

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

In Figure 41 on page 61 and Figure 42 on page 62, drive channel 1 of controller A and drive channel 3 of controller B combine to form a DS4800 Storage Subsystem drive channel pair. If any component of drive channel 1 fails, the RAID controllers can still access the storage expansion enclosures in drive channel 1 through drive channel 3. Similarly, drive channel 2 of controller A and drive channel 4 of controller B combine to form the second of the two DS4800 Storage Subsystem drive channel pairs. If any component of drive channel 2 fails, the RAID controllers can still access the storage expansion enclosures in drive channel 2 through drive channel 4.

Figure 41 on page 61 shows the storage expansion enclosures in each drive channel pairs connected to only one drive port in the two-ported drive channel. For example, in drive channel pair 1, only port 4 of channel 1 and port 1 of channel 3 are used. Figure 42 on page 62 shows that half of the storage expansion enclosures in each drive channel pair are connected to the first port of the dual-ported drive channel. The other half of the enclosures are connected to the

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

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

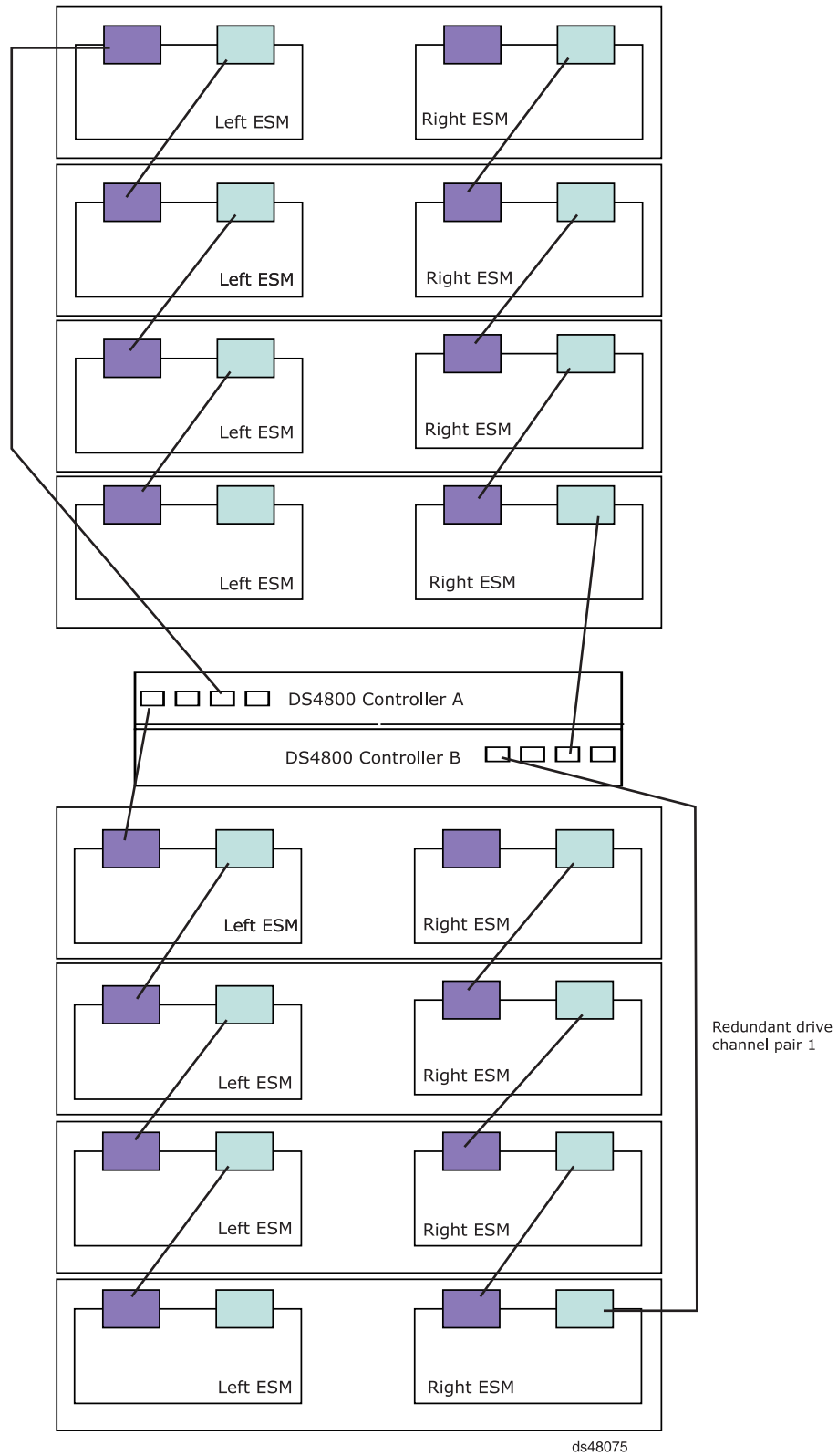


Figure 41. Example 1 of redundant drive channel pairs

Figure 42 on page 62 shows a second example of the drive channel cabling for redundant drive channel pairs.

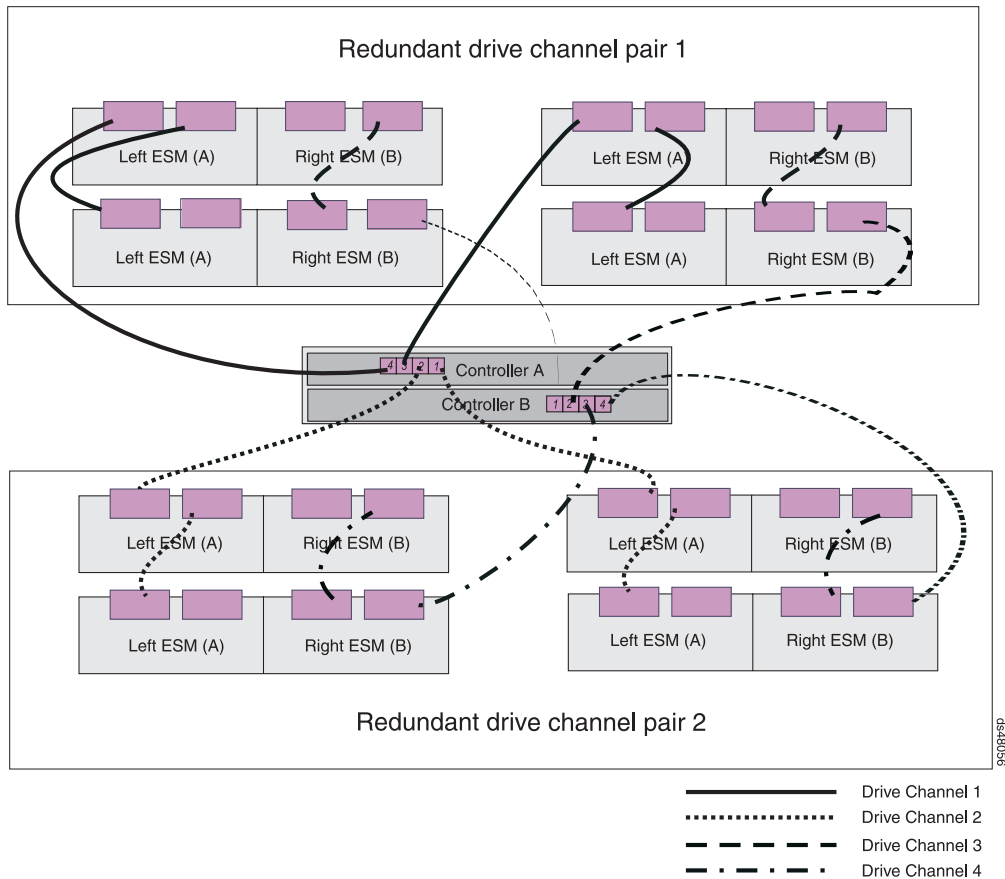


Figure 42. Example 2 of redundant drive channel pairs

To connect storage expansion enclosures to the storage subsystem, perform the following steps:

Note: The following procedures are for "cold-case" procedures (in which the DS4800 is powered down when storage expansion enclosures are connected, as in the case of initial installation). For "hot-case" procedures (in which the DS4800 is powered on when storage expansion enclosures are connected), refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

1. Follow the instructions in the *Installation, User's, and Maintenance Guide* for your DS4000 storage expansion enclosure, for setting up and mounting the storage expansion enclosures.
2. Select a cabling topology appropriate for the number of storage expansion enclosures you will connect to the DS4800. (You must connect at least one storage expansion enclosure, populated with at least two drives, before you power on the DS4800.)

"DS4800 Storage Subsystem drive cabling topologies" on page 69 describes the recommended schemes for cabling different numbers of storage expansion enclosures to the DS4800 and to each other (that is, if you are connecting more than one storage expansion enclosure).

After you select the cabling topology for your configuration, continue with step 3 on page 63, following the cabling diagram for your chosen topology.

3. The following steps describe the cabling sequence for connecting at least two storage expansion enclosures to a DS4800 using the preferred topologies identified in “DS4800 Storage Subsystem drive cabling topologies” on page 69.

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

For EXP710 and EXP100 storage expansion enclosure connections:

Perform the following steps to cable EXP100/EXP710 storage expansion enclosures to each other and to the DS4800. You can match the connections described these steps with the cabling diagram (provided in “DS4800 Storage Subsystem drive cabling topologies” on page 69) that most closely matches your configuration. Figure 43 shows the name of the ESM ports in the EXP100/EXP710 storage expansion enclosures.

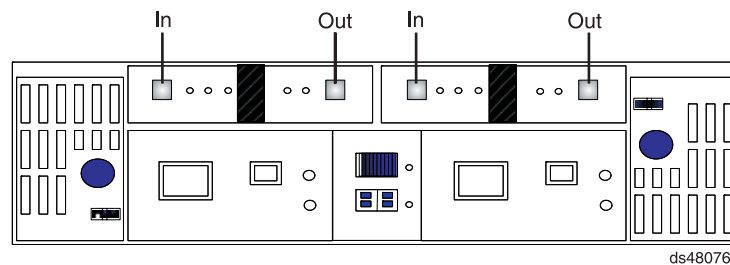


Figure 43. EXP710/EXP100 port labels

- a. Start with the first storage expansion enclosure from the group of drive expansion enclosures that will be cabled together behind a drive port of a drive channel. Connect the In port on the left ESM board to the Out port on the left ESM board of the second (next) enclosure. (See callout 2 in Figure 44 on page 64.)
- b. On the first storage expansion enclosure from the group of drive expansion enclosures, connect the In port on the right ESM board to the Out port on the right ESM board of the second (next) enclosure. (See callout 6 in Figure 44 on page 64.)
- c. If you are cabling more storage expansion enclosures to this group, repeat steps 3a and 3b for all enclosures except the final enclosure in the loop, starting with the second enclosure. (See callouts 3 and 4 for the left ESM connections and callouts 7 and 8 for the right ESM connections in Figure 44 on page 64.)

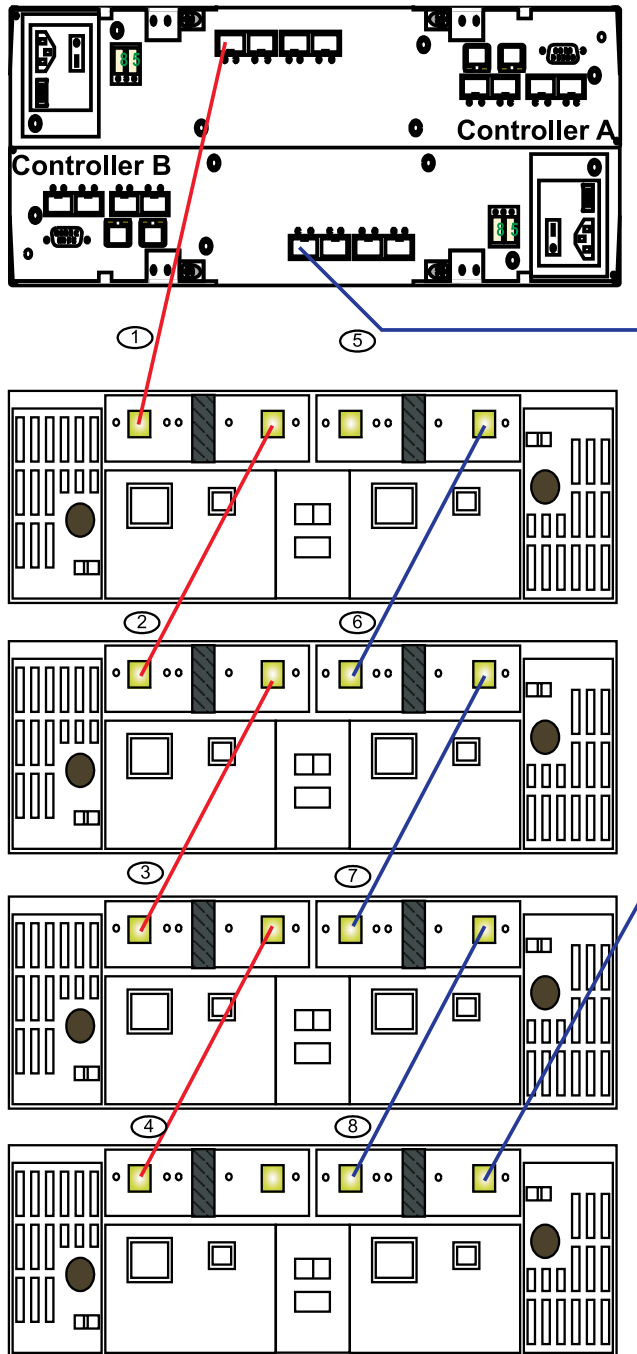


Figure 44. Connecting EXP710 or EXP100 enclosures to DS4800

- d. Connect drive port 4 (drive channel 1) of controller A to the In port on the left ESM board of the first storage expansion enclosure in the group. (See callout 1 in Figure 44.)
- e. Connect drive port 1 (drive channel 3) of controller B to the Out port on the right ESM board of the last storage expansion enclosure in the group. (See callout 5 in Figure 44.)

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

For EXP810 storage expansion enclosure connections:

Perform the following steps to cable EXP810 storage expansion enclosures to each other and to the DS4800. You can match the connections described in these steps with the cabling diagram (provided in “DS4800 Storage Subsystem drive cabling topologies” on page 69) that most closely matches your configuration. Figure 45 shows the name of the ESM ports in the EXP810 storage expansion enclosures.

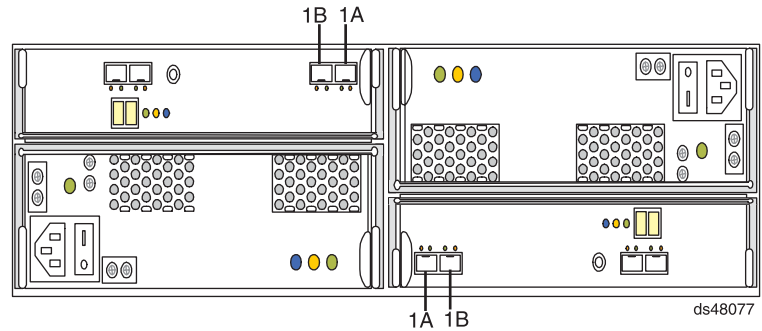


Figure 45. EXP810 port labels

- a. Start with the first storage expansion enclosure from the group of EXP810 drive expansion enclosures that will be cabled together. Connect the 1A port on the left ESM board to the 1B port on the left ESM board of the second (next) enclosure. (See callout 2 in Figure 46 on page 66.)
- b. On the first storage expansion enclosure from the group of drive expansion enclosures that will be cabled together, connect the 1B port on the right ESM board to the 1A port on the right ESM board of the second (next) enclosure. (See callout 8 in Figure 46 on page 66.)
- c. If you are cabling more storage expansion enclosures to this group, repeat steps 3a and 3b for all enclosures except the final enclosure in the loop, starting with the second enclosure. (See callouts 3 and 4 for the left ESM connections and callouts 7 and 6 for the right ESM connections in Figure 46 on page 66.)

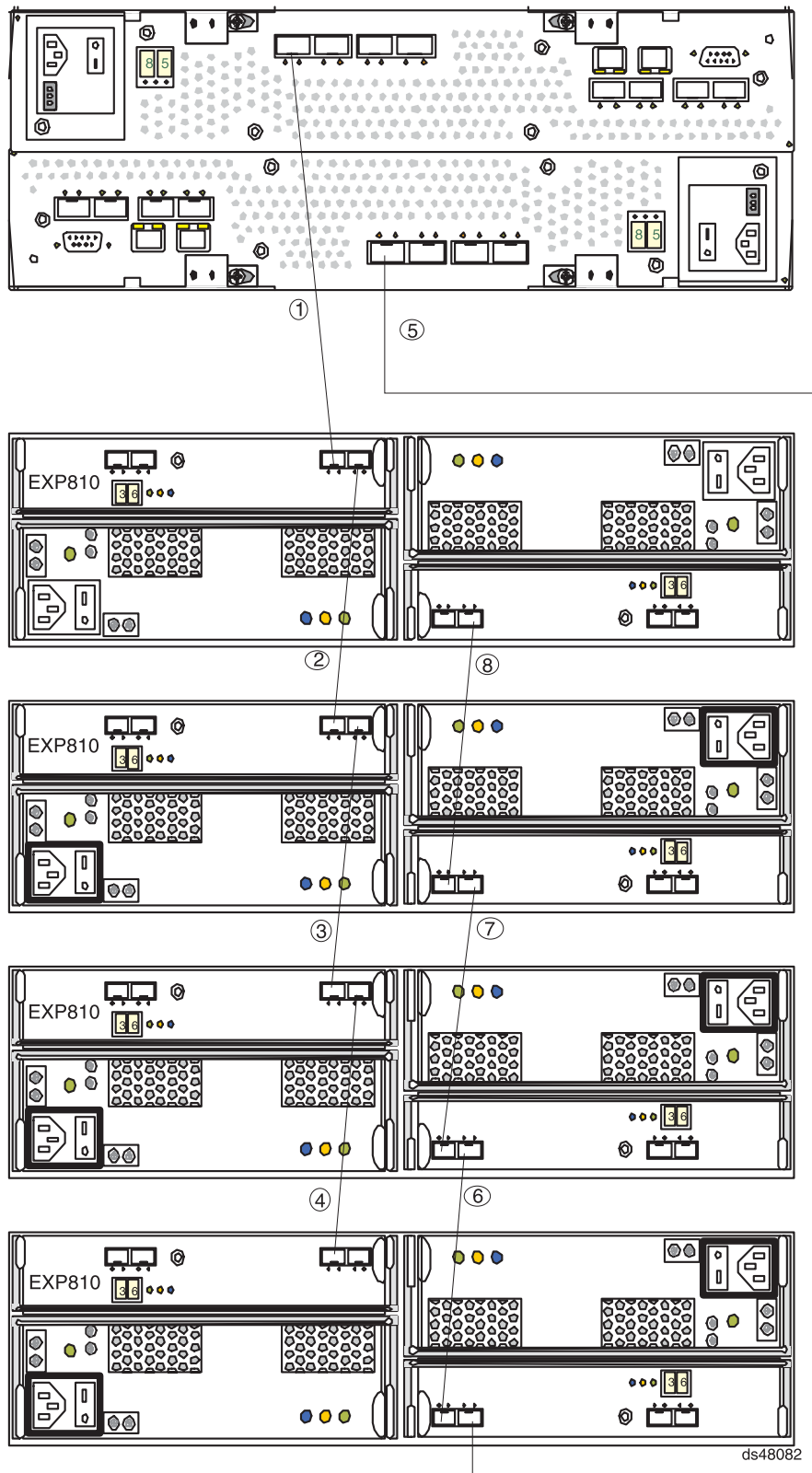


Figure 46. Connecting EXP810 enclosures to DS4800

- d. Connect drive port 4 (drive channel 1) of controller A to the to the 1B port on the left ESM board of the first storage expansion enclosure in the group of drive expansion enclosures. (See callout 1 in Figure 46.) **Important:** Always

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

- e. Connect drive port 1 (drive channel 3) of controller B to the port 1B on the right ESM board of the last storage expansion enclosure in the group of drive expansion enclosures. (See callout 5 in Figure 46 on page 66.)

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

4. You can repeat steps 3a on page 63 to 3e on page 64 in order to connect other groups of storage expansion enclosures to the DS4800, using the second ports of the same dual-ported drive channel pair, and the first and second ports in the other dual-ported drive channel pair, replacing the DS4800 drive ports (mentioned in steps 3d on page 64 and 3e on page 64) with the appropriate drive ports in the drive channels. The DS4800 currently supports a maximum of 112 drives in either eight 14-drive storage expansion enclosures or seven 16-drive storage expansion enclosures per drive channel in each controller. One drive channel from each of controllers A and B must be connected to the same set of storage expansion enclosures to provide drive channel redundancy. This will result in the support of a maximum of 224 drives in 16 or 14 storage expansion enclosures per DS4800, depending on storage expansion enclosure type.

Attention:

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

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

- c. It is recommended that you add storage expansion enclosures to the DS4800 drive ports in a round-robin fashion. For example, if you have 4 EXP810s needing to be cabled to the DS4800, instead of cabling all 4 EXP810s to one drive port of a drive channel, you should distribute the enclosures to all drive ports, which results in one enclosure per drive port of a drive channel.
- d. Do not connect more than the recommended maximum number of enclosures per drive channel (7 for 14-drive and 8 for 16-drive enclosures). When mixing 14-drive and 16-drive enclosures, the maximum number of expansion enclosures is 7 per redundant drive channel pair.
- e. DS4800 supports storage expansion enclosures operating at different Fibre Channel speeds (for example, 2 Gbps or 4 Gbps) only when they are installed in separate redundant drive channel pairs. DS4800 does not support a mix of storage expansion enclosures operating at different Fibre Channel speeds in the same redundant drive channel pair.
- f. DS4800 does support a mix of EXP710 and EXP810 storage expansion enclosures in the same redundant drive channel pair; however, it is recommended that you cable the storage expansion enclosures of the same type together, to ease maintenance and troubleshooting in the event of failures. If possible, connect only the same drive expansion enclosure type behind each DS4800 controller drive port of a dual-ported drive channel.
- g. The DS4000 controller drive port must always be connected to the EXP810 port labeled 1B. Because the left and right EXP810 ESMs (ESMs A and B) are inserted in the ESM bays in different orientations, you must look for the port labeled 1B before making the Fibre Channel connections.

Table 14 on page 69 indicates a number of ways that four storage expansion enclosures can be attached to the DS4800 controller drive ports. Case 7 is the recommended way. Depending on your need and the type of storage expansion enclosures that you used, you may also choose one of the other ways described in the table. For example, in a given drive channel, you can connect 3 storage expansion enclosures to the first port and 5 storage expansion enclosures to the second port, or you can connect 4 storage expansion enclosures to the first port and 4 storage expansion enclosures to the second port. You cannot connect 3 storage expansion enclosures to the first port and 6 storage expansion enclosures to the second port or 1 storage expansion enclosure to the first port and 8 storage expansion enclosures to the second port; in these cases, the total number of storage expansion enclosures connected to a single drive channel is greater than 8.

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

	Drive Channel 1 port 4	Drive Channel 1 port 3	Drive Channel 2 port 2	Drive Channel 2 port 1
Case 1	4	0	0	0
Case 2	3	1	0	0
Case 3	0	3	1	0
Case 4	2	2	0	0
Case 5	0	2	2	0
Case 6	1	3	0	0
Case 7	1	1	1	1

- Set unique enclosure IDs for all storage expansion enclosures that are cabled to the DS4800 for the EXP710 and EXP100 only. See “DS4000 storage expansion enclosure ID settings” on page 78, and refer to your storage expansion enclosure installation manual for details on setting the enclosure ID.

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

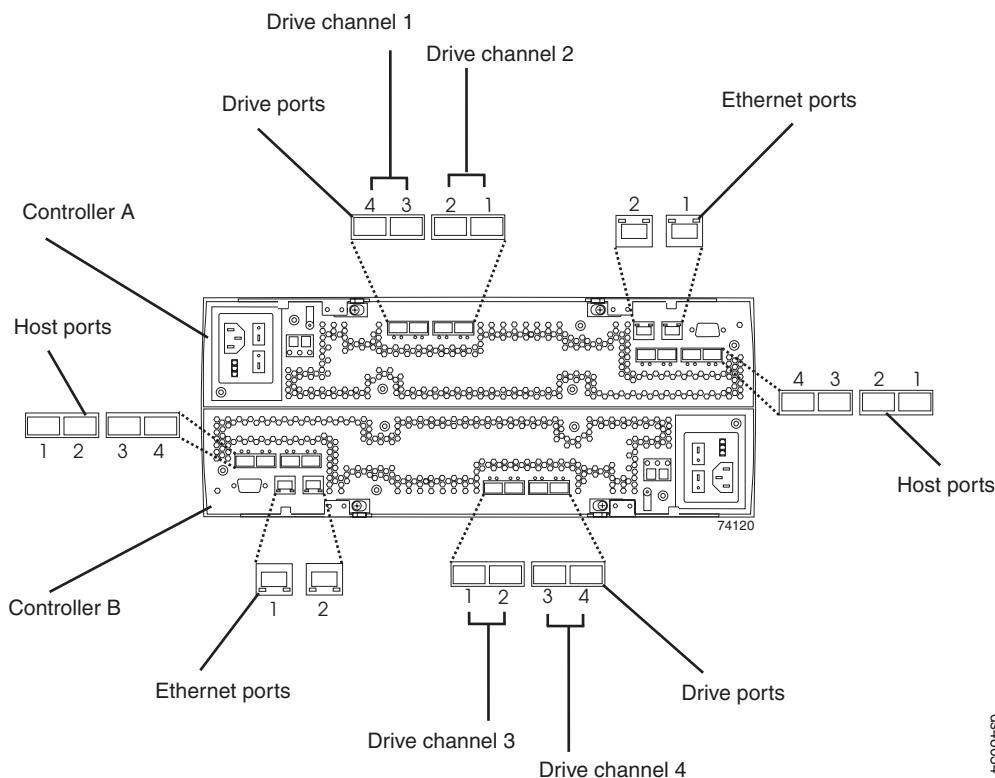
DS4800 Storage Subsystem drive cabling topologies

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

Attention: The DS4800 supports the connection of a maximum of 8 storage expansion enclosures per redundant drive channel pair. The DS4800 supports two redundant drive channel pairs.

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

Figure 47 on page 70 shows the locations of controllers A and B, and the single-ported host channels, Ethernet ports, and dual-ported drive channels at the back of the DS4800 Storage Subsystem.



DS48034

Figure 47. DS4800 Storage Subsystem ports and controllers

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

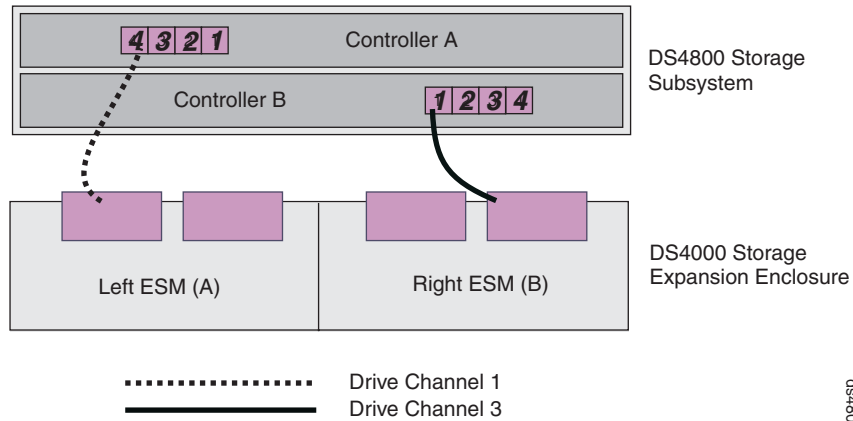
Table 15. DS4800 Storage Subsystem drive ports and drive channels

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

Note: In the following drive cabling figures, the DS4800 graphics are simplified to show only the drive ports of each controller. In addition, the storage expansion enclosures are simplified to show only the ESM FC ports. Do not use these graphics for actual cabling diagrams; instead, use the relevant instructions found in “Connecting storage expansion enclosures to the DS4800” on page 59.

One DS4800 and one storage expansion enclosure

If you are cabling one DS4800 Storage Subsystem to one storage expansion enclosure, Figure 48 on page 71 shows the recommended cabling scheme.



ds48052

Figure 48. One DS4800 and one storage expansion enclosure — Recommended cabling

One DS4800 and two storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to two storage expansion enclosures, Figure 49 shows the recommended cabling schemes.

As Figure 49 and Figure 50 on page 72 show, when you connect additional storage expansion enclosures, you can connect them either by using the additional port of the drive channel or by continuing the connection from the existing redundant drive channel pair. View 1 is the recommended cabling topology; View 2 is a possible cabling topology, however, it is *not* recommended.

