

IBM TotalStorage DS4100 Storage Subsystem



Installation, User's, and Maintenance Guide

IBM TotalStorage DS4100 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 151.

Second Edition (November 2005)

© Copyright International Business Machines Corporation 2005. All rights reserved.

US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

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 TotalStorage® DS4100 storage server. Each caution and danger statement is numbered for easy reference to the corresponding statements in the translated document.

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

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

Statement 1:



DANGER

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

To avoid a shock hazard:

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

To Connect:	To Disconnect:
<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 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:

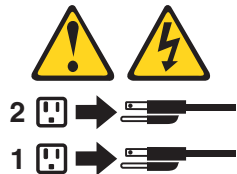
Use safe practices when lifting.

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 8:



CAUTION:

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



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

Contents

Safety	iii
Figures	xiii
Tables	xv
About this document	xvii
FAST product renaming	xvii
DS4000 Storage Subsystem installation tasks - General overview	xvii
Who should read this document	xx
How this document is organized	xx
Notices and statements used in this document	xxi
Figures used in this document	xxii
Getting information, help, and service	xxii
Before you call.	xxii
Using the documentation	xxii
Web sites	xxiii
Software service and support	xxiii
Hardware service and support	xxiii
Fire suppression systems	xxiv
How to send your comments	xxiv
Chapter 1. Introduction	1
Overview	1
New Features	1
About the DS4100 base storage subsystem.	2
About the DS4100 single-controller storage subsystem	3
Fibre channel defined	4
SATA defined	4
Product updates	4
Features at a glance	5
Clustering support	6
Inventory checklist	6
Best practices guidelines.	8
Storage subsystem components	9
Hot-swap drive bays	9
Front controls and indicators	10
Back view	11
Interface ports and switches	13
Storage subsystem operating environment.	15
DS4100 specifications	16
Heat output, airflow, and cooling	17
Chapter 2. Installing the storage subsystem	19
Installation overview	19
Handling static-sensitive devices	20
Preparing for installation	20
Preparing the site	21
Preparing the rack cabinet.	21
Installing the DS4100	22
Rack mounting template	22
Installing the support rails	24
Removing the CRUs	27

Removing a RAID controller	27
Removing a power supply	28
Removing a fan	29
Removing a hard disk drive	30
Installing the DS4100 into a rack cabinet	30
Replacing the DS4100 CRUs	31
Replacing a RAID controller	32
Replacing a power supply	32
Replacing a fan.	33
Replacing a hard disk drive	34
Setting the interface options	34
Fibre channel loop and ID settings.	35
Server ID (enclosure ID) settings	35
Storage subsystem speed settings.	36
Configuring the storage subsystem	36
Storage subsystem management methods.	36
Host-agent (in-band) management method.	36
Direct (out-of-band) management method	37
Fibre channel connections.	38
Fibre channel loop configurations	39
Redundant host and drive loops	39
Installing the storage subsystem configuration	45
Chapter 3. Cabling the storage subsystem.	47
Working with SFPs and fiber-optic cables	47
Handling fiber-optic cables	47
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	54
Using LC-SC fibre-channel cable adapters.	55
Connecting an LC-SC cable adapter to a device	55
Removing an LC-LC cable from an LC-SC cable adapter	57
Connecting hosts to the RAID controllers	58
Connecting hosts to a DS4100 base storage subsystem.	58
Connecting hosts to a DS4100 single-controller storage subsystem	59
Connecting secondary interface cables	59
Connecting secondary interface cables to a DS4100 base storage subsystem	59
Connecting secondary interface cables to a DS4100 single-controller storage subsystem.	60
Connecting storage expansion enclosures (base storage subsystem only)	60
DS4000 EXP100 loop redundancy (DS4100 base storage subsystem only)	62
Power cabling	63
Installing the DS4000 Storage Manager client	65
Chapter 4. Operating the storage subsystem.	67
Performing the DS4000 Health Check process	68
Web pages	69
Hardware responsibilities	69
Turning the storage subsystem on and off	70
Turning on the storage subsystem	70
Turning off the storage subsystem	71
Restoring power after an unexpected shutdown	73
Performing an emergency shutdown	73

|
|
|

Restoring power after an emergency shutdown	74
Restoring power after an over-temperature shutdown	74
Software and firmware upgrades	74
Firmware updates	75
Monitoring status through software	76
Checking the LEDs	77
Cache memory and RAID controller battery	80
Cache memory	80
RAID controller cache battery	81
Chapter 5. Installing and replacing components	83
Handling static-sensitive devices	83
Working with hot-swap hard disk drives	83
Notes for installing the 400 SATA drive option or the new 250 GB SATA drive CRU/FRU (P/N 40K6837)	85
Installing hot-swap hard disk drives	86
Replacing hot-swap hard disk drives	87
Upgrading drives	89
Adding larger-capacity drives	89
Replacing all drives at the same time	90
Replacing the drives one at a time	92
Working with hot-swap cooling fans	95
Working with power supplies	96
Removing a power supply	97
Installing a power supply	99
Working with RAID controllers	100
Replacing a RAID controller	102
Manually upgrading the firmware for the DS4100 single-controller storage subsystem	110
Replacing the battery in the RAID controller	112
Installing SFPs and fiber-optic cables	116
Adding a DS4000 storage expansion enclosure to an existing DS4100 configuration (base storage subsystem only)	116
Chapter 6. Hardware maintenance	119
General checkout	119
Using the diagnostic hardware	119
Solving problems	119
Parts listing	123
Appendix A. Records	127
Identification numbers	127
Installed device records	127
Appendix B. Rack mounting template	129
Appendix C. Power cords	133
Appendix D. Additional DS4000 documentation	135
DS4000 Storage Manager Version 9 library	135
DS4500 Fibre Channel Storage Server library	136
DS4400 Fibre Channel Storage Server library	137
DS4300 Fibre Channel Storage Server library	138
DS4100 SATA Storage Server library	139
DS4800 Storage Subsystem library	140
Other DS4000 and DS4000-related documents	141

Appendix E. European Directive About Product Recycling and Disposal	143
Appendix F. Battery Return Program	145
Appendix G. Cable Warning	147
Appendix H. Accessibility	149
Notices	151
Trademarks.	151
Important notes	152
Electronic emission notices	152
Federal Communications Commission (FCC) statement	152
Chinese class A compliance statement.	153
Industry Canada Class A emission compliance statement.	153
Australia and New Zealand Class A statement	153
United Kingdom telecommunications safety requirement	153
European Union EMC Directive conformance statement	153
Taiwan Class A warning statement	154
Japanese Voluntary Control Council for Interference (VCCI) statement	154
Glossary	155
Index	165

Figures

1.	DS4100 hot-swap drive bays	10
2.	Front controls and indicators	11
3.	Back view of DS4100 base storage subsystem.	12
4.	Back view of DS4100 single-controller storage subsystem.	12
5.	Interface ports and switches for DS4100 base storage subsystem.	13
6.	Interface ports and switches for DS4100 single-controller storage subsystem.	14
7.	Example of cold aisle/hot aisle rack cabinet configuration	18
8.	Front rack mounting template	23
9.	Rear rack mounting template	24
10.	Alignment pins with and without spacers	25
11.	Installing the support rails	26
12.	Removing a RAID controller.	28
13.	Removing a power supply	29
14.	Removing a fan	29
15.	Removing a drive CRU	30
16.	Installing the DS4100	31
17.	Replacing a RAID controller.	32
18.	Replacing a power supply	33
19.	Replacing a fan	33
20.	Removing a drive CRU	34
21.	Enclosure ID switches	35
22.	Host-agent (in-band) managed storage subsystems	37
23.	Direct (out-of-band) managed storage subsystems	38
24.	Examples of redundant host and drive fibre channel loop configurations (base storage subsystem)	40
25.	Example of a single SAN fabric configuration (base storage subsystem)	41
26.	Example of a dual SAN fabric configuration (base storage subsystem)	41
27.	Example of a two-cluster configuration (base storage subsystem)	42
28.	Example of a single server configuration with one adapter (single-controller storage subsystem)	43
29.	Example of a single server configuration with two adapters (single-controller storage subsystem)	43
30.	Example of a dual server configuration with one adapter on each server (single-controller storage subsystem)	44
31.	Example of a dual-server, single-SAN fabric configuration with one adapter on each server (single-controller storage subsystem)	44
32.	Example of a dual-server, single-SAN fabric configuration with two adapters on each server (single-controller storage subsystem)	45
33.	Small Form-Factor Pluggable (SFP) module	49
34.	Installing an SFP module into the host port	50
35.	Unlocking the SFP module latch - plastic variety	50
36.	Unlocking the SFP module latch - wire variety	51
37.	Removing caps from fiber-optic cables	51
38.	Connecting cables to the installed SFP.	52
39.	LC-LC fibre-channel cable	52
40.	Removing fiber-optic cable protective caps	53
41.	Inserting an LC-LC fibre-channel cable into an SFP module	54
42.	LC-LC fibre-channel cable lever and latches.	54
43.	Removing the LC-LC fibre-channel cable	55
44.	LC-SC fibre-channel cable adapter	55
45.	Removing the LC-SC cable adapter protective caps	56
46.	Connecting an LC-LC cable into the LC-SC cable adapter	57
47.	LC-LC fibre-channel cable lever and latches.	57
48.	Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter	58
49.	Location of host cables (base storage subsystem)	58
50.	Location of host cables (single-controller storage subsystem)	59

51. Ethernet and serial port locations	60
52. Adding a storage expansion enclosure	61
53. DS4000 EXP100 redundant loop configuration	62
54. Power cord locations	63
55. Redundant AC power connections to controllers and storage expansion enclosures	65
56. Storage subsystem LEDs (front)	77
57. RAID controller LEDs	78
58. Fan and power supply LEDs	80
59. Cache active LED	81
60. Battery LED	82
61. Hot-swap hard disk drive LEDs	86
62. Drive CRU handle	87
63. Fan locations	95
64. Removing a fan	96
65. Power supply controls	97
66. Lever for power supply removal	98
67. Installing a hot-swap power supply	99
68. Connecting the power cord to the AC power connector	100
69. RAID controller levers and labels	102
70. Location of SFPs and fiber-optic cables	104
71. Unlocking the SFP module latch - plastic variety	105
72. Unlocking the SFP module latch - wire variety	105
73. Pull-rings for removing a controller	106
74. Controller battery-access panel screws	106
75. Removing the controller battery	107
76. Installing a new RAID controller	115
77. Add a new storage expansion enclosure to a redundant loop	117
78. DS4100 parts list	124
79. Front rack mounting template	130
80. Rear rack mounting template	131

Tables

1.	Mapping of FASTT names to DS4000 Series names.	xvii
2.	Where to find DS4000 installation and configuration procedures	xviii
3.	Features at a glance	6
4.	IBM TotalStorage DS4100 specifications	16
5.	IBM TotalStorage DS4100 AC power requirements	17
6.	Alignment pin requirements for different rack flange hole types	25
7.	Current and previous software and firmware versions for DS4100 storage subsystems	75
8.	Storage subsystem LEDs (front)	77
9.	RAID controller LEDs	78
10.	Fan LED	80
11.	Power supply LEDs	80
12.	Drive LED activity	85
13.	Symptom-to-FRU index	120
14.	Parts listing (TotalStorage DS4100 storage subsystem)	124
15.	Hard disk drive record	127
16.	TotalStorage DS4000 Storage Manager Version 9.1 titles by user tasks	135
17.	TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks	136
18.	TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks	137
19.	TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks	138
20.	TotalStorage DS4100 SATA Storage Server document titles by user tasks	139
21.	TotalStorage DS4800 Storage Subsystem document titles by user tasks	140
22.	TotalStorage DS4000 and DS4000–related document titles by user tasks	141
23.	DS4000 Storage Manager alternate keyboard operations	149

About this document

This document provides instructions for installing and customizing the configuration of your IBM TotalStorage DS4100 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)

DS4000 Storage Subsystem installation tasks - General overview

Table 2 on page xviii provides a sequential list of many installation and configuration tasks that are common to most DS4000 configurations. When you install and configure your DS4000 storage subsystem, refer to this table to find the documentation that explains how to complete each task.

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

Table 2. Where to find DS4000 installation and configuration procedures

	Installation task	Where to find information or procedures
1	Plan the installation	<ul style="list-style-type: none"> • DS4000 Storage Manager Concepts Guide • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
2	Mount the DS4000 storage subsystem in the rack	<ul style="list-style-type: none"> • DS4800 Installation, User's, and Maintenance Guide • DS4400 and DS4500 Rack Mounting Instructions • DS4300 Rack Mounting Instructions • DS4100 Installation, User's and Maintenance Guide
3	Mount the DS4000 EXP storage expansion unit in the rack	<ul style="list-style-type: none"> • DS4000 EXP100 Storage Expansion Unit Installation, User's and Maintenance Guide • DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide • FAStT EXP500 Installation and User's Guide
4	Route the storage expansion unit Fibre Channel cables	<ul style="list-style-type: none"> • DS4100 Fibre Channel Cabling Instructions • DS4300 Fibre Channel Cabling Instructions • DS4400 Fibre Channel Cabling Instructions • DS4500 Fibre Channel Cabling Instructions • DS4800 Installation, User's, and Maintenance Guide
5	Route the host server Fibre Channel cables	<ul style="list-style-type: none"> • DS4100 Fibre Channel Cabling Instructions • DS4300 Fibre Channel Cabling Instructions • DS4400 Fibre Channel Cabling Instructions • DS4500 Fibre Channel Cabling Instructions • DS4800 Installation, User's, and Maintenance Guide

Table 2. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
6	Power up the subsystem	<ul style="list-style-type: none"> • DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
7	Configure DS4000 network settings	<ul style="list-style-type: none"> • DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
8	Zone the fabric switch (SAN-attached only)	<ul style="list-style-type: none"> • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4000 Storage Manager Copy Services Guide (describes switch zoning for the Remote Mirror Option) • See also the documentation provided by the switch manufacturer
9	Install DS4000 Storage Manager software on the management station	<ul style="list-style-type: none"> • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4000 Storage Manager online help (for post-installation tasks)
10	Install host software (failover drivers) on host server	
11	Start DS4000 Storage Manager	
12	Set the DS4000 Storage Manager clock	
13	Set the DS4000 Storage Manager host default type	

Table 2. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
14	Verify DS4000 subsystem health	<ul style="list-style-type: none"> • DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
15	Enable DS4000 Storage Manager premium feature keys	<p>Copy Services premium features DS4000 Storage Manager Copy Services Guide</p> <p>FC/SATA Intermix premium feature DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</p> <p>Storage Partitioning (and general premium features information)</p> <ul style="list-style-type: none"> • DS4000 Storage Manager Concepts Guide • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux
16	Configure arrays and logical drives	<ul style="list-style-type: none"> • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER
17	Configure host partitions	<ul style="list-style-type: none"> • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux
18	Verify host access to DS4000 storage	<ul style="list-style-type: none"> • DS4000 Storage Manager online help

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 TotalStorage DS4100 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 19 contains instructions for installing the 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 storage subsystem.

Chapter 4, “Operating the storage subsystem,” on page 67 contains instructions for power the 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, “Installing and replacing components,” on page 83 contains step-by-step instructions for how to install or remove customer replaceable units (CRUs), such as hard disk drives, power supplies, RAID controllers, and fan units.

Chapter 6, “Hardware maintenance,” on page 119 contains problems, symptoms, and error messages that are specific to your storage subsystem.

Appendix A, “Records,” on page 127 provides a table that you can use to record and update important information about your DS4100, including serial number and device records. Whenever you add options to your DS4100, be sure to update the information in this table.

Appendix B, “Rack mounting template,” on page 129 provides the rack mounting templates for installation of the DS4100. If you want to tear out the templates from the document for use during installation, use these copies of the templates.

Appendix C, “Power cords,” on page 133 lists power cord information for the DS4100.

Appendix D, “Additional DS4000 documentation,” on page 135 lists the documents that are available in the IBM TotalStorage DS4000 Storage Manager and DS4000 Storage Subsystem product libraries, and other related documents.

Appendix E, “European Directive About Product Recycling and Disposal,” on page 143 provides information regarding the European Directive About Product Recycling and Disposal, an environmental directive that is in effect throughout the European Union.

Appendix H, “Accessibility,” on page 149 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.

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 DS4100. 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.

Figures used in this document

The figures used in this document are for illustrative purposes only. In some cases, the actual device might look different from the figure.

Note: This applies particularly in cases where the DS4100 single-controller storage subsystem differs from the DS4100 base storage subsystem.

Getting information, help, and service

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

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.
- Use the troubleshooting information in your system documentation and use the diagnostic tools that come with your system.
- Check for technical information, hints, tips, and new device drivers at the following Web site:

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

- Use an IBM discussion forum on the IBM Web site to ask questions.

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

Using the documentation

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

Web sites

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

- For DS4000 information, go to the following Web site:
www.ibm.com/servers/storage/support/disk/
The support page has many sources of information and ways for you to solve problems, including:
 - Diagnosing problems using the IBM Online Assistant
 - Downloading the latest device drivers and updates for your products
 - Viewing frequently asked questions (FAQ)
 - Viewing hints and tips to help you solve problems
 - Participating in IBM discussion forums
 - Setting up e-mail notification of technical updates about your products
- You can order publications through the IBM Publications Ordering System at the following web site:
www.elink.ibm.com/public/applications/publications/cgibin/pbi.cgi/
- For the latest information about IBM xSeries products, services, and support, go to the following Web site:
www.ibm.com/eserver/xseries/
- For the latest information about IBM pSeries products, services, and support, go to the following Web site:
www.ibm.com/eserver/pseries/
- For the latest information about the IBM IntelliStation information, go to the following Web site:
www-132.ibm.com/content/home/store_IBMPublicUSA/en_US/IntelliStation_workstations.html
- For the latest information about operating system and HBA support, clustering support, SAN fabric support, and Storage Manager feature support, see the TotalStorage DS4000 Interoperability Matrix at the following Web site:
www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Software service and support

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

www.ibm.com/services/sl/products/

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

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

Hardware service and support

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

www.ibm.com/planetwide/

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

Fire suppression systems

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

Table 4 on page 16 lists the environmental specifications for the DS4100.

How to send your comments

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

E-mail

Submit your comments by e-mail to:

starpubs@us.ibm.com

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

Mail

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

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

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

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

Chapter 1. Introduction

This chapter describes the operating specifications, features, and components for the IBM TotalStorage DS4100 storage subsystem (hereafter referred to as *DS4100* or *storage subsystem*). This chapter also includes a list of hardware that comes with the storage subsystem.

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.

Designed for data archival, data reference, and near-line storage applications, the DS4100 utilizes the latest Serial Advanced Technology Attachment (SATA) disk drive technology. The DS4100 supports up to fourteen 1.5 Gbps 250 GB or 400 GB SATA disk drive modules, offering up to 5.6 terabytes (TB) of capacity per enclosure.

Notes:

1. SATA hard drive CRUs cannot be interchanged with the fibre-channel hard drive CRUs that are supported in other DS4000 storage products.
2. To use the 400 GB drive option or the new 250 drive CRU, you must install DS4100 controller firmware version 06.12.15.xx or later.
3. To use 400 GB drives in the EXP100 storage expansion enclosure, you must install ESM firmware version 956x or later.

The DS4100 can be used in storage area networks to satisfy the needs of various fixed content, data-reference applications that require large amounts of storage capacity but do not have the high utilization and access characteristics satisfied by fibre channel disk drive storage. The storage subsystem provides continuous, reliable service, using hot-swap technology for easy replacement without shutting down the system.

IBM currently offers two versions of the DS4100:

- DS4100 base storage subsystem (Machine Type 1724, Model 100)
- DS4100 single-controller storage subsystem (Machine Type 1724, Model 1Sx)

New Features

The DS4100 storage subsystem now supports the following new features:

- If you currently have the DS4100 single-controller storage subsystem, you can now upgrade to the DS4100 base storage subsystem by purchasing the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. Contact your IBM service representative for more information.
- Controller firmware version 6.12.xx.xx is now supported in all DS4100 storage subsystems.
- A 400 GB drive option/CRU is now available, and is supported in DS4100 storage subsystems.
- A new 250 GB drive CRU is also supported in DS4100 storage subsystems. The new drive CRU (P/N 40K6837) is the functional equivalent of the previously-supported 250 GB drive CRU (P/N 90P1349).