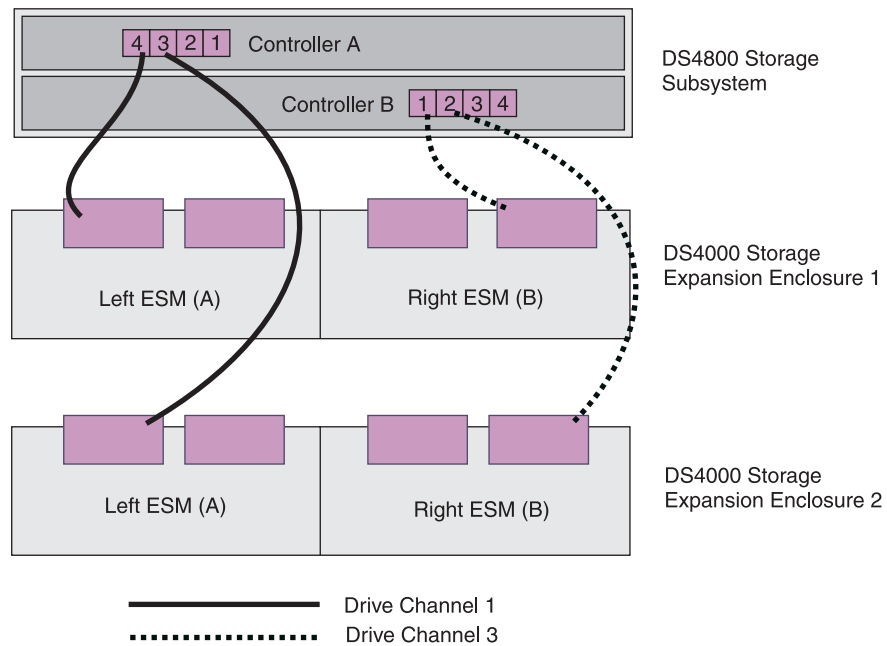


Figure 49. View 1: One DS4800 and two storage expansion enclosures cabling — Recommended

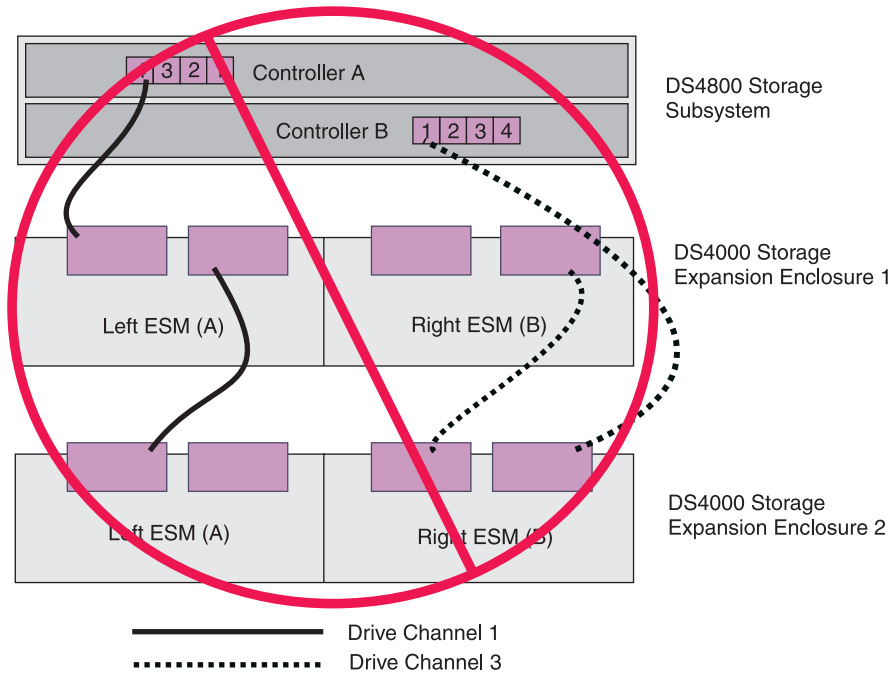


Figure 50. View 2: One DS4800 and two storage expansion enclosures cabling — Not recommended

One DS4800 and four storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to four storage expansion enclosures, Figure 51 on page 73 shows the recommended cabling scheme.

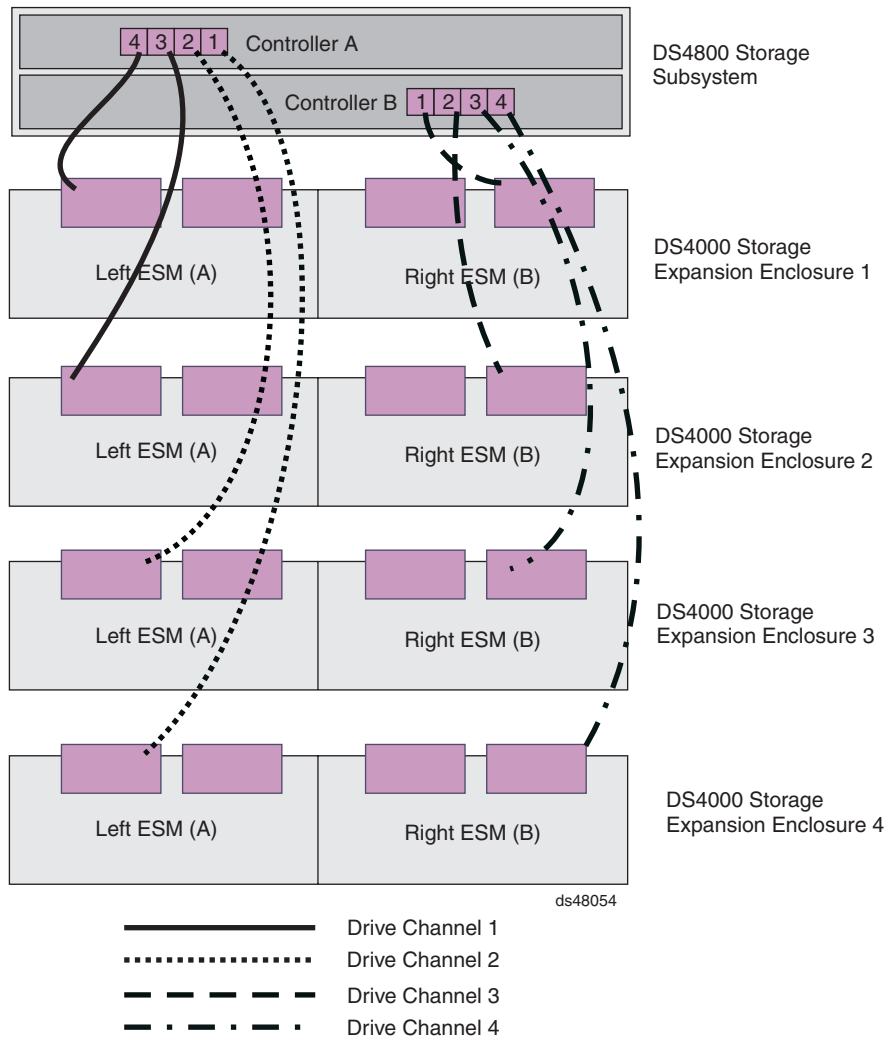


Figure 51. One DS4800 and four storage expansion enclosures — Recommended cabling

One DS4800 and eight storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to eight storage expansion enclosures, Figure 52 on page 74 shows the recommended cabling scheme.

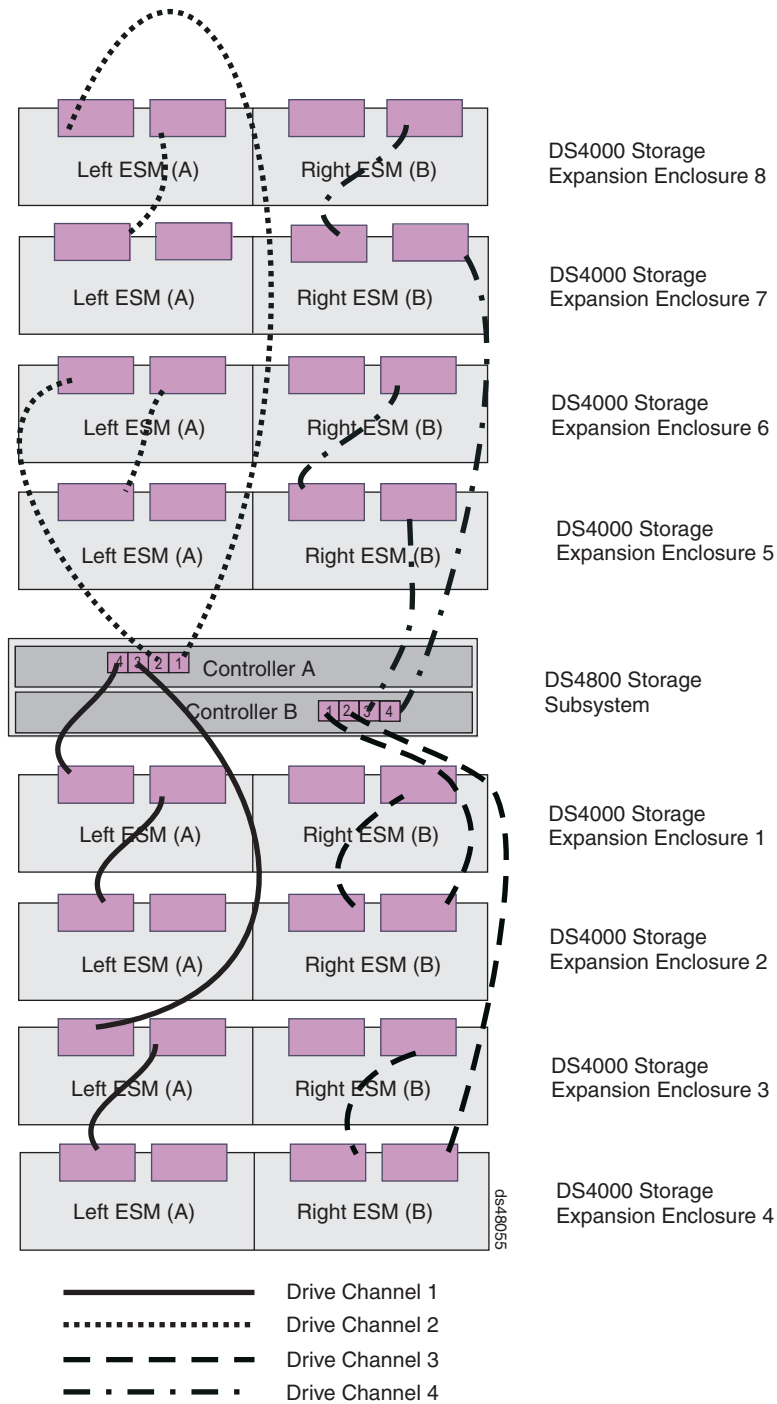


Figure 52. One DS4800 and eight storage expansion enclosures — Recommended cabling

One DS4800 and fourteen EXP810 storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to fourteen EXP810 storage expansion enclosures, Figure 53 on page 75 shows the recommended cabling scheme.

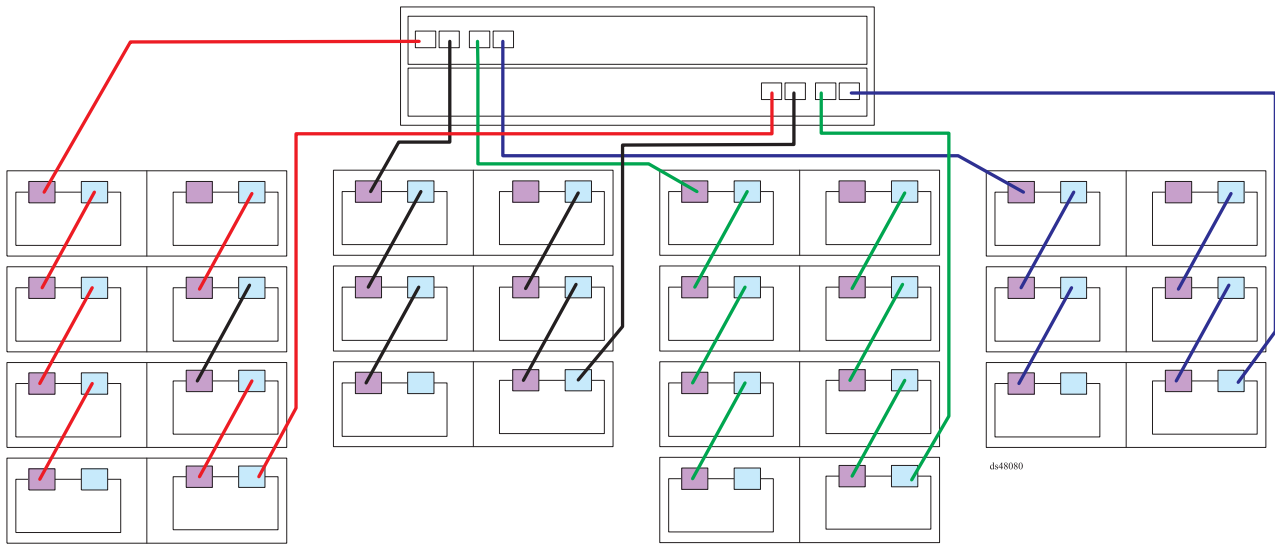


Figure 53. One DS4800 and fourteen EXP810 storage expansion enclosures — Recommended cabling

One DS4800 and sixteen EXP710 storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to sixteen EXP710 storage expansion enclosures, Figure 54 shows the recommended cabling scheme.

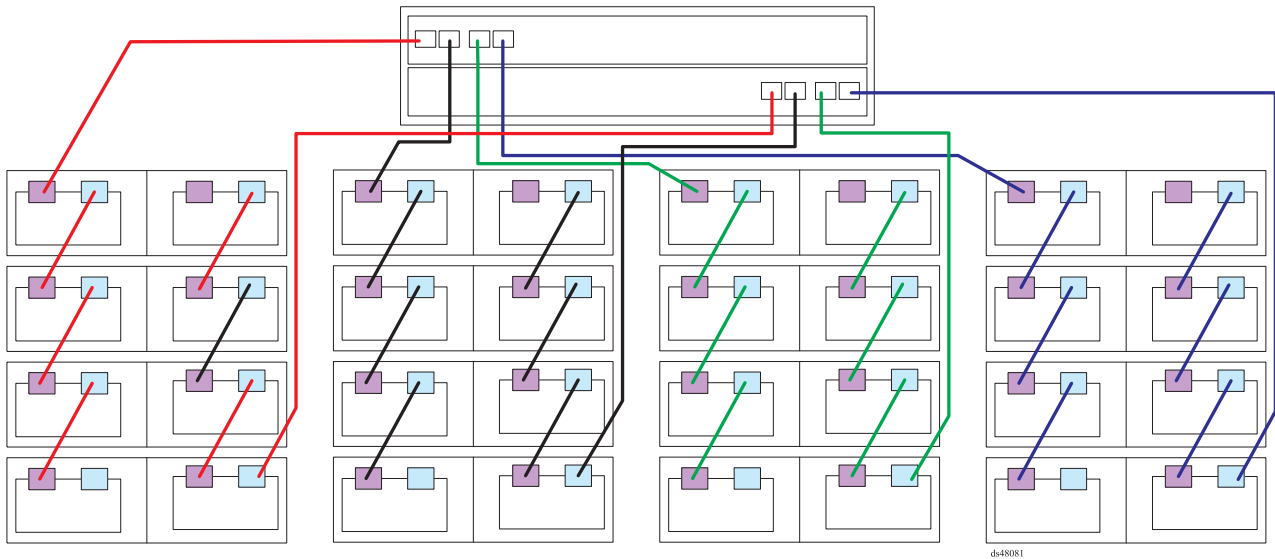


Figure 54. One DS4800 and sixteen EXP710 storage expansion enclosures — Recommended cabling

One DS4800 to seven EXP810 and eight EXP710 storage expansion enclosures

If you are cabling one DS4800 Storage Subsystem to seven EXP810 storage expansion enclosures operating at 4 Gbps and eight EXP710 storage expansion

enclosures operating at 2 Gbps Figure 55 shows the recommended cabling scheme.

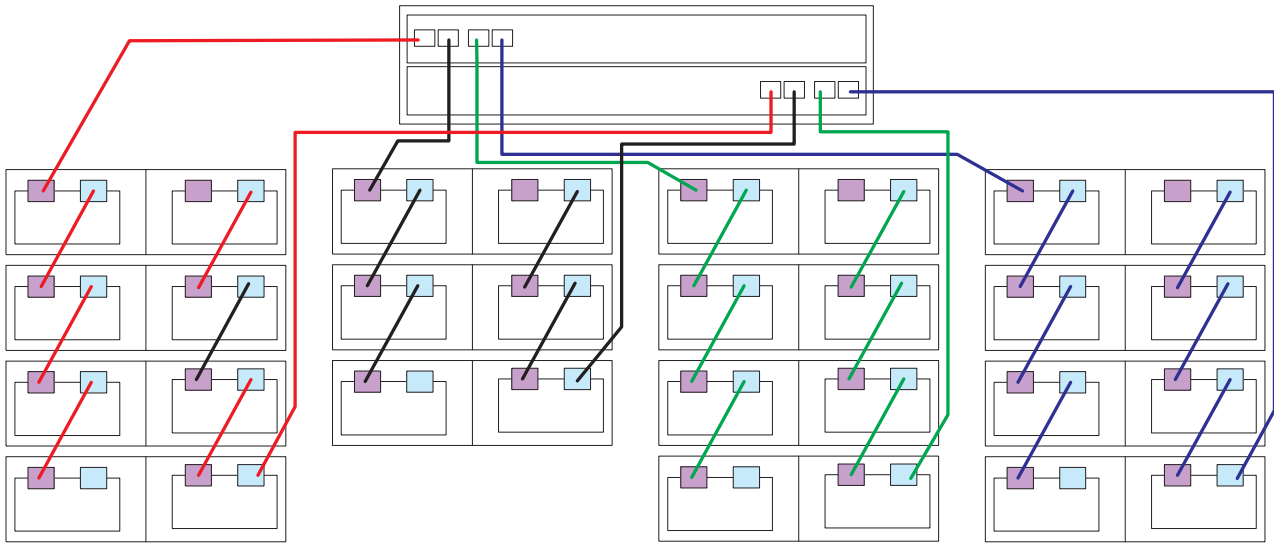


Figure 55. One DS4800 to seven EXP810 and eight EXP710 storage expansion enclosures — Recommended cabling

Cabling the storage expansion enclosures to a DS4800 storage subsystem

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

Install an SFP module in the drive mini hub port on the back of the DS4800 Storage Subsystem, as shown in Figure 56 on page 77.

Connect an LC-LC fiber-optic cable into the SFP module, as shown in Figure 57 on page 77.

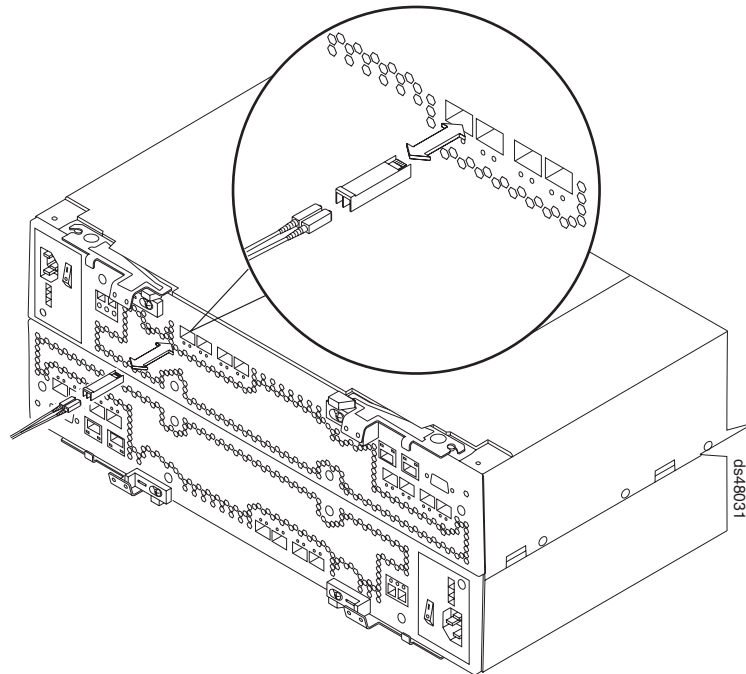


Figure 56. Installing an SFP module and LC-LC cable in a DS4800

Install an SFP module in the SFP port on the back of the storage expansion enclosures; then, connect the other end of the LC-LC cable into the SFP module, as shown in Figure 57.

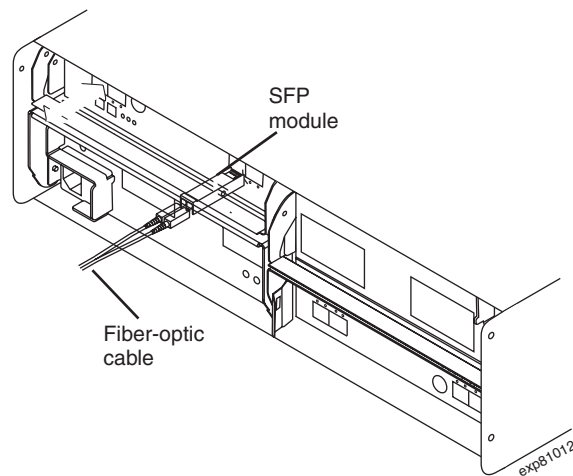


Figure 57. Installing an SFP module and connecting an LC-LC cable to the storage expansion enclosures

For important information about connection rules and recommendations, see 4 on page 67.

Storage expansion enclosure settings

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

Fibre channel loop and ID settings

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

DS4000 storage expansion enclosure ID settings

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

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

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

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

Attention: When connecting storage expansion enclosures, it is recommended that you use the tens digit (x10) enclosure ID setting to distinguish different redundant loops and use the ones digit (x1) enclosure ID setting to distinguish storage expansion enclosures IDs within a redundant loop. For example, in a DS4800 configuration with 16 storage expansion enclosures distributed equally behind the four controller drive ports, the recommended enclosure ID settings for the enclosures dsare shown in Table 16.

Table 16. Recommended enclosure ID settings scheme

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

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

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

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

Connecting hosts to the DS4800

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

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

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

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

2. Connect the fibre channel cables from the SFP modules in the DS4800 RAID controller host ports to either the SFP modules in the fibre channel switch or the SFP modules of the host bus adapters. Figure 58 on page 80 shows the location on the RAID controllers where the host-system cables connect.

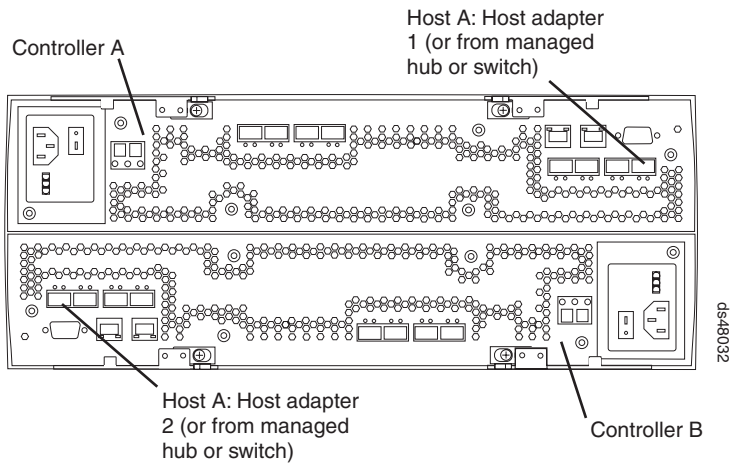


Figure 58. Location of host cables on RAID controllers

- Repeat steps 1 on page 79 and 2 on page 79 for each additional redundant host connection. You can create a maximum of four redundant host connections, as shown in Figure 59.

Note: Figure 59 shows that the DS4800 host ports are connected to four sets of FC host bus adapters (HBAs). You can replace one or all of these sets of FC HBAs with FC switches as required.

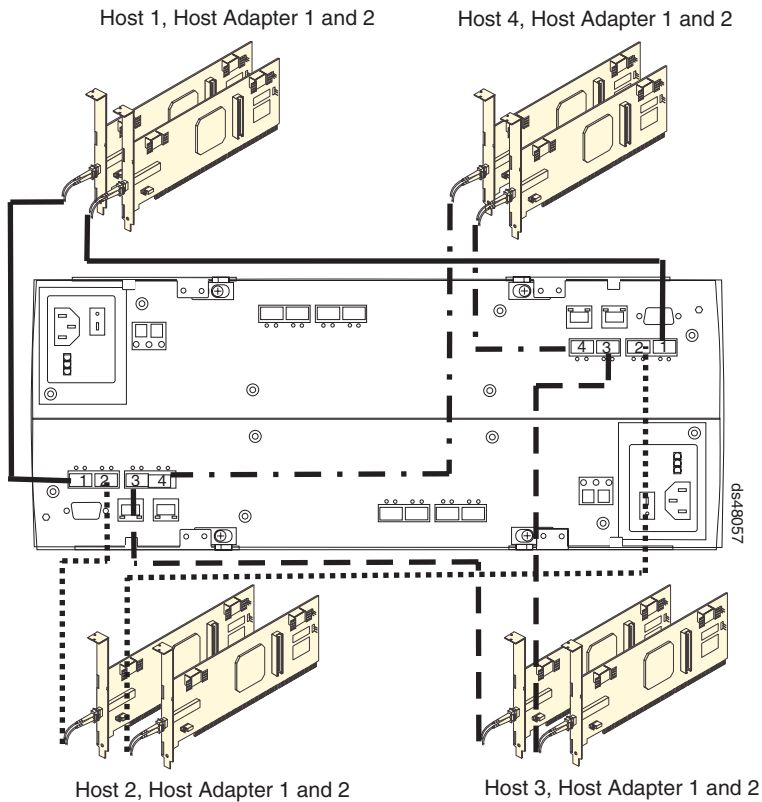


Figure 59. Cabling diagram for four redundant host connections

For examples of redundant, partially-redundant, and non-redundant host and drive channel configurations, see “Fibre channel host loop configurations” on page 84.

Connecting secondary interface cables

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

Use the Ethernet interface ports on the back of the storage subsystem to connect the controllers for direct management of the storage subsystems (see “Direct (out-of-band) management method” on page 83).

Important:

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

Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for Controller A (located on the top) and Controller B (located on the bottom) on the back of the storage subsystem. Figure 60 shows the location of the ports. Only one Ethernet port connection from each controller is required to establish a direct (out-of-band) management connection to the DS4800 Storage Subsystem.

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

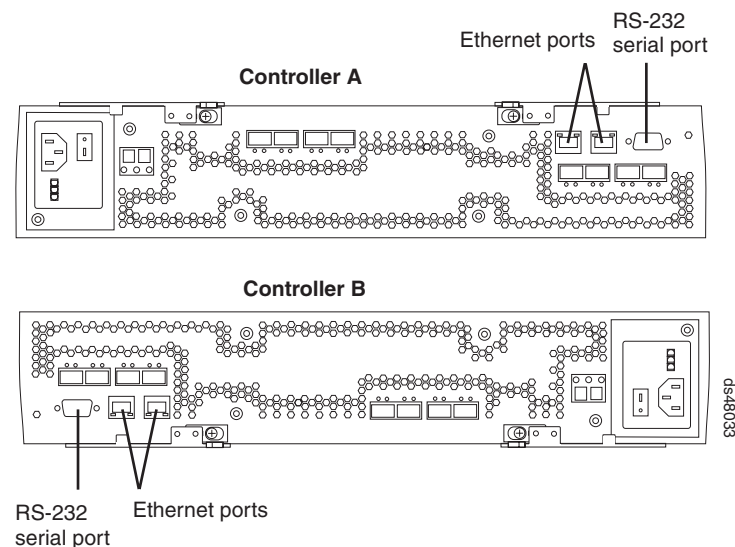


Figure 60. Ethernet and serial port locations

Configuring the storage subsystem

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

Storage subsystem management methods

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

For more information on setting up in-band or out-of-band management connections, refer to the DS4000 Storage Manager Installation and Support Guide for the operating system of the host computer that will be used to manage the DS4800 Storage Subsystem.

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

Host-agent (in-band) management method

This method requires host-agent software that you install on the host server. The host-agent software allows the DS4000 Storage Manager client program to manage the DS4000 Storage Subsystem using the same fibre channel connections between the host server and the storage subsystem. You must install at least one management station and a software agent host. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Figure 61 on page 83 shows the host-agent (in-band) management method.

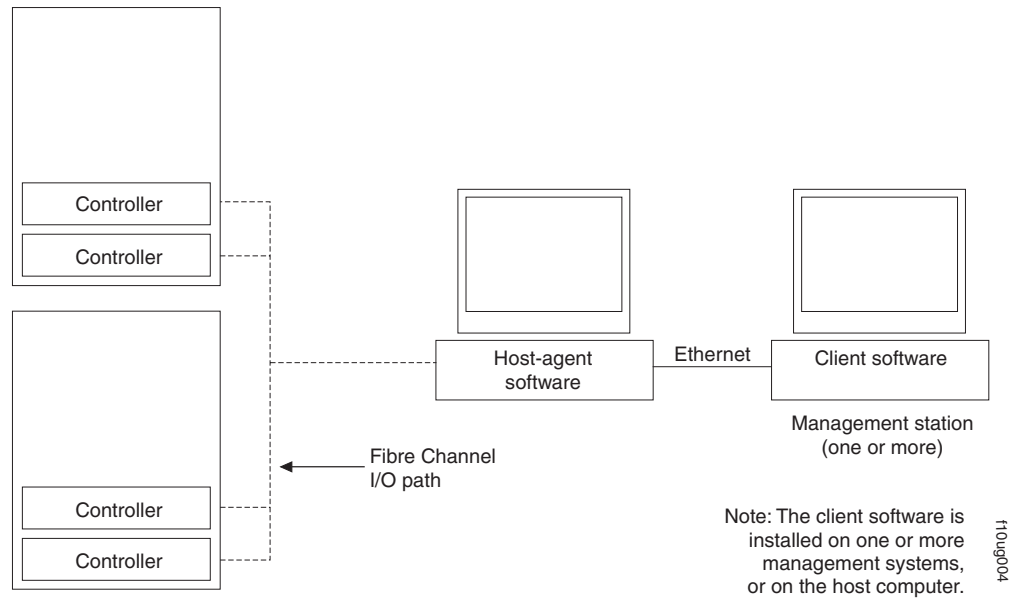


Figure 61. Host-agent (in-band) managed storage subsystems

Direct (out-of-band) management method

This method uses Ethernet connections from a management station to each controller. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Attach Ethernet cables to each management station (one pair per storage subsystem). You will connect the cables to each storage subsystem controller later when you install the storage subsystem. Figure 62 on page 84 shows the direct (out-of-band) management method.

Note: Do not connect the DS4800 Storage Subsystem Ethernet ports to a public network or public subnet. It is strongly recommended that you create a private network between the DS4800 Storage Subsystem and the management station.

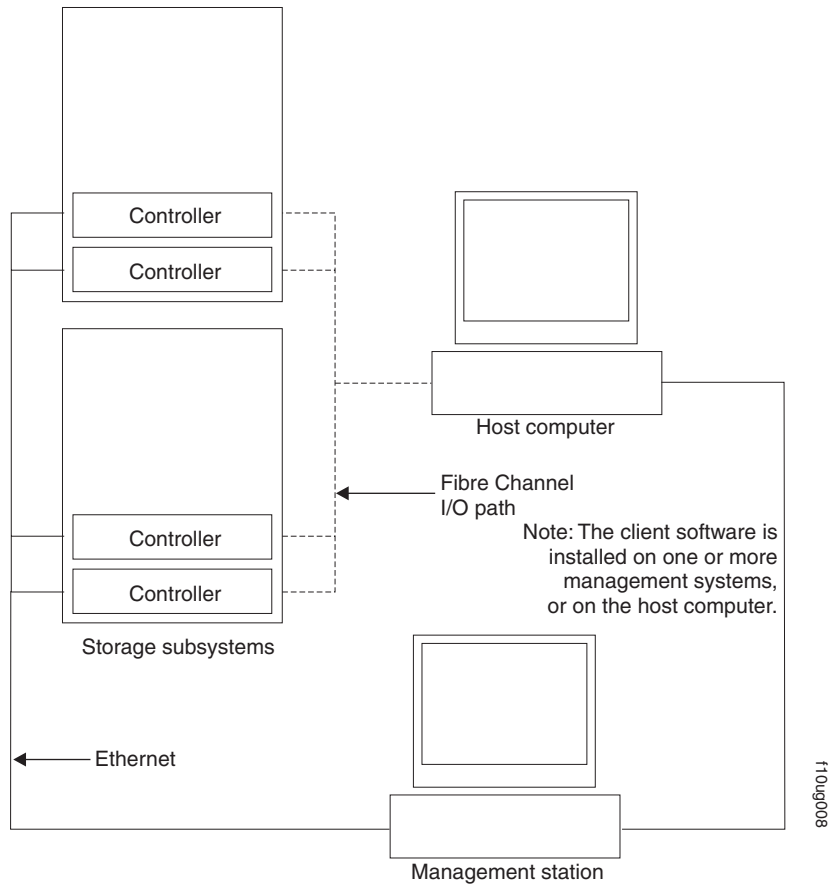


Figure 62. Direct (out-of-band) managed storage subsystems

Fibre channel connections

The storage subsystem fibre channel connection consists of up to four host fibre-channel loops and a redundant drive fibre-channel loop. The host fibre-channel loops provide the fibre path for host attachment. They can consist of fibre-channel cables, SFPs, host bus adapters, fibre-channel switches, and RAID controllers. The redundant drive fibre-channel loop provides the fibre path from the DS4800 Storage Subsystem to the hard disk drives (HDDs) in the storage expansion enclosures. The redundant drive fibre-channel loop consists of the DS4800 Storage Subsystem, the storage expansion enclosures, fibre-channel cables, and SFPs.

The DS4800 supports redundant drive channel pair configurations. You can build a redundant drive channel pair by connecting one or more storage expansion enclosures to the redundant RAID controllers. Then, use dual fiber-optic cables to connect one storage expansion enclosure to another in a daisy-chain. For more information, see “Connecting storage expansion enclosures to the DS4800” on page 59.

Fibre channel host loop configurations

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

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

Redundant host and drive loops

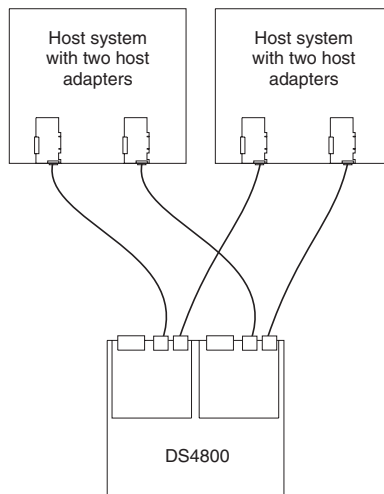
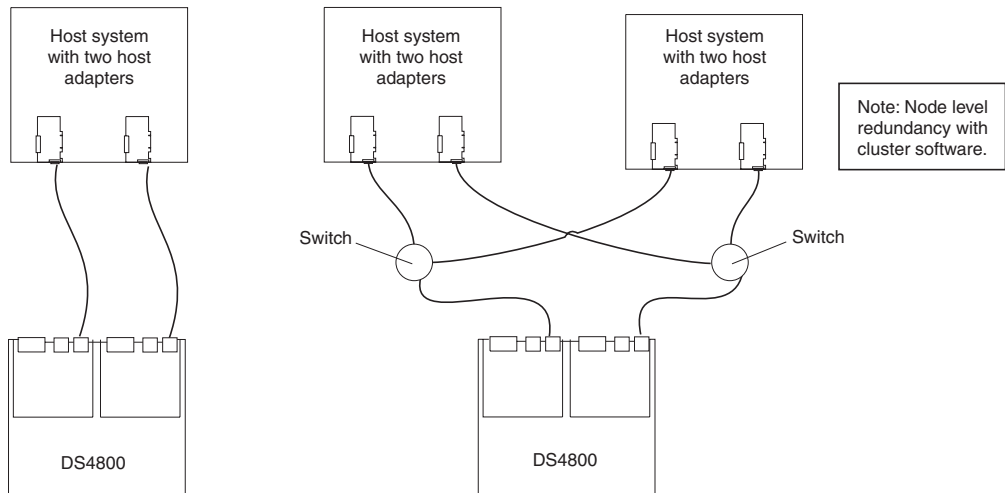
This section provides examples of DS4800 host fibre channel configurations.

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

- Redundant host and drive fibre channel loop configurations, as shown in Figure 63 on page 86
- Single SAN fabric configuration, as shown in Figure 64 on page 87
- Dual SAN fabric configuration, with an additional DS4800 attached, as shown in Figure 65 on page 87
- Two clusters, as shown in Figure 66 on page 88

Notes:

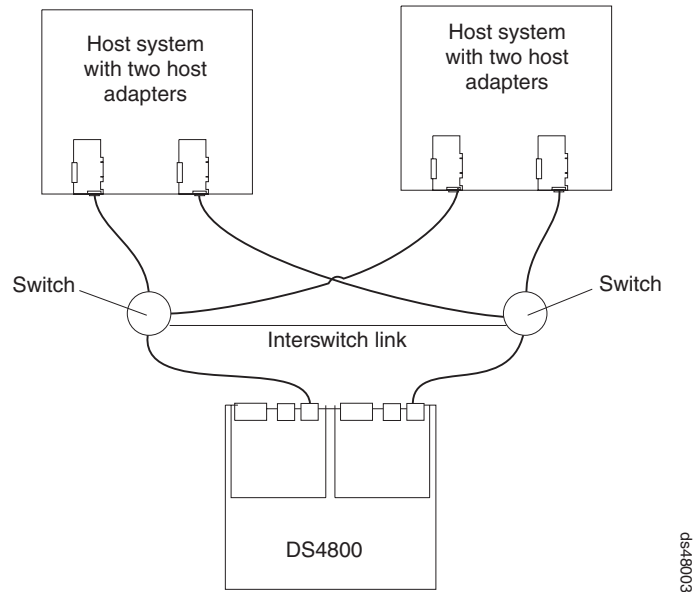
1. These configurations have host and drive path failover protection and are recommended for high availability.
2. The following illustrations do not accurately represent the controller locations in the DS4800.



100919P

Figure 63. Examples of redundant host direct attached fibre channel configurations

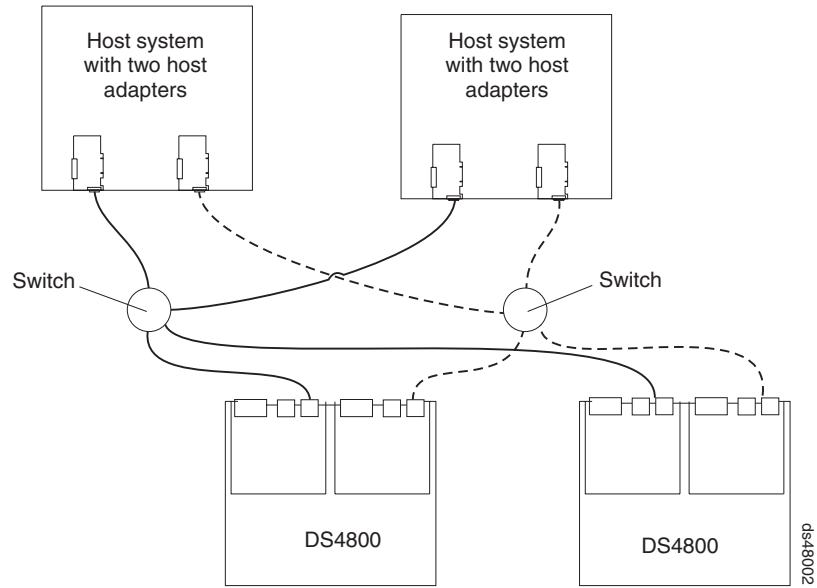
In Figure 64 on page 87, the fibre channel switches are connected together via the inter-switch link (ISL) to form a single SAN fabric.



ds48003

Figure 64. Example of a single SAN fabric configuration

In Figure 65, the fibre channel switches are not connected together. Each switch forms its own SAN fabric.



ds48002

Figure 65. Example of two storage subsystems in a dual SAN environment

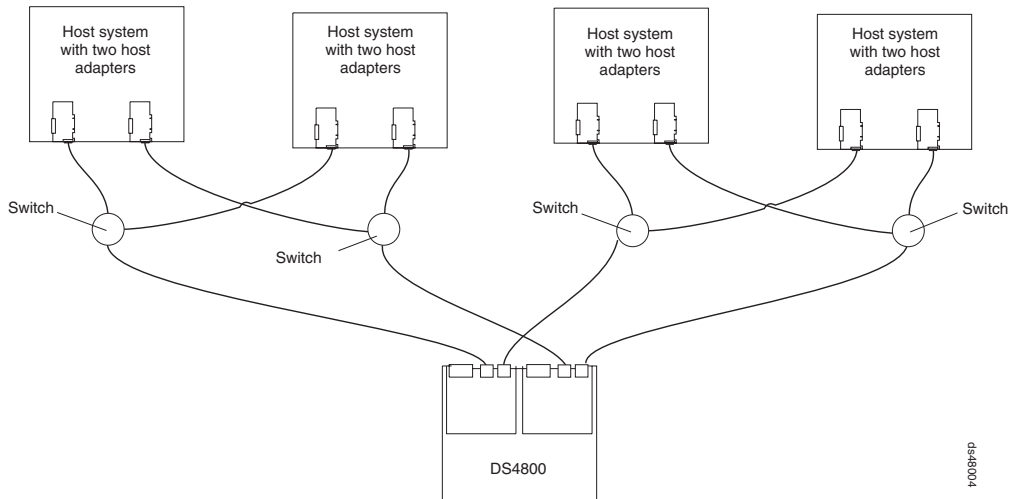


Figure 66. Example of a two-cluster configuration

Installing the storage subsystem configuration

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

Notes:

1. See the documentation provided with your host adapters for installation requirements and procedures.
2. Use the correct host adapter driver. For the latest supported host adapters and drivers, go to the following Web site:

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

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

Connecting the power cables

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

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

The DS4800 does not ship with the power cords used to connect the DS4800 to the electrical outlets outside the rack cabinet. Refer to Appendix D, “Power cords,” on page 185 for the list of IBM-approved power cords for your region. The DS4800 does ship with two line jumper cords for connecting the DS4800 RAID controller units to IBM-approved rack PDUs.

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

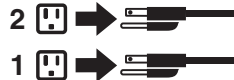
cabinet. If your cabinet contains components that you do not want to power off, turn off all power switches on the components of the storage configuration you are currently installing.

Statement 5:



CAUTION:

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



1. Verify that the main circuit breakers in the cabinet are turned off.
2. If you have not already done so, turn off all power switches on each storage subsystem and storage expansion enclosure in the cabinet. Figure 67 shows the locations of the power switches and connectors on the storage subsystem.

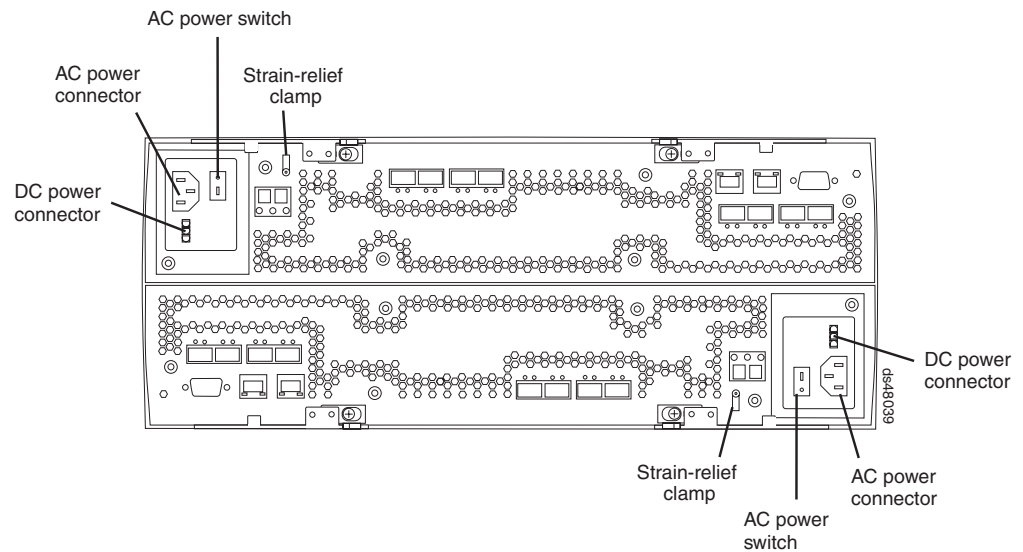


Figure 67. AC power switch and AC and DC power connectors

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

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

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

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

It is recommended that you determine the maximum surge current possible when all devices in the power circuit are started at the same time. Based on the total number of devices on a power circuit, find the maximum (worst-case) specification value in order to prevent the circuit from tripping. When both RAID controllers are connected and the storage subsystem is powered on, each RAID controller unit will handle approximately one-half of the current load. To ensure maximum protection against power loss due to RAID controller unit failure or a power circuit tripping, both RAID controller units must be connected and powered on. See Table 13 on page 23 for the DS4800 AC power requirements.

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

See Figure 68 on page 91 for an example of redundant power cabling.

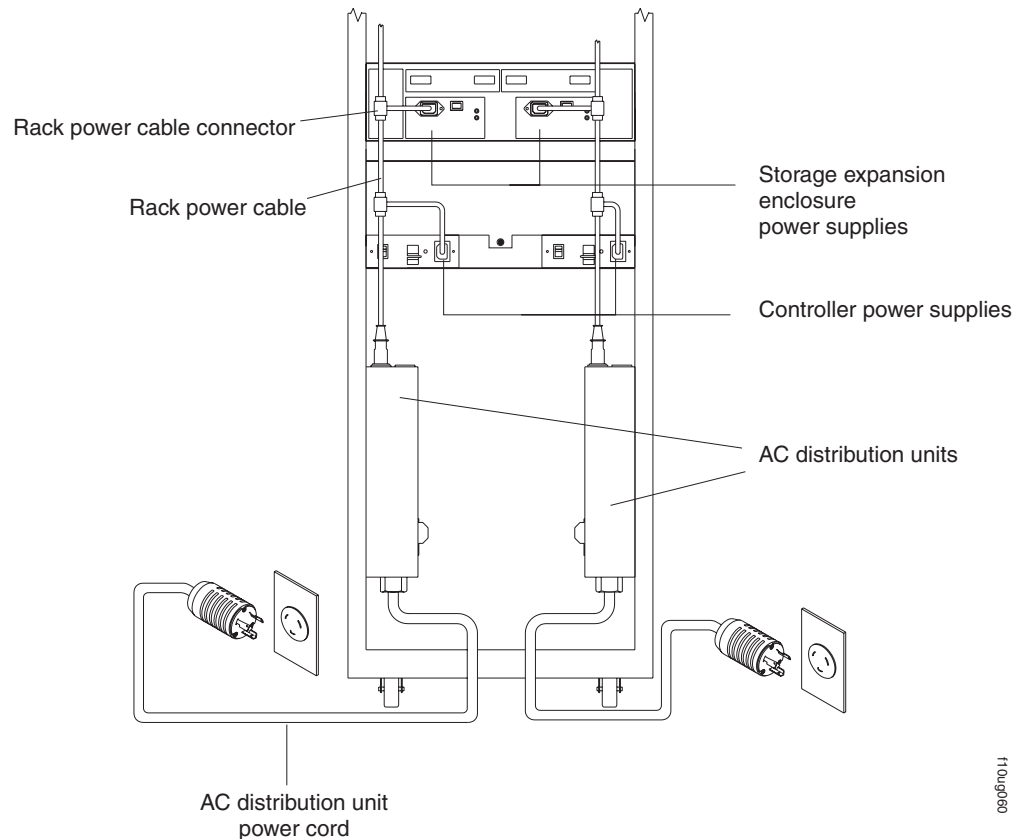


Figure 68. Redundant AC power connections to controllers and storage expansion enclosures

For details about power requirements, see “Electrical requirements” on page 23.

10. Go to “Turning on the storage subsystem” on page 97.

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

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

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

Chapter 4. Operating the storage subsystem

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

- Ensure that your system is in an optimal state before you shut it down. Never turn the power off if any Needs Attention LED is lit; be sure to resolve any error conditions before you shut down the system.
- Back up the data on your storage drives periodically.
- To maintain power redundancy, plug the storage subsystem's right and left RAID controller units into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4800 should be plugged into the same two independent external power circuits as the DS4800. This ensures that the DS4800 and all its attached storage expansion enclosures will have power if only one power circuit is available. In addition, having all the right or all the left power cables plug into the same power circuit will enable the components in the storage subsystem to power on simultaneously during an unattended restoration of power. See Figure 68 on page 91 for an example of redundant power connections.

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

- Before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on), save the storage subsystem profile as explained in the DS4000 Storage Manager guide for your operating system. Save the profile in a location other than the logical drives created for the DS4800.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in "Turning on the storage subsystem" on page 97. You should check that each component of the subsystem is powered-on in the proper order during this entire power-up procedure to ensure that the controller will optimally access all of your storage subsystems.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in "Turning on the storage subsystem" on page 97 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and arrays are not displayed in the DS4000 Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and arrays do not come online.
 - The storage subsystem logical drives and arrays seem to be degraded.

Performing the DS4000 Health Check process

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

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

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

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

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

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

If you discover your firmware is not up-to-date, upgrade the firmware and software to the latest level appropriate to your DS4000 storage configuration. See “Web pages” on page 95 for information about where to find the latest firmware and software.

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

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

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

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

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

Web pages

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

For DS4000 information, go to the following Web site:

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

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

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

Hardware responsibilities

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

IBM suggests you follow these guidelines:

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

Note: Some updates might require storage subsystem downtime.

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

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

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

Removing and replacing the front bezel

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

Figure 69 shows the following steps to remove and replace the front bezel.

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

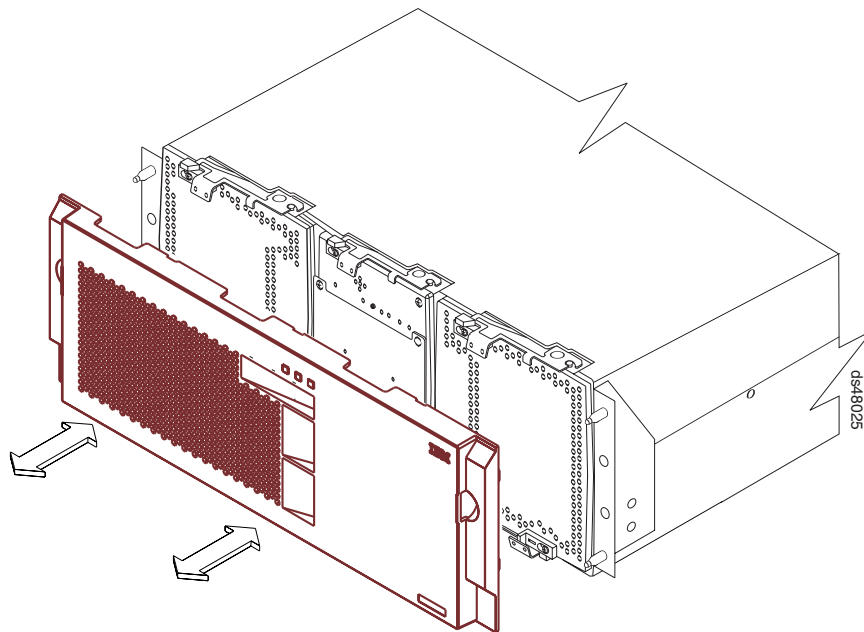


Figure 69. Installing the front bezel

Turning the storage subsystem on and off

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

If you are turning on the storage subsystem after an emergency shutdown or power outage, see “Restoring power after an unexpected shutdown” on page 102.

Turning on the storage subsystem

Power-on overview

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

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

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

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

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

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

Use this procedure to turn on power to a storage configuration at the initial startup or after a normal shutdown. To restore power after an unplanned shutdown, see “Restoring power after an unexpected shutdown” on page 102.

Important:

1. If needed, remove the front bezel, as described in “Removing and replacing the front bezel” on page 96.
2. Ensure that all power cords are connected, as described in “Connecting the power cables” on page 88.

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

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

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

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

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

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

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

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

5. Turn on the AC power switch on the back of each controller in the storage subsystem. Figure 70 shows the location of the AC power switches on the controllers.

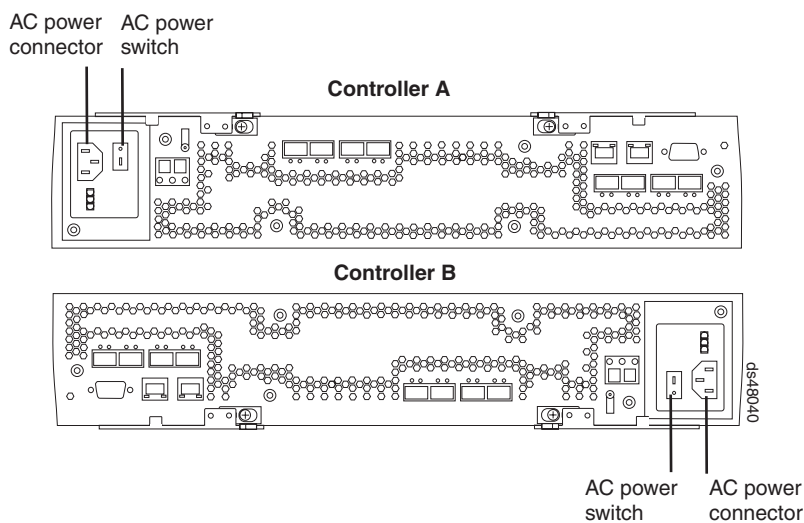


Figure 70. AC power switches on the controllers

Depending on the number of storage expansion enclosures in the configuration, the DS4800 Storage Subsystem might take several minutes to power up. The

battery self-test might take an additional 15 minutes. The LEDs will blink intermittently until the storage subsystem powers up and completes the battery self-test. Before attempting any operations, wait at least five minutes for the storage subsystem to completely power up.

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

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

6. Determine the status of all storage subsystems and components in the configuration by completing the following steps.
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status. For more information on LED status for storage expansion enclosures, see the Installation, User's, and Maintenance Guide for your DS4000 storage expansion enclosure.
 - b. Check all LEDs on each component in the storage subsystem. Ensure that all the LEDs show normal status. For information about LED status, see "Checking the LEDs" on page 111.
 - c. Open the DS4000 Storage Manager Subsystem Management Window, and display the Physical View for the configuration.
The status for each component will be either Optimal or Needs Attention.
 - d. Review the status of the configuration components shown in the Subsystem Management Window by selecting the appropriate component button for each storage subsystem.
7. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes – End of procedure. Replace front bezel, as described in "Removing and replacing the front bezel" on page 96.
 - No – Go to step 8.
8. Diagnose and correct the fault by completing the following steps.
 - a. Run the DS4000 Storage Manager Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management Window.
 - b. Complete the recovery procedure.
If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the failed component. (For procedures to replace a failed component, see Chapter 5, "Replacing components," on page 133.)
 - c. When the recovery procedure is completed, select Recheck in the Recovery Guru. This action reruns the Recovery Guru to ensure that the problem has been fixed.
 - d. If the problem has not been fixed, contact your IBM service representative.

Turning off the storage subsystem

Attention: Except in an emergency, never turn off the power if any storage subsystem Needs Attention LEDs are on. Correct the fault before you turn off the power. Use the DS4000 Storage Manager client and the Needs Attention LEDs to check the overall status of the storage subsystem and its components. All LEDs should be green on the front of the storage subsystem. If they are not, use the DS4000 Storage Manager client to diagnose the problem (see “Monitoring status through software” on page 107). This ensures that the storage subsystem will power up correctly later.

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

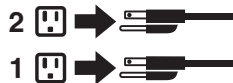
- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.
- A planned power outage or emergency situation occurs (see “Performing an emergency shutdown” on page 103).

Statement 5:



CAUTION:

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



Attention: Turning 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 subsystems for a planned shutdown. To turn off power for an unplanned shutdown, see “Performing an emergency shutdown” on page 103.

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

1. Stop all I/O activity to the storage subsystems.
2. Determine the status of all storage subsystems and components in the configuration by completing the following steps.
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status.
 - b. Check all LEDs on each component in the storage subsystem. Ensure that all the LEDs show normal status. For information about LED status, see “Checking the LEDs” on page 111.
 - c. Open the Subsystem Management Window for the configuration and display the Physical View for the configuration.
 - d. Review the status of the configuration components shown in the Subsystem Management Window by selecting the appropriate component button for each storage subsystem.

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

3. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes – Go to step 5 on page 102.
 - No – Go to step 4.
4. To diagnose and correct the fault, complete the following steps.
 - a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management Window.
 - b. Complete the recovery procedure.

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

- c. When the recovery procedure is completed, select Recheck in the Recovery Guru. This action reruns the Recovery Guru to ensure that the problem has been fixed.
 - d. If the problem has not been fixed, contact your IBM service representative. Do not turn off power until all problems are corrected.
5. Check the back of the storage subsystem, and verify that the Cache Active LED is off.
If the Cache Active LED is on steady, the cache contains data. Wait for the data to clear from cache memory before turning off the power.
 6. Check the LEDs on the storage expansion enclosures to verify that all Drive Active LEDs are on steady (not blinking).
If one or more LEDs are blinking, data is being written to or from the drives. Wait for all Active LEDs to stop blinking.
 7. Turn off the AC power switch on the back of each controller in the storage subsystem. (Figure 67 on page 89 shows the location of the AC power switch on a controller.)

Note: Until the power switch on each controller is turned off, power still remains turned on for the both controllers; therefore, the seven-segment display on each controller stays on until the power switch on each controller is turned off.
 8. Turn off both power switches on the back of each storage expansion enclosure in the configuration.
 9. After you perform the necessary maintenance procedures, turn on the power using the procedure in “Turning on the storage subsystem” on page 97.

Restoring power after an unexpected shutdown

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

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

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

- You are forced to shut down the storage subsystem without performing the normal shutdown procedures (listed in “Turning off the storage subsystem” on page 100) because of an emergency situation.

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

Note: Unattended restoration of power is supported; however, if power restoration is attended, you should follow the best practices guidelines and the power restoration sequence in “Turning on the storage subsystem” on page 97.

Performing an emergency shutdown

Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This will help safeguard your equipment from potential damage due to electrical surges when power is restored. If the storage subsystem loses power unexpectedly, it might be due to a hardware failure in the power system or midplane (see Chapter 6, “Hardware maintenance,” on page 159).

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

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

Restoring power after an emergency shutdown

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

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

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

Potential data loss – Before resetting circuit breakers in the cabinet, ensure that the storage subsystem and storage expansion enclosures power switches are turned off. Resetting circuit breakers after an emergency situation while the storage subsystem and storage expansion enclosure power switches are turned on can cause potential data loss because the configuration components might not be powered on in the correct sequence. See “Turning on the storage subsystem” on page 97 for details about the correct power-on sequence.

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

3. Verify the main circuit breakers in the cabinet are turned off.
4. Verify that the AC power switch on each DS4800 Storage Subsystem is turned off. (Figure 67 on page 89 shows the location of the AC power switch on each controller.)
5. Verify that both power switches on all storage expansion enclosures in the configuration are turned off.
6. Turn on the main circuit breakers in the cabinet.
7. Turn on both power switches on the back of each storage expansion enclosure.

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

8. Verify that no ESM port bypass LEDs are lit on any storage expansion enclosures.

If any ESM port bypass LEDs are lit, reseal the ESMs and check the ESM port bypass LEDs again.

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

If the problem is not resolved, use the fibre channel wrap-plug and coupler to attempt to isolate the problem to the ESM port, SFP, or fibre channel cable.

See the *IBM System Storage DS4000 Problem Determination Guide* for information on performing wrap plug tests.

9. Turn on the AC power switch on the back of each controller in the storage subsystem. Figure 67 on page 89 shows the location of the AC power switch on the controller. The storage subsystem might take several minutes to power up, depending on the number of attached storage expansion enclosures. The battery self-test might take an additional 15 minutes. The LEDs will blink intermittently until the storage subsystem powers up and completes the battery self-test.
10. Determine the status of all storage subsystems and their components in the configuration, by completing the following steps.
 - a. Check all LEDs on each component in the storage expansion enclosures. Ensure that all the LEDs show normal status.
 - b. Check all LEDs on each component in the DS4800 Storage Subsystem. Ensure that all the LEDs show normal status. For information about LED status, see “Checking the LEDs” on page 111.
 - c. Open the Subsystem Management Window, and display the Physical View for the configuration.
 - d. Review the status of the configuration components shown in the Subsystem Management Window by selecting the appropriate component button for each storage subsystem. The status for each component will be either Optimal or Needs Attention.
11. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?
 - Yes – End of procedure.
 - No – Go to step 12.
12. Diagnose and correct the fault by completing the following steps.
 - a. Run the Recovery Guru by selecting the Recovery Guru toolbar button in the Subsystem Management Window.
 - b. Complete the recovery procedure. If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage

subsystem to locate the specific failed component. (For more on troubleshooting the storage subsystem, see “Troubleshooting the storage subsystem” on page 109.)

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

Responding to the audible alarm

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

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

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

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

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

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

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

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

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

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

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

If the alarm sounds, check the storage subsystem for faults. For troubleshooting procedures, see “Troubleshooting the storage subsystem” on page 109.

Installing the DS4000 Storage Manager client

Refer to the *IBM System Storage DS4000 Storage Manager 9.16 Installation and Support Guide* for the appropriate operating system for instructions on how to install the Storage Manager software. Use that document and the online help to configure the logical drives, partitions, and so on for the RAID controllers. Use your operating system documentation to make the new logical drives accessible to the operating system. Do not proceed with the configuration setup until you have completed the DS4000 Storage Manager installation.

Firmware requirements

You must ensure that your system's firmware is at the levels shown in Table 17.