Important: The following firmware versions are required to support the new 250 GB drive CRU and the 400 GB drive CRU:

- DS4100 controller firmware version: 06.12.15.xx or later
- EXP100 ESM firmware version: 956x or later

IBM strongly recommends that you upgrade your subsystem's controller firmware to 6.12.15.xx or later to incorporate the quality enhancements and to ensure compatibility with the 400 GB CRU and the new 250 GB CRU.

About the DS4100 base storage subsystem

The DS4100 base (dual-controller) storage subsystem (Machine Type 1724, Model 100) is a rack-mountable storage subsystem that comes with two RAID controllers, two power supplies, and two cooling units. It provides dual, redundant controllers, redundant cooling, redundant power, and battery backup of the RAID controller cache. The DS4100 base storage subsystem is designed to provide maximum host and drive-side redundancy, enabling full redundant drive loop support to additional disk storage capacity in the storage expansion enclosures via the drive loop port from each RAID controller. In addition, each RAID controller supports direct attachment of two hosts that contain two fibre channel host bus adapters each. External cables and small form-factor pluggable (SFP) modules connect the storage subsystem to the storage expansion enclosure and the host servers.

Up to seven DS4000 EXP100 storage expansion enclosures can be connected together with the DS4100 base storage subsystem in a fibre-channel loop, providing connections to a maximum of 112 hard drives. With the DS4100 base storage subsystem, you can configure RAID-protected storage solutions of up to 89.6 TB (by connecting the DS4100 base storage subsystem to seven storage expansion enclosures with 250 GB or 400 GB SATA hard drives), providing economical and scalable storage for your rapidly growing application needs for limited access, data reference storage capacity. The DS4100 base storage subsystem is designed with redundant 2 Gbps fibre channel connections for expanding the DS4100 storage capacity to SATA hard drives in external DS4000 EXP100 storage expansion enclosures.

Note: To support the 400 GB drive option, you must install EXP100 expansion enclosure ESM firmware version 956x or later, and DS4100 controller firmware version 06.12.15.xx or later.

Currently, the only DS4000 storage expansion enclosure model that can be attached to the DS4100 base storage subsystem is the DS4000 EXP100. Do not connect other DS4000 storage expansion enclosures (such as the DS4000 EXP700 or DS4000 EXP710) to the DS4100 base storage subsystem. Please contact your IBM support representative for information about the availability of future support for connecting other DS4000 storage expansion enclosure models.

Note: You must make fibre channel connections from the host server fibre channel HBA ports to both controllers in the DS4100 base storage subsystem to ensure full host-side redundancy.

Attention

To ensure proper operation when connecting DS4000 EXP100 storage expansion enclosures to the DS4100 base storage subsystem with controller firmware 6.12.1x.xx or later, you must verify that the DS4000 EXP100 ESM firmware level is at level 956x or later. If the ESM firmware level is 9554, you must upgrade it to 956x or later after you connect the EXP100 to the DS4100 storage subsystem. In addition, if the ESM firmware level is lower than 9554, disconnect the DS4000 EXP100 and contact IBM support, your IBM reseller, or your IBM representative for assistance.

About the DS4100 single-controller storage subsystem

The DS4100 single-controller storage subsystem (Machine Type 1724, Model 1Sx, where x represents an upper-case alphanumeric character) is a rack-mountable storage subsystem that comes with one RAID controller, one power supply, and two cooling units. It supports up to fourteen hot-swap internal SATA disk drive slots, which support over 5.6 TB of storage capacity when using 400 GB SATA disk drives. External cables and small form-factor pluggable (SFP) modules connect the storage subsystem to the host server fibre channel HBA ports.

The DS4100 single-controller storage subsystem does not support storage capacity expansion using external DS4000 EXP100 storage expansion enclosures (or any other models of DS4000 storage expansion enclosures). The cache in the controller of the DS4100 single-controller storage subsystem is used for read operations only. No write operations will be cached. In addition, the DS4100 single-controller storage subsystem does not offer RAID controller and drive loop redundancy.

Note: You can upgrade the DS4100 single-controller storage subsystem to the DS4100 base storage subsystem, which does offer full redundancy, by purchasing the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. Contact your IBM service representative for more information.

Important: To support the 400 GB drive CRU in the DS4100 single-controller storage subsystem, or the new 250 GB drive CRU, you must install DS4100 controller firmware version 06.12.15.xx or later. You need to schedule downtime for controller firmware upgrades in the DS4100 single-controller storage subsystem.

The following limitations apply to this release of the DS4100 single-controller storage subsystem.

- All factory-delivered DS4100 RAID controllers are shipped with a recent version of controller firmware loaded on the RAID controller, but that firmware version might not match precisely the firmware version the RAID controller you need to replace. When you replace the RAID controller in the DS4100 single-controller storage subsystem, if the firmware version of the replacement RAID controller is determined to be incompatible with the configuration database during the boot process, the DS4100 single-controller storage subsystem will enter a Stop State and will not allow any DS4000 Storage Manager operations to be performed. In this case, you must manually upgrade or downgrade the replacement RAID controller firmware to match the version required by the configuration database. See “Manually upgrading the firmware for the DS4100 single-controller storage subsystem” on page 110.

- The DS4100 single-controller storage subsystem does not support automatic firmware updates. All firmware upgrades and downgrades for the DS4100 single-controller storage subsystem must be performed manually, as described in “Manually upgrading the firmware for the DS4100 single-controller storage subsystem” on page 110.
- All DS4100 single-controller storage subsystem controller firmware updates must be performed offline.
- If you currently have the DS4100 single-controller storage subsystem, you can upgrade to the DS4100 base storage subsystem by purchasing the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. Contact your IBM service representative for more information.

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 connection from the DS4100 base storage subsystem to the DS4000 EXP100 storage expansion enclosure ports or fibre channel host bus adapter ports is a 2 Gb fibre-channel device that supports data transfer rates up to 200 MBps half-duplex and 400 MBps full-duplex on optical interfaces.

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. See the following Web site for more information:

www.serialata.org

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.

1. For the DS4100, each drive is considered to be a device in a fibre-channel loop, even though the DS4100 drive interface is SATA (not fibre channel). The DS4000 EXP100 ESM and the DS4100 controller and SATA hard drive interposer convert SATA interface protocol to fibre channel protocol.

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

Features at a glance

Table 3 on page 6 summarizes the features of the storage subsystem. For a list of the operating specifications, such as weight, height, and heat output, see Table 4 on page 16.

Table 3. Features at a glance

<p>General</p> <ul style="list-style-type: none"> • Modular components: <ul style="list-style-type: none"> – High-capacity SATA disk drives – RAID controllers – Power supplies – Cooling fans • Technology: <ul style="list-style-type: none"> – Support for disk arrays – Support for clustering – Fibre channel host interface – Redundant data storage, RAID controllers, and power system (base storage subsystem only) – Hot-swap technology for drives and fans – Hot-swap technology for RAID controllers and power supplies (base storage subsystem only) – DS4100 single-controller has a non-redundant hard disk drive interface, power supply, and RAID controller. However, it does offer a redundant cooling system. <p>Attention: You will lose access to data if you attempt to hot-swap the controller or power-supply components in a DS4100 single-controller storage subsystem.</p>	<ul style="list-style-type: none"> • User interface: <ul style="list-style-type: none"> – Built-in power, activity, and fault light emitting diodes (LEDs) – Identification labeling on customer replaceable units (CRUs), rear LEDs, switches, and connectors – Easy-to-replace drives, power supplies, RAID controllers, and fans <p>Disk drive storage</p> <p>1.5 Gbps SATA hard disk drives Maximum drives per storage subsystem: 14</p> <p>Attached Storage Expansion Enclosures (base storage subsystem only)</p> <p>2 Gbps connections only</p>	<p>RAID controllers</p> <ul style="list-style-type: none"> • Technology and interfaces: <ul style="list-style-type: none"> – Fibre channel interface: <ul style="list-style-type: none"> - For base storage subsystem: six small form-factor pluggable (SFP) ports for incoming and outgoing fibre-channel cables (three SFP ports on each RAID controller) - For single-controller storage subsystem: three SFP ports for incoming and outgoing fibre-channel cables <p>Note: The SFP port labelled <i>Expansion</i> is not active).</p> <ul style="list-style-type: none"> – Two 1 Gbps/2 Gbps (auto-negotiated) fibre channel host side connections per controller
--	---	--

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 site:

www.pc.ibm.com/us/compat/nos/matrix.shtml

Inventory checklist

After you unpack the DS4100 storage subsystem, verify that you have the following items. See Figure 1 on page 10 and Figure 3 on page 12 for the locations of hardware components on the DS4100 storage subsystem.

- **Hardware**

- Up to 14 hard disk drives (shipped installed in the DS4100)

Note: The DS4100 base storage subsystem is shipped with no SATA hard disk drives as standard. You can order the unit with up to 14 400 GB SATA drive options installed at the factory. The DS4100 single-controller storage subsystem is shipped with two SATA drive options as standard. You can order the unit with up to 11 additional SATA drive CRUs installed at the factory.

- RAID controllers (shipped installed in the DS4100)
 - 2 controllers on the base storage subsystem

- 1 controller on the single-controller storage subsystem

Note: A blank controller tray is installed in the empty controller slot in the DS4100 single-controller storage subsystem chassis. For proper cooling and EMI shielding, do not remove this blank controller tray.

- Two fan units (shipped installed in the DS4100)
- Power supplies (shipped installed in the DS4100)
 - 2 power supplies on the base storage subsystem
 - 1 power supply on the single-controller storage subsystem

Note: A blank power supply tray is installed in the empty power supply slot in the DS4100 single-controller storage subsystem chassis. For proper cooling and EMI shielding, do not remove this blank power supply tray.

- Line cord jumpers
 - 2 line cord jumpers on the base storage subsystem
 - 1 line cord jumper on the single-controller storage subsystem

Line cord jumpers are power cords used to connect the DS4100 power supply units to the IBM-certified rack power distribution units (PDUs).

- One rack-mounting hardware kit, including:
 - Two rails (right and left assembly)
 - Eight M6 black hex-head slotted screws
 - Eight M6 cage nuts
 - Eight M6 clip nuts

- Up to 14 blank drive trays (shipped installed in the DS4100)

Your DS4100 storage subsystem has 14 hard disk drive slots; any drive slots not containing hard disk drives will contain blank drive trays. Each of the 14 drive slots must always contain either a blank tray or a hard disk drive.

- Box ID labels (used to label the storage subsystem IDs on the front of the DS4100)
- Wrap plug and coupler kit

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

Attention: The DS4100 does not ship with region-specific power cords. You must obtain the IBM-approved power cords for your region. See Appendix C, "Power cords," on page 133 for the IBM-approved power cords for your region.

- **Software and documentation**

- *DS4000 Storage Manager Version 9.1x Support CD*, including client software and firmware, and online help and Storage Manager publications in Adobe Acrobat Portable Document Format (PDF)

For a list of available IBM DS4000 publications, see Appendix D, "Additional DS4000 documentation," on page 135.

- *IBM TotalStorage DS4100 Storage Subsystem Installation, User's, and Maintenance Guide*
- *IBM TotalStorage DS4100 Fibre Channel Cabling Instructions*
- *IBM Safety Information*
- *IBM TotalStorage Storage Subsystem and Storage Expansion Enclosure Quick Start Guide*

- 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 in the table in Appendix A, “Records,” on page 127. The serial number is located on a label at the rear of the DS4100. The machine and model number are found on the product information label above the serial number.

A rack mounting template and instructions for installing the support rails and the storage subsystem are provided in this document in Chapter 2, “Installing the storage subsystem,” on page 19.

To connect your DS4100 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 must order these options separately.

Best practices guidelines

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

- Back up the data on your storage drives periodically.
- **DS4100 base storage subsystem only:** To maintain power redundancy, plug the DS4100 storage subsystem’s right and the left power supplies 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 DS4100 storage subsystem should be plugged into the same two independent external power circuits as the DS4100. This ensures that the DS4100 storage subsystem 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 supplies plug into the same power circuit enables the components in the storage subsystem to power on simultaneously during an unattended restoration of power. See Figure 55 on page 65 for an example of redundant power connections.

Note: This guideline cannot be followed for the DS4100 single-controller storage subsystem, which does not offer redundant power supplies. However, you can use Uninterruptible Power Supply (UPS) units with the DS4100 single-controller storage subsystem to provide protection against power brown-outs and short power outages.

- Before any planned system shutdown or after any system additions, removals, or modifications (including 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 DS4100 storage subsystem.

- Ensure that your system is in an optimal state before you shut it down. Never turn the power off if any fault light is lit; be sure to resolve any error conditions before you shut down the system.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in “Turning on the storage subsystem” on page 70. 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 70 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.
- Using the DS4000 Storage Manager client, save the DS4000 subsystem configuration profile to a disk that is not affected every time you make changes (such as logical drive creation or modification, or storage partitioning changes) to the DS4000 subsystem configuration.

Storage subsystem components

The following sections show the components of the DS4100 storage subsystem.

Hot-swappable devices enable you to maintain the availability of your system while you remove, install, or replace a hot-swap device. All DS4100 storage subsystem models support hot-swap SATA hard disk drives and cooling fan CRUs, so you can remove and replace these components without turning off the storage subsystem. In addition, the DS4100 base storage subsystem supports hot-swap RAID controllers and power supplies.

Attention: The DS4100 single-controller storage subsystem does not support hot-swap RAID controllers or power supplies. You will lose access to data if you attempt to remove or replace a functioning (non-failed) RAID controller or power supply in a DS4100 single-controller storage subsystem without first powering down the storage subsystem.

Hot-swap drive bays

The hot-swap drive bays that are accessible from the front of your storage subsystem are shown in Figure 1 on page 10.

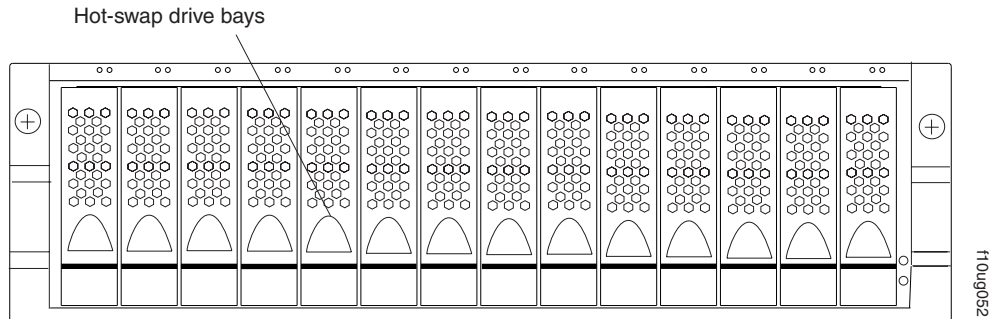


Figure 1. DS4100 hot-swap drive bays

The DS4100 supports up to 14 DS4000 1.5 Gbps SATA hard disk drives. These drives are preinstalled in drive trays. The unit consisting of the drive and the drive carrier assembly is called a *drive CRU*. The SATA drive CRU includes the drive tray, the SATA drive, and the hard disk drive (HDD) interposer card. You install the drive CRUs in the 14 drive bays on the front of the storage subsystem. There are no serviceable parts in a drive CRU. If it fails, it must be replaced in its entirety (drive, interposer, bezel, and tray).

Attention:

1. Never hot-swap a drive CRU when its associated green Activity LED is flashing. Hot-swap a drive CRU only when its associated amber Fault LED lights and is not flashing or when the drive is inactive and its associated green Activity LED lights and is not flashing.
2. The SATA drive and its HDD card are digitally signed together at the factory. Do not swap drives and interposers between drive CRUs. Do not replace one SATA drive with another SATA drive. These actions will result in a drive CRU that cannot be recognized by the storage subsystem RAID controller.
3. After you remove a drive CRU, wait at least 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

Note: If the hard disk drive you want to remove is not in a failed or bypass state, always use the DS4000 Storage Manager client program either to place the drive in a failed state or to place the array that is associated with the drive (or drives) in an offline state before you remove the drive from the enclosure.

Front controls and indicators

This section describes the primary controls on the front of the storage subsystem. The locations of these primary controls are shown in Figure 2 on page 11.

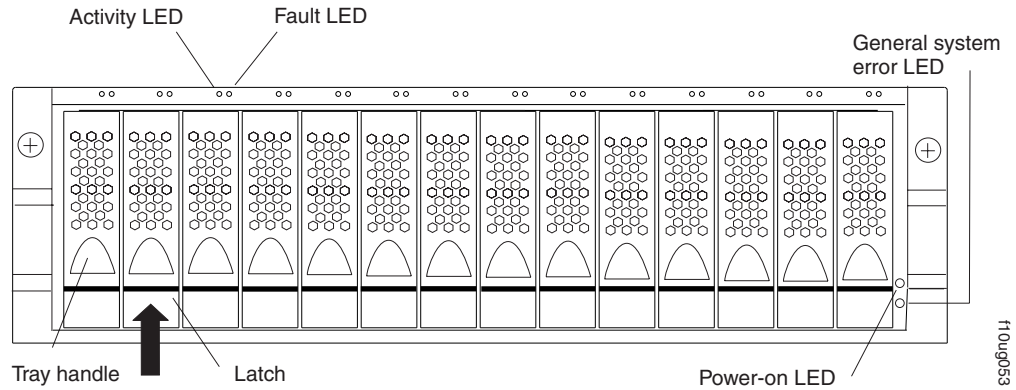


Figure 2. Front controls and indicators

The DS4100 has blank trays in the unused drive bays. To begin installing new drives, you must first remove the blank trays and save them. Each of the 14 bays must always contain either a blank tray or a drive CRU. You can install up to 14 hot-swap drive CRUs in the storage subsystem.

- **Activity LED:** Each drive CRU has an associated Activity LED on the DS4100 chassis. A flashing green LED indicates drive activity. A solid green LED indicates that the drive is properly installed and powered on.
- **Fault LED:** Each drive CRU has an associated Fault LED on the DS4100 chassis. A solid amber LED indicates a drive failure. A flashing amber LED indicates that a drive identify process is in progress.
- **General system error LED:** A solid amber LED indicates a power supply, fan unit, or hard disk drive error. Use the DS4000 Storage Manager client to diagnose and repair the problem. For more information, see “Checking the LEDs” on page 77.
- **Latch:** Use this multipurpose latch to release or lock the drive CRU in place.
- **Power-on LED:** A solid green LED indicates that the storage subsystem has dc power.
- **Tray handle:** Use this multipurpose handle to insert and remove a drive CRU in the bay.

Back view

Figure 3 on page 12 shows the components at the back of the DS4100 base storage subsystem.

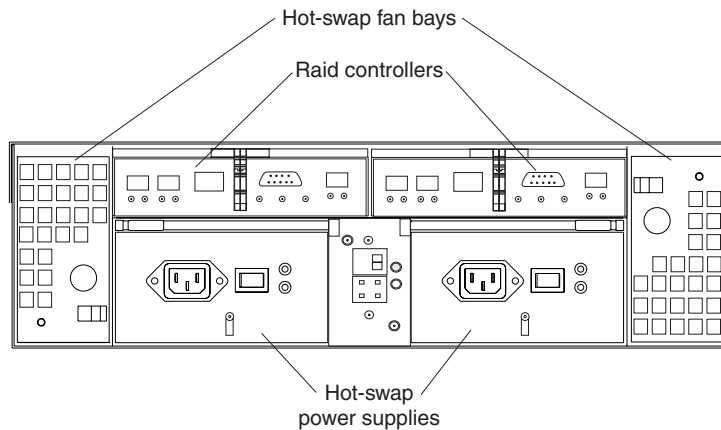


Figure 3. Back view of DS4100 base storage subsystem

Figure 4 shows the components at the back of the DS4100 single-controller storage subsystem. The DS4100 single-controller storage subsystem has a controller blank instead of a second RAID controller and a power supply blank instead of a second power supply.

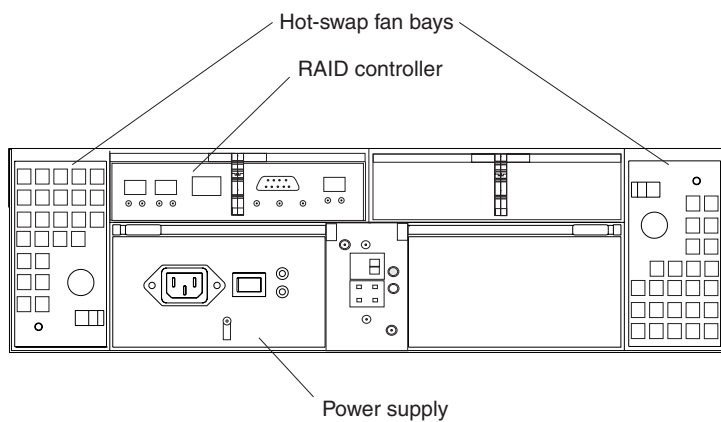


Figure 4. Back view of DS4100 single-controller storage subsystem

RAID controller

Each RAID controller contains three ports for Small Form-Factor Pluggable (SFP) modules that connect to the fibre channel cables. Two of the SFP ports (labelled *Host 1* and *Host 2*) are for host server attachment. The third SFP port (labelled *Expansion*) is used to connect additional storage expansion enclosures to the storage subsystem.

Note: In the DS4100 single-controller storage subsystem, the third SFP port (labelled *Expansion*) is present but not active.

Each RAID controller also contains a battery to maintain cache data in the event of a power failure. For more information, see “Cache memory and RAID controller battery” on page 80.

Attention: You will lose access to data if you attempt to hot-swap the RAID controller in a DS4100 single-controller storage subsystem.

Hot-swap fans

The storage subsystem has two interchangeable hot-swap and redundant fan CRUs. Each fan CRU contains two fans. If one fan CRU fails, the

second fan CRU continues to operate. You must install both fan CRUs to maintain proper cooling within the storage subsystem, even if one fan CRU is not operational.

Hot-swap power supplies

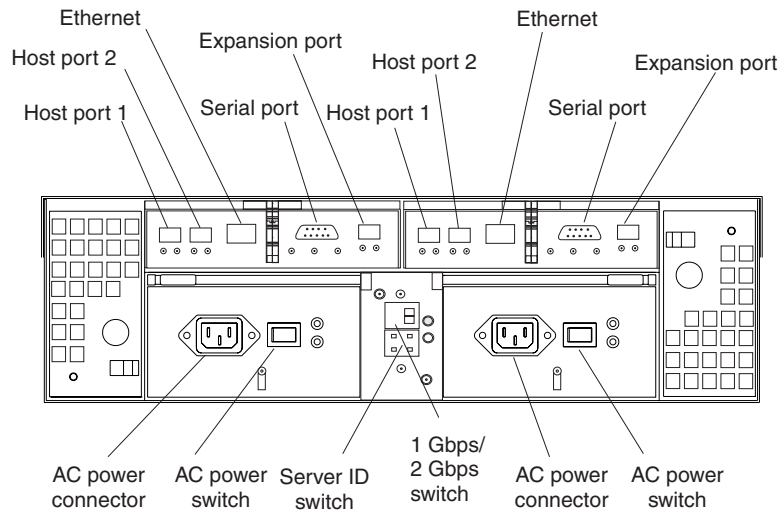
The DS4100 base storage subsystem comes with two hot-swap power supplies. You must install both power supplies to maintain proper cooling.

The DS4100 single-controller storage subsystem comes with one power supply.

Attention: You will lose access to data if you attempt to hot-swap the power supply in a DS4100 single-controller storage subsystem.

Interface ports and switches

Figure 5 shows the ports and switches on the back of the DS4100 base storage subsystem.



F10ug022

Figure 5. Interface ports and switches for DS4100 base storage subsystem

Figure 6 on page 14 shows the ports and switches on the back of the DS4100 single-controller storage subsystem.

Note: The DS4100 single-controller storage subsystem has a controller blank instead of a second RAID controller and a power supply blank instead of a second power supply.

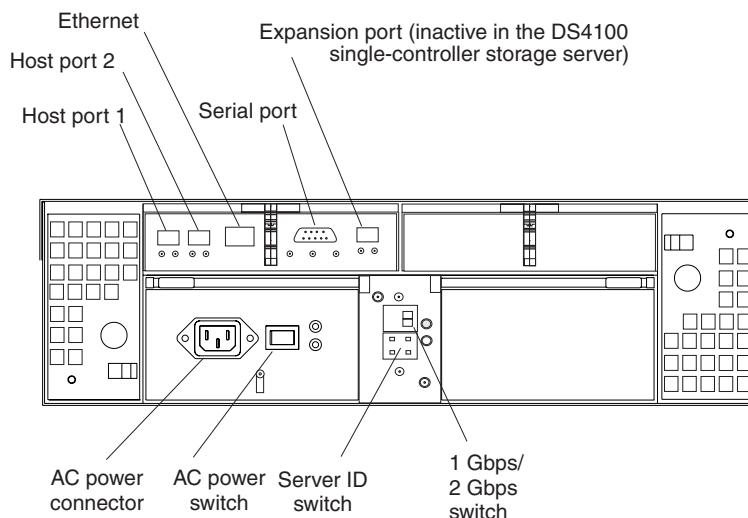


Figure 6. Interface ports and switches for DS4100 single-controller storage subsystem

RAID controller

Each RAID controller contains several connectors and LEDs. Each controller has two host ports and one expansion port for connecting the storage subsystem to hosts or storage expansion enclosures. You first insert SFPs into the ports and then connect the fibre channel cables.

Host ports

The host ports (labelled *Host 1* and *Host 2*) are used to connect a fibre channel cable from the host systems. You first insert an SFP into the port and then connect a fibre channel cable. The two host ports in each controller are independent. They are not connected in the controller module as they would be in a hub configuration. The host port connections can auto-negotiate between 1 Gbps and 2 Gbps.

Ethernet port

The Ethernet port is used for an RJ-45 10BASE-T or 100BASE-T Ethernet connection to each controller. Use the Ethernet connection to directly manage the DS4100.

Expansion port

The expansion port (labelled *Expansion*) is used to connect additional storage expansion enclosures to the RAID controllers on the DS4100 base storage subsystem. You first insert an SFP into the port and then connect a fibre channel cable.

Note: In the DS4100 single-controller storage subsystem, the expansion port on the RAID controller is not active.

Serial port

The serial port is used by service personnel to perform diagnostic operations on the RAID controllers. Incorrect use of the serial port can result in loss of data access and, in some cases, in loss of data.

Note: The maximum baud rate is 57 600 bps.

Server ID switch (enclosure ID switch)

The server ID (also referred to as *enclosure ID*) switch settings range from

0 through 7. When connecting the DS4100 base storage subsystem to DS4000 storage expansion enclosures, only the unique IDs ranging from 00 through 07 can be set.

Attention: When connecting the DS4100 to DS4000 storage expansion enclosures, DO NOT use the tens digit (x10) when setting the enclosure IDs. Use only the ones digit (x1) setting to set unique DS4100 storage subsystem IDs or storage expansion enclosure IDs. For more information, see “Server ID (enclosure ID) settings” on page 35.

1 Gbps/2 Gbps switch

The default switch setting is 2 Gbps. This is the *only* speed setting that is allowed for the DS4100.

Attention: Do not remove the metal plate that covers the storage subsystem speed setting. Do not adjust the storage subsystem speed setting.

Storage subsystem operating environment

This section provides general operating information about the DS4100. All components plug directly into the backplane.

DS4100 specifications

Table 4 lists the physical specifications for the DS4100.

Table 4. IBM TotalStorage DS4100 specifications

<p>Size</p> <ul style="list-style-type: none"> • Width: 48.18 cm (18.97 in.) • Height: 13.23 cm (5.21 in.) • Depth: 59.74 cm (23.52 in.) <p>Weight</p> <ul style="list-style-type: none"> • Drive-ready weight (without disk drive modules installed): <ul style="list-style-type: none"> – Model 100: 26.64 kg (58.9 lb) – Model 1Sx: 23.44 kg (51.9 lb) • Fully configured weight (with 14 disk drives installed): <ul style="list-style-type: none"> – Model 100: 40.36 kg (89 lb) – Model 1Sx: 37.16 kg (82 lb) <p>Environment</p> <ul style="list-style-type: none"> • Air temperature <ul style="list-style-type: none"> – Operating: <ul style="list-style-type: none"> - Altitude: 0 - 914 m (3000 ft): 10° - 35° C (50° - 95° F) - Altitude: 914 m - 2133 m (3000 - 7000 ft): 10° - 32° C (50° - 90° F) <p>Important: The recommended operating environment air temperature is 22° C (72° F) or lower.</p> <ul style="list-style-type: none"> – Storage: <ul style="list-style-type: none"> - Altitude: 0 - 914 m (3000 ft): 1° - 60° C (33° - 140° F) - Altitude: 914 m - 2133 m (3000 - 7000 ft): 1° - 57° C (33° - 135° F) • Humidity <ul style="list-style-type: none"> – 8% - 80% – Noncondensing 	<p>Heat dissipation</p> <ul style="list-style-type: none"> • Fully configured storage subsystem (14 1.5 Gbps SATA hard disk drives) <ul style="list-style-type: none"> – 1235 BTU per hour <p>Acoustical noise emission values</p> <p>For open bay (0 drives installed) and typical system configurations (eight hard disk drives installed):</p> <ul style="list-style-type: none"> • Sound power (idling): <ul style="list-style-type: none"> – 5.9 bel (open bay) – 6.1 bel (typical) • Sound power (operating): <ul style="list-style-type: none"> – 5.9 bel (open bay) – 6.2 bel (typical) • Sound pressure (idling): <ul style="list-style-type: none"> – 44 dBA (open bay) – 46 dBA (typical) • Sound pressure (operating): <ul style="list-style-type: none"> – 44 dBA (open bay) – 47 dBA (typical) <p>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.</p>
---	--

Notes:

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

The AC power sources must provide the correct voltage, current, and frequency specified on the storage subsystem. The storage subsystem can run without interruption within the limits shown in Table 5 on page 17.

Table 5. IBM TotalStorage DS4100 AC power requirements

	Low Range	High Range
Nominal Voltage	90 to 136 VAC	180 to 264 VAC
Frequency	50 to 60 Hz	50 to 60 Hz
Idle Current	2.50 A ^a	1.33 A ^b
Maximum Operating Current	3.01 A ^a	1.57 A ^b

^a. Typical voltage: 115 V AC, 60 Hz at 77% power-supply efficiency and 0.96 power factor

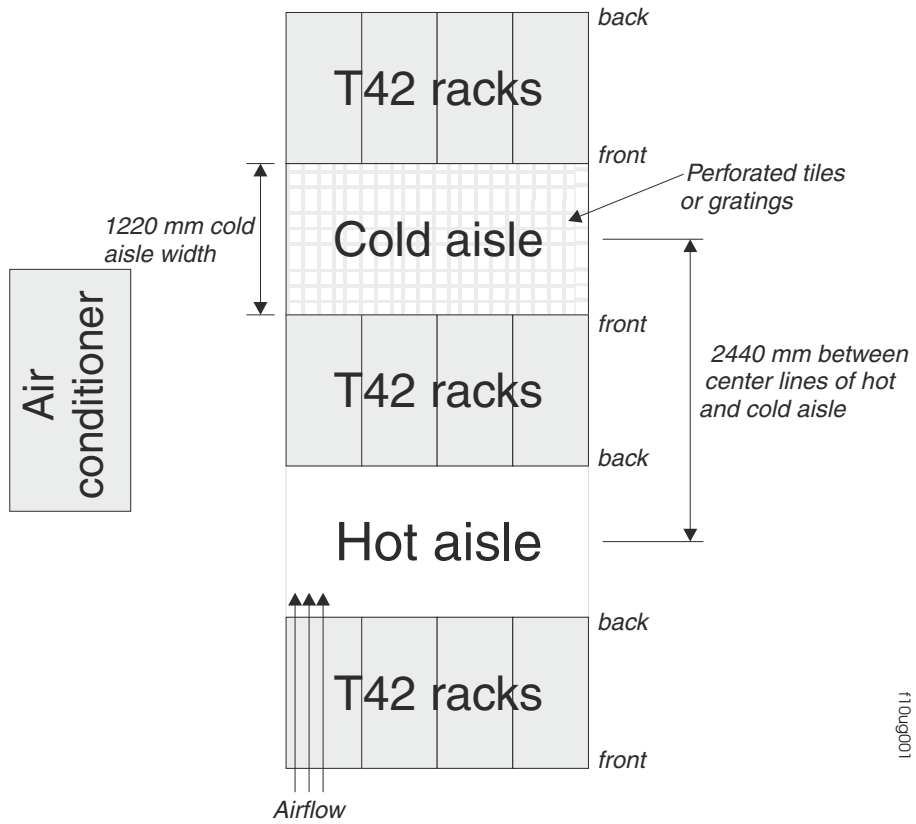
^b. Typical voltage: 230 V AC, 60 Hz at 77% power-supply efficiency and 0.96 power factor

Heat output, airflow, and cooling

The maximum heat output of the DS4100 is 390 watts (1235 BTU/hr). Each DS4100 rack-mounted unit requires an airflow of 2.5 m³ (87 ft³) 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 DS4100s are to be installed together, the following requirements must be met to ensure that the DS4100s 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 7 on page 18.
- Where rack cabinets are in rows, each rack cabinet must touch the rack cabinet that is next to it to reduce the amount of hot air that can flow around from the back of the rack into the intakes of the storage 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.



110u9001

Figure 7. Example of cold aisle/hot aisle rack cabinet configuration

Chapter 2. Installing the storage subsystem

This chapter provides the information that you need to install the DS4100 into a rack cabinet. This chapter also contains information about cabling, setting interface options, and installing optional cables.

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

Installation overview

The following steps provide an overview of the installation process you will perform in this chapter. Each step is detailed in the sections following the overview.

Statement 4:

		
18-32 kg (39.7-70.5 lbs)	32-55 kg (70.5-121.2 lbs)	≥ 55 kg (≥121.2 lbs)

svc00146

CAUTION:

Use safe practices when lifting.

Before you begin: The fully configured DS4100 weighs up to 40.8 kg (85.7 lbs). At least three persons are required to safely lift the DS4100 from the shipping box and to place it in the rack cabinet. If desired, you can open the sides of the shipping box and remove the CRUs from the DS4100 before you lift it from the shipping box in order to reduce the weight of the storage subsystem. See “Removing the CRUs” on page 27.

1. Review the preparation recommendations. See “Preparing for installation” on page 20.
2. Prepare the installation site. See “Preparing the site” on page 21.
3. Prepare the rack cabinet. See “Preparing the rack cabinet” on page 21.
4. Put on the antistatic strap and unpack the DS4100 and other hardware from the shipping box.
5. Install the support rails in the rack cabinet. See “Installing the support rails” on page 24.
6. If necessary, remove the CRUs from the DS4100 in order to lighten the DS4100. See “Removing the CRUs” on page 27.
7. Install the DS4100. See “Installing the DS4100 into a rack cabinet” on page 30. If necessary, replace the CRUs in the DS4100. See “Replacing the DS4100 CRUs” on page 31.
8. Set the DS4100 interface options. See “Setting the interface options” on page 34.
9. **DS4100 base storage subsystem only:** If required, cable the DS4100 to other DS4000 EXP100s. See Chapter 3, “Cabling the storage subsystem,” on page 47.
10. Install the DS4000 Storage Manager 9.1x host software. Refer to the *IBM TotalStorage DS4000 Storage Manager 9.1x Installation and Support Guide* for

the appropriate host operating system for instructions on how to install the DS4000 Storage Manager 9.1x host software.

11. Turn on the DS4100. See “Turning the storage subsystem on and off” on page 70.
12. Use the DS4000 Storage Manager 9.1x host software to verify the configuration.

Handling static-sensitive devices

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

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

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

Preparing for installation

Complete the following steps to prepare the DS4100 for installation into a rack cabinet.

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Storage subsystem operating environment” on page 15.
2. Move the DS4100 to the site.

Statement 4:

		
18-32 kg (39.7-70.5 lbs)	32-55 kg (70.5-121.2 lbs)	≥ 55 kg (≥ 121.2 lbs)

svc00146

CAUTION:
Use safe practices when lifting.

3. Remove the DS4100 from its shipping container and check the contents (see “Inventory checklist” on page 6). If any items are missing, contact your IBM reseller before proceeding.

4. Assemble the tools and equipment that you will need for installation. These might include:
 - The power cords that are shipped with the DS4100
 - Number 2 Phillips and medium flat-blade screwdrivers
 - Antistatic protection (such as a grounding wrist strap)
 - Fibre channel and Ethernet interface cables and cable straps
 - SFP modules
 - The rack-mounting hardware that ships with the DS4100
 - The *DS4000 Storage Manager Version 9.1x Support CD*, which includes the IBM DS4000 Storage Manager 9.1 software and DS4000 storage subsystem controller firmware 06.1x.xx.xx. You use this software to configure the DS4000 storage subsystems. For the latest controller firmware, check the IBM support web site for DS4000 storage products.
www.ibm.com/servers/storage/support/disk/
5. Continue with “Preparing the site.”

Preparing the site

This section lists the floor space requirements and weight information for the DS4100. For information on interface cables and connections, see Chapter 3, “Cabling the storage subsystem,” on page 47.

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

- Enough stability to support the weight of the fully configured DS4100 and associated systems
- Sufficient space to install the DS4100

Weight: The DS4100 total weight depends on the number of DS4000 1.5 Gbps SATA hard disk drives that are installed. A fully configured DS4100 with two fans, two power supplies, two RAID controllers, and up to 14 SATA hard disk drives installed weighs 40.8 kg (85.7 lbs).

Continue with “Preparing the rack cabinet.”

Preparing the rack cabinet

Important: Before you install the DS4100 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 DS4100 in a recommended 22° C (72° F) environment.
- To ensure proper airflow, do not block the air vents; 15 cm (6 in.) of air space is sufficient.
- To ensure rack stability, load the rack 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 rack power distribution units (PDUs) to at least two different power circuits or sources.

Complete the following steps to prepare the rack cabinet before you install the DS4100:

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 DS4100.”

Installing the DS4100

This section provides instructions on how to install the DS4100 in a rack cabinet.

Rack mounting template

Attention: Duplicate copies of the rack mounting templates are provided in Appendix B, “Rack mounting template,” on page 129. If you want to tear out the templates from this document for easier use, use the copies in Appendix B, “Rack mounting template,” on page 129 rather than the copies provided in this section.

Use the following templates (Figure 8 on page 23 and Figure 9 on page 24) to identify the proper locations for inserting M6 screws when mounting the support rails and DS4100 to a rack cabinet. The locations for the M6 screws are highlighted in the templates.

The DS4100 is 3 U high. Align the template with the rack at a U boundary. U boundaries are shown as horizontal dashed lines in the rack mounting templates.

Note: The mounting holes that are shown in the following templates are square. The holes in your rack cabinet might be round, square, or threaded.