Table 17. Firmware requirements

Software/firmware	Level
DS4000 Storage Manager software	9.16
DS4000 controller firmware and NVSRAM	06.16.xx.xx or 06.16.xx.xx Controller firmware version 06.16.16.xx is required to support EXP810 storage expansion enclosure attachment. It also supports EXP710 storage expansion enclosures but does not support EXP100 storage expansion enclosure attachment. Controller firmware version 06.15.xx.xx is required to support EXP100 storage expansion enclosure attachment. It also supports EXP710 storage expansion enclosures but does not support EXP810 storage expansion enclosure attachment.
EXP710 ESM firmware	983x or later
EXP810 ESM firmware	986x or later
EXP100 ESM firmware	9563 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/

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

- HBA drivers
- Controller firmware version 06.15.xx.xx or 06.16.xx.xx. Controller firmware 6.15.xx.xx is currently shipped with the DS4800 subsystem models 82A/H, 84A/H and 88A/H. This version of DS4800 controller firmware supports the EXP100 and EXP710 storage expansion enclosures. It does not support the attachment of EXP810 enclosures. The DS4800 controller firmware version 06.16.xx.xx is shipped with the EXP810 storage expansion enclosures and DS4800 model 80A/H. It supports the attachment of EXP710s and EXP810s to the DS4800 subsystem. Do not install the controller firmware version 6.16.xx.xx in the DS4800 subsystems having an EXP100 attached.

Note: DS4800 model 80A/H does not support 06.15.xx.xx and 06.14.xx.xx controller firmware versions. You cannot downgrade DS4800 model 80A/H to 06.15.xx.xx and 06.14.xx.xx controller firmware versions.

- IP addresses for RAID controllers (for in-band management only)
- Additional documentation for switches and HBAs, if needed
- *DS4000 Storage Manager Version 9.16 Support CD*, which includes the storage subsystem controller firmware 06.15.xx.xx for DS4800 models 82A/H, 84A/H, and 88A/H and storage subsystem controller firmware 06.16.xx.xx for DS4800 model 80A/H.
- For EXP810 attachment, the *DS4000 Storage Server Controller Firmware Version 6.16 Support for DS4000 EXP810 Fibre-Channel Storage Expansion Enclosure CD*, included in the EXP810 shipping group. This CD contains controller firmware required to upgrade the DS4800 models 82A/H, 84A/H, and 88A/H to a version that supports EXP810 attachment. Even when a newer 06.16.xx.xx version of controller firmware is available on the IBM DS4000 support web site, you must first upgrade the firmware in DS4800 models 82A/H, 84A/H, and 88A/H using the controller firmware file on this CD before applying the latest 06.16.xx.xx controller firmware version available on the IBM DS4000 support web site. The 06.16.xx.xx code on the IBM support web site will not load into DS4800 controllers that do not already have a 06.16.xx.xx version of the controller firmware installed.
- Appropriate host kit for your operating system

Depending on the DS4800 model you order, your DS4800 will ship with either the Microsoft Windows host software attachment kit or with your choice of host software kits (Windows, AIX, Linux, Netware, SUN Solaris, HP-UX, Linux on POWER, or VMware). The host software kit grants you permission to attach host servers using the appropriate operating system to the DS4800. The kit includes a *DS4000 Storage Manager Version 9.16 Support CD* that has the appropriate IBM DS4000 Storage Manager host software. The CD also contains includes controller firmware version 06.15.

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

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

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

Always refer to the readme that is included with the DS4800 Storage Subsystem firmware package (whether the firmware is accessed by the Web or CD) for any special requirements or restrictions that apply to that particular firmware version.

Note: Make sure that you install the DS4000 Storage Manager event monitoring service to enable continuous monitoring of the status of the storage subsystem. For more information about the importance of this information, see “Monitoring status through software.”

Monitoring status through software

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

Notes:

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

For more information, see the Enterprise Management online Help.

Important: Refer to the *IBM System Storage DS4000 Storage Manager 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.

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

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

Note: The version of controller firmware determines which version of the DS4000 Storage Manager interface is displayed. For example, the interface for DS4000 Storage Manager version 9.12 subsystem management would be displayed when managing a DS4800 Storage Subsystem with controller version 06.12.xx.xx installed, even if the installed version of the DS4000 Storage Manager client code is actually 9.16.

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

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

Although the storage subsystem has Needs Attention LEDs, these LEDs do not necessarily indicate which component has failed or needs to be replaced, or which type of recovery procedure you must perform. In some cases (such as in the case of a hard disk drive exceeding its PFAs), the Needs Attention LED does not turn on. Only the DS4000 Storage Manager client can detect the failure.

For example, the recovery procedure for a Predictive Failure Analysis[®] (PFA) flag (impending drive failure) on a drive varies depending on the drive status (hot spare, unassigned, RAID level, current logical drive status, and so on). Depending on the circumstances, a PFA flag on a drive can indicate a high risk of data loss (if the drive is in a RAID 0 volume) or a minimal risk (if the drive is unassigned). Only the DS4000 Storage Manager client can identify the risk level and provide the necessary recovery procedures.

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

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

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

Firmware updates

DS4800 models 82, 84 and 88 will be shipped with controller firmware version 6.15.xx.xx. The DS4800 model 80 will be shipped with version 6.16.xx.xx and will not have support for versions 6.15.xx.xx or 6.14.xx.xx as will the other models.

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

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

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

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

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

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

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

Troubleshooting the storage subsystem

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

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

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

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

- Interconnect-battery unit and battery packs in the component
- SFPs
- Power supply-fans
- Temperature sensors

The status for each component is either Optimal, Charging (applicable to battery packs only), or Needs Attention.

6. Do any components have a Needs Attention status?
 - Yes – Go to step 7.
 - No – All components are Optimal. Go to step 8.
7. Select the Recovery Guru toolbar button. Perform the procedure in the Recovery Guru to correct the problem. The Recovery Guru might direct you to replace the failed component; if so, go to step 10, otherwise continue with step 8.
8. Check the LEDs on the storage subsystem to determine if a fault has occurred in the storage subsystem.

For the definition of the LED statuses, see “Checking the LEDs” on page 111.

9. Are any Needs Attention LEDs indicating a fault condition?
 - Yes – Go to step 10.
 - No – You are finished with this procedure.

If you are still experiencing a problem with this storage subsystem, go to step 11.

10. Replace the failed component. For instructions on replacing the controllers, power supply-fans, interconnect-battery, battery pack, and SFP modules, see Chapter 5, “Replacing components,” on page 133.
11. If the problem has not been fixed, contact your IBM service representative. Print a storage subsystem profile, and save the storage subsystem support data. The profile and support data are helpful when troubleshooting storage subsystem problems. (For information about printing a storage subsystem profile and saving the support data, refer to the Subsystem Management Window online help.)

Checking the LEDs

The LEDs display the status of the storage subsystem and components. Green LEDs indicate a normal operating status; amber LEDs (Needs Attention) indicate a possible failure; a blue LED indicates that is safe to remove a component.

It is important to check all the LEDs on the front and back of the storage subsystem when you turn on the power. In addition to checking for faults, you can use the LEDs on the front of the storage expansion enclosures to determine if the drives are responding to I/O transmissions from the host.

Front bezel LEDs

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

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

Important: The displayed order of the Overall DS4800 Configuration Needs Attention and Locate/Identify LEDs on the interconnect-battery unit are reversed when the bezel is removed. See “Interconnect-battery unit LEDs” on page 119.

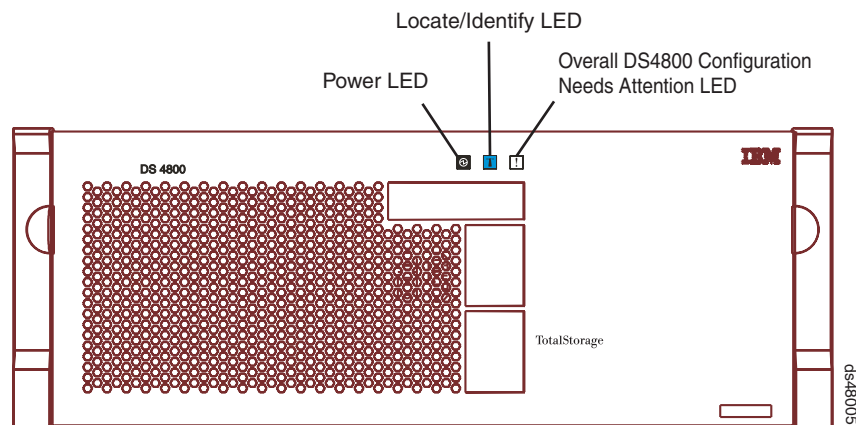


Figure 71. Front bezel LEDs

Table 18. Front bezel LEDs

LED	Color	Normal Status	Problem Status	Procedure
Power	Green LED	On = Storage subsystem is powered on	Off = Storage subsystem is powered off	

Table 18. Front bezel LEDs (continued)

LED	Color	Normal Status	Problem Status	Procedure
Locate/Identify	Blue LED Note: This LED is shown as white (and displayed in a different order) on the interconnect-battery unit when the DS4800 bezel is removed. See "Interconnect-battery unit LEDs" on page 119.	Off	On = Storage subsystem locate	
Overall DS4800 Configuration Needs Attention	Amber LED	Off	On = There are one or more failures in the DS4800 storage subsystem configuration. The cause of failure could be one of the components in the DS4800 chassis or one of the components in the attached DS4000 storage expansion enclosures.	"Troubleshooting the storage subsystem" on page 109

RAID controller LEDs

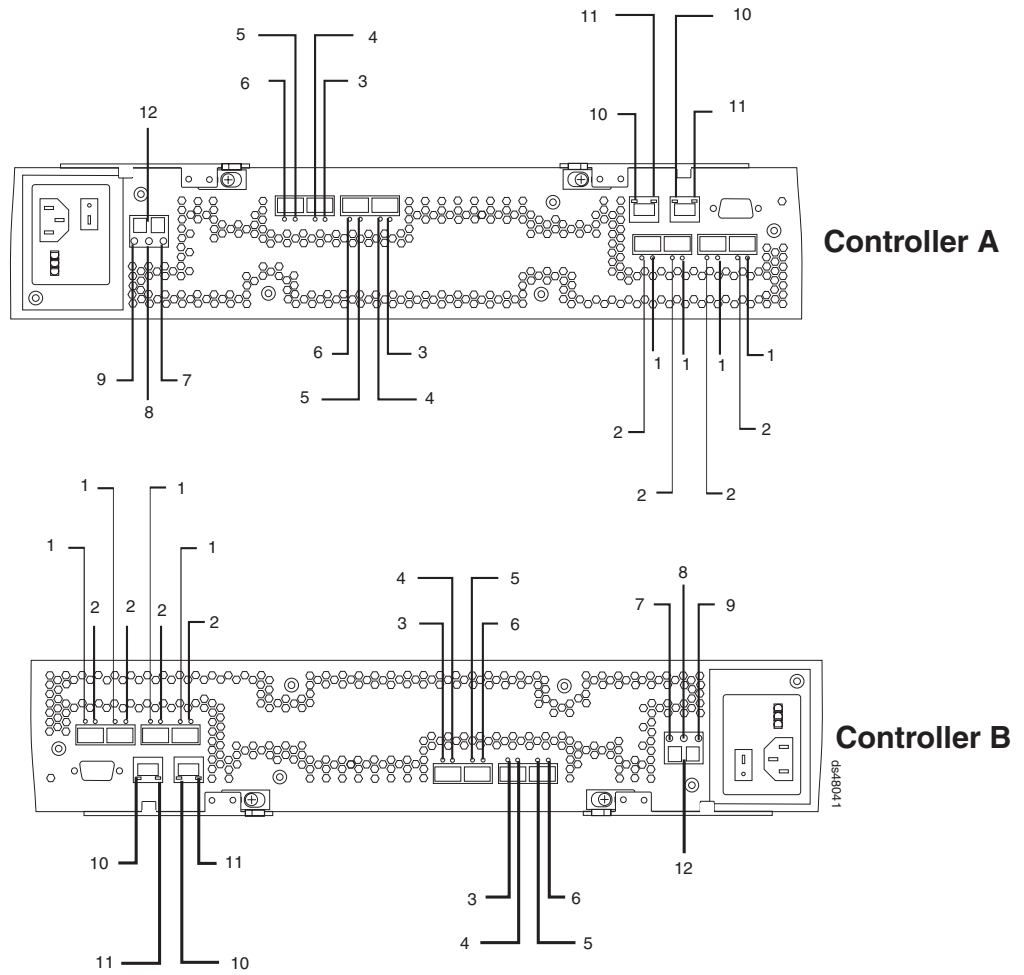


Figure 72. RAID controller LEDs

Table 19. RAID controller LEDs

Legend	LED	Color	Normal Status	Problem Status	Procedure
1	Host Channel Speed – L1	Green LED	See Table 20 on page 116.		
2	Host Channel Speed – L2	Green LED			

Table 19. RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status	Procedure
3	<p>Drive Port Bypass (one LED per port)</p> <p>Note: The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that made up a drive channel. The LED marked 6 shows the status of the other port.</p>	Amber LED	Off	<p>On = Bypass problem</p> <ul style="list-style-type: none"> • An SFP module is inserted in the port and the connected fibre channel is either absent or not properly connected • The storage expansion enclosure connected to this port is not powered on • There is a problem with the fibre channel connection between this port and the fibre channel port of the connected ESM in the storage expansion enclosure. 	
4	Drive Channel Speed – L1	Green LED	See Table 20 on page 116.		
5	Drive Channel Speed – L2	Green LED			

Table 19. RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status	Procedure
6	Drive Port Bypass (one LED per port) Note: The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that made up a drive channel. The LED marked 3 shows the status of the other port.	Amber LED	Off	On = Bypass problem <ul style="list-style-type: none"> • An SFP module is inserted in the port and the connected fibre channel is either absent or not properly connected • The storage expansion enclosure connected to this port is not powered on • There is a problem with the fibre channel connection between this port and the fibre channel port of the connected ESM in the storage expansion enclosure. 	
7	Service Action Allowed	Blue LED	Off	On = Safe to remove	“Replacing a controller” on page 137
8	Needs Attention	Amber LED	Off	On = Controller needs attention There is a controller fault or a controller is off-line.	“Troubleshooting the storage subsystem” on page 109
9	Cache Active	Green LED	On = Data in cache Off = No data in cache	Not applicable	
10	Ethernet Link Speed	Green LED	Off = 10BASE-T On = 100BASE-T	Not applicable	

Table 19. RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status	Procedure
11	Ethernet Link Activity	Green LED	Off = No link established On = Link established Blinking = Activity	LED is off when a Ethernet cable is connected:	<ul style="list-style-type: none"> • Check to see whether there are problems with the Ethernet cables or Ethernet switch. • Verify that the controller is not offline. • Verify that the controller Ethernet port has not been disabled. • Verify that the controller Ethernet port is not bad.
12	Numeric Display (enclosure ID and Diagnostic Display)	Green/ yellow seven-segment display	Diagnostic LED = flashing: Controller enclosure ID is displayed Diagnostic LED = on: Diagnostic code is displayed The Diagnostic LED is located on the Numeric Display. See “Numeric display LEDs.”		

The L1 and L2 LEDs for each host and drive channel combine to indicate the status and the operating speed of each host or drive channel.

Table 20. Host and drive channel LED definitions

L1	L2	Definition
Off	Off	When both LEDs for a host or drive channel are off, this indicates one or more of the following conditions: <ul style="list-style-type: none"> • The host or drive channel ports are bad. • An SPF module is inserted with no fibre channel cable attached. • No SFP module is inserted in one or both of the host or drive ports in the channel.
On	Off	The host channel is operating at 1 Gbps.
Off	On	The host or drive channel is operating at 2 Gbps.
On	On	The host or drive channel is operating at 4 Gbps.

Numeric display LEDs

The numeric display consists of two seven-segment LEDs that provide information about enclosure identification and diagnostics. Figure 73 on page 117 shows the numeric display and the diagnostic LED.

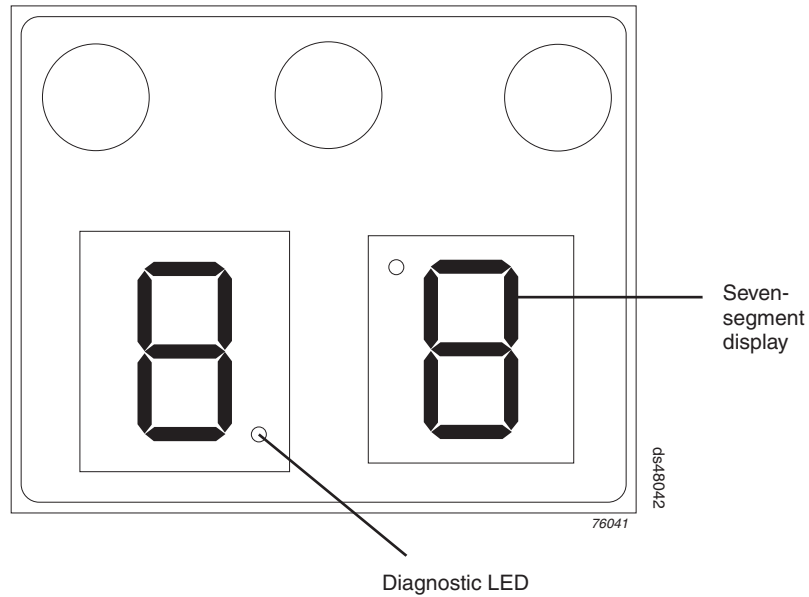


Figure 73. Numeric display LEDs

When the storage subsystem is operating normally, the numeric display shows the enclosure identification (enclosure ID) of the storage subsystem and the diagnostic LED flashes once every two seconds. The storage subsystem tray ID is normally set at the factory to either values 85 or 00. Verify that the attached storage expansion enclosures are not set to either of these enclosure IDs.

Note: It is not recommended, but you can set the storage subsystem enclosure ID through the DS4000 Storage Manager software. The enclosure ID is an attribute of the storage subsystem; both controllers display the same enclosure ID. It is possible, however, that one controller will display the enclosure ID, while the other controller displays a diagnostic code.

If an error has occurred and the controller Needs Attention LED is on, the numeric display shows diagnostic information. The numeric display indicates the information is diagnostic by illuminating an LED that appears as a decimal point between the display numbers. The diagnostic LED turns off when the numeric display shows the storage subsystem enclosure ID. The numeric display shows various diagnostic codes as the controllers perform the startup process after each power cycle or reset. After diagnostics are complete, the current storage subsystem enclosure ID is displayed.

Diagnostic codes in the form of Lx, where x is a hexadecimal digit, indicate controller state information. In general, these codes are displayed only when the controller is in a non-operational state. The controller might be non-operational due to a configuration problem (such as mismatched controller types), or it might be non-operational due to hardware faults. If the controller is non-operational due to system configuration, the controller Needs Attention LED is off. If the controller is non-operational due to a hardware fault, the controller Needs Attention LED is on. The definitions for Lx diagnostic codes are listed in Table 21 on page 118.

Table 21. Numeric display diagnostic codes

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

Power supply-fan LEDs

The LED positions on the right and left power supply-fan units differ, as shown in the following figure.

Note: The right power supply-fan unit is linked with RAID controller A. The left power supply-fan unit is linked with RAID controller B in the DS4800.

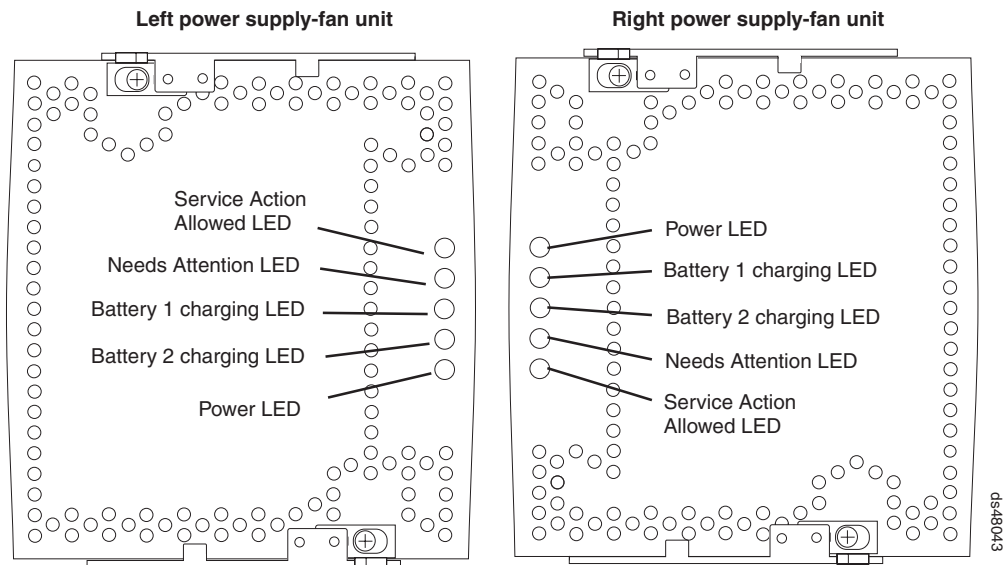


Figure 74. Power supply-fan LEDs

Table 22. Power supply-fan LEDs

LED	Color	Normal Status	Problem Status	Procedure
Power	Green LED	On = Power supply-fan is providing power	Off = Power supply-fan is not providing power	Examine the power supply-fan unit, connected PDUs, and connected power circuits for any of the following conditions: <ul style="list-style-type: none"> • The power supply-fan unit power switch is off. • A circuit breaker has tripped in the controller linked to this power supply-fan unit is linked. (The right power supply-fan is linked to Controller A; the left power supply-fan is linked to Controller B.) • The connected PDUs are turned off or have been tripped. • There is no power at the wall circuit. • The power supply-fan unit is bad.
Battery 1 Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted, discharged, or missing	
Battery 2 Charging	Green LED	On = Battery charged and ready Blinking = Battery charging	Off = Battery faulted, discharged, or missing	
Needs Attention	Amber LED	Off	On = Power supply-fan needs attention	“Troubleshooting the storage subsystem” on page 109
Service Action Allowed	Blue LED	Off	On = Safe to remove	“Resetting the controller circuit breakers” on page 124 “Replacing a power supply-fan” on page 144

Interconnect-battery unit LEDs

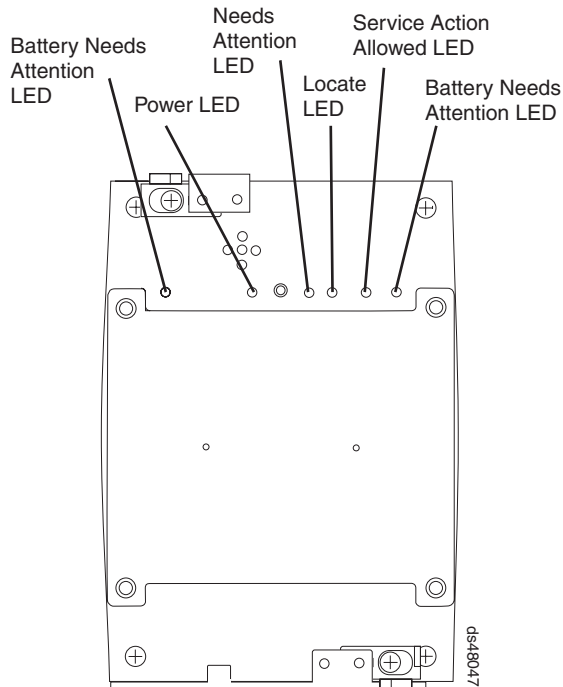


Figure 75. Interconnect-battery unit LEDs

Table 23. Interconnect-battery unit LEDs

Legend	LED	Color	Normal Status	Problem Status/Procedure
1	Battery Needs Attention	Amber LED	Off	On = Battery failed See "Replacing a backup battery pack" on page 152.
2	Power	Green LED	On = storage subsystem is powered on	Off = storage subsystem is powered off If the storage subsystem is powered on but this LED remains off, examine the power supply-fan units, the connected PDUs, and the connected power circuits for any of the following conditions: <ul style="list-style-type: none"> • Both power supply-fan units are not turned on. • A circuit breaker has tripped. • The connected PDUs are turned off or have been tripped. • There is no power at the wall circuit. • The interconnect-battery unit is bad.

Table 23. Interconnect-battery unit LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status/Procedure
3	Overall DS4800 Configuration Needs Attention	Amber LED	Off	<p>On = A component in the storage subsystem configuration has developed a fault</p> <p>Inspect the Needs Attention LEDs on the other components in the DS4800 Storage Subsystem and in all connected DS4000 storage expansion enclosures to isolate the fault.</p> <p>However, it is recommended that you use the DS4000 Storage Manager Subsystem Management window to identify the cause of the problem and use the Recovery Guru to help fix the problems. Some of the problems may not cause the Needs Attention LED on the individual CRU to light, but they will cause this Overall DS4800 Configuration Needs Attention LED to light. For example, a hard disk drive that exceeds its PFA errors will cause this LED to light, but the drive Needs Attention LED for the individual drive in the attached storage expansion enclosure will not light.</p> <p>See "Troubleshooting the storage subsystem" on page 109.</p>
4	Locate/Identify	White LED Note: This LED is shown as blue (and displayed in a different order) when the DS4800 bezel is installed. See "Front bezel LEDs" on page 111.	Off	On = storage subsystem locate
5	Service Action Allowed	Blue LED	Off	<p>On = Safe to remove</p> <p>See "Replacing the interconnect-battery unit" on page 148.</p>
6	Battery Needs Attention	Amber LED	Off	<p>On = Battery failed</p> <p>See "Replacing a backup battery pack" on page 152.</p>

The Power, Overall DS4800 Configuration Needs Attention, and Locate LEDs are general indicators for the entire DS4800 storage subsystem (or configuration, in the case of the Overall DS4800 Configuration Needs Attention), not specifically for the interconnect-battery unit. The Overall DS4800 Configuration Needs Attention LED turns on if a fault condition is detected in any component in the storage subsystem configuration, including all attached storage expansion enclosures. The Power, Overall DS4800 Configuration Needs Attention, and Locate LEDs shine through the front bezel.

Attention: If the Overall DS4800 Configuration Needs Attention LED lights, refer to the DS4000 Storage Manager client software to determine the problem with the storage subsystem. Also, inspect the Needs Attention LEDs on the other components in the storage subsystem to help isolate the fault to a specific component.

Recovering from an overheated power supply-fan

The storage subsystem has two power supply-fans. Each power supply-fan contains a power supply, a cooling fan, a battery charger, and a built-in temperature sensor designed to prevent the power supplies from overheating. Under normal operating conditions, with an ambient air temperature range of 10° C to 35° C (50° F to 95° F), the cooling fans maintain a proper operating temperature inside the storage subsystem.

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

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

If the internal temperature rises above 70° C (158° F), one or both power supplies automatically shut down. If one power supply shuts down, the DS4000 Storage Manager client software displays a Needs Attention status in the Subsystem Management Window, the alarm sounds (if enabled), and the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem turns on.

If a common environmental stress causes both power supplies to shut down, the storage subsystem shuts down, and the DS4000 Storage Manager client software displays a Not Responding status in the Subsystem Management Window.

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

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

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

Attention: Power supplies automatically shut down when air temperature inside the cabinet reaches 70° C (158° F) or above. If the power supplies have shut down, immediately remove all cabinet panels to help cool the cabinet air temperature and prevent damage to the storage subsystem.

Note: If both power supply-fan units have shut down, start with step 4 below.

1. If applicable, turn off the alarm.
2. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
3. In the DS4000 Storage Manager client Subsystem Management window, select **Advanced ► Troubleshooting ► View Event Log** to display the DS4800 critical events. Look for one of the following critical event entries:
 - Event 281B - Nominal temperature exceeded
 - Event 281C- Maximum temperature exceeded
4. Try alleviating the overheating problem by:
 - Removing all panels from the cabinet
 - Cooling the area using external fans
 - Shutting down the power to the storage subsystem or storage expansion enclosures (Follow the power-down procedure described in “Turning off the storage subsystem” on page 100.)
5. Stop all I/O activity to the storage subsystem and to all attached storage expansion enclosures.
6. Wait until the ambient air temperature around the storage subsystem cools. The storage subsystem is capable of power-up recovery without operator intervention after the temperature inside the power supply-fan cools to below 70° C (158° F). After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers reset and return to normal operation.
7. Did the power supplies restart automatically?
 - Yes – Go to step 9.
 - No – Go to step 8.
8. Turn off the power switch on each controller in the storage subsystem and then power off all connected storage expansion enclosures. Wait 1 minute and then turn on power to all connected storage expansion enclosures and then to the storage subsystem. If the power supplies go into operation, go to step 9. If not, call your IBM service representative.
9. Check the status LEDs on the front and back of the storage subsystem. For information about storage subsystem LEDs, see “Checking the LEDs” on page 111.
10. Are the LEDs on the storage subsystem indicating normal status?
 - Yes – Go to step 11.
 - No – Go to step 12.
11. Use the DS4000 Storage Manager client software to check the status of all storage subsystems in the configuration. Is the status Optimal for each storage subsystem?
 - Yes – End of procedure. Resume normal operation.
 - No – Go to step 12.
12. Diagnose and correct the fault by completing the following steps.

- a. Select the Recovery Guru toolbar button in the Subsystem Management Window to run the Recovery Guru.
- b. Complete the recovery procedure.
If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the specific failed component.
- c. When the procedure is completed, select Recheck in the Recovery Guru. This will rerun the Recovery Guru to ensure that the problem has been fixed.
- d. If the problem has not been fixed contact your IBM service representative.
Print a storage subsystem profile and save the storage subsystem support data. The profile and support data will be helpful when troubleshooting storage subsystem problems. (For information about printing a storage subsystem profile and saving the support data, refer to the Subsystem Management Window online help.)

Resetting the controller circuit breakers

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

Note: DC power input is not currently supported for the DS4800. Contact your IBM service representative or reseller for information about possible future support for DC power input.

The internal power cable runs from the AC connector on a controller to the power supply in a power supply-fan. Power to the right power supply-fan (as viewed from the front of the storage subsystem) is routed through the top controller (controller A); power to the left power supply-fan is routed through the bottom controller (controller B).

If a circuit breaker has tripped, the condition might appear as if a power supply-fan has failed. The power supply is no longer providing power to the storage subsystem. A tripped circuit breaker is indicated when all of the following conditions are present:

- The Overall DS4800 Configuration Needs Attention on the storage subsystem front bezel is turned on
- The controller Needs Attention LEDs are not turned on
- The power supply-fan Needs Attention LEDs are not turned on
- The Service Action Allowed LED is turned on for the power supply-fan connected to the controller with the open circuit breaker
- The DS4000 Storage Manager client shows the power supply-fan unit has failed

Use the following procedure to reset the circuit breaker.