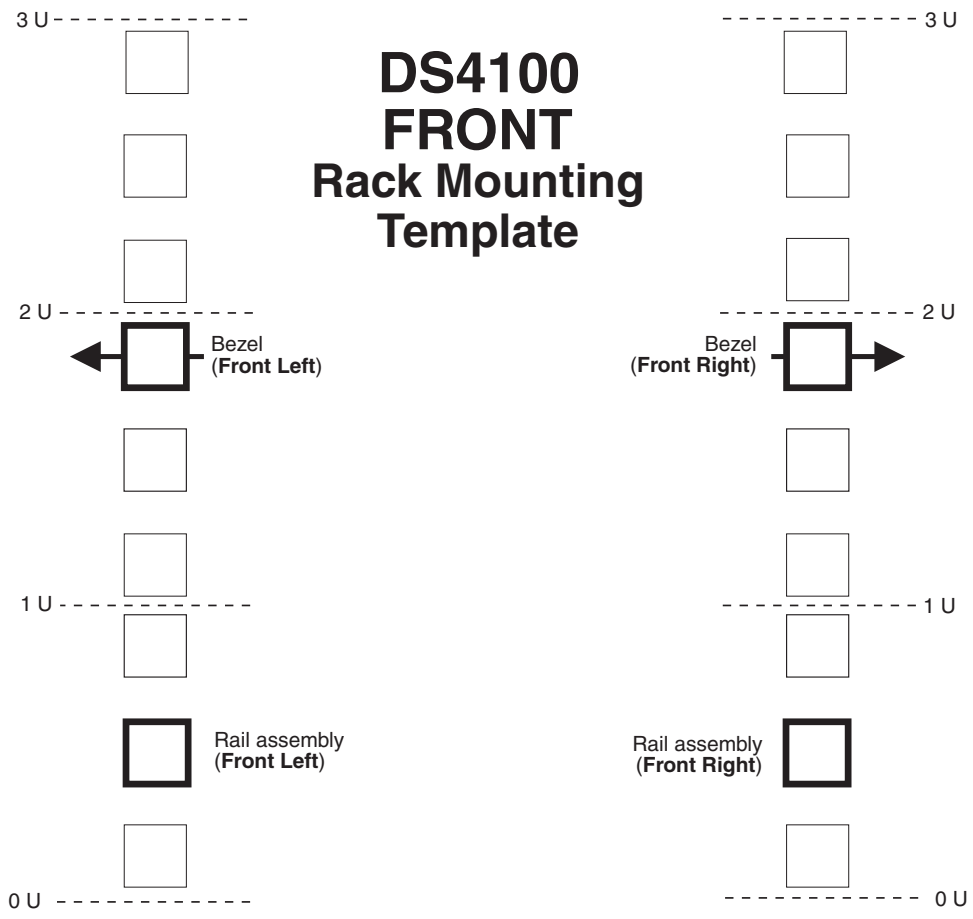


Figure 8. Front rack mounting template

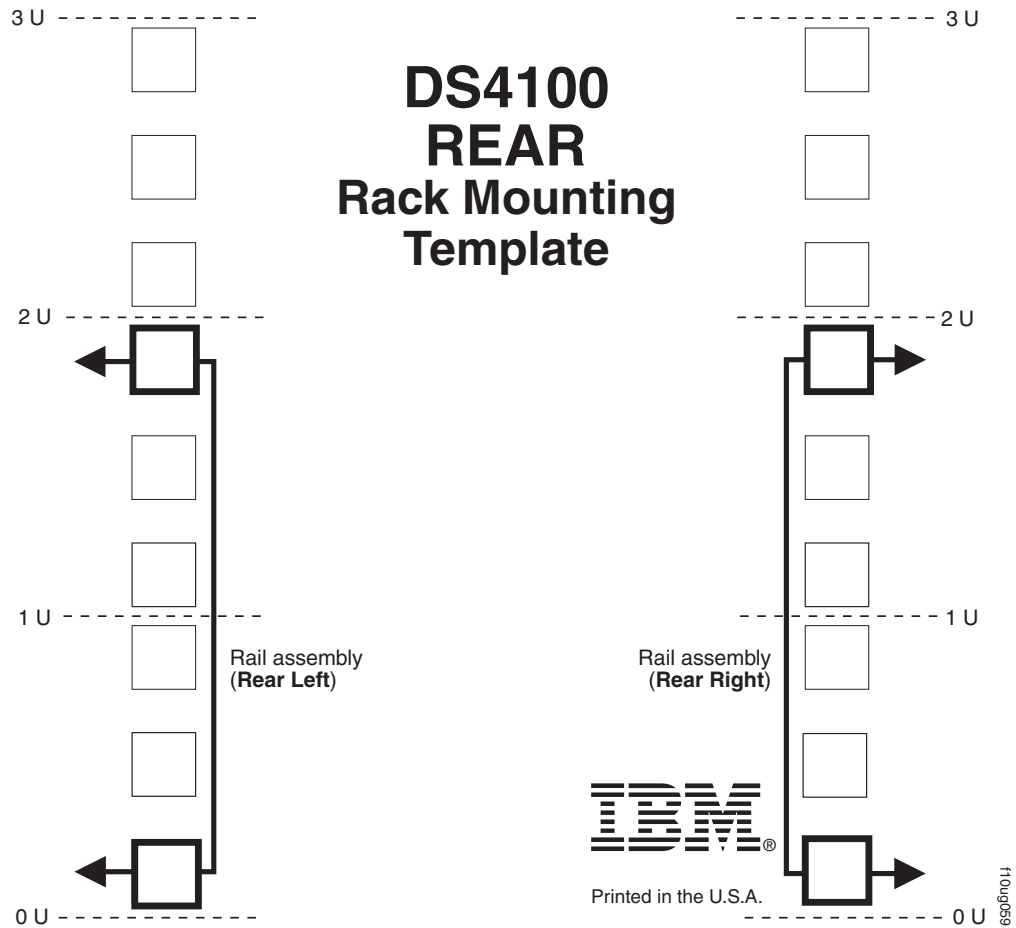


Figure 9. Rear rack mounting template

Installing the support rails

Before installing the DS4100 in a rack cabinet, you must install the rails and rack-mounting hardware that come with your storage subsystem. The DS4100 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.

Complete the following steps to install the support rails:

Note: Refer to Figure 11 on page 26 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 DS4100 is being installed.

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

3. Locate the two support rails and six of the eight M6 screws that are supplied with the DS4100.

Attention: Both support rails are shipped with three screws and spacers, called *alignment pins*, already installed at the front of each rail. They have been inserted in the front of each support rail as guides to indicate where *not* to use M6 screws when you attach the front of the support rail to the rack cabinet. See Figure 10.

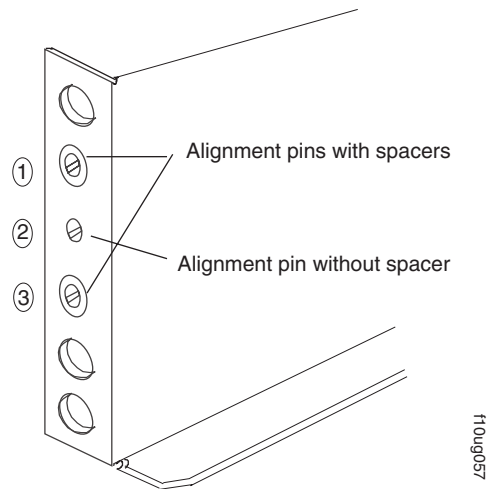


Figure 10. Alignment pins with and without spacers

Depending on which type of rack mounting flange is present on your rack cabinet, you might have to remove some or all of the spacers. For example, if the rack cabinet in which you are installing the support rails has round holes, you will need to remove the spacers from the top and bottom alignment pins so that the rail sits flush with the rack cabinet. See Table 6.

Table 6. Alignment pin requirements for different rack flange hole types

Rack flange type	Pins to remove
Square hole	None
Round hole	1 and 3
Threaded hole	All

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

Attention: Use the rack mounting template provided in Figure 8 on page 23 and Figure 9 on page 24 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:

- If you are installing the DS4100 into an empty rack, install it into the lowest available position so that the rack does not become unstable.
- If you are installing more than one DS4100 in the rack, start at the lowest available position, and work upward.
- If appropriate, allow for possible later installation of other units.
- If necessary, remove the rack power distribution unit before you install the support rails.
- For procedures and more information, refer to the installation and service guide, or equivalent, for the rack cabinet.

- Starting with the left rail, remove and save the 6/32 in. screw (**5**). Loosen the four rail adjustment screws (**2**).

Note: The support rails are not marked as Left or Right. However, each rail can be correctly mounted on only one side of the rack cabinet. The rails should be mounted with the alignment pins at the front of the rack cabinet. Figure 11 shows the installation of the left support rail.

- Hold the front of the rail against the inside of the right rack-mounting flange and loosely tighten the lower M6 screw (**4**). See Figure 8 on page 23 for the location for this screw.
- Extend the rear of the support rail until it makes contact with the rear rack rail.
- From the rear of the rack, thread and tighten two M6 screws (**1**) (see Figure 9 on page 24 for the location for these screws). From the front of the rack cabinet, finish tightening the front M6 screw (**4**).

When you are finished, the rail should be attached to the cabinet using one M6 screw in the front (inserted at the second-to-lowest hole) and two M6 screws at the back.

- Repeat step 5 through step 8 for the right rail.

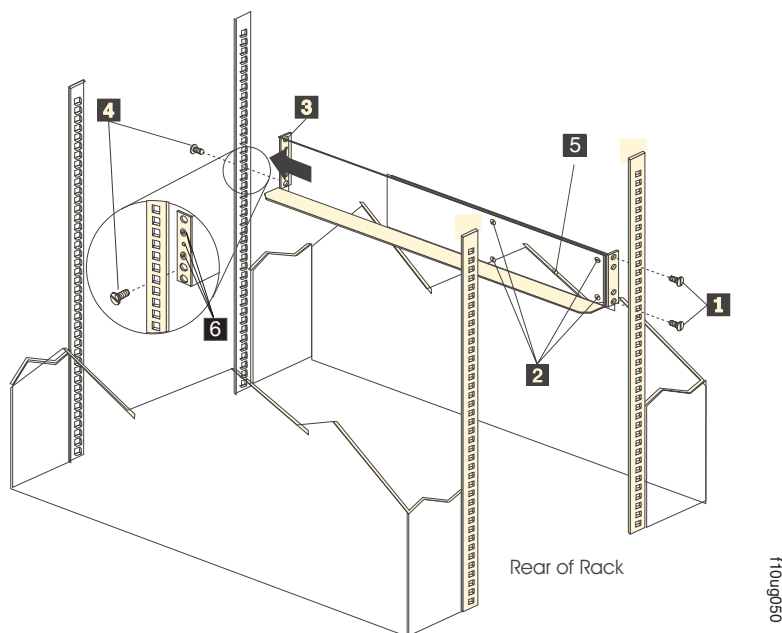


Figure 11. Installing the support rails

- Tighten the rail adjustment screws (**2**) on both rails.
- Continue with “Removing the CRUs” on page 27.

Removing the CRUs

Attention: This section describes how to remove the CRUs in order to minimize the weight of the DS4100 before you install it in the rack cabinet. However, if you have three or more people available to lift and install the DS4100 in a rack cabinet, you might not find it necessary to remove the CRUs before you install the DS4100. If this is the case, you can skip the CRU removal instructions provided in this section. Instead, continue with “Installing the DS4100 into a rack cabinet” on page 30, and then skip the CRU replacement instructions provided in “Replacing the DS4100 CRUs” on page 31.

Use the following procedures to remove the CRUs from the DS4100 before installation. Use these instructions after you have completed all applicable site, rack cabinet, and DS4100 preparations (as discussed in “Preparing for installation” on page 20) and installed the support rails (as discussed in “Installing the support rails” on page 24). Alternately, if necessary, you can use these instructions to lighten the DS4100 before removing it from the shipping box. The shipping box opens to provide access to the storage subsystem CRUs.

The DS4100 comes with a rack-mounting hardware kit for installing it in a rack cabinet. It is easier to lift the DS4100 and install it in a rack cabinet if you remove all the CRUs first. You will need an antistatic wrist strap and a cart or level surface (to hold the CRUs). Observe the precautions listed in “Handling static-sensitive devices” on page 20. In the following procedure, you will remove the following CRUs from the storage subsystem before you install it in the rack cabinet:

- RAID controllers
- Power supplies
- Fans
- Hot-swap hard disk drives

You do not need to remove the blank trays.

Statement 4:

		
18-32 kg (39.7-70.5 lbs)	32-55 kg (70.5-121.2 lbs)	≥ 55 kg (≥121.2 lbs)

svc00146

CAUTION:

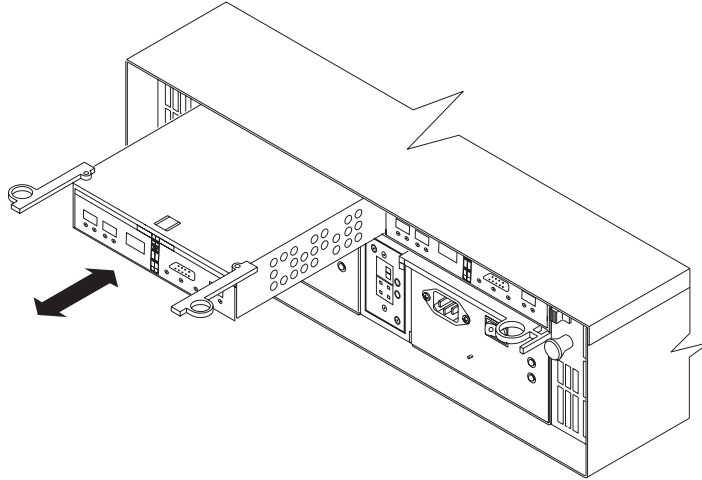
Use safe practices when lifting.

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

Removing a RAID controller

Complete the following steps to remove a RAID controller:

1. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.



110ug033

Figure 12. Removing a RAID controller

2. Grasp the pull-rings; then pull on the levers and remove the RAID controller.
3. Place the RAID controller on a level surface.
4. For the DS4100 base storage subsystem, repeat step 1 through step 3 for the second RAID controller.

Note: In the DS4100 single-controller storage subsystem, you do not need to remove the controller blank.

Removing a power supply

Complete the following steps to remove a power supply:

1. Grasp the pull-ring on the power supply lever and squeeze the latch to release it.
2. Pull the lever open 90° and remove the power supply, as shown in Figure 13 on page 29.

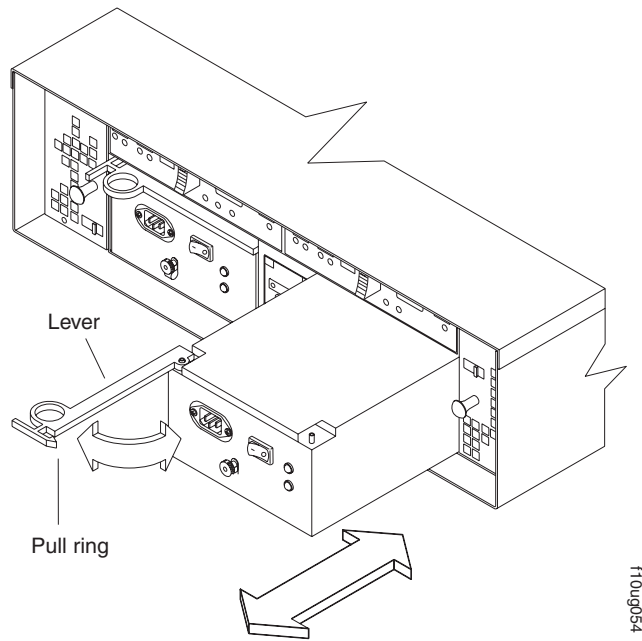


Figure 13. Removing a power supply

3. Place the power supply on a level surface.
4. For the DS4100 base storage subsystem, repeat step 1 through step 3 for the second power supply.

Note: In the DS4100 single-controller storage subsystem, you do not need to remove the power supply blank.

Removing a fan

Complete the following steps to remove a fan:

1. Unlock the latch by moving the latch in the same direction as the latch direction arrow shown on the back of the fan.
2. Grasp the handle and pull the fan unit out of the bay, as shown in Figure 14.

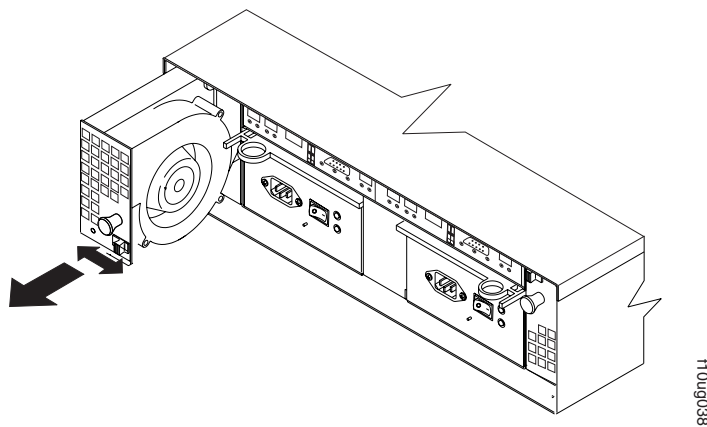


Figure 14. Removing a fan

3. Place the fan unit on a level surface.
4. Repeat step 1 through step 3 for the second fan unit.

Removing a hard disk drive

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

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

1. Use Table 15 on page 127 to record the location and identify your DS4000 SATA hard disk drives. You must record this information to be able to replace the hard disk drives in their original order before they were removed.
2. Release the latch on the drive CRU by pinching together the blue line on the tray latch and the finger hole on the tray handle.
3. Pull the tray handle out so that it is in the open position to release the drive CRU. Pull the drive out of the bay, as shown in Figure 15.

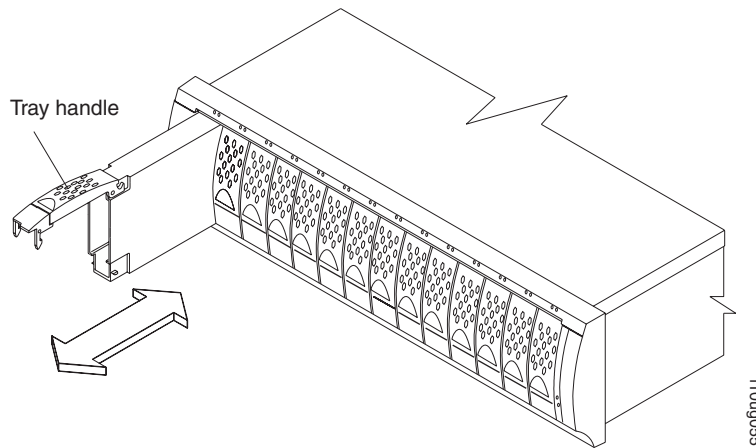


Figure 15. Removing a drive CRU

4. Place the removed drive CRUs horizontally on a level surface, with the printed circuit boards facing down.

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

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

Continue with “Installing the DS4100 into a rack cabinet.”

Installing the DS4100 into a rack cabinet

Complete the following steps to install the DS4100 in a rack cabinet.

1. Place the DS4100 in the rack cabinet.

Note: If you have removed the CRUs from the DS4100, you should be able to lift the unit into the cabinet with the help of one other person. If you have not removed the CRUs before the installation, you should have at least two other people available to help you lift the unit into the rack cabinet.

- a. Move the DS4100 to the front of the rack-mount cabinet.
- b. With help from another person, place the back of the storage subsystem on the support rails. Slide the unit into the rack cabinet, as shown in Figure 16 on page 31.

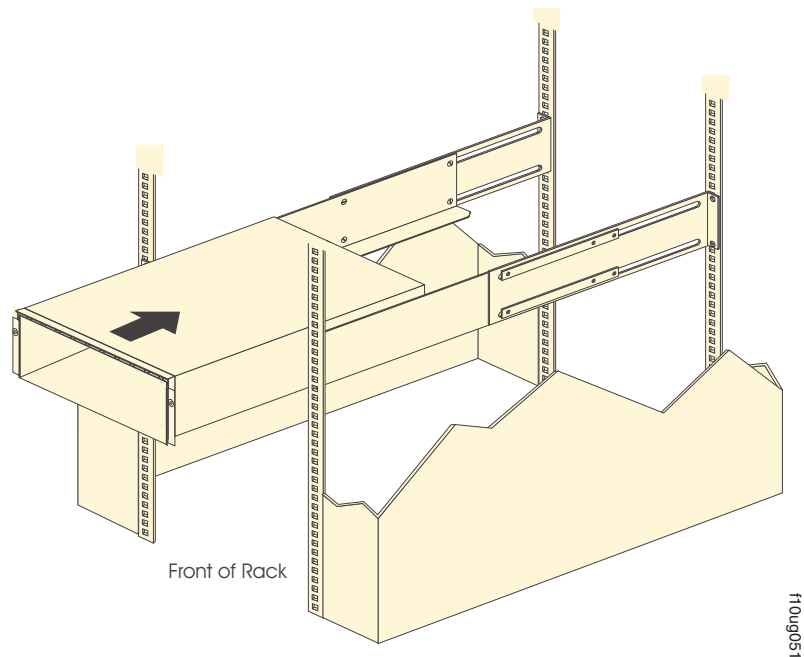


Figure 16. Installing the DS4100

2. The bezel is secured to the front of the DS4100 either by plastic wingnuts or by adhesive tape. Remove and discard the wingnuts or the adhesive tape. The bezel should remain attached to the DS4100 chassis.

Attention: The bottom cross member of the bezel has a tab that must fit beneath the DS4100 chassis and snap into place. The top cross member of the bezel has a recess that must be mated with a metal tab on the bottom of the DS4100 chassis.

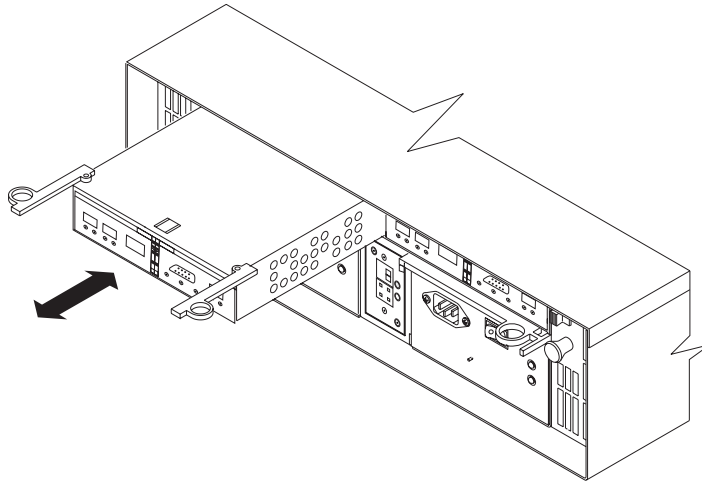
3. Secure the DS4100 to the rack cabinet:
 - a. Align the front mounting holes on each side of the storage subsystem with the mounting holes on the front of the support rails.
 - b. Secure the bezel to the DS4100.
Insert an M6 screw into the mounting hole on both sides of the front of the unit (see Figure 8 on page 23). Gently tighten the screws to secure the bezel and the front of the DS4100 to both of the front rack cabinet rails.
Attention: Do not overtighten. If you overtighten these screws, you could break the bezel.
 - c. From the back of the rack cabinet, insert the two 6/32 in. screws (**5** in Figure 11 on page 26), one on each side, in the holes located on the tab on each side of the unit. Tighten the screws.
4. Continue with one of the following actions:
 - If you did remove the DS4100 CRUs before installation (as described in “Removing the CRUs” on page 27), continue with “Replacing the DS4100 CRUs.”
 - If you did not find it necessary to remove the DS4100 CRUs before installation, continue with “Setting the interface options” on page 34.

Replacing the DS4100 CRUs

Use the following procedures to replace the CRUs in the DS4100 after installation.

Replacing a RAID controller

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



110ug033

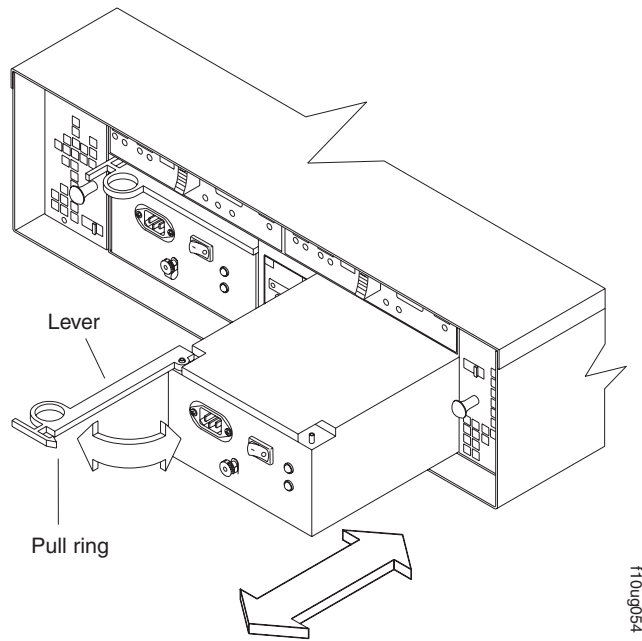
Figure 17. Replacing a RAID controller

1. Slide the RAID controller all the way into the empty slot.
2. Close both levers until the latch locks into place.
Attention: Make sure that the levers lock into place in the storage subsystem chassis.
3. For the DS4100 base storage subsystem, repeat step 1 and step 2 to replace the second RAID controller.

Replacing a power supply

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

1. Slide one power supply into the storage subsystem. Be sure to replace the power supplies so that the lever on each power supply opens toward the interior of the storage subsystem, as shown in Figure 18 on page 33.
Attention: Be sure that the lever is pulled straight out as you slide the power supply into the storage subsystem, as shown in Figure 18 on page 33.



110ug054

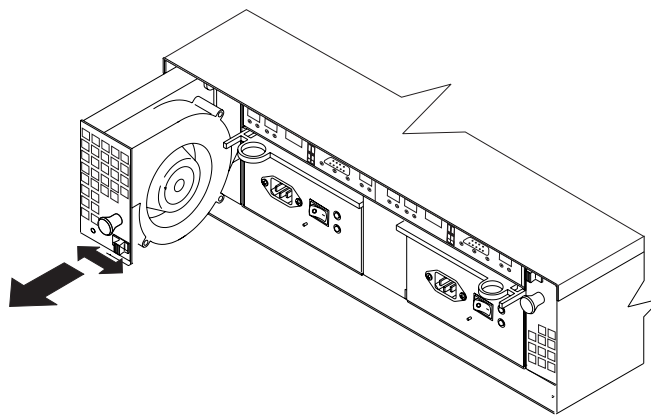
Figure 18. Replacing a power supply

2. Close the lever until the pull-ring latch locks in place. Make sure that the lever locks into place in the storage subsystem chassis. Then gently push the front of the power supply to ensure that it is fully seated.
3. For the DS4100 base storage subsystem, repeat step 1 and step 2 to replace the second power supply.

Replacing a fan

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

1. Place the fan in front of the fan bay.
2. Ensure that you move the fan latch in the same direction as the arrow before you slide the fan all the way into the bay. If the fan does not go into the bay, rotate it 180° (see Figure 19).



110ug038

Figure 19. Replacing a fan

3. If the latch does not automatically lock when you have successfully inserted the fan unit into the bay, pull back slightly on the fan and then push it in again until the latch snaps into place.
4. Repeat step 1 through step 3 to replace the second fan.

Replacing a hard disk drive

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

Note: Use Table 15 on page 127 to verify the proper replacement locations of your DS4000 1.5 Gbps SATA hard disk drives.

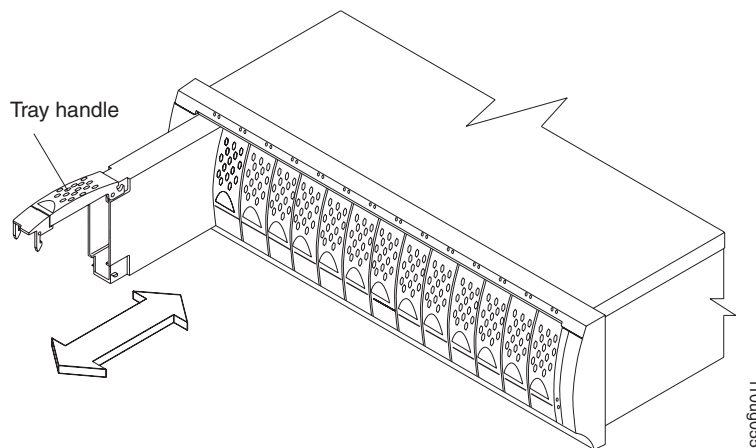


Figure 20. Removing a drive CRU

1. Lift up on the handle and gently push the drive CRU into the empty bay until the hinge of the tray handle latches beneath the storage subsystem bezel.
2. Push the tray handle down until the latch clicks into place.
3. Repeat step 1 and step 2 to replace additional drives.

Setting the interface options

The DS4100 has two server ID switches that identify the DS4100 on a fibre-channel loop and that assign physical addresses to the drives. The server ID switches are located on the back of the storage subsystem, as shown in Figure 21 on page 35.

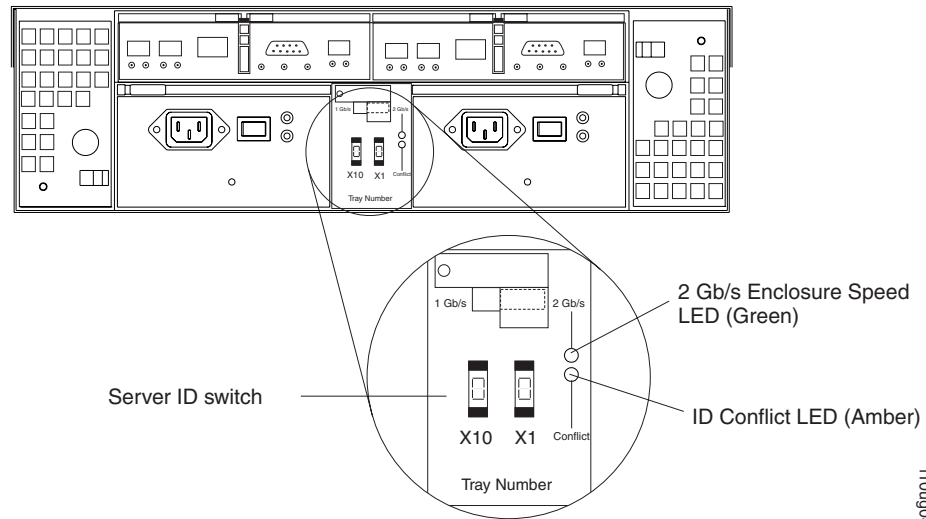


Figure 21. Enclosure ID switches

110ug046

Fibre channel loop and ID settings

When you install a hard disk drive in the storage subsystem, 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.

Server ID (enclosure ID) settings

The DS4100 comes with a server ID switch (also referred to as an *enclosure ID switch*) that is used to identify the DS4100 on a fibre channel loop. The server ID switch is located on the back of the unit, as shown in Figure 21.

Use the small buttons above and below each server ID digit to change the server 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 storage subsystems ship with a panel installed over the server ID switch to prevent the server ID from being changed accidentally. If your storage subsystem has a protective panel over the server ID switch, use a pencil or a small screwdriver to change the server 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 slot that a fibre channel 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 ones digit (x1).

Note: The DS4100 is shipped with 00 as the default server ID setting. If you connect the storage subsystem to a storage expansion enclosure, you must set the storage expansion enclosure ID setting to a value other than 00. Each server unit should have a unique ID if it is going to be connected to other storage expansion enclosures through the drive loop ports. The Server

ID setting is only valid for the drive loop. The amber ID Conflict LED (located on the right-side of the switch) will be lit if another unit in the drive loop has the same ID setting as the server ID.

Attention: When connecting the DS4100 to storage expansion enclosures, DO NOT use the tens digit (x10) setting. Use only the ones digit (x1) setting to set unique server IDs or storage expansion enclosure IDs.

Give each storage expansion enclosure in a redundant drive loop 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 loop 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 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 loop problems, since one cannot easily ascertain whether the same device with a different address or different device may be causing a problem.

Storage subsystem speed settings

The default switch setting is 2 Gbps. This is the *only* speed setting allowed for the DS4100.

Attention: Do not remove the metal plate that covers the storage subsystem speed setting. Do not adjust the storage subsystem speed setting.

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 DS4100 storage subsystem.

Important: If the operating system of the host server that the storage subsystem logical drive(s) is mapped to is not Microsoft® Windows NT®, 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 22 shows the host-agent (in-band) management method.

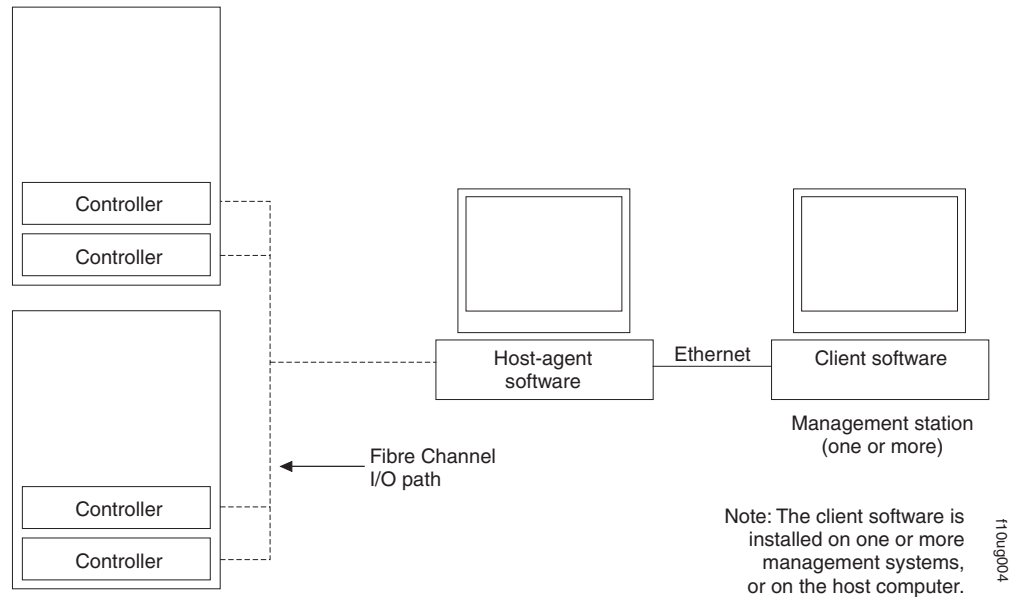


Figure 22. Host-agent (in-band) managed storage subsystems

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 23 on page 38 shows the direct (out-of-band) management method.

Note: Do not connect the DS4100 storage subsystem Ethernet ports to a public network or public subnet. It is strongly recommended that you create a private network between the DS4100 storage subsystem and the management station.

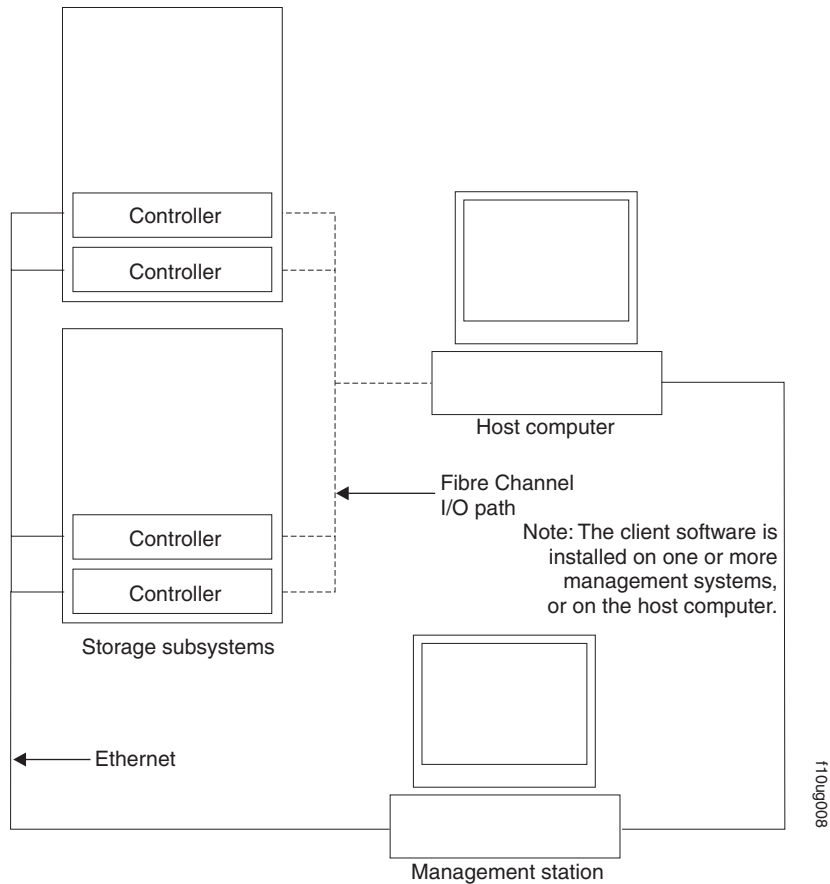


Figure 23. Direct (out-of-band) managed storage subsystems

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 to the hard disk drives (HDDs). The redundant drive fibre-channel loop consists of fibre channel HDDs and optional storage expansion enclosures, fibre-channel cables, and SFPs.

Exception: The DS4100 single-controller storage subsystem does not support drive loops or storage expansion enclosures.

The DS4100 base (dual-controller) storage subsystem supports redundant disk-drive-loop configurations. Each RAID controller has three SFP ports. These SFP ports are labeled *Host 1*, *Host 2*, and *Expansion*. You can build a redundant drive loop 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 about adding storage expansion enclosures, see “Connecting storage expansion enclosures (base storage subsystem only)” on page 60.

Note: If you currently have the DS4100 single-controller storage subsystem, you can upgrade to the DS4100 base storage subsystem by purchasing the IBM

Fibre channel loop configurations

You must determine how the host systems will connect to the storage subsystem. You can connect up to two 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 default configuration is one partition. Four-partition, eight-partition, and sixteen-partition configuration upgrades are available as upgrade options. You must perform partition upgrades one increment at a time, which means you cannot upgrade directly from a four-partition configuration to a sixteen-partition configuration; in this case, you would have to upgrade from a four-partition configuration to an eight-partition configuration, and then from the eight-partition configuration to a sixteen-partition configuration. Contact your IBM reseller or marketing representative for more information.

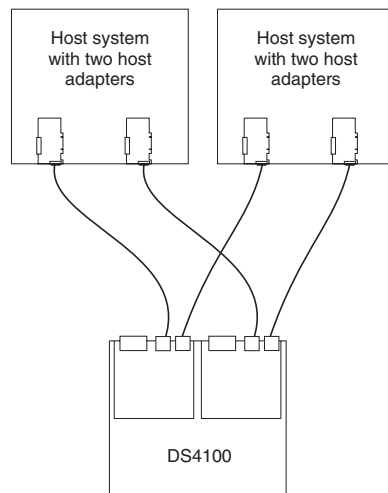
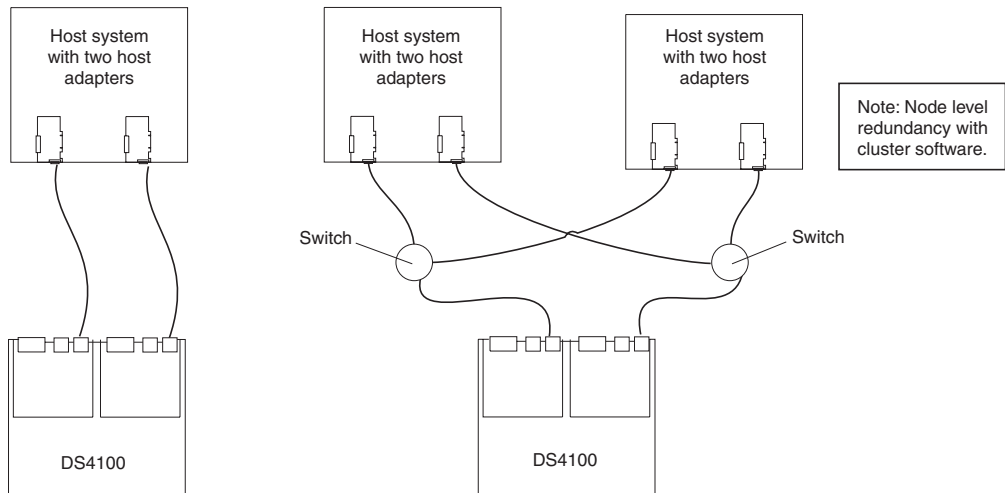
Redundant host and drive loops

This section provides examples of DS4100 host fibre channel configurations.

DS4100 base storage subsystem configurations: This section provides the following examples of DS4100 base storage subsystem host fibre channel configurations.