Tools and Equipment

- Antistatic protection
- Nonconducting stylus

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

1. If the alarm is sounding, turn off the alarm.
2. Check to ensure that the external power cables are completely plugged into the controllers and into the power source.
3. Put on antistatic protection.
4. Remove the front bezel by grasping the sides and pulling the cover toward you.
5. Check the Needs Attention LED on each power supply-fan. (Figure 76 shows the location of the Needs Attention LEDs.)

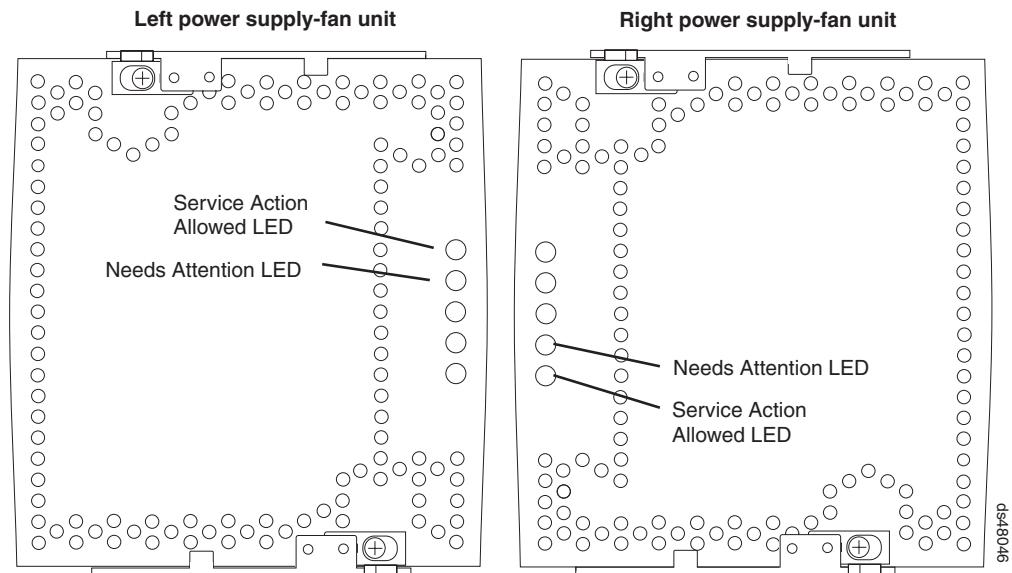


Figure 76. Power supply-fan Needs Attention LEDs

Is a power supply-fan Needs Attention LED on?

- Yes – A power supply-fan has failed. To replace the failed power supply-fan, see “Replacing a power supply-fan” on page 144.
- No – Go to step 6 on page 126.

Attention: Fiber-optic cables are fragile. Bending, twisting, folding, or pinching fiber optic cables can cause damage to the cables, degraded performance, or data loss. To prevent damage, do not twist, fold, pinch, or step on the cables. Do not bend the cables in less than a 2-inch radius.

Note: You do not need to remove the interface cables from the controllers to reset the circuit breakers; however, IBM recommends that you remove the cables to make this procedure easier. If you choose to remove the interface cables, ensure that you label each cable so that you can reconnect them correctly to the controller. Figure 77 on page 126 identifies all of the connectors on the back of the controller.

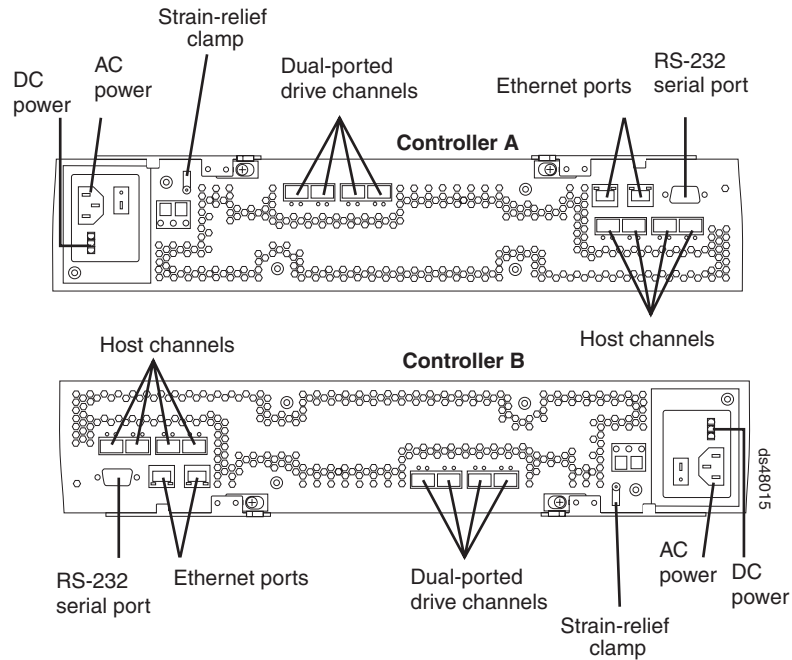


Figure 77. RAID controller connections

6. Use the DS4000 Storage Manager client software to take the controller offline. After the controller is offline, the Service Action Allowed LED turns on, and you can safely remove the controller.
7. Slide the controller with the open circuit breaker from the storage subsystem. You do not need to completely remove the controller. Only slide it out far enough to reveal the holes over the circuit breakers.
 - a. Using your index fingers, simultaneously push the latches to release the levers, and rotate the levers to disengage them from the locking pins.
 - b. Use the levers to slide the controller from the storage subsystem chassis. (Figure 78 on page 127 shows a controller sliding from the storage subsystem chassis.)

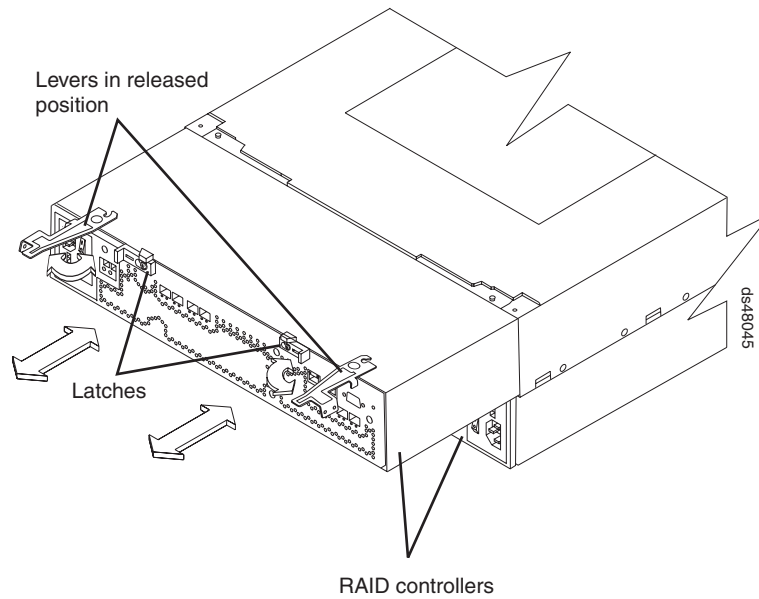


Figure 78. Removing the controller from the storage subsystem

8. Insert a nonconducting stylus through the appropriate hole in the cover of the controller and press down gently. One hole is over the AC circuit breaker, a second hole is over the DC circuit breaker. (DC is not currently supported for the DS4800.) Figure 79 shows the location of the circuit breaker access holes in the Controller B cover.

Note: When Controllers A and B are inserted in their respective controller slots in the DS4800, the location of the circuit breaker access holes are as follows. On Controller A, the circuit breaker access holes are located on the left side on the bottom of the controller. On Controller B, the circuit breaker access holes are located on the right side on the top of the controller (as shown in Figure 79).

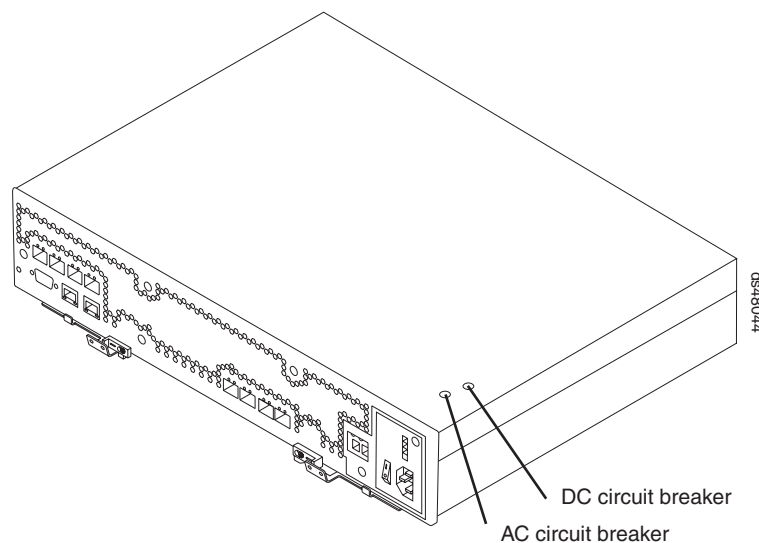


Figure 79. Circuit breaker access holes

9. Reset the circuit breaker that tripped by pressing down with the stylus on the rocker switch.
10. Slide the controller into the storage subsystem chassis.
 - a. Holding both levers, slowly push the controller until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the controller is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on all interface pins.
Attention: Verify that the controller does not snag any other DS4800 cables when you slide it into the controller bay.
 - b. Press the controller fully into the slot, engaging the pins on the enclosure.
 - c. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the component is locked in place.
11. If you removed the interface cables, reconnect all host interface cables and drive interface cables, including the SFP modules.
12. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the controller.
13. Complete any remaining Recovery Guru procedures for controller replacement, if needed.
14. Based on the Host Channel Speed, Drive Channel Speed, and Needs Attention LED status, proceed to one of the following steps:
 - All channel speed LEDs are on and the Needs Attention LED is off – Go to step 16.
 - All channel speed LEDs are off or the Needs Attention LED is on – Verify the controller has been installed correctly. Remove and reinstall the controller. Go to step 15.

Note: If a host channel or drive channel does not have a cable connected, the channel speed LEDs are not illuminated.
15. Did this action correct the problem?
 - Yes – Go to step 16.
 - No – If the problem has not been fixed, contact your IBM service representative.
16. Remove the antistatic protection.
17. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover and then pressing the cover toward the chassis until the pins snap into place.
18. Using the Enterprise Management Window, view the status of the storage subsystems. Do any storage subsystems indicate Needs Attention?
 - Yes – Go to step 19.
 - No – All components display Optimal status. You are finished with this procedure.
19. Use the Subsystem Management Window to check the status of all storage subsystems in the configuration.
20. Do any storage subsystems have a Overall DS4800 Configuration Needs Attention status?
 - a. Yes – Select the Recovery Guru toolbar button in the Subsystem Management Window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.

- b. No – Contact your IBM service representative. Print a storage subsystem profile, and save the storage subsystem support data. The profile and support data are helpful when troubleshooting storage subsystem problems. (For information about printing a storage subsystem profile and saving the support data, refer to the Subsystem Management Window online help.)

Cache memory and cache battery

Each RAID controller in the DS4800 Storage Subsystem contains either 2 GB, 4 GB, or 8 GB of cache memory to store read and write operations. (Both RAID controllers in the DS4800 must have the same amount of cache memory.) The interconnect-battery unit contains two Lithium Ion battery packs that can maintain the data in the RAID controller caches for up to three days in the event that the DS4800 Storage Subsystem loses power.

Important::

Do not replace the battery until it is marked failed by the controller. If the batteries are shown as expired, use the reset battery age function in the SM client subsystem management window to reset the age.

Attention: There are different replacement FRU part numbers for the DS4800 controller with certain cache sizes. The DS4800 storage subsystem profile has the information on the installed cache memory size in the DS4800 controllers. Refer to the storage subsystem profile and see “Parts list” on page 166 for the correct FRU part number for the DS4800 controller. In addition, the DS4800 model 80A/H has different replacement FRU part numbers than the DS4800 model 82A/H controllers, even though they both have the same cache size.

Cache memory

Cache memory is memory on the RAID controller that is used for intermediate storage of read and write data on the DS4800 RAID controllers. Using cache memory can increase system performance. The data for a read operation from the host might be in the cache memory from a previous operation (thus eliminating the need to access the drive itself), and a write operation is completed when it is written to the cache, rather than to the drives.

The RAID controller has a Cache Active LED that displays the current status of the cache. The LED is on if there is data in the cache, and it is off if there is no data in the cache.

If caching is enabled and the Cache Active LED never comes on during I/O activity, it indicates one of the following conditions:

- The cache memory from either Controller A or Controller B has failed.
- The cache sizes in Controller A and Controller B are not the same.
- The battery has failed. (In this case, one or both of the green Battery LEDs will be off and one or both amber Battery Needs Attention LEDs will be lit.)

Note: Always use the DS4000 Storage Manager client to check your cache memory settings before assuming a hardware failure.

Figure 80 on page 130 shows the locations of the Cache Active LEDs on the front of the RAID controllers.

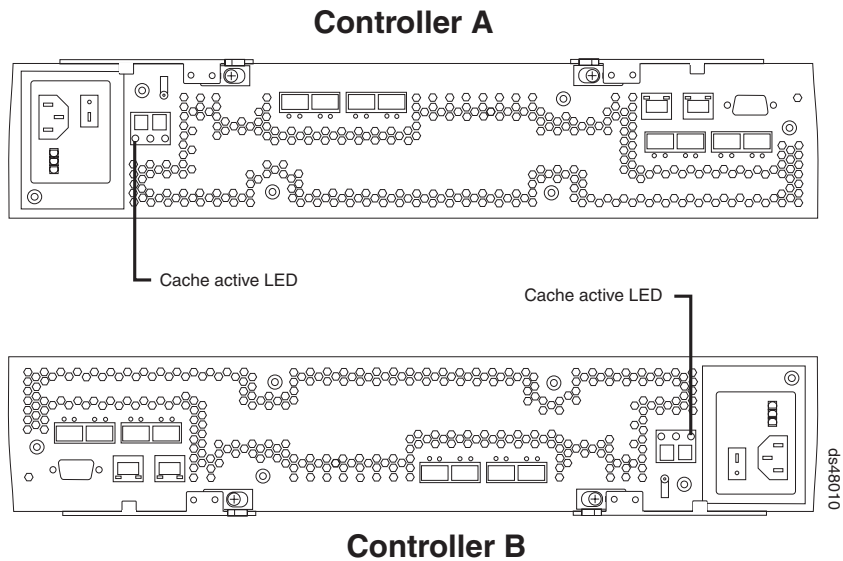


Figure 80. Cache Active LEDs

Subsystem cache battery

The DS4800 interconnect-battery unit contains two battery packs that provide backup power to maintain any cached data not written to disks in the event of a power loss. The battery packs can provide power to the data caches in the RAID controllers for up to three days.

Statement 2:



CAUTION:

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

Do not:

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

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

Replace the battery packs in the DS4800 interconnect-battery unit when they are identified as failing by the DS4000 Storage Manager Subsystem Management window, or when the Battery LEDs or Battery Needs Attention LEDs light (these LEDs are located on the power supply-fan units and on the interconnect-battery unit respectively, as shown in Figure 81 on page 131).

Replace only the battery pack that is indicated as failed by the LEDs or in the DS4000 Storage Manager Subsystem Management window. You do not need to replace both battery packs when the Battery LEDs indicate that only one battery pack has failed.

In the event that the battery age expires, do not call on IBM technical support to replace the battery. Instead, reset the battery age using the procedure described in the Storage Manager online help. You should only replace the battery when it is in a failed state, as reported by the Storage Manager Recovery Guru.

Note: Controller firmware version 6.14.xx.xx does not provide the Storage Manager menu option to reset the battery age. This option is available with controller firmware version 6.15.xx.xx or later.

Each power supply-fan unit has green Battery LEDs on the back that indicates the battery status of each battery pack, as follows:

- The LED is on and remains steady when the battery is fully charged.
- The LED flashes when the battery is charging or performing a self-test.
- The LED is off if the battery or the battery charger has failed.

The interconnect-battery unit also has a battery failure indicator LED for each battery pack that is located on the interconnect-battery unit. This LED will light if the battery fails to hold a charge.

The battery performs a self-test at startup and every 25 hours thereafter (during which time the Battery LED flashes). If necessary, the battery begins recharging at that time. If the battery fails the self-test, the Battery LED turns off, indicating a battery fault.

Data caching starts after the battery completes the startup tests.

Attention: Write caching is suspended while a battery pack is either charging or self-testing.

Figure 81 shows the location of the Battery LEDs and the Battery Needs Attention LEDs on the power-supply-fan units and the interconnect-battery unit.

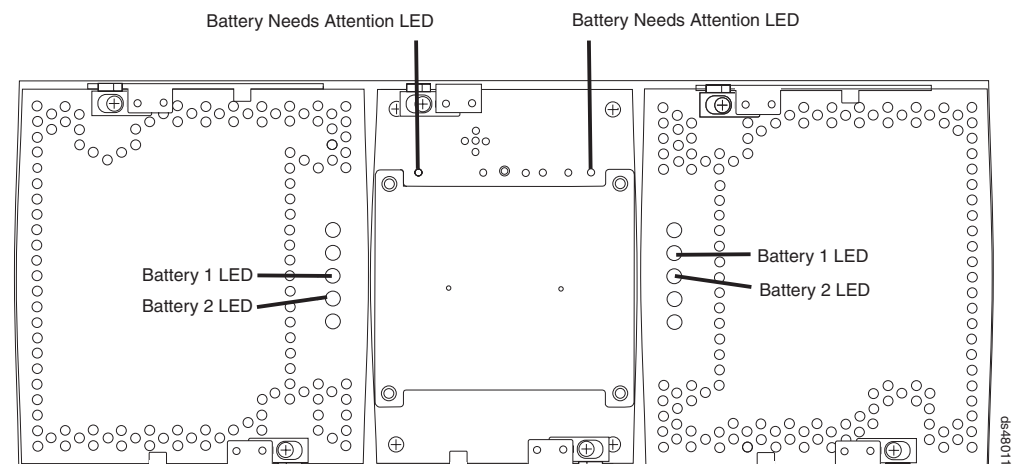


Figure 81. Battery LEDs

Chapter 5. Replacing components

This chapter lists replacement parts and explains the procedures for replacing a controller, a power supply-fan, an interconnect-battery unit, and an SFP module. Before using the procedures in this chapter, perform the appropriate troubleshooting steps described in “Troubleshooting the storage subsystem” on page 109, and in the Recovery Guru.

The following list shows the components that you can replace on site. To order parts, contact your IBM service representative.

- RAID controllers
- Power supply-fans (containing power supplies, fans, and battery chargers)
- Interconnect-battery unit (containing the midplane and batteries for the cache backup)
- SFP modules
- Interface cables
- Ethernet cables

Attention: Never remove the interconnect-battery unit unless directed to do so by an IBM Service representative. Refer to “Replacing the interconnect-battery unit” on page 148 for complete information about the conditions required for safe removal of the interconnect-battery unit.

This chapter also provides instructions to help you add new DS4000 storage expansion enclosures to existing DS4800 configuration.

You can perform all replacement procedures in this chapter as hot-swap procedures. Hot swap refers to the ability to remove and replace a storage subsystem component while the storage subsystem is under power and processing data. The DS4800 Storage Subsystem has three major components you can replace on site: the controller, power supply-fan, and interconnect-battery unit. In a fully-configured storage subsystem, the controllers and power supply-fans are redundant. If any one of these redundant components fails, the component can be replaced without powering off the storage subsystem, and without interrupting data processing.

For more CRU and Option part number information, see the following Web site:

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

Handling static-sensitive devices

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

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

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.

- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the storage subsystem for at least two seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into your storage subsystem without setting it down. If it is necessary to set the device down, place it in its static-protective package. Do not place the device on your storage subsystem cover or any metal surface.
- Take additional care when handling devices during cold weather because heating reduces indoor humidity and increases static electricity.

Service Action Allowed Status LED

Each controller, power supply-fan, and interconnect-battery unit has a blue Service Action Allowed status LED. The purpose of the Service Action Allowed status LED is to help ensure that a component is not removed before it is safe to do so. Do not remove any DS4800 component unless the component's Service Action Allowed status LED is lit.

Attention

Never remove a controller, power supply-fan, or interconnect-battery unit unless the Service Action Allowed status LED is turned on. Doing so can result in a potential loss of data. If the Needs Attention LED is lit and the associated Service Action Allowed status LED is *not* lit, then you must perform additional diagnostics *before* you can remove the indicated component. Use the Recovery Guru instructions in the DS4000 Storage Manager Subsystem Management window or refer to the appropriate component replacement instructions 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.

The following sections discuss the behavior of the Service Action Allowed status LED in cases of single and multiple component failures.

Single component failures

When a single component in the DS4800 has failed, the following list indicates the behavior of the Service Action Allowed status LED lights:

- If a controller or power supply-fan fails and needs to be replaced, the amber Needs Attention status LED on that component turns on to indicate that a service action is required. If there are no data availability dependencies or other conditions that dictate that the component should not be removed, the blue Service Action Allowed status LED turns on. Do not remove any components other than the component indicated by the lit blue Service Action Allowed status LED.
- The interconnect-battery unit contains the mid-plane that communicates between controllers A and B in the DS4800 Storage Subsystem. If the interconnect-battery unit needs to be replaced, the Service Action Allowed status LED does *not*

automatically turn on. Before the interconnect-battery unit Service Action Allowed status LED can turn on, you must use the DS4000 Storage Manager client to place Controller B offline. (Controller A is the controller designated to receive all I/O activity when the interconnect-battery unit is removed from the DS4800.) By placing Controller B offline, you route all controller and I/O activity through Controller A. This maintains data availability while the interconnect-battery unit is removed, preventing any problems that would normally arise from the loss of communication between Controllers A and B.

Attention: Before you remove the interconnect-battery unit, you must verify that Controller A is in an optimal state, and the power supply-fan CRU that is connected to controller A (the right power supply) is optimal. *Never* remove the interconnect-battery unit when Controller A or the power supply-fan CRUs are not in an optimal state.

Multiple component failures

When multiple components in the DS4800 have failed, the behavior of the Service Action Allowed and Needs Attention LEDs can vary from situation to situation. In some cases, multiple Service Action Allowed status LEDs light when their corresponding Needs Attention LEDs are lit. In other cases, none of the Service Action Allowed status LEDs light when their corresponding Needs Attention LEDs are lit. This variance exists because the ability to remove a component depends on the different data availability dependencies of the storage subsystem components.

If replacing any one of the multiple components that have their Needs Attention LEDs lit will cause the DS4800 Storage Subsystem to shut down, the Service Action Allowed status LEDs will *not* light on any of the components that need attention. For example, if both the right power supply-fan (which is linked to Controller A) and Controller B need attention, then neither of the Service Action Allowed status LEDs on these components would light. Removing the Controller B before replacing the failed right power supply-fan would cause Controller A to lose power, resulting in a loss of data availability. (This linkage exists because the power distribution from each power supply-fan runs through the controller physically connected to that power supply-fan.)

However, if replacing any one of the multiple components that have their Needs Attention LEDs lit will *not* cause the DS4800 Storage Subsystem to shut down, then the Service Action Allowed status LEDs will light on all of the components that need attention. For example, if the right power supply-fan (which is linked to Controller A) and Controller A both need attention, then the Service Action Allowed status LEDs on both of these components would light, indicating that either component can be replaced first.

Important: In this situation (in which replacing any one of the multiple components that have their Needs Attention LEDs lit will *not* cause the DS4800 Storage Subsystem to shut down), after you remove one failed component, the Service Action Allowed status LEDs on the remaining components that need attention might turn off. This change in the Service Action Allowed status LEDs indicates that removing additional components now might cause the storage subsystem to shut down.

For example, if both power supply-fans have failed, the Needs Attention and the Service Action Allowed status LEDs would be lit for both components. However, when you remove one power supply-fan from the system, the Service Action Allowed status LED on the remaining power supply-fan turns off, indicating that you now cannot remove the

second power supply-fan unit (because the storage subsystem requires that at least one power supply-fan unit, functioning or not, must be present in the storage subsystem at all times).

Releasing a component lever

Each component is secured into the storage subsystem chassis by two cam lock levers mounted to the component. The lever engages with a pin on the storage subsystem chassis to pull the component securely into the chassis. The levers are locked in place by spring-loaded latches. The control components have the levers on the same side. The power supply-fans and the interconnect-battery unit have the one lever mounted to the top of the component and one lever mounted to the bottom of the component. Figure 82 shows a component lever and the latch that secures the lever. The top view shows the lever in the closed and latched position. The bottom view shows the lever in the released position.

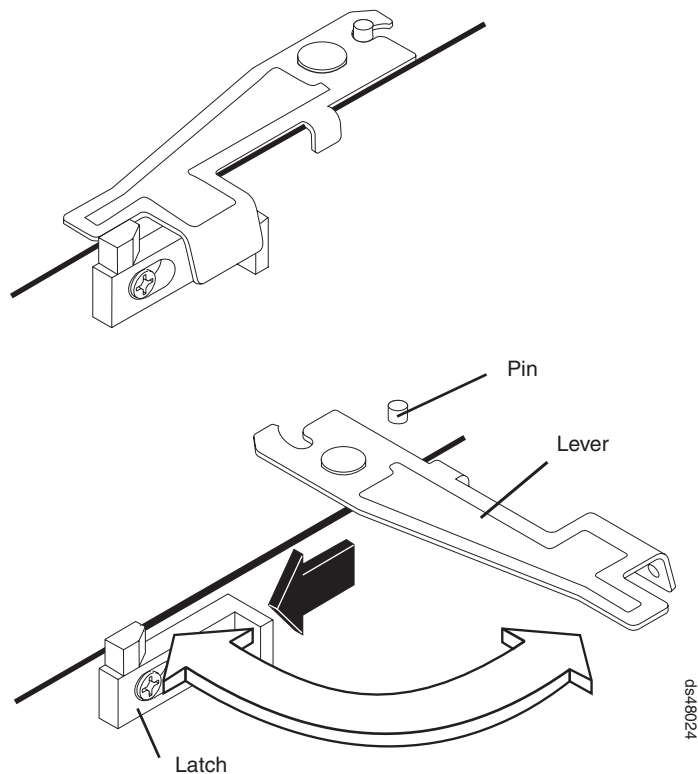


Figure 82. Component lever and latch

To release both latches on a component and remove the component:

1. Push the latches to the side until the latches release the levers. Do not proceed with the next step until you have released both levers from the latches.
2. Rotate both levers out simultaneously. Ensure that the levers are completely free of the pins. Then place one hand under the component and use the levers to pull the component from the DS4800 Storage Subsystem.

To replace a component and lock the latches:

1. With both levers rotated out perpendicular to the face of the component, slide the back of the component into the appropriate slot.

2. Push the component into the slot and, when the component is almost fully installed, verify that the notches in both levers are aligned with the pins on the storage subsystem. Verify this alignment to ensure that the component is pulled evenly into the storage subsystem, ensuring full electrical connection contact on all interface pins.
3. Press the component fully into the slot, engaging the pins on the storage subsystem.
4. Hold open both latches and rotate both levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers. This indicates that the component is locked in place.

Replacing a controller

Attention: Before you replace a RAID controller, verify the following:

- The replacement RAID controller part number matches the part number of the RAID controller to be replaced. To provide full functionality, the two controllers should have the same memory capacity. Although two controllers of different memories can be paired in a storage subsystem, the mismatch causes some functions to be disabled (for example, the cache mirroring function).
- Inserting a DS4800 model 80A/H controller into a non-model 80A/H DS4800 subsystems (that is, model 82A/H, model 84A/H, model 88A/H) will result in the controller to be held in lockdown state. Similarly, inserting a non-model 80 DS4800 controller into a DS4800 model 80 subsystem will cause it to be held in lock down state.
- Both power supply-fan units must be connected and powered on with no Needs Attention LEDs lit. Ensure that the Power LEDs on each of the power supply-fan units are lit. If either of the power supply-fan units is not optimal, it is recommended that you replace that component before you proceed with the controller replacement procedure.
- If you are replacing an optimal controller, first make sure that the other RAID controller is optimal and that the fibre channel path from the hosts to the other RAID controller is also optimal.

Use the following procedure to replace a controller in an DS4800 Storage Subsystem.

Attention: If you are upgrading controllers you received through an upgrade kit, refer to “Upgrading controllers” on page 142 and use the instructions provided in the upgrade kit to replace the controllers instead of the instructions in this section.

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front.

1. Use the DS4000 Storage Manager client software to print a storage subsystem profile. Move logical drive ownership to the other controller. If the controller you are replacing has failed but is still operating, move the failed controller to an Offline state.

Attention: Never remove a controller unless the Service Action Allowed status LED is turned on. Doing so can result in a potential loss of data.

2. Locate the failed controller by checking the Needs Attention status LEDs on the controllers in the storage subsystem. (Figure 83 on page 138 shows the location of the Needs Attention LED on the back of a controller.)

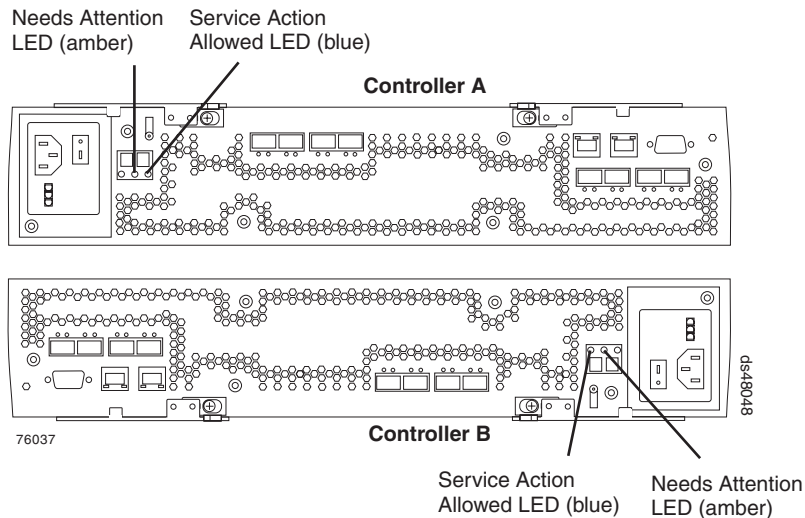


Figure 83. RAID controller Needs Attention and Service Action Allowed LEDs

3. Is the Service Action Allowed status LED turned on? (Figure 83 shows the location of the Service Action Allowed status LED on the back of a controller.)
 - Yes – Go to step 4.
 - No – Another component requires attention before you can remove the controller. Normally, this situation indicates that a power supply-fan is either powered off or failed. Ensure that both power supply-fans are powered on and in an optimal state. If the Service Action Allowed status LED of the failed controller is unlit and both power supply-fans are in an optimal state, contact your IBM support representative.

Electrostatic discharge can damage sensitive components. Touching the storage subsystem or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

4. Put on antistatic protection.
5. Unpack the new controller. Save all packing materials in the event you need to return the new controller.
6. Determine whether the replacement controller will serve as Controller A or Controller B (Controller A is inserted in the top controller bay; Controller B is inserted in the bottom controller bay), and then apply the controller labels for host channels, drive channels, power inputs, and numeric display to the replacement controller. The controller labels and instructions are included with the replacement controller. Make sure that the labels are aligned properly and do not cover any ports or LEDs.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. 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 in.).

7. Disconnect all attached interface cables from the failed controller, including the SFP modules. Ensure that you label each cable so that you can reconnect them correctly to the new controller. Figure 84 on page 139 shows the location of the connectors on the back of a controller.

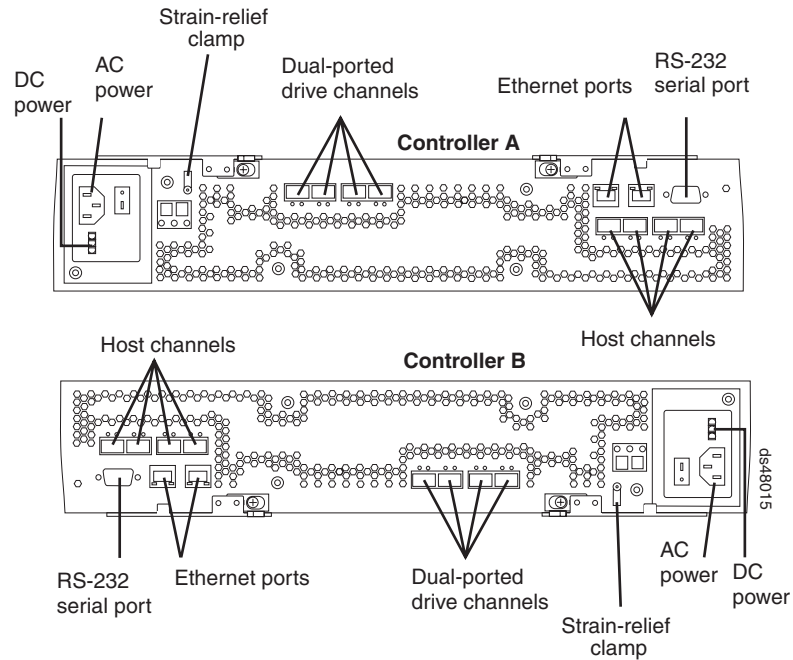


Figure 84. Connectors on the back of each controller

Use the following procedure to remove the SFPs from the RAID controller that has failed.

- a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see “Handling fiber-optic cables” on page 48.
- b. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 85.

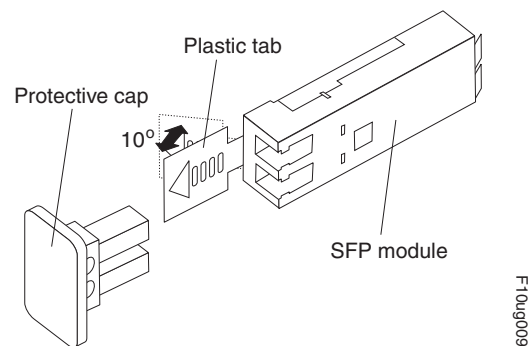


Figure 85. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 86 on page 140.

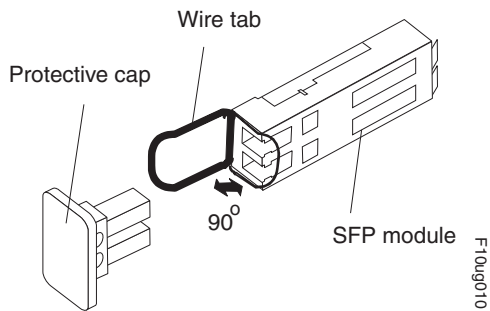


Figure 86. Unlocking the SFP module latch - wire variety

- c. With the SFP latch in the unlocked position, extract the SFP module.
 - For SFP modules that contain plastic tabs, slide the SFP module out of the port.
 - For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the minihub port.
 - d. Replace the protective cap on the SFP module.
 - e. Place the SFP module into a static-protective package.
 - f. Replace the protective cap on the port.
8. Remove the strain-relief nut and cable strain-relief clamp from the RAID controller.
 9. Unplug the power cord from the electrical outlet and then disconnect the power cord from the ac power connector on the controller.
 10. Release the controller levers and remove the failed controller. Figure 87 shows the controller sliding from the storage subsystem chassis.

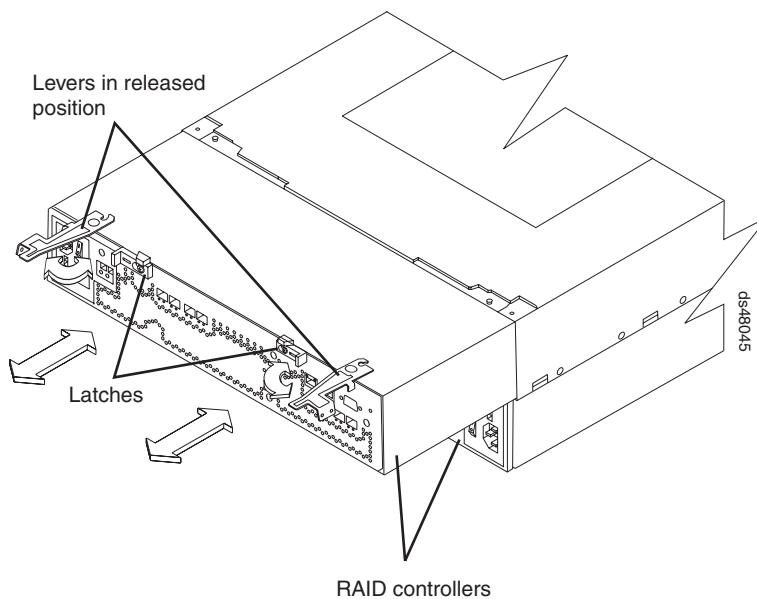


Figure 87. Removing a controller from the DS4800

11. Install the new controller.
 - a. Carefully position the controller at the back of the storage subsystem chassis. Ensure that the controller can slide into the storage subsystem chassis without obstruction.

- b. With the left and right levers rotated out perpendicular to the face of the controller, slide the back of the controller into the appropriate slot.
 - c. Push on both sides of the controller so that it slides into the slot evenly. *Stop inserting the controller when it is about 1 inch from being fully inserted into the slot.* With the controller not fully inserted in the slot, attach all the SFPs and cables that you disconnected from the failed controller in step 7 on page 138.
 - 1) Replace the SFPs into the appropriate ports. See “Installing SFP modules” on page 48.
 - 2) Reconnect all cables, including all host and drive channel cables and secondary cables (such as Ethernet connections).
 - d. Holding both levers, slowly push the controller until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the controller is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on all interface pins.

Attention: Verify that the controller does not snag any other DS4800 cables when you slide it into the controller bay.
 - e. Press the controller fully into the slot, engaging the pins on the enclosure.
 - f. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the component is locked in place.
12. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the controller connection end. Leave some slack between the clamp and the controller end of the power cord. Replace the strain-relief nut and tighten it securely to secure the clamp to the controller unit.
 13. Connect the power cord to the new DS4800 controller AC power connector. Plug the power cord into a properly grounded electrical outlet.
 14. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new controller.
 15. Complete any remaining Recovery Guru procedures for controller replacement, if needed.
 16. Check the LEDs on the new controller to verify that the controller is fully operational. See “RAID controller LEDs” on page 113.
 17. Remove the antistatic protection.
 18. Use the DS4000 Storage Manager client Subsystem Management Window to check the status of all components in the storage subsystem.
 - If the new controller is online and the DS4000 Storage Manager client Subsystem Management Window indicates normal operation, go to step 21 on page 142.
 - If the new controller is online and the DS4000 Storage Manager client Subsystem Management Window indicates a problem status, go to “Troubleshooting the storage subsystem” on page 109.
 - If the new controller is offline, go to step 19.
 19. If the newly inserted controller is in an offline state, see the DS4000 Storage Manager client online help for instructions on bringing the controller online. If necessary, open the DS4000 Storage Manager Subsystem Management window and place the controller on-line; select the off-line controller and click **Advanced ► Recovery ► Place controller online**.
 20. Verify the state of the LEDs on the newly inserted controller. See “RAID controller LEDs” on page 113. You can also use the DS4800 Storage Manager

client Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?

- Yes – Select the Recovery Guru toolbar button in the Subsystem Management Window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
- No – Go to step 21.

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

Upgrading controllers

The IBM System Storage DS4800 Controller Cache Upgrade Kit enables you to upgrade the DS4800 controller memory cache either in the DS4800 storage subsystem models 82A/H to 4 GB of memory cache per controller or in the DS4800 storage subsystem models 82A/H and 84A/H to 8 GB of cache memory per controller. There are three DS4800 controller cache upgrade options that are available from IBM:

- DS4800 Model 82A/H Cache upgrade to 8 GB. This option upgrades the DS4800 controllers with 2 GB of cache memory per controller to DS4800 controllers with 4 GB of cache memory per controller.
- DS4800 Model 82A/H Cache upgrade to 16 GB. This option upgrades the DS4800 controllers with 2 GB of cache memory per controller to DS4800 controllers with 8 GB of cache memory per controller.
- DS4800 Model 84A/H Cache upgrade to 16 GB. This option upgrades the DS4800 controllers with 4 GB of cache memory per controller to DS4800 controllers with 8 GB of cache memory per controller.

Important:

- The machine type and model for the DS4800 are printed on the product label affixed to the DS4800 storage subsystem chassis. As a result, the label that identifies this information does not change when you perform a DS4800 controller upgrade. However, after you upgrade the controller cache, the DS4800 storage subsystem functions as and is treated as the DS4800 model with the cache memory to which you have upgraded. If you perform a future controller replacement, ensure that you identify the correct controller part number for your DS4800 and mention that you have previously upgraded the DS4800 storage subsystem controllers.
- Whenever you add options to your DS4800 storage subsystem, be sure to update the MAC information in Appendix B, “Records,” on page 179.

Attention: Do not dispose of the DS4800 controller CRUs that you replace with the controller CRUs in this upgrade kit. If separate return processing instructions for the DS4800 controller CRUs you replace are included with this upgrade kit, follow the instructions to return the replaced controllers.

Upgrade preparations requirements

Before you upgrade the controller cache in your existing DS4800 storage subsystems, perform the following steps:

1. Save the DS4800 storage subsystem profile. Store the profile in a different location than the disks that are attached to the DS4800 storage subsystem to be upgraded. Also, save the configuration of the setup, including the topology and logical drives to logical unit number (LUN) mapping. Refer to the online help in the Subsystem Management window for instructions on how to save the subsystem profile and configuration information.
2. Perform a full system backup.
3. Upgrade the DS4000 drive expansion enclosure ESM firmware version of the existing DS4000 drive expansion enclosures to the latest levels that are posted on the DS4000 System Storage Disk Support Web site:
www.ibm.com/servers/storage/support/disk/
You must perform the drive expansion enclosure ESM firmware version upgrade before you upgrade the controller firmware in the following step.
4. Upgrade the DS4000 Storage Manager client host software to DS4000 Storage Manager version 9.16 or later and the DS4800 storage subsystem controller firmware to version 06.15 or 06.16 or higher.
5. Verify that both of the DS4800 storage subsystem power supply fan units are plugged in, powered on, and in optimal state. Use the DS4000 Storage Manager client host software to verify that the DS4800 storage subsystem is in optimal state. (This step is not required for cold upgrades.)
6. If the DS4800 host ports are connected to a FC switch, use the switch monitor tool to make sure that the DS4800 host ports and the server FC HBA ports are operating optimally. No unexpected port log-out and log-in events should be reported. If there are any, make sure that the cause or causes of these events are corrected before starting the DS4800 controller cache upgrade. (This step is not required for cold upgrades.)
7. Verify that the premium feature keys are available. Also, locate all premium feature and entitlement proofs of purchase and ensure that they can be accessed when needed.
8. Use the *DS4800 Installation, User's, and Maintenance Guide* for reference as needed. This upgrade procedure may refer to specific sections in the *DS4800 Installation, User's, and Maintenance Guide*. A hard copy of this guide was included in the original DS4800 shipment. Additional copies of this guide in pdf format are available on the DS4000 System Storage Disk Support Web site:
www.ibm.com/servers/storage/support/disk/
9. If you use out-of-band (direct) management and assign IP addresses to the DS4800 controllers using Dynamic Host Configuration Protocol (DHCP) based on the DS4800 controller MAC addresses, you must upgrade your DHCP server with the new MAC addresses for the replacement DS4800 controllers in the upgrade kit.

Two upgrade methods are possible when you perform the DS4800 controller cache upgrade:

- Hot-case upgrade procedure — The DS4800 storage subsystem remains powered on and receives I/Os during the controller cache upgrade. Because the DS4800 storage server controllers will be swapped during the upgrade, you

should schedule the upgrade during a non-peak I/O (low-usage) period. Use the DS4800 Storage Manager performance monitor function to determine the non-peak I/O load time if required.

- Cold-case upgrade procedure — The DS4800 storage subsystem is powered down when controllers are upgraded.

Note: The cold-case controller upgrade procedure is recommended if your production environment allows the scheduling of downtime for maintenance purposes.

Refer to the IBM System Storage DS4800 Controller Upgrade Kit Instructions for step-by-step instructions for upgrading DS4800 controller cache.

Replacing a power supply-fan

The power supply-fan is a component that includes both a 400-W power supply unit and two fans. The power supply-fans provide power and cooling for the DS4800 Storage Subsystem. 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 102.

The storage subsystem cooling system consists of two fans in each of the two power supply-fans. 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 102.

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 48 hours to maintain redundancy and optimum cooling. Do not remove the failed power-supply fan unit from the DS4800 chassis 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 DS4800 chassis.

Do not run the storage subsystem without adequate ventilation and cooling, because it might cause damage to the internal components and circuitry.

Use the following procedure to replace a power supply-fan. Each power supply-fan contains a power supply, cooling fan, battery charger, and temperature sensor. If any of these components fail, you must replace power supply-fan. The power supply, fan, battery charger, and temperature sensor are not individually replaceable components within the power supply-fan.

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. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
2. Locate the storage subsystem that contains the failed power supply-fan by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 88 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

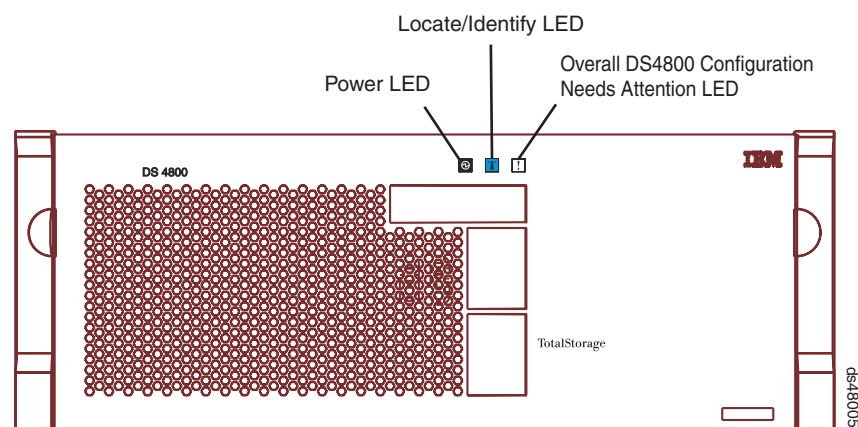


Figure 88. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

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

4. Locate the failed power supply-fan by checking that the power supply-fan Needs Attention LED that is turned on. (Figure 89 shows the LEDs on the power supply-fan.)

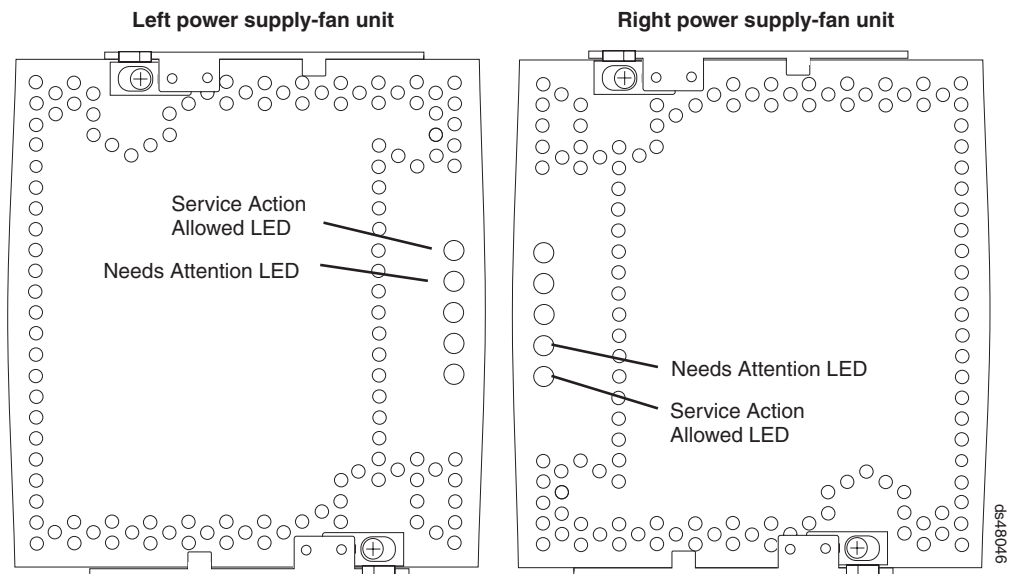


Figure 89. Power supply-fan LEDs

Attention: Never remove a power supply-fan unless the Service Action Allowed status LED is turned on.

5. Is the Service Action Allowed status LED turned on? (Figure 89 shows the location of the Service Action Allowed status LED on the power supply-fan.)
 - Yes – Go to step 6.
 - No – Another component requires attention before you can remove the power supply-fan. Normally, this indicates that a RAID controller is either powered off or failed. Ensure that both DS4800 RAID controllers are optimal. If the Service Action Allowed status LED of the failed power supply-fan is not lit when both RAID controllers are optimal, contact your IBM support representative.

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

6. Put on antistatic protection.
7. Unpack the new power supply-fan.
Save all packing materials in the event you need to return the new power supply-fan.
8. Apply the appropriate label to the LED column for the replacement power supply-fan unit. The labels and instructions are included with the replacement power supply-fan. Make sure that the labels are aligned properly and do not cover any LEDs.
9. Unlatch the top and bottom levers on the failed power supply-fan. Rotate both levers out simultaneously and remove the failed power supply-fan. (Figure 90 on page 147 shows a power supply-fan sliding from the storage subsystem chassis.)

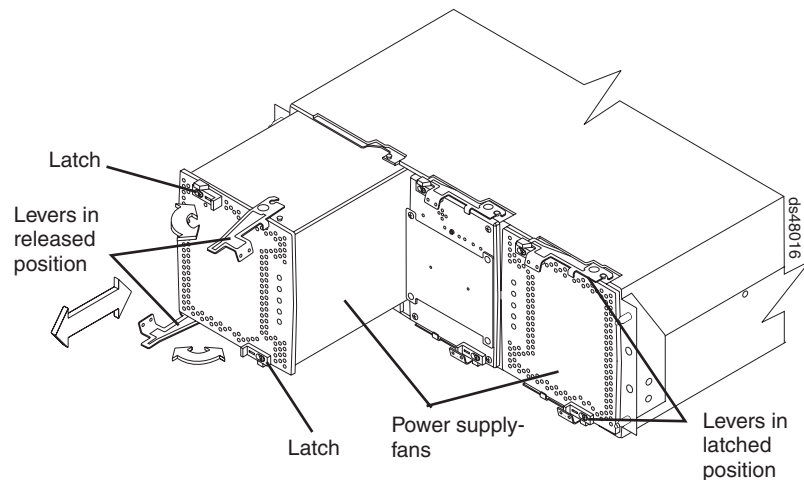


Figure 90. Removing a power supply-fan from the DS4800

10. Install the new power supply-fan.
 - a. Carefully position the power supply-fan in the storage subsystem chassis. The power supply-fan has a relief formed along one long edge of the component. The component relief fits onto a rail cast into the storage subsystem chassis. Ensure that the component relief fits onto the rail before attempting to slide the controller into the storage subsystem chassis.
 - b. With the left and right levers rotated out perpendicular to the face of the power supply-fan, slide the back of the power supply-fan into the appropriate slot.
 - c. Holding both levers, slowly push the power supply-fan until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the power supply-fan is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on all interface pins.

Attention: Verify that the power supply-fan does not snag any other DS4800 cables when you slide it into the bay.
 - d. Press the power supply-fan fully into the slot, engaging the pins on the enclosure.
 - e. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the power supply-fan is locked in place.
11. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new power supply-fan.
12. Complete any remaining Recovery Guru procedures for power supply-fan replacement, if needed.
13. Did this correct the problem?
 - Yes – Go to step 14 on page 148.
 - No – Verify the following:
 - Both power supply-fan switches on the back of the DS4800 are turned on.
 - The circuit breaker for the electrical outlet that DS4800 connects to has not been tripped.

- The circuit breaker in the DS4800 RAID controller that the power supply-fan is linked to has not been tripped. (The right power supply-fan is linked to Controller A; the left power supply-fan is linked to Controller B.) See “Resetting the controller circuit breakers” on page 124.

If the problem persists after you have checked the above, contact your IBM service representative.

14. Remove the antistatic protection.
15. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover, and then press the cover toward the chassis until the pins snap into place.
16. Use the DS4000 Storage Manager Subsystem Management Window to check the status of components in the storage subsystem.
17. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the Subsystem Management Window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 18.
18. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Replacing the interconnect-battery unit

Use the following procedure to replace the interconnect-battery unit.

Attention:

Never remove the interconnect-battery unit unless directed to do so by an IBM Service representative. In addition, do not replace the interconnect-battery unit in any of the following situations:

- The DS4800 Controller A is not in optimal state.
- The FC paths from the hosts to the host ports in Controller A are not optimal.
- The drive paths from Controller A to the storage expansion enclosures are not optimal.
- The right power-supply fan is not powered on or not optimal.

The reason not to replace the interconnect-battery unit in any of the above situations is because Controller A is the designated controller to receive all I/Os when the interconnect-battery unit is removed from the DS4800. Use the DS4000 Storage Manager client Subsystem Management window and the appropriate SAN monitoring tools to ensure that there are no problems with Controller A or with the connection from the host to controller A.

Also note that LUN Failover between controllers is disabled during this procedure because Controller B must be placed off-line before the interconnect-battery unit is removed from the DS4800. It is recommended to perform the interconnect-battery unit replacement procedure during off-peak I/O traffic hours.

Before removing the interconnect-battery unit, you *must* use the DS4000 Storage Manager client to place Controller B off-line. Controller A must display Optimal status before removing the interconnect-battery unit. Do *not* remove the interconnect-battery unit if Controller A does not display Optimal status.

Electrostatic discharge can damage sensitive components. Touching the storage subsystem or its components without using a proper ground might damage the equipment. To avoid damage, use proper antistatic protection while handling any components.

1. Locate the failed interconnect-battery unit by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 91 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

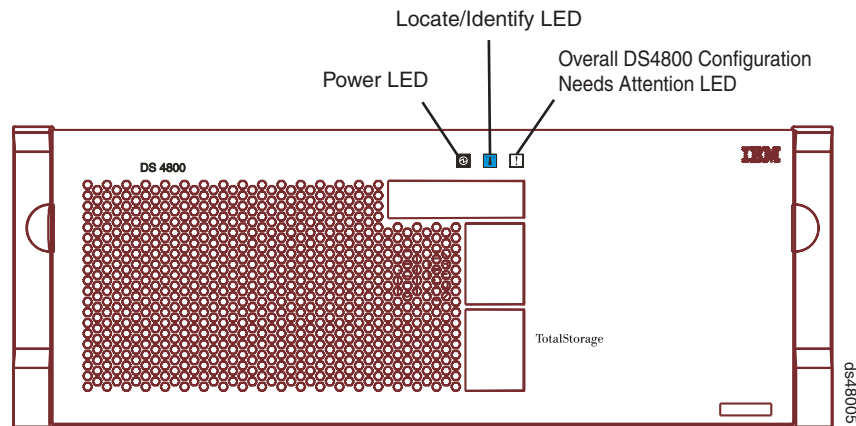


Figure 91. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

2. Use the DS4000 Storage Manager client to place Controller B off-line.

Attention: Controller A must display Optimal status before removing the interconnect-battery unit. Do *not* remove the interconnect-battery unit if Controller A does not display Optimal status.
3. Remove the front bezel by grasping the sides and pulling the cover toward you.

Attention: Never remove a power supply-fan unless the Service Action Allowed status LED is turned on.
4. Is the Service Action Allowed status LED turned on? (Figure 92 on page 150 shows the location of the Service Action Allowed status LED on the interconnect-battery unit.)
 - Yes – Go to step 5 on page 150.
 - No – Make sure that the right power supply-fan unit is connected, powered on, and in optimal state.

If the right power supply-fan unit is connected, powered on, and in optimal state and Service Action Allowed status LED remains unlit, run the Recovery Guru to determine what other components might require attention. If the Recovery Guru does not indicate any other component problems, contact your IBM Support representative.

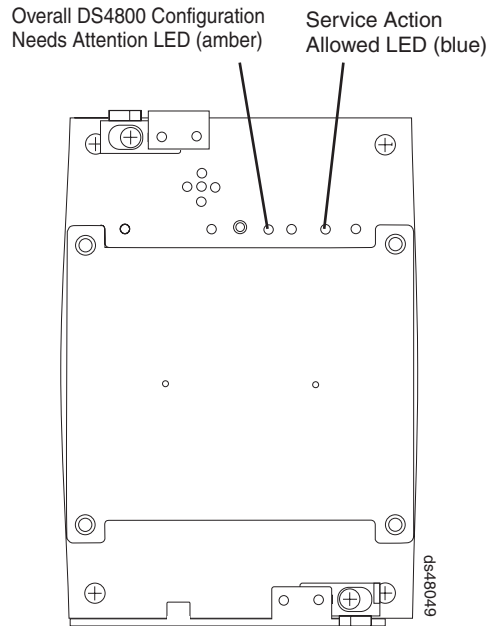


Figure 92. Interconnect-battery unit Needs Attention and Service Action Allowed LEDs

5. Put on antistatic protection.
6. Unpack the interconnect-battery unit.
Save all packing materials in the event you need to return the new interconnect-battery unit.
7. Unlatch both the top and bottom levers of the interconnect-battery unit and rotate both levers straight out simultaneously to remove the failed interconnect-battery unit. (Figure 93 on page 151 shows the interconnect-battery unit sliding from the storage subsystem chassis.)

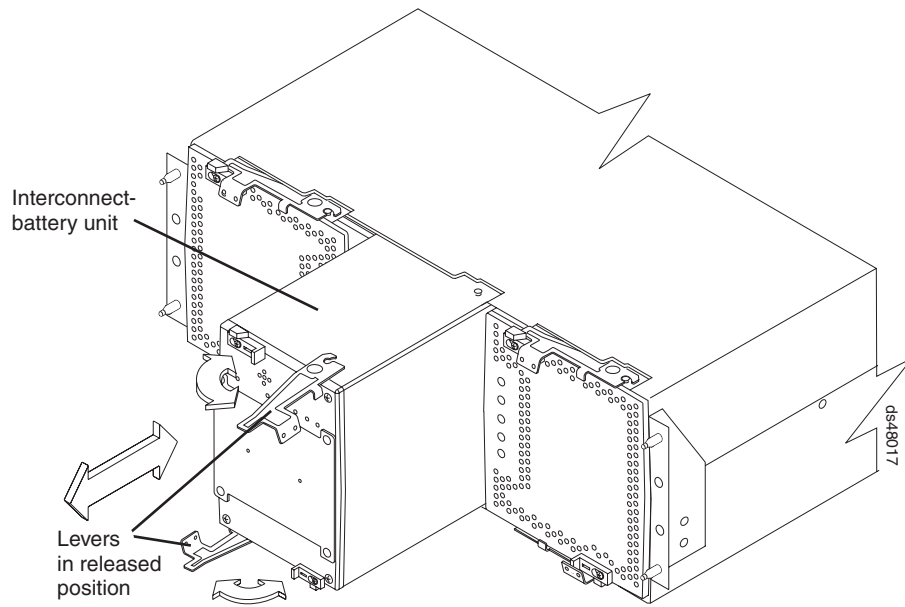


Figure 93. Removing an interconnect-battery unit from the DS4800

8. Remove both battery packs from the failed interconnect-battery unit and replace the battery packs in the replacement interconnect-battery unit. See “Replacing a backup battery pack” on page 152 for instructions on how to remove and replace the battery packs from an interconnect-battery unit.
9. Install the new interconnect-battery unit.

- a. Carefully position the interconnect-battery unit in the storage subsystem chassis.

The interconnect-battery unit has a pin on the connector end of the component. The pin fits onto a relief cast into the storage subsystem chassis. (You can see the relief by peering into the slot for the interconnect-battery unit.) Ensure that the interconnect-battery unit pin is aligned with the relief in the storage subsystem chassis before attempting to slide the interconnect-battery unit into the storage subsystem chassis.

- b. With the top and bottom levers rotated out perpendicular to the face of the interconnect-battery unit, slide the back of the unit into the appropriate slot.
- c. Holding both levers, slowly push the interconnect-battery unit until the notches in both the left and right levers are aligned with the pins on the DS4800 enclosure so that the interconnect-battery unit is pulled evenly into the DS4800 storage subsystem chassis, ensuring full electrical connection contact on the interface pin.

Attention: Verify that the interconnect-battery unit does not snag any other DS4800 cables when you slide it into the bay.

- d. Press the interconnect-battery unit fully into the slot, engaging the pins on the enclosure.
 - e. Hold open both latches and push both left and right levers simultaneously to the closed position. Release the latches. When you release the latches, you should hear both latches snap over the levers, indicating that the interconnect-battery unit is locked in place.
10. Wait up to 5 minutes for the DS4000 Storage Manager client software to recognize the new interconnect-battery unit.