- Redundant host and drive fibre channel loop configurations, as shown in Figure 24 on page 40
- Single SAN fabric configuration, as shown in Figure 25 on page 41
- Dual SAN fabric configuration, with an additional DS4100 and a DS4000 EXP100 attached, as shown in Figure 26 on page 41
- Two clusters, as shown in Figure 27 on page 42

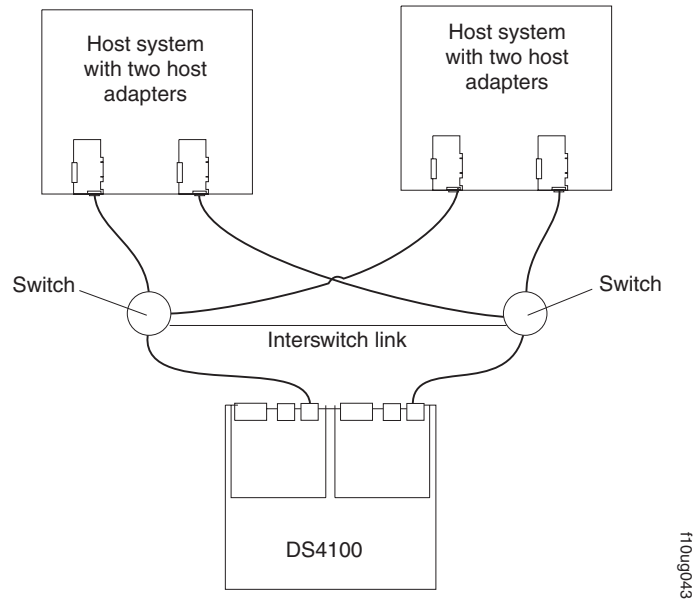
Note: These configurations have host and drive path failover protection and are recommended for high availability.



11049028

Figure 24. Examples of redundant host and drive fibre channel loop configurations (base storage subsystem)

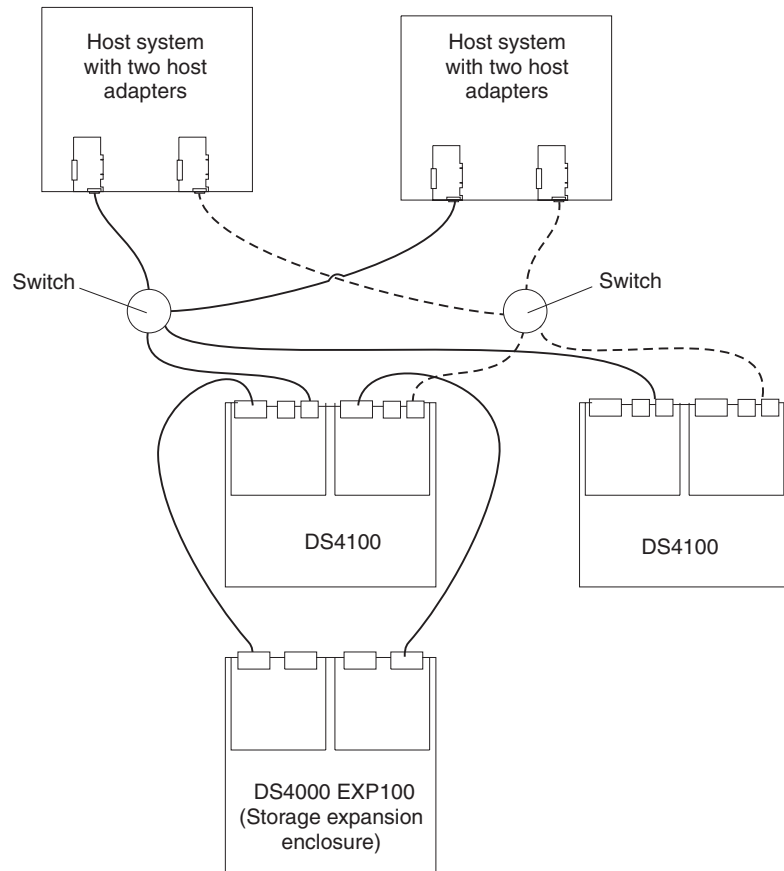
In Figure 25 on page 41, the fibre channel switches are connected together via the inter-switch link (ISL) to form a single SAN fabric.



f10ug043

Figure 25. Example of a single SAN fabric configuration (base storage subsystem)

In Figure 26, the fibre channel switches are not connected together. Each switch forms its own SAN fabric.



f10ug042

Figure 26. Example of a dual SAN fabric configuration (base storage subsystem)

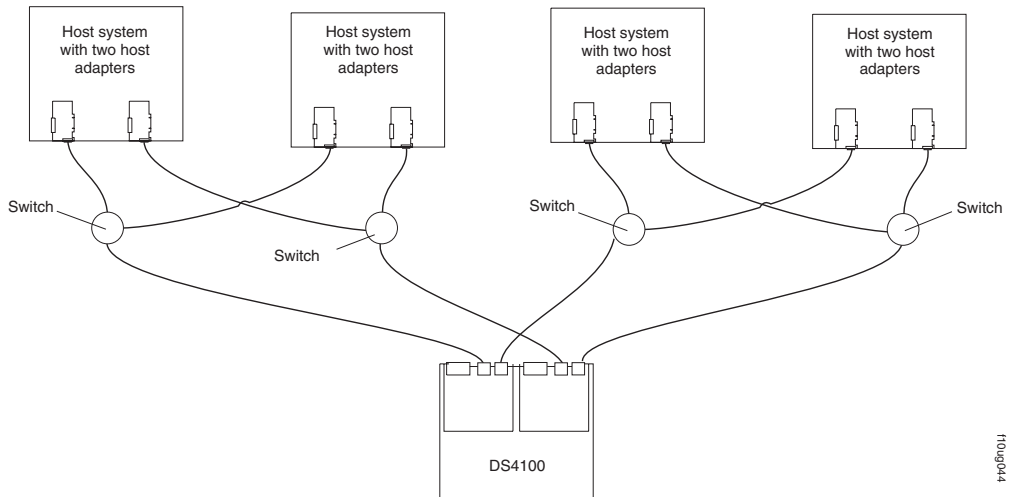


Figure 27. Example of a two-cluster configuration (base storage subsystem)

DS4100 single-controller storage subsystem configurations: This section provides the following examples of DS4100 single-controller storage subsystem host fibre channel configurations.

Note: If you currently have the DS4100 single-controller storage subsystem, you can upgrade to the DS4100 base storage subsystem by purchasing the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. Contact your IBM service representative for more information.

- Single server configuration with one adapter, as shown in Figure 28 on page 43
- Single server configuration with two adapters, as shown in Figure 29 on page 43
- Dual server configuration with one adapter on each server, as shown in Figure 30 on page 44
- Dual-server, single-SAN fabric configuration with one adapter on each server, as shown in Figure 31 on page 44
- Dual-server, single-SAN fabric configuration with two adapters on each server, as shown in Figure 32 on page 45

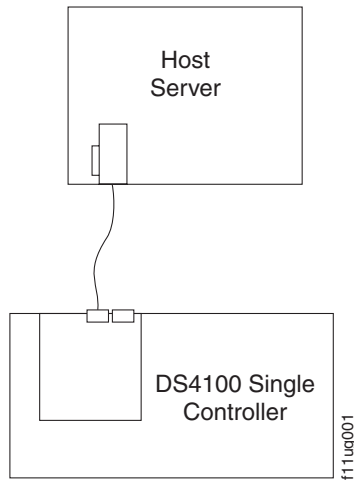


Figure 28. Example of a single server configuration with one adapter (single-controller storage subsystem)

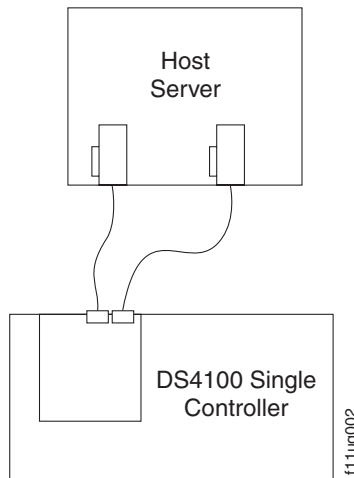


Figure 29. Example of a single server configuration with two adapters (single-controller storage subsystem)

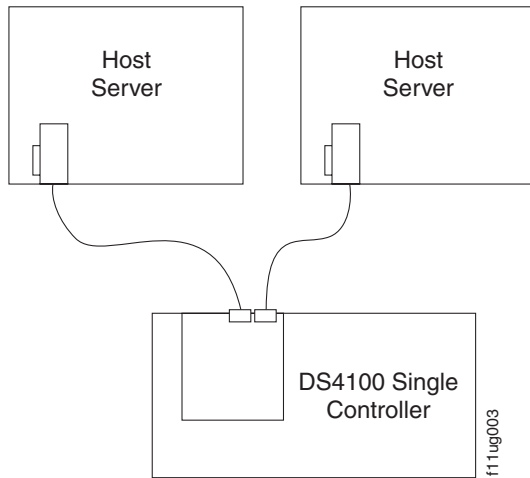


Figure 30. Example of a dual server configuration with one adapter on each server (single-controller storage subsystem)

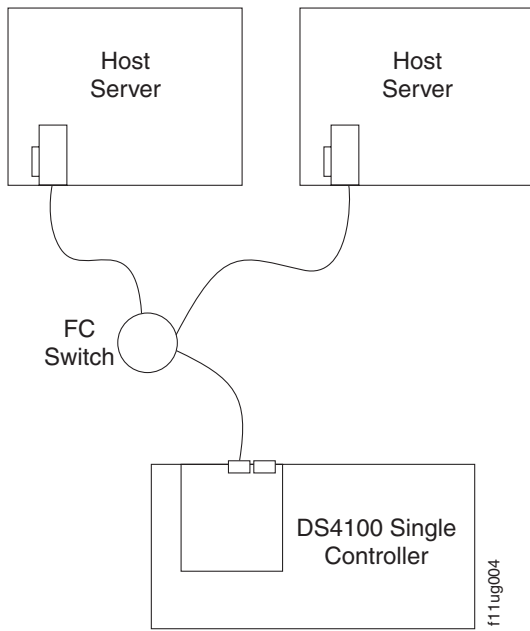


Figure 31. Example of a dual-server, single-SAN fabric configuration with one adapter on each server (single-controller storage subsystem)

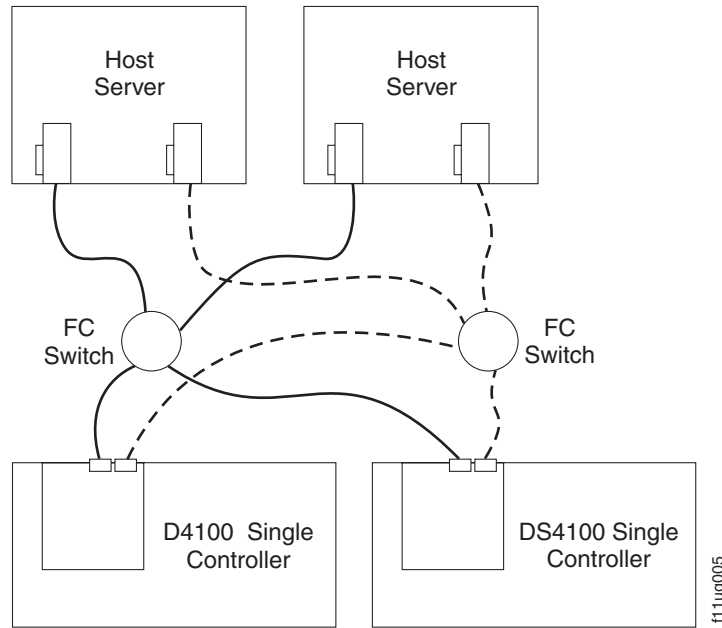


Figure 32. Example of a dual-server, single-SAN fabric configuration with two adapters on each server (single-controller storage subsystem)

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 47.

Note: Do not install the DS4000 Storage Manager client at this time, if it is not already installed. Install the storage subsystem completely before you install the software because you cannot test the software installation until the hardware is connected.

Chapter 3. Cabling the storage subsystem

This chapter provides fibre channel and power cabling information for the storage subsystem.

After you attach the storage subsystem power cables, use the instructions that are provided in “Turning the storage subsystem on and off” on page 70 for the initial startup of the storage subsystem.

Working with SFPs and fiber-optic cables

Each RAID controller has two host ports and one expansion port. You use a small-form factor pluggable transceiver (SFP) to connect each host port and expansion 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:

- Remove SFP modules from any unused host-side or drive-side SFP ports in the DS4100 storage subsystem.
- 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 diameter of less than 76 mm (3 in.), or a radius less than 38 mm (1.5 in.) when extended or become pinched when retracted.

- 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 diameter of less than 76 mm (3 in.), or a radius 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 DS4100 host 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 DS4100 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 DS4100 to other fibre channel devices.

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

- Do not mix long-wave SFPs and short-wave SFPs on a single storage subsystem. Use either long-wave SFPs or short-wave SFPs. You can use the DS4000 Storage Manager client to view the storage subsystem profile in order to verify that you are not mixing long-wave and short-wave SFPs.
- 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 port. See “Removing SFP modules” on page 50 for more information.

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 20.

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 33. Save the protective cap for future use.

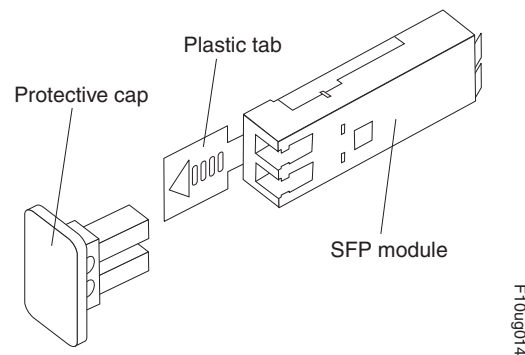


Figure 33. Small Form-Factor Pluggable (SFP) module

3. Remove the protective cap from the host port. Save the protective cap for future use.
4. Insert the SFP module into the host port until it clicks into place. See Figure 34 on page 50.

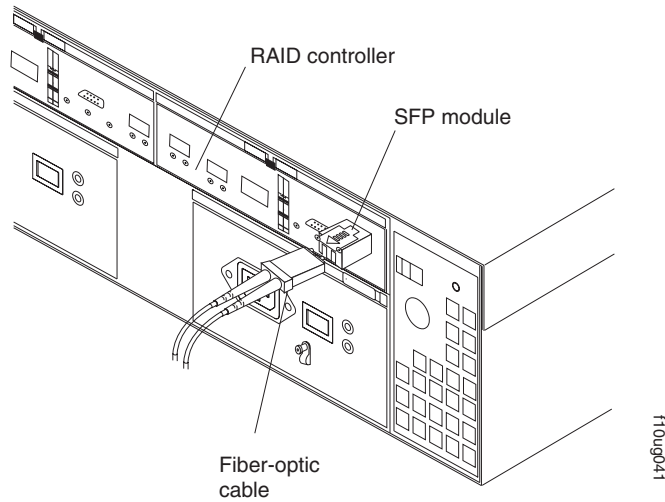


Figure 34. Installing an SFP module into the host port

5. Connect a fibre channel cable.

Removing SFP modules

To remove the SFP module from the host 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 47.
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 35.

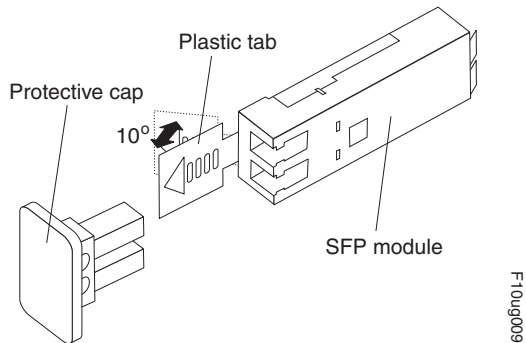


Figure 35. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 36 on page 51.

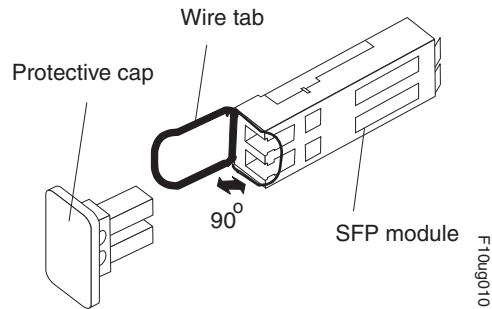


Figure 36. Unlocking the SFP module latch - wire variety

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 minihub 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 37.

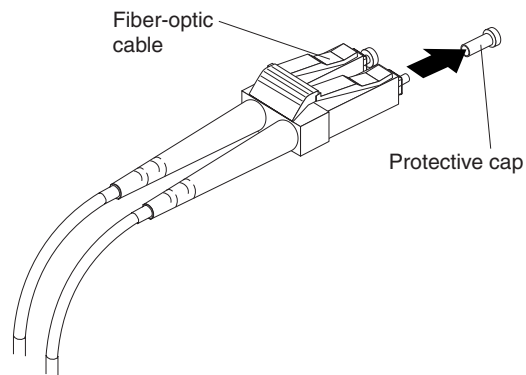


Figure 37. Removing caps from fiber-optic cables

2. Connect the fiber-optic cable to the installed SFP, as shown in Figure 38 on page 52.

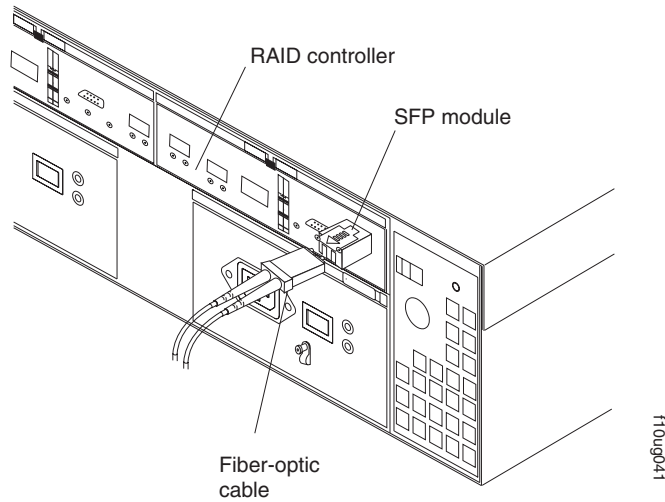


Figure 38. Connecting cables to the installed SFP

3. Check the LEDs on the RAID controller. When the RAID controller is operating properly, the amber Fault LED is off. For information about the status of the RAID controller LEDs, see Table 9 on page 78.
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 into one of the following devices:

- An SFP module installed in an IBM DS4100
- An SFP module installed in an IBM DS4000 EXP100 storage expansion enclosure

See Figure 39 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.

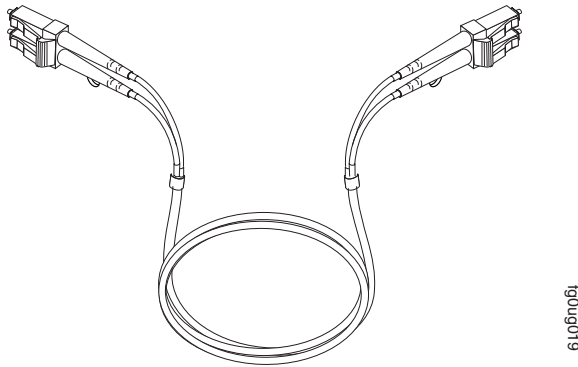


Figure 39. LC-LC fibre-channel cable

Note: If you are connecting the DS4100 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 47.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 33 on page 49. 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 40. Save the protective caps for future use.

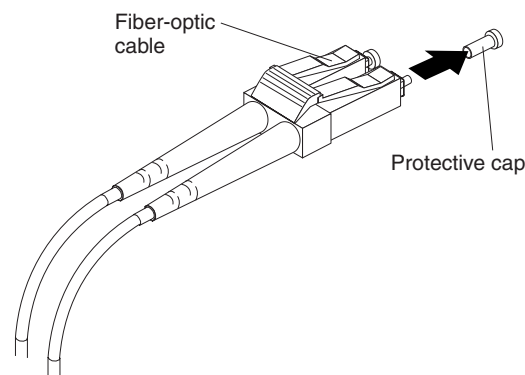


Figure 40. Removing fiber-optic cable protective caps

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the DS4100. 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 41.