11. Use the DS4000 Storage Manager client to place Controller B on-line.
12. Complete any remaining Recovery Guru procedures for interconnect-battery unit replacement, if needed.
13. Did this correct the problem?
 - Yes – Go to step 14.
 - No – If the problem has not been fixed, contact your IBM service representative.
14. Remove the antistatic protection.
15. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover and then press the cover toward the chassis until the pins snap into place.
16. Use the Subsystem Management Window to check the status of all components in the storage subsystem.
17. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the DS4000 Storage Manager Subsystem Management Window, and complete the recovery procedure. If the problem persists, contact your IBM support representative.
 - No – Go to step 18.
18. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Replacing a backup battery pack

Use the following procedure if the DS4000 Storage Manager client instructs you to replace the battery because the current battery has failed . You can also use the DS4000 Storage Manager client to check the status of the battery. Because write-caching is disabled when either one of the backup battery packs fail, IBM recommends that you replace the failed battery pack as soon as possible to minimize any impact due to the disabling of the write-caching function.

Replace only the battery pack that is indicated as failed by the LEDs. You do not need to replace both battery packs when the Battery LEDs indicate that only one battery pack has failed.

Note: Unlike the batteries for other DS4000 Storage Subsystems, the DS4800 Storage Subsystem battery packs do not have set expiration dates. Do not replace these batteries after a certain usage period.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 133.

Use the following procedure to replace a backup battery pack in the interconnect-battery unit.

1. Use the DS4000 Storage Manager client software to print a storage subsystem profile.
2. Locate the storage subsystem that contains the interconnect-battery unit with the failed battery by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 94 on page 153 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

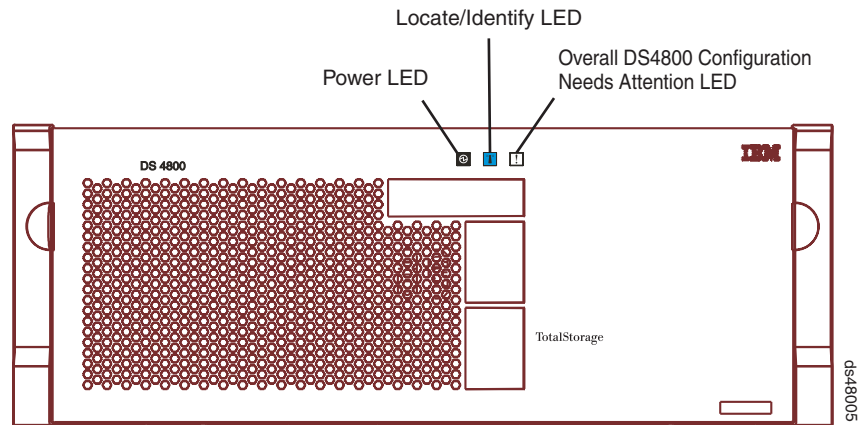


Figure 94. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

3. Remove the front bezel by grasping the sides and pulling the cover toward you.
4. Check the LEDs on the power supply-fan units to determine which of the two battery packs has failed. (See Figure 81 on page 131.) Replace only the battery pack that is indicated as failed by the LEDs.
5. Put on antistatic protection.
6. Unpack the new battery pack. Set the new battery pack on a dry, level surface. Save all packing materials in the event you need to return the new battery pack.
7. Remove the battery access cover from the front of the interconnect-battery unit by removing the thumb screws that secure the cover to the component. Figure 95 shows the access cover and mounting screws on the interconnect-battery unit.

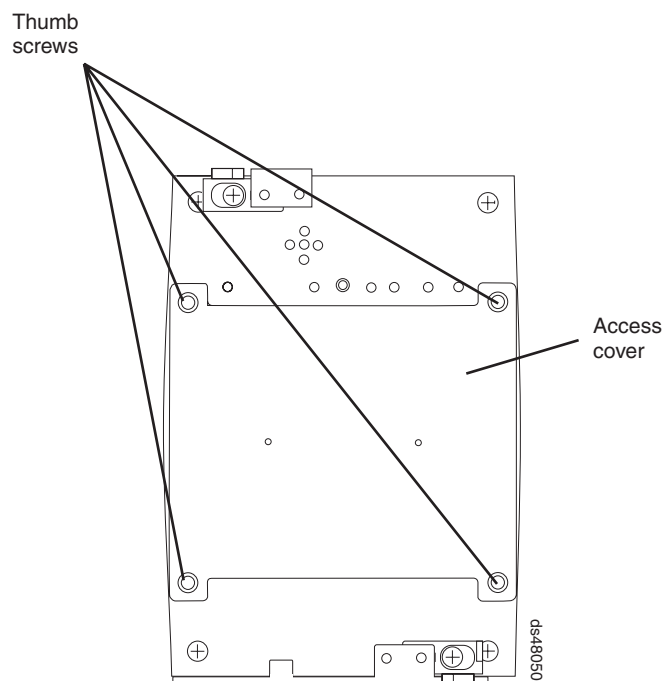
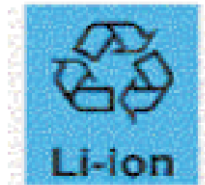


Figure 95. Battery access cover on the interconnect-battery unit

8. Remove the failed battery pack by sliding it out of the interconnect-battery unit.

Note: There are two battery packs in the interconnect-battery unit. The right and left Battery Needs Attention LEDs on the interconnect-battery unit correspond to each of the two battery packs. Be sure to remove the failed battery, as indicated by the lit amber Battery Needs Attention LED.

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



CAUTION:

This product contains a sealed Lithium Ion battery. Discharged Lithium and Lithium Ion batteries are currently designated to be disposed of in normal trash. However, users should contact their municipal waste disposal facility prior to discarding any used battery in normal trash. Alternatively, IBM recommends users may return Lithium, Lithium Ion and Lithium Ion battery packs to IBM for recycling.

In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM Lithium, Lithium Ion and Lithium Ion battery packs. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

For information on disposal of sealed Lithium Ion batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

9. Install the replacement battery pack. Carefully position the battery pack to ensure that the battery pack will slide correctly into the interconnect-battery unit. The flat side of the battery pack should face towards the outside of the chassis. Make sure that the battery bracket slides properly into the slots for the battery. Slide the battery pack into the interconnect-battery unit. Push the battery pack firmly into the interconnect-battery unit to ensure that the battery pack completely engages with the connectors in the interconnect-battery unit.
10. Reinstall the battery access cover onto the front of the interconnect-battery unit.
11. Once you have replaced the battery pack, you must reset the battery age through the DS4000 Storage Manager client, by performing these three steps.
 - First, you must select the "Controller enclosure components" icon in the Physical View of the Storage Manager client. The "Controller enclosure components" dialog will be displayed.
 - Next, you must select the "Batteries" icon, and then select "Reset." You will be asked to "Confirm Reset." Select "Yes" to confirm that you want to reset the battery age.

- Now, the battery age clock is reset to 0.
12. Remove the antistatic protection.
 13. Install the front bezel by aligning the pins on the storage subsystem chassis with the spring-steel retainers on the cover and then press the cover toward the chassis until the pins snap into place.
 14. Use the Subsystem Management Window to check the status of all components in the storage subsystem.
 15. Do any storage subsystems have a fault (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the DS4000 Storage Manager Subsystem Management Window, and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 16.
 16. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Note: Note that it might take from 15 minutes to a few hours for a new battery to become fully charged. The DS4000 Storage Manager client will show the battery as charging until it is fully charged. Controller caching is automatically disabled until the new battery becomes fully charged.

17. After 24 hours, check the Needs Attention and Battery LEDs to ensure that the battery is working properly.
If the replacement battery indicates a fault, contact your IBM support representative.

Replacing an SFP module

Use the following procedure to replace an SFP module in a controller. The SFP module shown in this procedure might look different from those you are using, but the difference does not affect SFP module performance.

Electrostatic discharge can damage sensitive components. To prevent electrostatic discharge damage to the storage subsystem, use proper antistatic protection when handling the DS4800 components.

Attention: Removing an SFP module that has not failed can cause data loss. To prevent data loss, remove only the SFP module that has a Bypass LED on or that displays a failed status in the DS4000 Storage Manager client software.

1. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.
2. Locate the storage subsystem that has the failed SFP module by checking the Overall DS4800 Configuration Needs Attention LED on the front bezel of the storage subsystem. (Figure 96 on page 156 shows the location of the Overall DS4800 Configuration Needs Attention LED on the front bezel.)

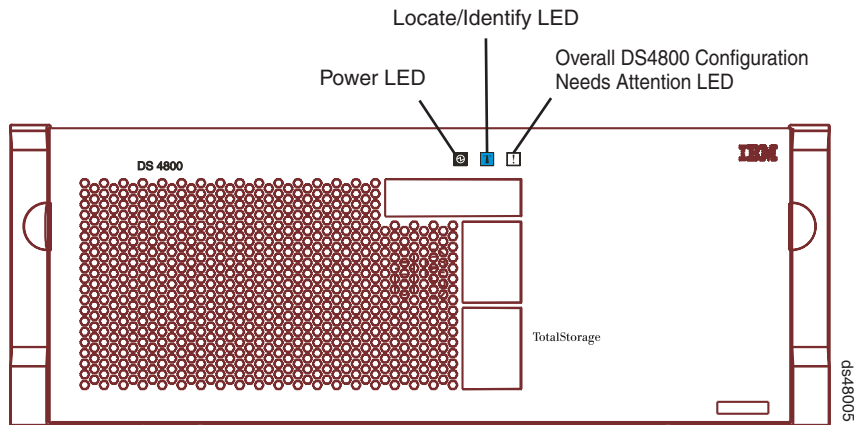


Figure 96. Overall DS4800 Configuration Needs Attention LED on the DS4800 front bezel

3. Locate the failed SFP module by checking the SFP Bypass LED and Needs Attention LED on the controllers. If a fault is detected, the LEDs are lit. Figure 97 shows the location of the controller SFP Bypass LED and Needs Attention LED on the controller.

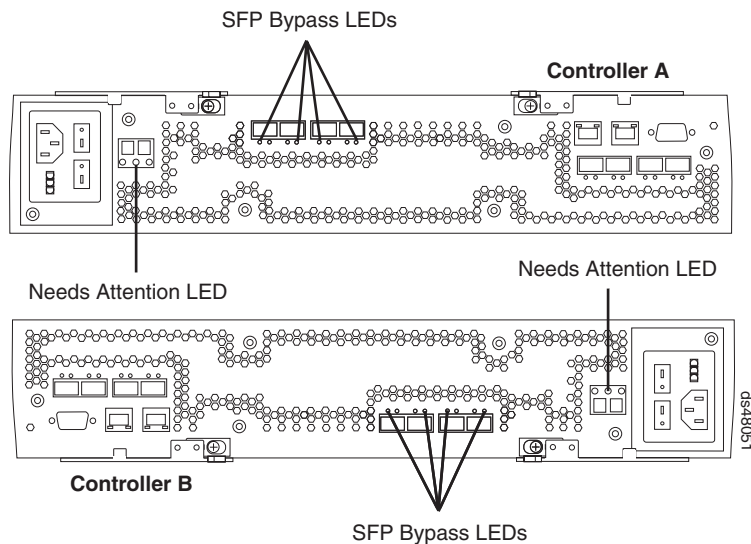


Figure 97. Needs Attention and SFP Model Bypass LEDs

4. Put on antistatic protection.
5. Unpack the new SFP module. Verify that it is the same type of module you are replacing. Save all packing materials in the event you might need to return the new SFP module.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. 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 in.).

6. Disconnect the interface cable from the SFP module. (Figure 98 on page 157 shows the SFP module, interface cable, and the rear of a controller.)

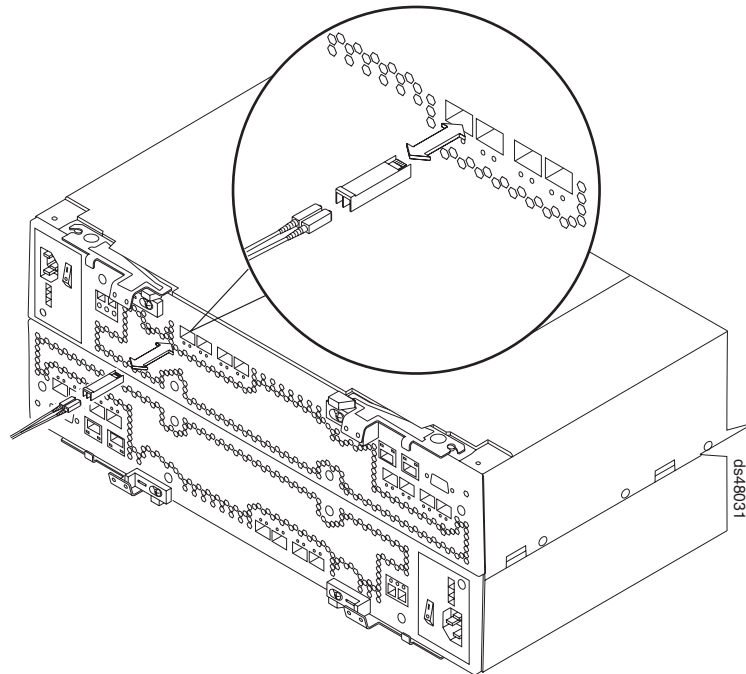


Figure 98. Replacing an SFP module

7. Remove the failed SFP module from the controller.
8. Install the new SFP module into the controller.
9. Reconnect the interface cable.
10. Check the Bypass and Needs Attention LEDs for the new SFP module. Based on the status of the Bypass and Needs Attention LEDs, choose one of the following steps.
 - Bypass LED or Needs Attention LED is illuminated – The SFP module and cables might be installed incorrectly, or the cable might not be securely connected. Reinstall the SFP module and cable, check the cable connection, and then go to step 11.
 - Bypass LED and Needs Attention LED are off – Go to step 12.
11. Is the problem corrected?
 - Yes – Go to step 12.
 - No – Contact your IBM support representative.
12. Remove the antistatic protection.
13. Use the DS4000 Storage Manager Subsystem Management Window to check the status of all components in the storage subsystem.
14. Do any storage subsystems have a Needs Attention (Needs Attention) status?
 - Yes – Select the Recovery Guru toolbar button in the Subsystem Management Window and complete the recovery procedure. If the problem persists, contact your IBM service representative.
 - No – Go to step 15.
15. Use the DS4000 Storage Manager client software to print a new storage subsystem profile.

Installing SFPs and fiber-optic cables

Each RAID controller unit has four single-ported host channels and two dual-ported drive channels. SFPs are inserted into the ports, and then fibre-channel cables are connected to the SFPs.

For information on installing SFPs and fiber-optic cables, see “Working with SFPs and fiber-optic cables” on page 47.

Chapter 6. Hardware maintenance

This chapter contains information to help you solve some of the simpler problems that you might have with your storage subsystem. It contains the problem indicators and error messages along with suggested actions to take to resolve the problem.

Note: See the *IBM System Storage DS4000 Problem Determination Guide* for additional troubleshooting and debugging procedures.

General checkout

Use the status LEDs, Symptom-to-FRU index, and the DS4000 Storage Manager client software to diagnose problems. See “Solving problems.”

To diagnose a cluster system, use the cluster problem determination procedure in the *IBM System Storage DS4000 Problem Determination Guide*.

Note: If power was just applied to the storage subsystem, the green and amber LEDs might turn on and off intermittently. Wait up to five minutes for the storage subsystem to finish powering up before you begin to check for faults.

Using the diagnostic hardware

The DS4800 comes with an LC wrap-plug adapter and LC-LC coupler. The wrap-plug adapter and LC-LC coupler are used to perform the loopback test and to identify fibre path problems. See the *IBM System Storage DS4000 Problem Determination Guide* for more information.

The loopback test and the sendEcho test are described in the *IBM System Storage DS4000 Problem Determination Guide*. In the IBM System Storage SAN Integration Server configuration, a loopback adapter (P/N 17P6918) is included to identify path problems on the drive loop when using fibre channel 1.2 m copper cable (P/N 18P5237).

Solving problems

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

You can use the symptom-to-FRU index (Table 24 on page 160) as a guide for troubleshooting problems in addition to the DS4000 Storage Manager Recovery Guru in the Subsystem Management window. Do not depend solely on Table 24 on page 160 for FRU replacement decision.

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

Attention: Do not remove any power supply-fan units, controllers, or interconnect-battery units from the storage subsystem unless the Service Action Allowed LED for the component is lit. Always use the appropriate procedure in Chapter 5, “Replacing components,” on page 133 to prevent an inadvertent shutdown of the DS4800 as a result of removing the DS4800 components in the wrong sequence.

Table 24. DS4800 Symptom-to-FRU index

Problem indicator	Component	Possible cause	Possible solutions
Amber Needs Attention LED on	RAID controller Needs Attention LED	RAID controller offline	<p>If you have placed the controller offline, use the DS4000 Storage Manager client software to place it online.</p> <p>If one controller has been placed offline by the other controller, contact IBM support. (This is the case if you use the DS4000 Storage Manager client software to make repeated attempts to bring an offline controller online, but the controller keeps reverting back to an offline state.)</p>
		RAID controller failure	<p>If the RAID controller Needs Attention LED is on and the Service Action Allowed LED for that RAID controller is lit, replace the RAID controller.</p> <p>If the Service Action Allowed LED for the RAID controller is not lit, perform additional diagnostics to identify other component failures. Replace the other failed components before replacing the RAID controller.</p>
	Drive bypass LED	Fibre-channel cable is not attached to the storage expansion enclosure	Connect the fibre-channel cable to the enclosure port; check other connections.
		No incoming signal detected	<p>Reattach the SFPs and fibre-channel cables.</p> <p>Verify that the fibre channel cables are in good condition and that there are no cable management issues (such as using plastic ties to wrap the cables or bending the cable loops to less than 1.5 inches).</p> <p>Verify the SFPs are working properly. Use the wrap-plug coupler kit that ships with the DS4800 and the wrap-plug instructions in the <i>DS4000 Problem Determination Guide</i>.</p> <p>Replace input and output SFPs or cables as necessary.</p>
Amber Needs Attention LED on (continued)	Overall DS4800 Configuration Needs Attention LED (located on interconnect-battery unit)	General system error	Indicates that a Needs Attention LED somewhere in the DS4800 storage subsystem configuration, including all attached storage expansion enclosures, has turned on. (Check for amber LEDs on DS4800 components as well as all attached storage expansion enclosures.) Use the DS4000 Storage Manager software to diagnose server problems.
	Various DS4800 components	Multiple component failures	Do not randomly replace components in the DS4800. This might result in a subsystem shutdown, causing a loss of data availability. Use the DS4000 Storage Manager client program to identify the failed components. Identify and replace the failed power supply-fan components first before fixing any other failed components.

Table 24. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs off	All CRUs	Subsystem power is off	Check that all power cords are plugged in and all power switches are on. If applicable, check that the main circuit breakers for the rack cabinet are turned on.
		AC power failure	Check the main circuit breaker and ac outlet.
		Both power supply-fans have failed	Replace the power supply-fans.
		Both controller circuit breakers have tripped	Reset the controller circuit breakers.

Table 24. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is on, green LED is off, blue LED is off, and Overall DS4800 Storage Subsystem Needs Attention LED is on	Power supply-fan <ul style="list-style-type: none"> • Amber Needs Attention LED on • Blue Service Action Allowed LED off • Green Power LED off 	<ul style="list-style-type: none"> • Power switch on a power supply-fan unit is turned off • An electrical outlet circuit breaker has been tripped • There has been an AC power failure • The circuit breaker in the RAID controller associated with this PSF has been tripped 	Check the power supply-fan unit power switches, circuit breakers, and AC power source. If none of these sources are the cause of the fault, then do not replace the failed power supply-fan unit until you have performed additional diagnostics to determine why the Service Action Allowed LED on the power supply-fan is not lit. Call IBM Support if needed.
	Interconnect-battery unit <ul style="list-style-type: none"> • Amber Battery Needs Attention LED on the interconnect-battery unit is on • Green Battery LED on the power supply-fan is off 	Battery failure	Verify the failure using DS4000 Storage Manger Client and replace the failing battery.
	Interconnect-battery unit <ul style="list-style-type: none"> • Green Power LED on interconnect-battery unit is off • Amber Battery Needs Attention LED on the interconnect-battery unit is on 	Interconnect-battery unit failure or midplane failure	Call IBM support.
	RAID Controller <ul style="list-style-type: none"> • Amber Controller Needs Attention LED is on 	Controller failure or controller placed offline	Use DS4000 Storage Manager client software to place the controller online. If the failure persists, do <i>not</i> replace the controller unit. Instead, perform additional diagnostics (such as checking the power supply-fan components) to determine what additional failures have caused the associated Service Action Allowed LED on the controller not to light.

Table 24. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is on and blue LED is on, and Overall DS4800 Storage Subsystem Needs Attention LED is on	Power supply-fan <ul style="list-style-type: none"> • Amber Needs Attention LED on • Blue Service Action Allowed LED on 	Power supply-fan failure or power supply failure	Use DS4000 Storage Manager client software to verify the failure and replace the power supply-fan.
	RAID controller <ul style="list-style-type: none"> • Amber Controller Needs Attention LED is on • Blue Controller Service Action Allowed LED is on 	RAID controller offline	If you have placed the controller offline, use the DS4000 Storage Manager client software to place it online. If one controller has been placed offline by the other controller, contact IBM support. (This is the case if you use the DS4000 Storage Manager client software to make repeated attempts to bring an offline controller online, but the controller keeps reverting back to an offline state.)
		RAID controller failure	If the RAID controller Needs Attention LED is on and the Service Action Allowed LED for that RAID controller is lit, replace the RAID controller. If the Service Action Allowed LED for the RAID controller is not lit, perform additional diagnostics to identify other component failures. Replace the other failed components before replacing the RAID controller.
Interconnect-battery unit <ul style="list-style-type: none"> • Amber Needs Attention LED is on • Blue Service Action Allowed LED is on 	Interconnect-battery unit failure	Contact IBM Support.	

Table 24. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more Green LEDs off	Controller Cache LED off	<p>Caching is not enabled or was disabled because:</p> <ul style="list-style-type: none"> • The cache memory in controllers A and B is mismatched. • The battery is charging or performing a diagnostic test. • One of the cache backup battery packs has failed. <p>Or, there are no I/Os being sent to the DS4800.</p>	<p>Enable write-caching using the DS4000 Storage Manager client program.</p> <p>Or:</p> <ul style="list-style-type: none"> • Use the DS4000 storage manager client program to verify the cache memory for both controllers. • The DS4800 performs battery diagnostic tests and recharges every 25 hours. Write caching is disabled during the test and will be enabled automatically after the test completes. The test duration time varies depending on the recharging requirement, but the duration should be less than 15 minutes. • Replace the failing battery. <p>If there are no I/Os being sent to the DS4800, generate I/Os to send to the DS4800.</p>
	Battery LED off and power supply-fan Power LED off	The battery is missing	Verify that the battery is missing. All DS4800s are shipped with both cache battery packs installed. Call IBM support if a cache battery pack is missing and you did not remove any of the cache battery packs from the DS4800.
	L1 and L2 (Link Speed) LEDs for a host port	Fibre-channel cable is not attached to the DS4800 host port or the FC device that should be connected to this DS4800 host port.	Connect the fibre-channel cable to the enclosure port; check other connections.
		No FC signal detected	<p>Reattach the SFPs and fibre-channel cables.</p> <p>Verify that the fibre channel cables are in good condition and that there are no cable management issues (such as using plastic ties to wrap the cables or bending the cable loops to less than 1.5 inches).</p> <p>Verify the SFPs are working properly. Use the wrap-plug coupler kit that ships with the DS4800 and the wrap-plug instructions in the <i>DS4000 Problem Determination Guide</i>.</p> <p>Replace input and output SFPs or cables as necessary.</p>
	L1 and L2 (Link Speed) LEDs of drive port	SFP module failure or SFP module not seated properly	<p>Reseat the SFP.</p> <p>Verify the SFPs are working properly. Use the wrap-plug coupler kit that ships with the DS4800 and the wrap-plug instructions in the <i>DS4000 Problem Determination Guide</i>.</p> <p>Replace SFPs as necessary.</p>

Table 24. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
Only one Blue Service Action Allowed LED is lit with no other amber Needs Attention LEDs lit	Interconnect-battery unit	A command from the DS4800 Subsystem Management window placed the interconnect-battery unit in Identify/Locate mode.	Stop the Identify/Locate action in the DS4800 Subsystem Management window.
Only one Blue Service Action Allowed LED is lit and the amber Needs Attention LED for the same component is lit	Power supply-fan, controller, or interconnect-battery unit	The component indicated by both the blue (Service Action Allowed) LED and the amber (Needs Attention) LED has failed and can be replaced.	
Unable to access drives	Expansion drive channel	Fibre-channel cabling has failed.	Ensure that the fibre-channel cables are undamaged and properly connected.
		RAID controller has failed.	Replace the RAID controller.
		An SFP module has failed.	Ensure the SFP module is seated properly; replace the SFP module.
		You have connected more than eight expansion enclosures to the ports of the drive channel. Even though the drive channel is dual-ported, the DS4800 currently does not support more than 112 drives per drive channel.	Power down the DS4800 and its storage expansion enclosures. Recable the expansion enclosures with a maximum of eight expansion enclosures per drive channel.

Table 24. DS4800 Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
The DS4000 Storage Manager client Enterprise Management window sees each storage subsystem controller as an independent storage subsystem or a partially managed device.	Controller	If this condition occurs after you have replaced a controller, the controller firmware for the replacement controller probably failed to synchronize with the firmware on the existing controller.	To recover, perform the following steps: <ol style="list-style-type: none"> 1. Remove and reinsert the controller blade. 2. Wait 5 minutes. 3. Delete the controller entry with the incorrect firmware version from the DS4000 Storage Manager Enterprise Management window. 4. Add the controller back to the DS4000 Storage Manager Enterprise Management window using the Add Device menu option in the Enterprise Management window. 5. If the DS4000 Storage Manager client Enterprise Management window still shows each storage subsystem controller as an independent storage subsystem or a partially managed device, contact IBM support for instructions on how to force firmware synchronization in the replacement controller.
		The DS4800 has been powered on without a connection to at least one storage expansion enclosure populated with at least two drives.	If this is the case, power off the DS4800 and connect at least one storage expansion enclosure populated with at least two drives.
		The attached storage expansion enclosures and/or drives in the attached storage expansion enclosures are not certified or not supported by the DS4800.	The DS4800 will not recognize non-IBM storage expansion enclosures and drive models. If you are positive that storage expansion enclosures and drives are of IBM models, obtain the DS4800 Subsystem Profile and call IBM support.
Random errors	Subsystem	Mid-plane has failed	Contact IBM Support.

Note: If you cannot find the problem in the Symptom-to-FRU index, test the entire system.

Parts list

Figure 99 on page 167 and the following table provide a parts list for the DS4800.

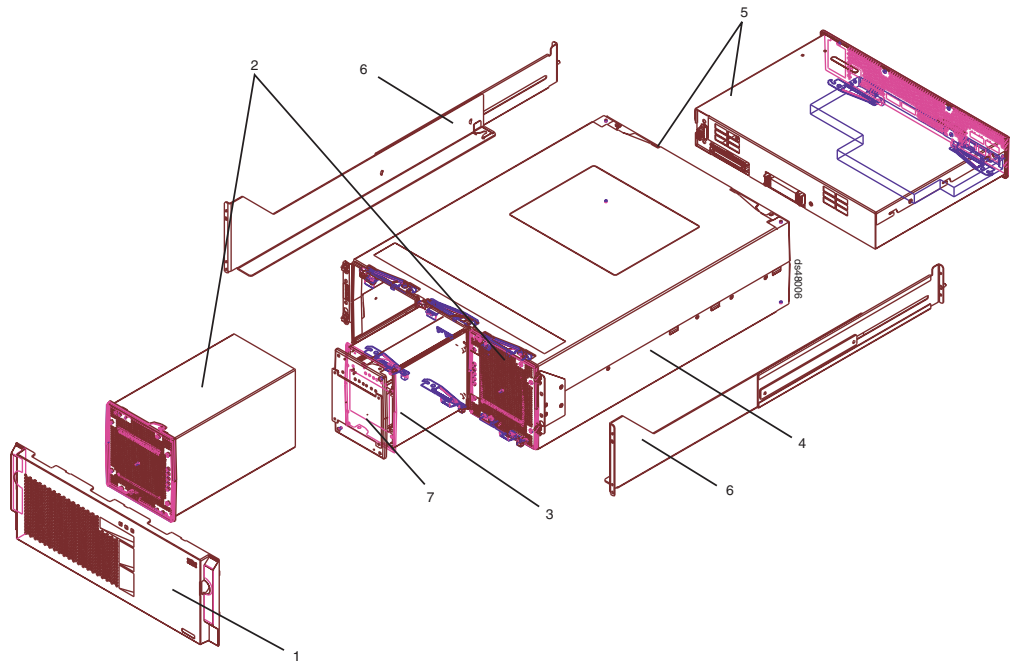


Figure 99. DS4800 parts list

Table 25. Parts list (System Storage DS4800 Storage Subsystem)

Index	DS4800 Storage Subsystem	FRU P/N
1	DS4800 bezel assembly	22R4271
2	DS4800 power supply-fan unit	23R1496
3	DS4800 interconnect-battery unit (with plate and without batteries)	23R0532
4	DS4800 chassis	23R1980 (Model 80H) 23R1982 (Model 80A Non Korea) 23R1981 (Model 80A Korea) 22R4272 (Model 82H) 22R4491 (Model 84H) 22R4493 (Model 82A Non Korea) 22R4494 (Model 82A Korea) 22R4495 (Model 84H Non Korea) 22R4496 (Model 84H Korea) 23R0531 (Model 88H) 23R0529 (Model 88A Non Korea) 23R0530 (Model 88A Korea)

Table 25. Parts list (System Storage DS4800 Storage Subsystem) (continued)

Index	DS4800 Storage Subsystem	FRU P/N
5	DS4800 RAID controller, 2 GB memory, Model 80A/H	23R1983
	DS4800 RAID controller, 2 GB memory, Model 82A/H	23R0535
	DS4800 RAID controller, 4 GB memory, Model 84A/H	23R0536
	DS4800 RAID controller, 8 GB memory, Model 88A/H	23R0537
6	DS4800 mounting rail assembly	22R4839
7	DS4800 battery cover/plate with 4 screws	22R4874
	DS4800 battery	22R4875
	LC wrap plug assembly	24P0950
	LC-SC fibre channel cable adapter	19K1268
	Power cord, 2.8-meter (9-ft.)	6952300
	Power cord, line jumper, high voltage	36L8886
	4-Gbps SFP module	77P2964
	Cable, 1-meter fiber-optic	19K1265
	Cable, 5-meter fiber-optic	19K1266
	Cable, 25-meter fiber-optic	19K1267

Appendix A. Additional DS4000 documentation

The following tables present an overview of the IBM System Storage DS4000 Storage Manager, Storage Subsystem, and Storage Expansion Enclosure product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address.

You can access the documents listed in these tables at both of the following Web sites:

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

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

DS4000 Storage Manager Version 9 library

Table 26 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

Table 26. 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
<i>IBM System Storage DS4000 Storage Manager Version 9 Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i>	✓		✓	✓		
<i>IBM System Storage DS4000 Storage Manager Version 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on POWER</i>	✓		✓	✓		
<i>IBM System Storage DS4000 Storage Manager Version 9 Copy Services User's Guide</i>	✓		✓	✓	✓	
<i>IBM TotalStorage DS4000 Storage Manager Version 9 Concepts Guide</i>	✓	✓	✓	✓	✓	✓

DS4800 Storage Subsystem library

Table 27 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 27. DS4800 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4800 Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4800 Installation and Cabling Overview</i>		✓				
<i>IBM TotalStorage DS4800 Controller Cache Upgrade Kit Instructions</i>	✓	✓		✓		

DS4700 Storage Subsystem library

Table 28 associates each document in the DS4700 Storage Subsystem library with its related common user tasks.

Table 28. DS4700 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4700 Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4700 Storage Subsystem Fibre Channel Cabling Guide</i>		✓				

DS4500 Fibre Channel Storage Server library

Table 29 associates each document in the DS4500 (previously FAStT900) Fibre Channel Storage Server library with its related common user tasks.

Table 29. 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
<i>IBM TotalStorage DS4500 Installation and Support Guide</i>	✓	✓		✓		
<i>IBM TotalStorage DS4500 Fibre Channel Cabling Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4500 Storage Server User's Guide</i>				✓	✓	✓
<i>IBM TotalStorage DS4500 Rack Mounting Instructions</i>	✓	✓				

DS4400 Fibre Channel Storage Server library

Table 30 associates each document in the DS4400 (previously FAStT700) Fibre Channel Storage Server library with its related common user tasks.

Table 30. 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
<i>IBM DS4400 Fibre Channel Storage Server User's Guide</i>	✓	✓		✓	✓	✓
<i>IBM DS4400 Fibre Channel Storage Server Installation and Support Guide</i>	✓	✓		✓	✓	
<i>IBM DS4400 Fibre Channel Cabling Instructions</i>	✓	✓				

DS4300 Fibre Channel Storage Server library

Table 31 associates each document in the DS4300 (previously FAStT600) Fibre Channel Storage Server library with its related common user tasks.

Table 31. 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
<i>IBM TotalStorage DS4300 Fibre Channel Storage Server Installation and User's Guide</i>	✓	✓		✓		
<i>IBM TotalStorage DS4300 Rack Mounting Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4300 Fibre Channel Cabling Instructions</i>	✓	✓				
<i>IBM TotalStorage DS4300 SCU Base Upgrade Kit</i>		✓	✓			
<i>IBM TotalStorage DS4300 SCU Turbo Upgrade Kit</i>		✓	✓			
<i>IBM TotalStorage DS4300 Turbo Models 6LU/6LX Upgrade Kit</i>		✓	✓			

DS4100 SATA Storage Server library

Table 32 associates each document in the DS4100 (previously FAStT100) SATA Storage Server library with its related common user tasks.

Table 32. DS4100 SATA Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4100 Installation, User's and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4100 Cabling Guide</i>		✓				

DS4000 Storage Expansion Enclosure documents

Table 33 associates each of the following documents with its related common user tasks.

Table 33. DS4000 Storage Expansion Enclosure document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM System Storage DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i>	✓	✓		✓	✓	✓
<i>Fibre Channel Solutions - IBM DS4000 EXP500 Installation and User's Guide</i>	✓	✓		✓	✓	✓
<i>IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide</i>	✓	✓				

Other DS4000 and DS4000-related documents

Table 34 associates each of the following documents with its related common user tasks.

Table 34. DS4000 and DS4000–related document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM Safety Information</i>					✓	
<i>IBM TotalStorage DS4000 Quick Start Guide</i>	✓	✓				
<i>IBM TotalStorage DS4000 Hardware Maintenance Manual</i>						✓
<i>IBM System Storage DS4000 Problem Determination Guide</i>						✓
<i>IBM Fibre Channel Planning and Integration: User's Guide and Service Information</i>	✓	✓			✓	✓
<i>IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide</i>		✓			✓	
<i>IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide</i>		✓			✓	
<i>IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i>	✓	✓	✓	✓		
<i>IBM Netfinity® Fibre Channel Cabling Instructions</i>		✓				
<i>IBM Fibre Channel SAN Configuration Setup Guide</i>	✓		✓	✓	✓	

Appendix B. Records

Whenever you add options to your DS4800, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other options and provide needed data whenever you contact your IBM technical support representative.

Identification numbers

Record and retain the following information. The machine type, model number, and serial number are located on top of each RAID controller unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 100.

Product name:	IBM System Storage DS4800 Storage Subsystem
Machine type:	1815
Model number:	
Serial number:	
RAID controller MAC addresses:	
Controller firmware version:	

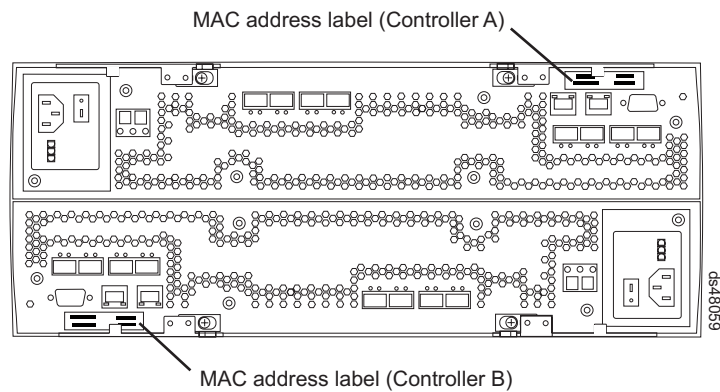


Figure 100. Location of MAC address labels

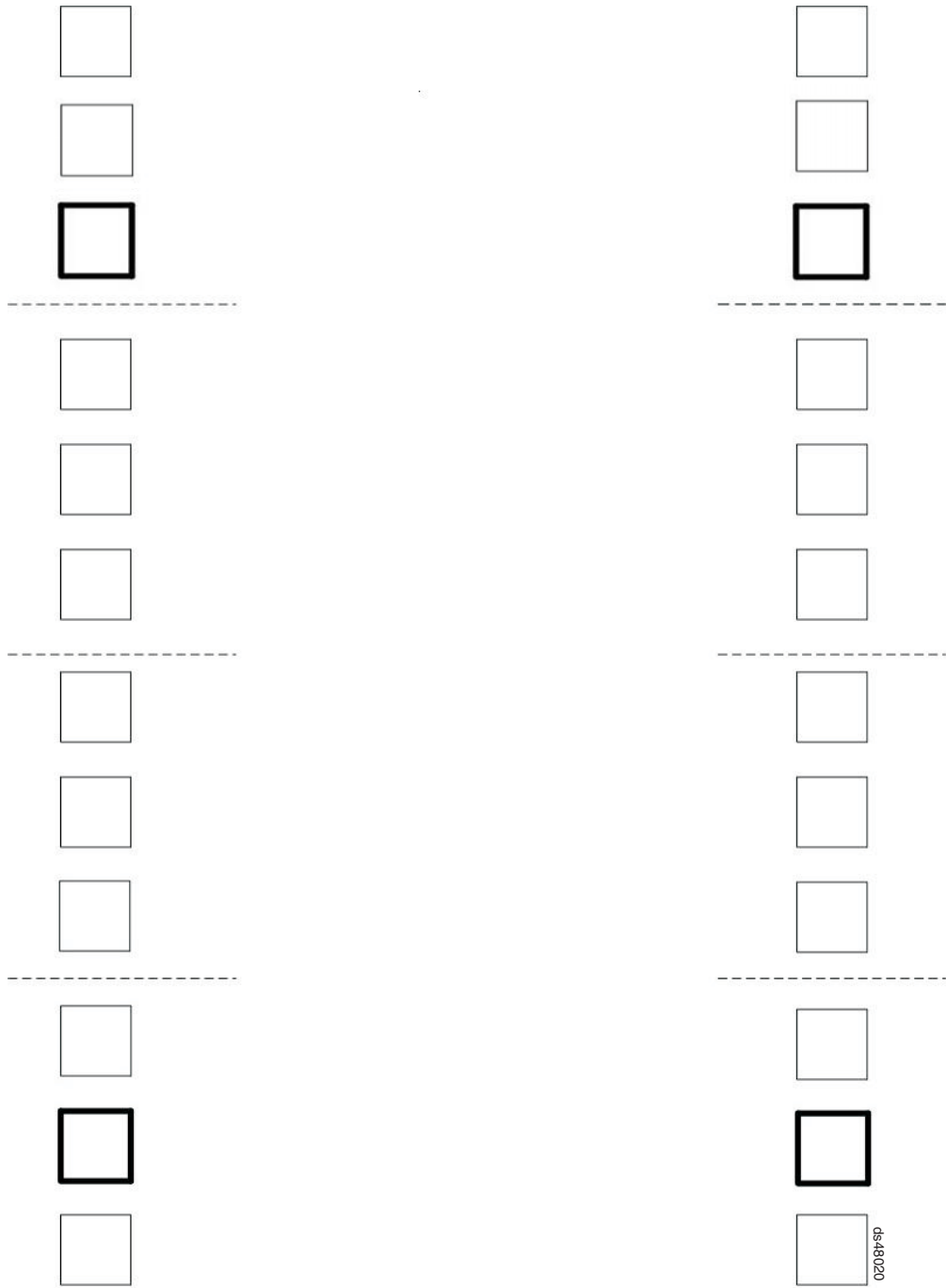
Appendix C. Rack mounting templates

This appendix provides duplicate copies of the rack mounting templates. If you want to tear out the templates from this document for easier use, use these copies rather than those provided in “Installing the support rails” on page 32.

Use the following templates (Figure 101 on page 182 and Figure 102 on page 183) to identify the proper locations for inserting M5 screws when mounting the support rails and DS4800 in a rack cabinet. The locations for the M5 screws are highlighted in the templates.

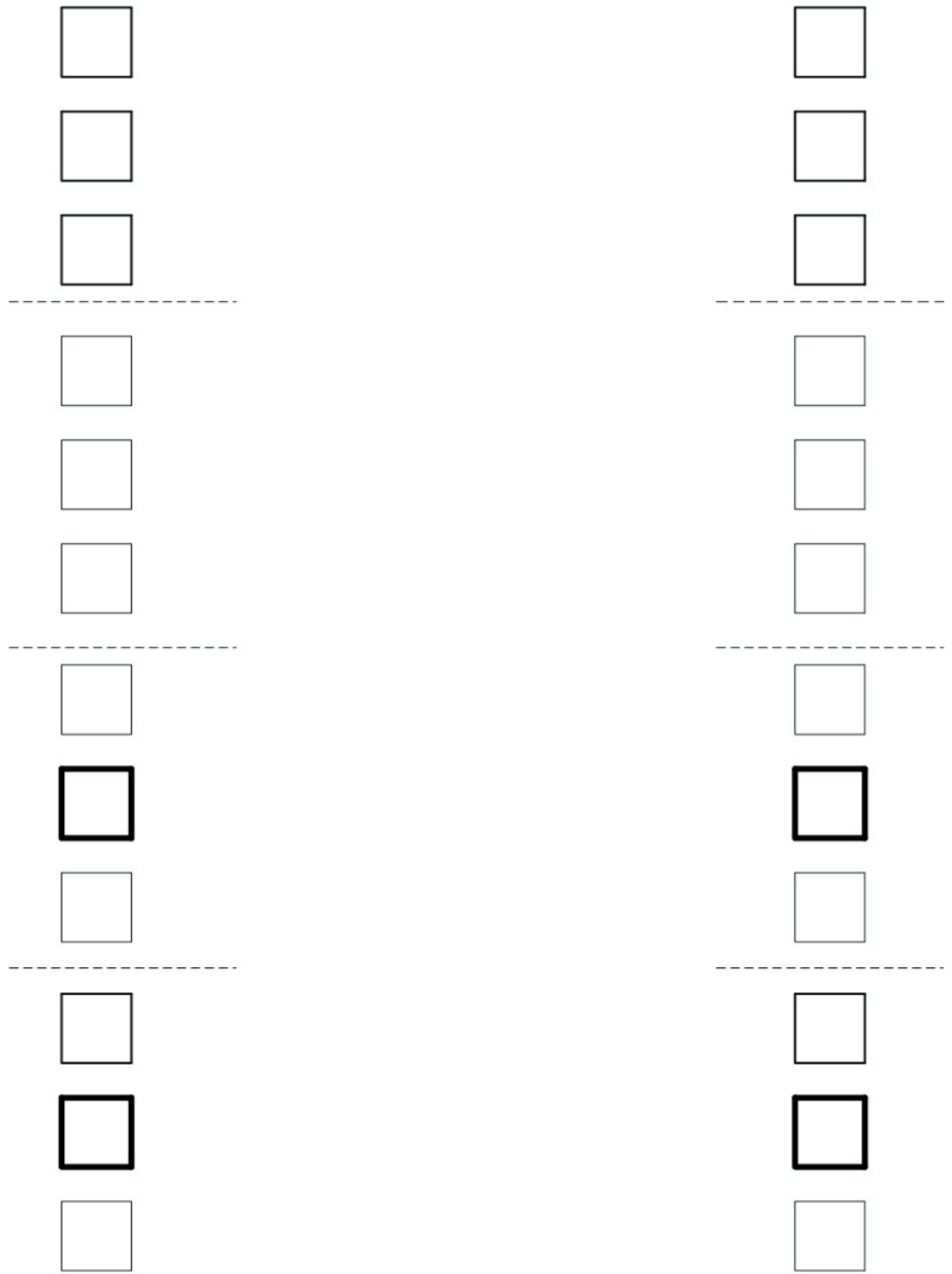
The DS4800 is 4 U high. Align the template with the rack at a U boundary. U boundaries are shown as horizontal dashed lines in the rack mounting templates.

Note: The mounting holes that are shown in the following templates are square. The holes in your rack cabinet might be round or square.



Front

Figure 101. DS4800 front rack mounting template



Back

ds48021

Figure 102. DS4800 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.

IBM power cord part number	Cord specifics	Used in these countries or regions
13F9940	250V/10A 2.8M	Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea
39Y7917	250V/10A 2.8M	Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Democratic Republic of), Congo (Republic of), Cote D'Ivoire (Ivory Coast), Croatia (Republic of), Czech Rep, Dahomey, Djibouti, Egypt, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, French Guyana, French Polynesia, Gabon, Georgia, Germany, Greece, Guadeloupe, Guinea, Guinea Bissau, Hungary, Iceland, Indonesia, Iran, Kazakhstan, Kyrgyzstan, Laos (Peoples Democratic Republic of), Latvia, Lebanon, Lithuania, Luxembourg, Macedonia (former Yugoslav Republic of), Madagascar, Mali, Martinique, Mauritania, Mauritius, Mayotte, Moldova (Republic of), Monaco, Mongolia, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Reunion, Romania, Russian Federation Rwanda, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia (Republic of), Somalia, Spain, Suriname, Sweden, SSyrian Arab Replublic, Tajikistan, Tahiti, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Upper Volta, Uzbekistan, Vanuatu, Vietnam, Wallis and Futuna, Yugoslavia (Federal Republic of), Zaire
39Y7918	250V/10A 2.8M	Denmark

IBM power cord part number	Cord specifics	Used in these countries or regions
39Y7922	250V/10A 2.8M	Bangladesh, Lesotho, Macao, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda
39Y7923	250V/10A 2.8M	Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, Cyprus, Dominica, Gambia, Ghana, Grenada, Guyana, Hong Kong S.A.R. of China, Iraq, Ireland, Jordan, Kenya, Kuwait, Liberia, Malawi, Malaysia, Malta, Myanmar (Burma), Nigeria, Oman, Qatar, Saint Kitts & Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, Sudan, Tanzania (United Republic of), Trinidad & Tobago, United Arab Emirates (Dubai), United Kingdom, Yemen, Zambia, Zimbabwe
39Y7919	250V/10A 2.8M	Liechtenstein, Switzerland
39Y7921	250V/10A 2.8M	Chile, Italy, Libyan Arab Jamahiriya
39Y7920	250V/10A 2.8M	Israel
39Y7931	250V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Caicos Islands, Canada, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Taiwan, United States, Venezuela
36L8880	250V/10A 2.8M	Argentina, Paraguay, Uruguay
02K0546	250V/6A 2.8M	PRC (China)
6952300	125V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Taiwan, Thailand, Turks and Caicos Islands, United States, Venezuela
6952301	125V/10A 1.8M	(Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Taiwan, Thailand, Turks and Caicos Islands, United States, Venezuela

Appendix E. Accessibility

This section provides information about alternate keyboard navigation, which is a DS4000 Storage Manager accessibility feature. Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

By using the alternate keyboard operations that are described in this section, you can use keys or key combinations to perform Storage Manager tasks and initiate many menu actions that can also be done with a mouse.

Note: In addition to the keyboard operations that are described in this section, the DS4000 Storage Manager 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 35 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 35. 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 35. DS4000 Storage Manager alternate keyboard operations (continued)

Short cut	Action
Alt+ underlined letter	<p>Access menu items, buttons, and other interface components by using the keys associated with the underlined letters.</p> <p>For the menu options, select the Alt + underlined letter combination to access a main menu, and then select the underlined letter to access the individual menu item.</p> <p>For other interface components, use the Alt + underlined letter combination.</p>
Ctrl+F1	Display or conceal a tool tip when keyboard focus is on the toolbar.
Spacebar	Select an item or activate a hyperlink.
Ctrl+Spacebar (Contiguous/Non-contiguous) AMW Logical/Physical View	<p>Select multiple drives in the Physical View.</p> <p>To select multiple drives, select one drive by pressing Spacebar, and then press Tab to switch focus to the next drive you want to select; press Ctrl+Spacebar to select the drive.</p> <p>If you press Spacebar alone when multiple drives are selected then all selections are removed.</p> <p>Use the Ctrl+Spacebar combination to deselect a drive when multiple drives are selected.</p> <p>This behavior is the same for contiguous and non-contiguous selection of drives.</p>
End, Page Down	Move keyboard focus to the last item in the list.
Esc	Close the current dialog (does not require keyboard focus).
Home, Page Up	Move keyboard focus to the first item in the list.
Shift+Tab	Move keyboard focus through components in the reverse direction.
Ctrl+Tab	Move keyboard focus from a table to the next user interface component.
Tab	Navigate keyboard focus between components or select a hyperlink.
Down arrow	Move keyboard focus down one item in the list.
Left arrow	Move keyboard focus to the left.
Right arrow	Move keyboard focus to the right.
Up arrow	Move keyboard focus up one item in the list.

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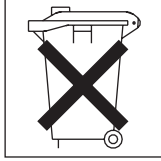
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This section gives the electronic emission notices or statements for the United States and other countries or regions.

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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.

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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.

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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*.

automatic ESM firmware synchronization. When you install a new ESM into an existing storage expansion enclosure in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, the firmware in the new ESM is automatically synchronized with the firmware in the existing ESM.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to

32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N_ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FC. See *fibre channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

fibre channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel (FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and

electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as "Asynchronous Mirroring without Consistency Group." Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode, Global Mirroring, remote mirroring, Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as "Asynchronous Mirroring with Consistency Group." Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode, Global Copy, remote mirroring, Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface*.

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

heterogeneous host environment. A host system in which multiple host servers, which use different operating systems with their own unique disk storage subsystem settings, connect to the same DS4000 storage subsystem at the same time. See also *host*.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC). In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring. This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB. See *management information base*.

micro channel architecture (MCA). Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS). MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub. An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant fibre channel connections from the host computers, either directly or through a fibre channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port*, *gigabit interface converter (GBIC)*, *small form-factor pluggable (SFP)*.

mirroring. A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

parity check. (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the

Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks (RAID)*.

RAID level. An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array, redundant array of independent disks (RAID)*.

RAID set. See *array*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array, parity check, mirroring, RAID level, striping*.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring, Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, 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 servers and storage expansion enclosures in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, 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 known as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP). A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping. Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-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.

Index

A

- AC power recovery 23
- acoustical noise emission values 22
- airflow 21, 28
- alarm 105
- altitude ranges 21
- area requirements 19

B

- battery
 - LEDs 130
 - recycling properly 154
 - replacing 130
- battery pack
 - replacing 152
- battery return 191
- best practices 6

C

- cabling
 - an IBM DS4000 storage expansion enclosure 52
 - an IBM DS4800 52
 - EXP810 to DS4800 76
- cabling the storage subsystem
 - connecting host to RAID controller 79
 - connecting power cables 88
 - connecting secondary interface cables 81
 - connecting storage expansion enclosures 59
 - maintaining redundancy 88
- cache battery
 - See battery 130
- cache memory
 - cache active LED 129
 - size of 129
- circuit breakers 124
- Class A electronic emission notice 192
- cluster support 3, 159
- components
 - controllers 10
 - interconnect-battery unit 16
 - overview 7
 - power supply-fans 15
 - releasing levers 37, 136
 - replacing 133
 - weights 19
- Concepts Guide 169
- configuration, installing the storage subsystem 88
- connecting to the DS4800
 - different ways to connect four storage expansion enclosures 68
- controller memory 14
- controllers
 - cable connections 11
 - drive channels 12
 - Ethernet ports 14

- controllers (*continued*)
 - host channels 13
 - LEDs 113
 - overview 10
 - replacing 137
 - resetting the circuit breakers 124
 - serial port 14
- cooling 28
- copper cables 159
- Copy Services Guide 169
- customer replaceable units (CRUs)
 - removing an interconnect-battery unit 40
 - removing power supply-fans 40
 - removing the controllers 40
 - replacing an SFP module 155
 - replacing the backup battery pack 152
 - replacing the controllers 44, 137
 - replacing the interconnect-battery unit 43, 148
 - replacing the power supply-fans 43, 144

D

- diagnostic hardware
 - wrap-plug 159
- diagnostic interface port 81
- direct management method 83
- disposal 191
- documentation
 - DS4000 169
 - DS4000 Storage Manager 169
 - DS4000-related documents 176, 177
 - DS4100 SATA Storage Server 175
 - DS4300 Fibre Channel Storage Server 174
 - DS4400 Fibre Channel Storage Server 173
 - DS4500 Fibre Channel Storage Server 172
 - DS4700 Storage Subsystem 171
 - DS4800 Storage Subsystem 170
- documentation inventory 4
- drive channel pairs, defined 59
- drive channel pairs, described 59
- drive channels 12
- DS4000 documentation 169
- DS4000 Hardware Maintenance Manual 176, 177
- DS4000 Problem Determination Guide 176, 177
- DS4000 Quick Start Guide 176, 177
- DS4000 storage expansion enclosures
 - drive cabling topologies 69
 - enclosure ID settings 78
- DS4000 Storage Manager
 - documentation 169
 - installing 106
 - related documents 176, 177
 - using to monitor storage subsystem status 107
- DS4000/FASTt product renaming xvii
- DS4100 SATA Storage Server library 175
- DS4300 Fibre Channel Storage Server library 174
- DS4400 Storage Server library 173
- DS4500 Fibre Channel Storage Server library 172

DS4700 Storage Subsystem library 171
DS4800 Storage Subsystem library 170

E

EIA 310-D Type A 19-inch rack cabinet 34
electrical requirements 23
electronic emission Class A notice 192
Electronic emission notices
 Australia and New Zealand Class A statement 193
 European Union EMC Directive conformance statement 193
 Federal Communications Commission (FCC) statement 192
 Industry Canada Class A emission compliance statement 193
 Japanese Voluntary Control Council for Interference (VCCI) statement 194
 Taiwanese Class A warning statement 193
emergency shutdown
 performing 103
 restoring power 103
enclosure ID settings 78
environmental requirements and specifications 20
Ethernet
 connecting to RAID controller 81
Ethernet ports 14

F

FAST/DS4000 product renaming xvii
FCC Class A notice 192
features of the storage subsystem 2
fiber-optic cable
 handling 48
 installing 51
 removing 52
 working with 47
fibre channel
 connections 84
 loop configurations 84
 technology 2
fibre channel loop ID
 midplane 78
 setting 78
fibre-channel cable adapter
 LC-SC, using the 55
firmware requirements 106
firmware updates 109

G

GBIC
 removing 52
glossary 195

H

handling static-sensitive devices 27
hardware inventory 3

Health Check process 94
heat dissipation 21
heat output 28
host adapter, connecting to RAID controller 79
host channels 13
host software kits 4
host-agent management method 82
hot-swap procedures 133
hub
 See managed hub 79

I

IBM Safety Information 176, 177
IBM System Storage DS4800
 audible alarm 105
 best practices 6
 cache memory and cache battery 129
 checking the LEDs 111
 components 7
 configuring 82
 connecting power cables 88
 controller LEDs 113
 controllers 10
 diagnostic hardware 159
 dimensions 19
 electrical requirements 23
 emergency shutdown 103
 environmental requirements and specifications 20
 features 2
 fibre channel connections 84
 front bezel 96
 front bezel LEDs 111
 heat output, airflow, and cooling 28
 identification numbers 179
 installation 36
 installation overview 25
 installing into a rack cabinet 25
 installing SFP modules 48
 installing the configuration 88
 installing the DS4800 on the support rails 41
 installing the support rails 32
 interconnect-battery unit 16
 interconnect-battery unit LEDs 119
 introduction 1
 inventory checklist 3
 numeric display 116
 operating 93
 over-temperature shutdown 103
 overheated power supply-fan recovery 122
 parts list 166
 power supply-fan LEDs 118
 power supply-fans 15
 preparing for installation 29
 preparing the rack cabinet 31
 records 179
 releasing levers 37
 removing components before installation 39
 replacing components 133
 replacing components before installation 43
 resetting the controller circuit breakers 124

- IBM System Storage DS4800 (*continued*)
 - restoring power after emergency shutdown 103
 - restoring power after over-temperature shutdown 103
 - restoring power after unexpected shutdown 102
 - SFP modules 18
 - site preparation 31
 - solving problems 159
 - specifications 19
 - storage expansion enclosure cabling topologies 69
 - troubleshooting 109
 - turning off 100
 - turning on 97
 - unpacking the 30, 35
 - weight 19
- in-band management method 82
- installation
 - installing the DS4800 on the support rails 41
 - into a rack cabinet 25
 - overview 25
 - performing 36
 - preparing for 29
 - preparing the rack cabinet 31
 - removing the components 39
 - replacing the components 43
 - site preparation 31
 - support rails 32
- interconnect-battery unit
 - battery packs 130
 - LEDs 18, 119
 - overview 16
 - replacing 148
- inventory checklist 3

L

- LC-LC fibre-channel cable 53
 - connecting to an SFP module 53
 - latches and lever 58
 - overview 52
 - removing 55
- LC-SC fibre-channel cable adapter
 - connecting to a device 56
 - connecting to an LC-LC fibre-channel cable 57
 - protective caps 57
 - removing an LC-LC fibre-channel cable 58
 - using 55
- LEDs
 - cache battery 130
 - controller 113
 - diagnostic 116
 - front bezel 111
 - interconnect-battery unit 119
 - power supply-fan 118
- levers and latches 37, 136
- line cord jumpers 3
- loop configurations
 - overview 84
 - redundant 85

M

- MAC address, recording 179
- managed hub
 - in fibre channel loop configurations 84, 85
 - using to connect host to RAID controller 79
- memory, cache
 - cache active LED 129
 - size of 129
- Migration Guide 169

N

- notes, important 190
- notices
 - electronic emission 192
 - FCC, Class A 192
 - static-sensitive precautions 133
 - trademarks 189
 - used in this book iii
 - used in this document xviii
- numeric display 116

O

- out-of-band management method 83
- over-temperature condition, shutdown 103

P

- parts list 166
- power cords 185
 - connecting 88
- power cords and receptacles 24
- power off sequence, storage subsystem 100
- power on sequence, storage subsystem 97
- power redundancy 6, 93
- power supply-fan
 - LEDs 118
 - recovery from overheating 122
 - replacing 144
- power supply-fans
 - overview 15

R

- rack cabinet
 - EIA 310-D Type A 19 inch 34
 - preparatory procedures 31
 - rail installation 34
 - site preparation 29
- rack mounting template for DS4800 32, 181
- RAID controller
 - cache battery 130
 - connecting Ethernet cable to 81
 - connecting host to 79
 - connecting RS-232 (serial) cable 81
- records, maintaining 179
- recycling 191
- recycling the battery 154
- redundant host and drive loops 85

- removing components
 - fiber-optic cable 52
 - GBIC 52
- renaming xvii
- replacing components
 - battery pack 152
 - controller 137
 - handling static-sensitive devices 133
 - hot-swap procedures 133
 - interconnect-battery unit 148
 - overview 133
 - power supply-fan 144
 - releasing levers 136
 - Service Action Allowed Status LED 134
 - SFP module 155
- restoring power
 - after emergency shutdown 103
 - after unexpected shutdown 102
- RS-232 serial port 14, 81

S

- safety information iii
- SATA technology 2
- serial number, recording 179
- SFP modules 18
 - important information 48
 - installing 49
 - operating speeds 48
 - removing 50
 - replacing 155
 - working with 47
- shutdown sequence, storage subsystem 100
- small form-factor pluggable module (SFP)
 - connecting to an LC-LC fibre-channel cable 53
 - port location 76
 - removing an LC-LC cable 55
- software inventory 4
- specifications 19
- static-sensitive devices, handling 27, 133
- storage expansion enclosures
 - connecting to storage subsystem 59
 - support 3, 10
 - turning on before storage subsystem 97
- storage subsystem configuration, installing 88
- storage subsystem profile 6, 93
- symptom-to-FRU index 159

T

- tasks by document title 169
- tasks by documentation title 169
- temperature and humidity 20
- trademarks 189
- troubleshooting 109
- turning off the storage subsystem 100
- turning on the storage subsystem 97

U

- United States electronic emission Class A notice 192
- United States FCC Class A notice 192

W

- wiring and power 23
- wrap-plug 4, 159

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