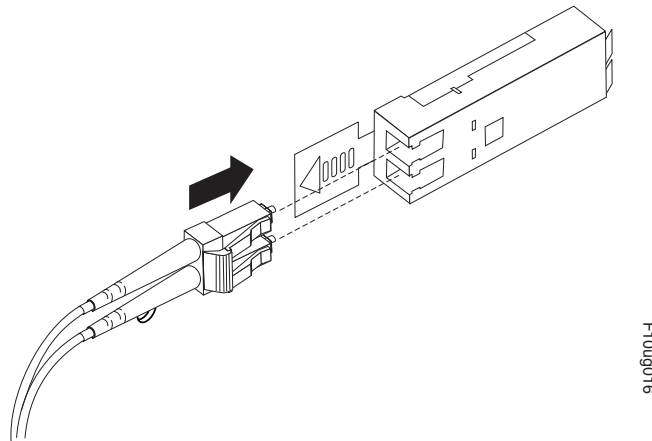


Figure 41. Inserting an LC-LC fibre-channel cable into an SFP module

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 a DS4000 EXP100.

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 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 removing the cable. When removing the cable from the SFP module, make sure that you do not grasp the SFP module plastic tab.

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 42.

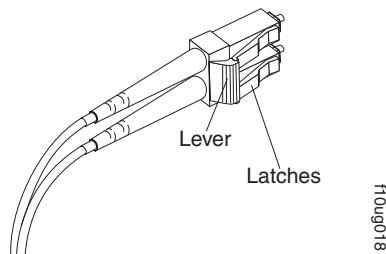
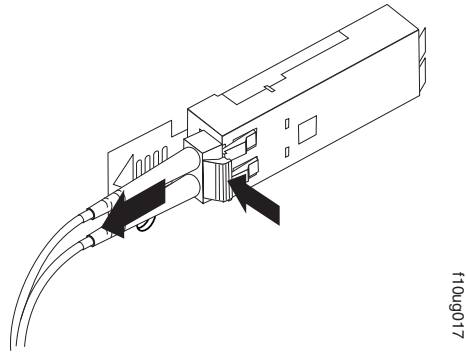


Figure 42. LC-LC fibre-channel cable lever and latches

2. Carefully pull on the connector to remove the cable from the SFP module, as shown in Figure 43 on page 55.



H10ug017

Figure 43. Removing the LC-LC fibre-channel cable

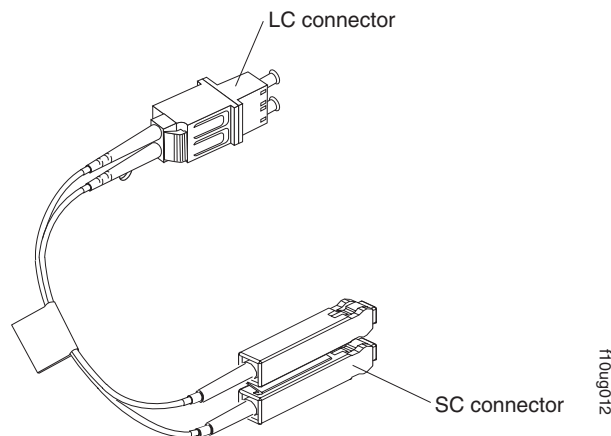
3. Replace the protective caps on the cable ends.
4. Replace the protective cap on the SFP module.

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

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



H10ug012

Figure 44. 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 47.
2. Connect one end of an LC-LC cable to an SFP module in the DS4100. 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 45. Save the protective caps for future use.

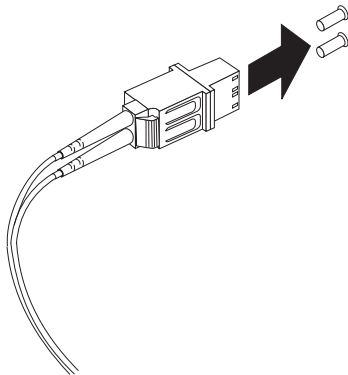


Figure 45. Removing the LC-SC cable adapter protective caps

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 46 on page 57. Push in the connector until it clicks into place.

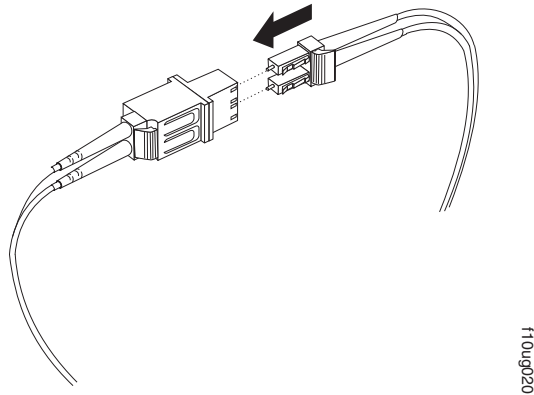


Figure 46. Connecting an LC-LC cable into the LC-SC cable adapter

5. If you are connecting the DS4100 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 47 shows the location of the lever and latches.

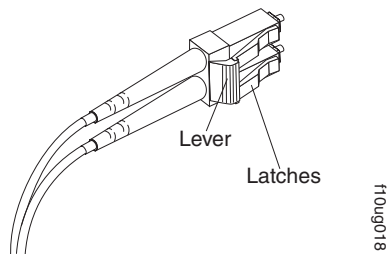


Figure 47. LC-LC fibre-channel cable lever and latches

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 48 on page 58.

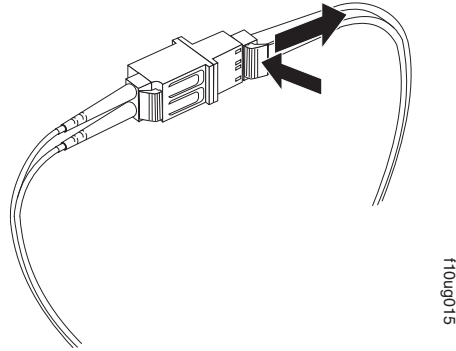


Figure 48. Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter

3. Replace the protective caps on the cable ends.

Connecting hosts to the RAID controllers

Complete the procedure that is appropriate to your DS4100 storage subsystem model:

- “Connecting hosts to a DS4100 base storage subsystem” on page 58
- “Connecting hosts to a DS4100 single-controller storage subsystem” on page 59

Note: If you currently have the DS4100 single-controller storage subsystem, you can upgrade to the DS4100 base storage subsystem by purchasing the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. Contact your IBM service representative for more information.

Connecting hosts to a DS4100 base storage subsystem

To connect a host adapter to the DS4100 base storage subsystem RAID controllers, perform the following steps:

1. Install an SFP in a host port on the RAID controller.
2. Connect the host-system cables to the RAID controller or to switches. Figure 49 shows the location on the RAID controllers where the host-system cables connect.

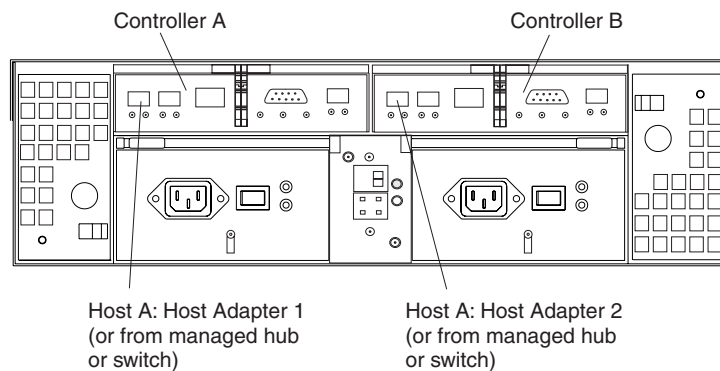


Figure 49. Location of host cables (base storage subsystem)

For examples of redundant, partially-redundant, and non-redundant host and drive loop configurations, see “Fibre channel loop configurations” on page 39.

Connecting hosts to a DS4100 single-controller storage subsystem

To connect a host adapter to the DS4100 single-controller storage subsystem RAID controllers, perform the following steps:

1. Install an SFP in a host port on the RAID controller.
2. Connect the host-system cables to the RAID controller or to switches. Figure 50 shows the location on the RAID controllers where the host-system cables connect.

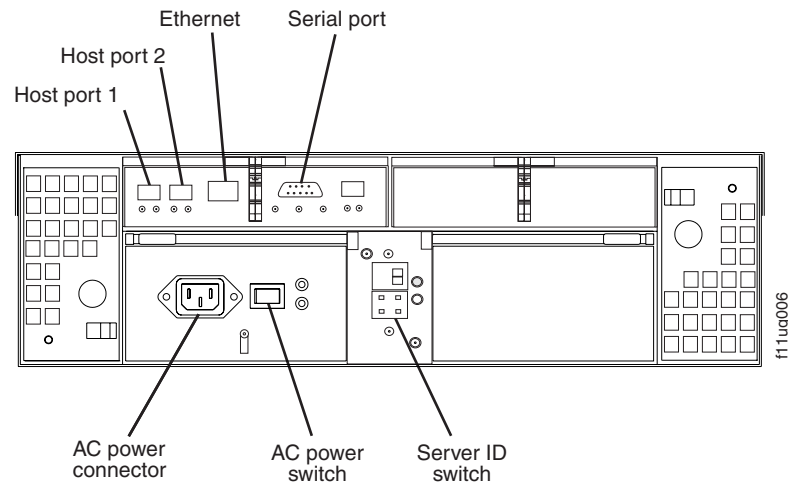


Figure 50. Location of host cables (single-controller storage subsystem)

Connecting secondary interface cables

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 37).

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

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.
2. Do not connect the DS4100 in a public LAN or public subnet. Use a local private network for the DS4100 storage subsystem and the management station Ethernet ports.
3. To ensure proper EMI shielding, always use quality shielded serial cables.

Connecting secondary interface cables to a DS4100 base storage subsystem

Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for Controller A (located on the left) and Controller B (located on the

right) on the back of the storage subsystem. Figure 51 shows the location of the ports.

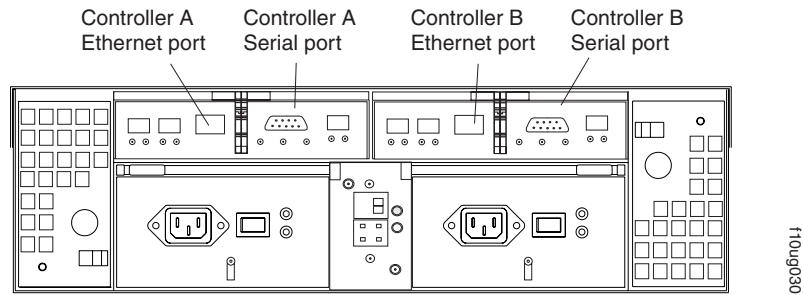


Figure 51. Ethernet and serial port locations

Connecting secondary interface cables to a DS4100 single-controller storage subsystem

Connect an Ethernet cable from the storage-management station to the Ethernet port of the controller.

Connecting storage expansion enclosures (base storage subsystem only)

Attention

Before attaching any new EXP100 storage expansion enclosures to the DS4100, you must ensure that the EXP100 has ESM firmware installed that is compatible with the DS4100. Refer to the sections "Controller firmware, ESM firmware, and EXP100 release levels" and "Adding a new EXP100 to an existing and configured drive loop" in the *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation, User's, and Maintenance Guide* for details on how to determine the appropriate firmware levels, and how to identify ESM firmware levels in the Subsystem Management window.

IBM recommends that you install EXP100 ESM firmware version 956x or later.

You cannot connect storage expansion enclosures to the DS4100 single-controller storage subsystem. If you are using the DS4100 single-controller storage subsystem, skip this section. Please contact your IBM support representative for information about the availability of such support in the future.

Attention: In the initial installation of the DS4100, you can add only *new* storage expansion enclosures to the DS4100 storage subsystem. This means that there must be no existing configuration information on the storage expansion enclosure that you want to install. If the storage expansion enclosure that you want to install currently contains logical drives or configured hot spares, and you want them to be part of the DS4100 storage subsystem, refer to the *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation, User's and Maintenance Guide*. Improper drive migration might cause loss of configuration and other storage subsystem problems. Contact your IBM support representative for additional information.

To connect a single additional storage expansion enclosure to the storage subsystem, perform the following steps:

Note: The following procedures are for "cold-case" procedures (the DS4100 is powered down when storage expansion enclosures are connected, as in the case of a new installation). For "hot-case" procedures (the DS4100 is powered on when storage expansion enclosures are connected), see "Adding a DS4000 storage expansion enclosure to an existing DS4100 configuration (base storage subsystem only)" on page 116. You can also refer to the *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation, User's and Maintenance Guide*.

1. Follow the instructions in your storage expansion enclosure installation manual to set up and mount the new storage expansion enclosure.
2. Use the following procedure and Figure 52 to connect a single storage expansion enclosure to the storage subsystem:
 - a. Ensure that the enclosure ID switch on the new storage expansion enclosure is set to a value different than the value set for the DS4100 and any other storage expansion enclosures in the loop. Also ensure that the link speeds of the storage expansion enclosures are set to 2 Gbps. See "Setting the interface options" on page 34.

Note: When connecting the DS4100 to DS4000 storage expansion enclosures, do not use the tens digit (x10) setting. Use only the ones digit (x1) setting to set unique server IDs or enclosure IDs. For more information, see "Server ID (enclosure ID) settings" on page 35.

- b. Use a fiber-optic cable to connect to the FC-Expansion Units port on the left RAID controller in the storage subsystem to the In port on the left ESM board of the storage expansion enclosure.
- c. Use a second fiber-optic cable to connect the FC-Expansion Units port on the right RAID controller in the storage subsystem to the Out port on the right ESM board of the storage expansion enclosure.

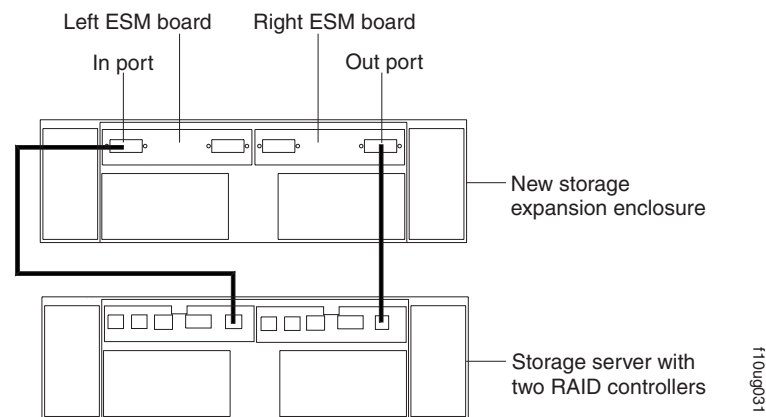


Figure 52. Adding a storage expansion enclosure

3. Remove the blank filler trays and insert drive trays. Connect power to the storage expansion enclosure first and then connect power to the DS4100. After the storage subsystem is powered on, the storage subsystem locates the new drives.
4. Use the DS4000 Storage Manager client to check the status of the new drives, correct any errors found, and configure the new drives.

For more detailed information about how to cable the storage subsystem and storage expansion enclosures, see the *DS4100 Fibre Channel Cabling Instructions* that come with the storage subsystem.

DS4000 EXP100 loop redundancy (DS4100 base storage subsystem only)

The DS4000 EXP100 provides redundant loop support when the second ESM is configured, and when both loops (called A and B) are connected to a DS4100 storage subsystem model that supports redundant loops. (The DS4100 base storage subsystem supports redundant loops; the DS4100 single-controller storage subsystem does not support redundant loops.) If a cable or SFP module fails on drive loop A, drive loop B provides redundancy, which is an alternate path to your disk drives.

Figure 53 shows a redundant loop that you might create with a DS4100 and three DS4000 EXP100s. The numbers provided in Figure 53 show the order in which cables should be attached.

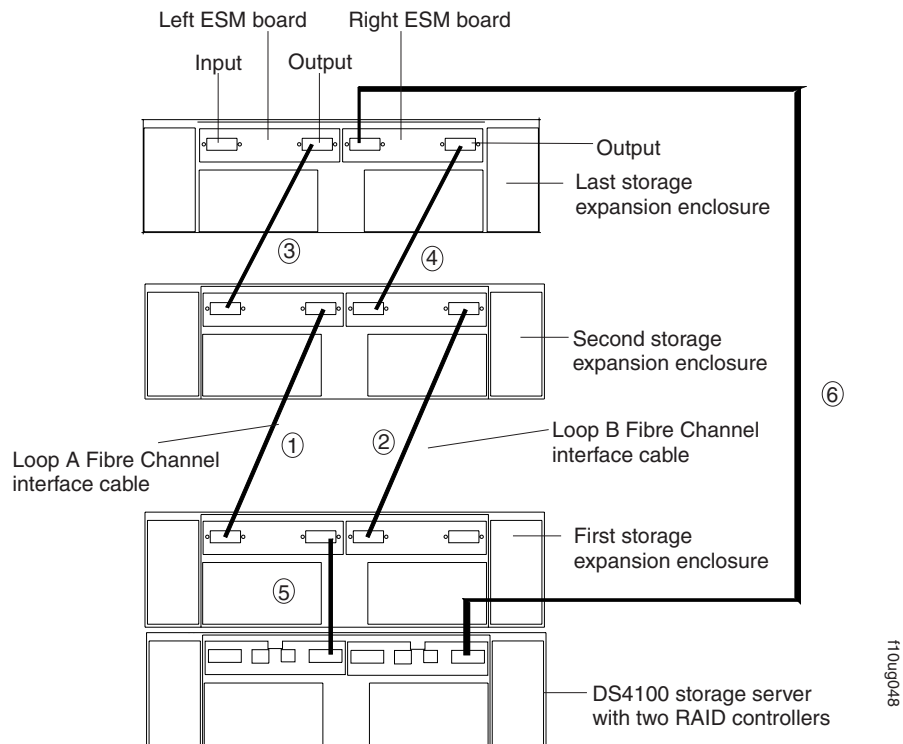


Figure 53. DS4000 EXP100 redundant loop configuration

To create the redundant loop shown in Figure 53, you would perform the following steps:

1. Make two fibre-channel connections from the *First storage expansion enclosure* to the *Second storage expansion enclosure* (connections 1 and 2).
2. Make two fibre-channel connections from the *Second storage expansion enclosure* to the *Last storage expansion enclosure* (connections 3 and 4). Currently, you can connect up to seven DS4000 EXP100s together in a redundant drive loop.

3. Make a fibre-channel connection from the storage subsystem drive port to the **OUT** port in the left ESM of the *First storage expansion enclosure* in the redundant drive loop (connection 5).
4. Make a fibre-channel connection from the storage subsystem drive port to the **IN** port in the right ESM of the *Last storage expansion enclosure* in the redundant drive loop (connection 6).

IBM SATA disk drives are dual-ported, providing individual access from two fibre-channel loops to the same disk drive. When configuring the ESMs, configure the second ESM the same way that you configured the first ESM. Refer to the *DS4100 Fibre Channel Cabling Instructions* for more information about dual-loop support and implementation.

Each ESM on the DS4000 EXP100 has an SFP module input port and an SFP module output port. As you cable DS4000 EXP100s together, connecting input ports to output ports can improve diagnostic capability. Refer to the *DS4100 Storage Subsystem Fibre Channel Cabling Instructions* for cabling connections between input and output ports.

Power cabling

The DS4100 base storage subsystem uses two standard power cords, and the single-controller storage subsystem uses only one. 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 DS4100 storage subsystem does not ship with power cords. Refer to Appendix C, “Power cords,” on page 133 for the list of IBM-approved power cords for your region. Depending on your model, the DS4100 storage subsystem does ship with one or two line jumper cords for connecting the DS4100 power supply or power supplies to an IBM-approved rack power distribution unit.

If you have not already done so, attach the power cords by using Figure 54 for the location of the component parts.

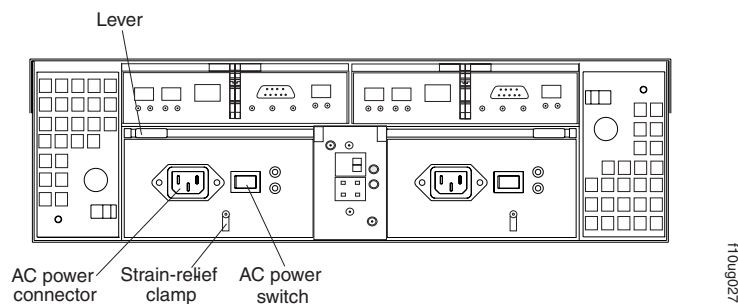


Figure 54. Power cord locations

Perform the following to cable the power cords:

1. Connect the power cord to the power supply.
2. Remove the nut that holds the power cable strain-relief clamp, and then remove the strain-relief clamp.

3. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power supply connection end. Leave some slack between the clamp and the power-supply end of the power cord.
4. Replace the power cable strain-relief clamp, and tighten it securely with the nut.
5. Plug the power cord into a properly grounded electrical outlet.

Note: To maintain power redundancy, plug the storage subsystem's right and left power supplies 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 DS4100 should be plugged into the same two independent external power circuits as the DS4100.

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 power supplies are connected and the storage subsystem is powered on, each power supply unit will handle approximately one-half of the current load. If there is only one power supply unit, it will handle all of the current load. To ensure maximum protection against power loss due to power supply unit failure or a power circuit tripping, both power supply units must be connected and powered on. See Table 5 on page 17 for the DS4100 AC power requirements.

See Figure 55 on page 65 for an example of redundant power cabling.

Exception: The DS4100 single-controller storage subsystem has only one power supply, so it does not support power redundancy.

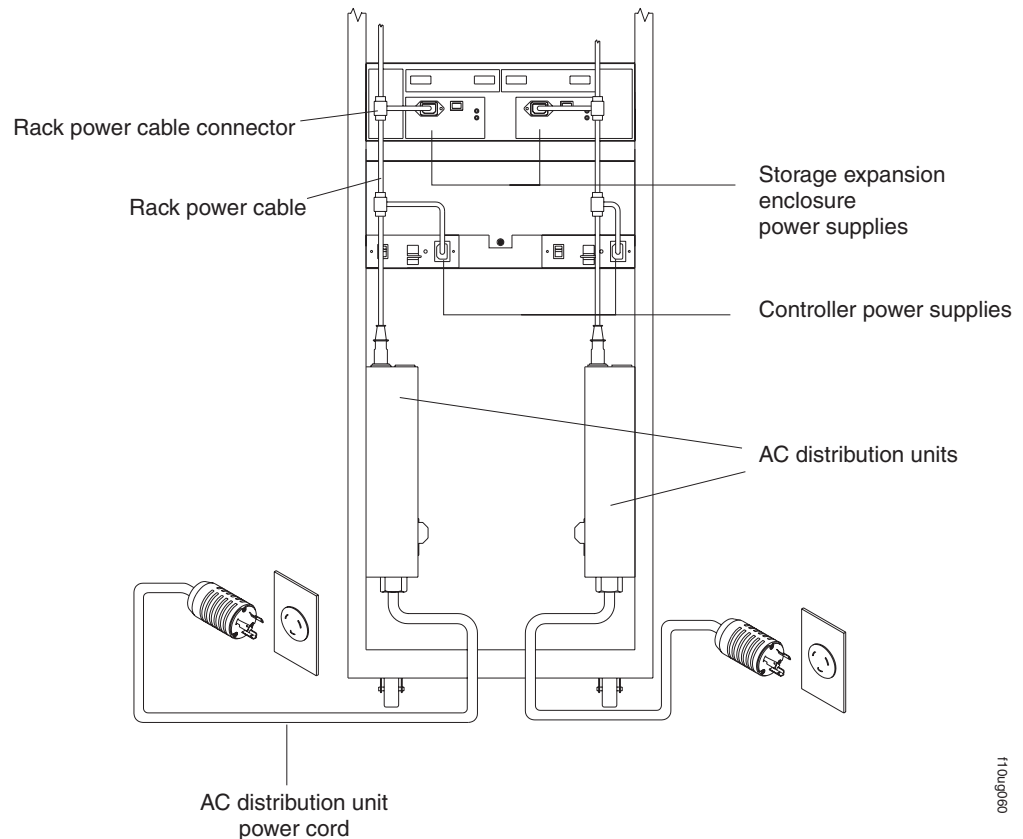


Figure 55. Redundant AC power connections to controllers and storage expansion enclosures

For details about power requirements, see “DS4100 specifications” on page 16.

- Go to “Turning the storage subsystem on and off” on page 70 for the initial startup of the storage subsystem.

Attention: Before you power on the storage subsystem, any storage expansion enclosures should be completely connected to the storage subsystem.

Installing the DS4000 Storage Manager client

Refer to the *IBM TotalStorage DS4000 Storage Manager 9 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 set-up until you have completed the DS4000 Storage Manager installation.

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

- HBA drivers
- Controller firmware version 06.12.15.xx (required to support the 400 GB drive option and the new 250 GB drive CRU)
- IP addresses for RAID controllers (for in-band management only)

- Additional documentation for switches and HBAs, if needed
- *DS4000 Storage Manager Version 9.1x Support CD*, which includes the IBM DS4000 Storage Manager 9.1x software and DS4000 storage subsystem controller firmware 06.12.15.xx. You use this software to configure the storage subsystems. For the latest controller firmware, check the IBM support web site for DS4000 storage products.
www.ibm.com/servers/storage/support/disk/

See “Software and firmware upgrades” on page 74 for more information.

Note: Before any planned system shutdown or after any system additions, removals, or modifications (including 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 DS4100 storage subsystem.

Important:

For the latest information about firmware, including any special requirements or restrictions that apply to a particular firmware version, always refer to the readme file that is included with the DS4100 storage subsystem firmware package (whether the firmware is accessed by the Web or CD).

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” on page 76.

Chapter 4. Operating the storage subsystem

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

- Back up the data on your storage drives periodically.
- **DS4100 base storage subsystem only:** To maintain power redundancy, plug the storage subsystem's right and the left power supplies 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 DS4100 should be plugged into the same two independent external power circuits as the DS4100. This ensures that the DS4100 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 supplies 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 55 on page 65 for an example of redundant power connections.
- Before any planned system shutdown or after any system additions, removals, or modifications (including 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 DS4100 storage subsystem.
- Ensure that your system is in an optimal state before you shut it down. Never turn the power off if any fault light is lit; be sure to resolve any error conditions before you shut down the system.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in "Turning on the storage subsystem" on page 70. 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 70 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.
- Using the DS4000 Storage Manager client, save the DS4000 subsystem configuration profile to a disk that is not affected every time you make changes (such as logical drive creation or modification, or storage partitioning changes) to the DS4000 subsystem configuration.

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 69 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.

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 emergency shutdown” on page 74.

Turning on the storage subsystem

Important: DS4100 base storage subsystem only: You must turn on the storage expansion enclosures and verify that the storage expansion enclosure fibre channel connections are optimal by checking the indicator lights *before* you turn on the DS4100. The controllers might not recognize the correct configuration if the hard disk drives are powered up after the DS4100. For instructions on how to power up the storage expansion enclosures, refer to the storage expansion enclosure documentation.

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

Perform the following steps to turn on the power for the initial startup of the storage subsystem:

1. Verify that:
 - a. All communication and power cables are plugged into the back of the storage subsystem and a properly grounded ac electrical outlet.
 - b. All hard disk drives are locked securely in place. For more information, see “Installing hot-swap hard disk drives” on page 86.

Note: At least one drive must be present before you start the DS4100.

- Attention:** If you are restarting the system after a normal shutdown, wait at least 10 seconds before you turn on the power by using the power-on sequence in step 2.
2. Check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:
 - a. Turn on the power to the supporting devices (for example, Ethernet switches and management stations) before the storage subsystem.

Attention: If you will be directly managing the storage array, you must set up the Dynamic Host Configuration Protocol (DHCP) or BOOT-P 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 array module. For more information, see the software installation guide for your operating system.

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

3. Turn on the power to each device, based on the power-on sequence in step 2 on page 70. To turn on power to the storage subsystem, turn on the power-supply switches on the back of the storage subsystem. You must turn on both power-supply switches to take advantage of the redundant power supplies.
4. Use the DS4000 Storage Manager client and the Fault 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 76).

Note: The green drive active LED and amber drive fault LED below the drive CRUs might flash intermittently as the drives spin-up. Wait until the storage subsystem is finished powering up before checking the LEDs on the front of the storage subsystem. For more information, see “Checking the LEDs” on page 77.

Turning off the storage subsystem

Attention: Except in an emergency, never turn off the power if any storage subsystem Fault LEDs are on. Correct the fault before you turn off the power. Use the DS4000 Storage Manager client and the Fault 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 76). This ensures that the storage subsystem will power up correctly later. For more information, see Chapter 6, “Hardware maintenance,” on page 119.

The storage subsystem is designed to run continuously, 24 hours a day. After you turn on the storage subsystem, do not turn it off. Turn off the power only when:

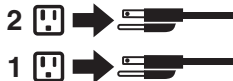
- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.
- A power outage or emergency situation occurs (see “Performing an emergency shutdown” on page 73).

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.



Perform the following steps to turn off the power:

1. 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.
2. Use the DS4000 Storage Manager client to check the status of the storage subsystem. Correct problems that are reported before you turn off the power.
3. Stop all I/O activity to the storage subsystem and attached storage expansion enclosures. Make sure that:
 - All of the green Drive active LEDs on the front of the storage subsystem (and on all attached storage expansion enclosures) are not flashing.
 - The green Cache active LEDs on the back of the storage subsystem are off.

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

4. Before the storage subsystem is powered off, use the operating system software to either disconnect the storage subsystem logical drives from the host or to flush the logical drive data cache in the host server memory.
5. If applicable, use the operating system software to disconnect the storage subsystem logical drives from the host before the storage subsystem is powered off.
6. Turn off the power to each device based on the following shutdown sequence:
 - a. 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.
 - b. 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.
 - c. 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.

7. After you perform the necessary maintenance procedures, turn on the power using the procedure in “Turning on the storage subsystem” on page 70.

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 fan CRUs 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 supplies 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).

- 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 71) because of an emergency situation.

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

If the storage subsystem shuts down unexpectedly, go to “Restoring power after an over-temperature shutdown” on page 74. Otherwise, go to “Restoring power after an emergency shutdown” on page 74.

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 70.

Performing an emergency shutdown

Attention: Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This 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 119).

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 Fault 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 this procedure to restart the storage subsystem if you turned off the power-supply switches during an emergency shutdown, or if a power failure or a power outage occurred:

1. After the emergency situation is over or power is restored, check the storage subsystem for damage. If there is no visible damage, continue with step 2; otherwise, have your system serviced.
2. After you have checked for damage, ensure that the power-supply switches are off; then plug in the storage-subsystem power cords.
3. Complete step 2 on page 70 to determine the proper power-on sequence for your system.
4. Complete steps 3 and 4 on page 71 to turn on power to the devices in your system and to check the status of the storage subsystem.

Restoring power after an over-temperature shutdown

Use this procedure to restart the storage subsystem after an unexpected shutdown due to an over-temperature condition:

1. Make sure that the power-supply switches on the back of the storage subsystem are turned off.
2. Do whatever is necessary to cool the unit (replace the fans, use external fans to cool the room, and so on).
3. Check all components and cables for visible damage. *Do not start the storage subsystem if you find evidence of damage.*
4. Complete step 2 on page 70 to determine the proper power-on sequence for your system.
5. When the internal temperature of the storage subsystem is below 35° C (95° F), complete steps 3 and 4 on page 71 to turn on power to the devices in your system and to check the status of the storage subsystem.

Software and firmware upgrades

See the *IBM TotalStorage DS4000 Storage Manager 9 Installation and Support Guide* for the appropriate operating system for instructions on how to install the DS4000 Storage Manager 9.1x host software.

In addition, to download the latest version of the DS4000 Storage Manager 9.1x host software, the DS4100 storage subsystem controller firmware and NVSRAM version 06.12.15.xx, and the latest DS4000 EXP100 R2 ESM firmware (version 9554 or higher), or EXP100 R3 ESM firmware (956x or higher), go to the following Web site:

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

See Table 7 on page 75 for the previous versions of Storage Manager software, controller firmware, and EXP100 ESM firmware that were supported with the DS4100. The table also shows the current versions.

Recommendation: IBM recommends that you upgrade your system to install the latest software and firmware versions, as shown in the table.

Table 7. Current and previous software and firmware versions for DS4100 storage subsystems

	Previous version(s)	Current version
DS4000 Storage Manager software	DS4000 Storage Manager 8.4x, 9.10, 9.12, 9.14	DS4000 Storage Manager 9.15 or later
DS4100 Storage Subsystem controller firmware	05.42.xx.xx	06.12.15.xx or later
DS4000 EXP100 Storage Expansion Enclosure ESM firmware	9554	956x or later

Notes:

1. Controller firmware version 06.12.15.xx is required for the 400 GB drive option and the new 250 drive CRU.
2. The version of controller firmware determines which version of the DS4000 Storage Manager subsystem management interface is displayed.
For example, if you are managing a DS4100 storage subsystem with controller version 05.42.xx.xx installed, the subsystem management interface for DS4000 Storage Manager version 8.4x would be displayed even if the client code for DS4000 Storage Manager version 9.1x is installed.

Firmware updates

In order to ensure the optimal operation of the DS4100 storage subsystem and its attached storage expansion enclosures, make sure that the storage expansion enclosure ESM firmware, the DS4100 controller firmware, the hard drive firmware, and the NVSRAM (for controllers only) are up to date. You can find the latest updates at the following Web site:

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

Apply the necessary updates before configuring the DS4100 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 4).

Attention: Always 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 that the storage expansion enclosure ESM firmware be upgraded first to a particular version, or the controller firmware download might require the halting of I/O activity to the DS4100 storage subsystem’s logical drives. Failure to observe the limitations, prerequisites, and dependencies in the readme file might result in a loss of data access. You can find the readme files at the following Web site:

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

Monitoring status through software

Attention: Before attaching any new EXP100 storage expansion enclosures to the DS4100, you must ensure that the EXP100 has ESM firmware installed that is compatible with the DS4100. Refer to the sections "Controller firmware, ESM firmware, and EXP100 release levels" and "Adding a new EXP100 to an existing and configured drive loop" in the *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation, User's, and Maintenance Guide* for details on how to determine the appropriate firmware levels, and how to identify ESM firmware levels in the Subsystem Management window.

IBM recommends that you install EXP100 ESM firmware version 956x or later.

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.

The DS4000 Storage Manager client provides the best way to diagnose and repair storage-subsystem 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 fault LEDs, these lights do not necessarily indicate which component has failed or needs to be replaced, or which type of recovery procedure you must perform. In some cases (such as loss of redundancy in various components), the fault 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 fault 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-subsystem failure might require you to perform procedures other than replacing the component (such as backing up the logical drive or failing a drive before removing it). The DS4000 Storage Manager client gives these procedures.

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

Checking the LEDs

The LEDs display the status of the storage subsystem and components. Green LEDs indicate a normal operating status; amber LEDs indicate a possible failure.

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 subsystem to determine if the drives are responding to I/O transmissions from the host.

For information about the LEDs on the front of the storage subsystem, see:

- Figure 56
- Table 8

For information about the LEDs on the back of the storage subsystem, see:

- Figure 58 on page 80
- Table 9 on page 78
- Table 10 on page 80

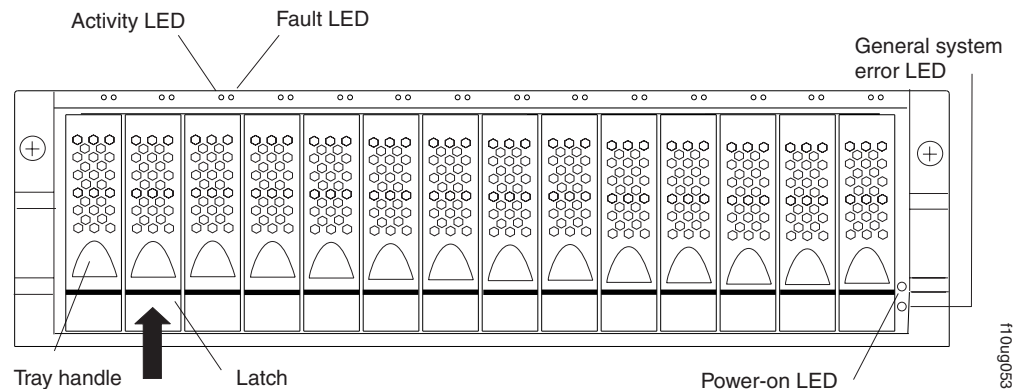


Figure 56. Storage subsystem LEDs (front)

Table 8. Storage subsystem LEDs (front)

LED	Color	Operating states ¹
Drive active	Green	<ul style="list-style-type: none"> • On - Normal operation. • Flashing - The drive is reading or writing data. • Flashing every 5 seconds - The drive has not spun up or the drive is bad. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The storage subsystem has no power. – The drive is not properly seated in the storage subsystem.
Drive fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • Flashing - The DS4000 Storage Manager client is locating a drive, logical drive, or storage subsystem. • On - The drive has failed, or a user failed the drive.

Table 8. Storage subsystem LEDs (front) (continued)

LED	Color	Operating states ¹
Power	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The storage subsystem has no power. – Both power supplies have failed. – There is an over-temperature condition.
General system error	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - A storage subsystem component has failed².

¹ Always use the DS4000 Storage Manager client to identify the failure.

² Not all component failures turn on this LED. For more information, see “Monitoring status through software” on page 76.

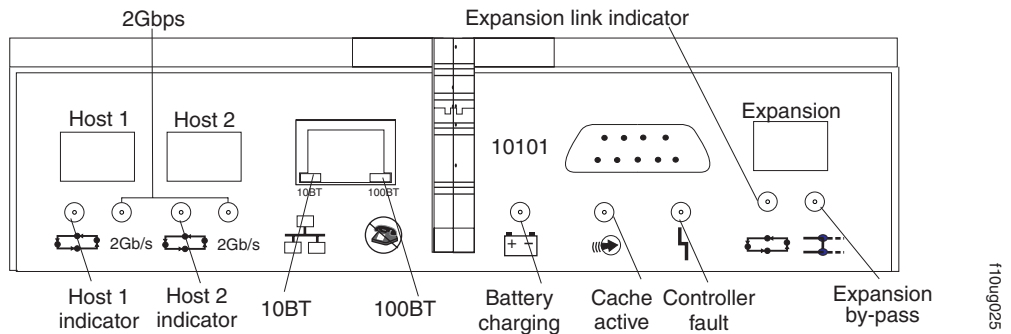






Figure 57. RAID controller LEDs

Table 9. RAID controller LEDs

Icon	LED	Color	Operating states ¹
	Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - One of the following situations has occurred: <ul style="list-style-type: none"> – The RAID controller has failed. – The RAID controller was placed offline. – The controller battery had failed (in conjunction with the battery LED in off state).
	Host loop	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The host loop is down, not turned on, or not connected. – A SFP has failed, or the host port is not occupied. – The RAID controller circuitry has failed, or the RAID controller has no power.

Table 9. RAID controller LEDs (continued)

Icon	LED	Color	Operating states ¹
	Cache active	Green	<ul style="list-style-type: none"> • On - There is data in the RAID controller cache. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – There is no data in cache. – There are no cache options selected for this array. – The cache memory has failed, or the battery has failed.
	Battery	Green	<ul style="list-style-type: none"> • On - Normal operation. • Flashing - The battery is recharging or performing a self-test. • Off - The battery or battery charger has failed.
	Expansion port bypass	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - One of the following situations has occurred: <ul style="list-style-type: none"> – An SFP module is inserted in the drive loop port and the fibre-channel cable is not attached to it. – The fibre-channel cable is not attached to a storage expansion enclosure. – The attached storage expansion enclosure is not turned on. – An SFP has failed, a fibre-channel cable has failed, or an SFP has failed on the attached storage expansion enclosure.
	Expansion loop	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - The RAID controller circuitry has failed, or the RAID controller has no power.
2Gbps	Fibre channel port speed	Green	<ul style="list-style-type: none"> • On - Normal operation (host connection is at 2 Gbps) • Off - Host connection is at 1 Gbps
10BT	10BT	Green	<ul style="list-style-type: none"> • If the Ethernet connection is 10BASE-T: The 10BT LED is on, 100BT LED flashes faintly. • If the Ethernet connection is 100BASE-T: 10BT LED is off, 100BT LED is on. • If there is no Ethernet connection - Both LEDs are off.
100BT	100BT		

¹ Always use the DS4000 Storage Manager client to identify the failure.

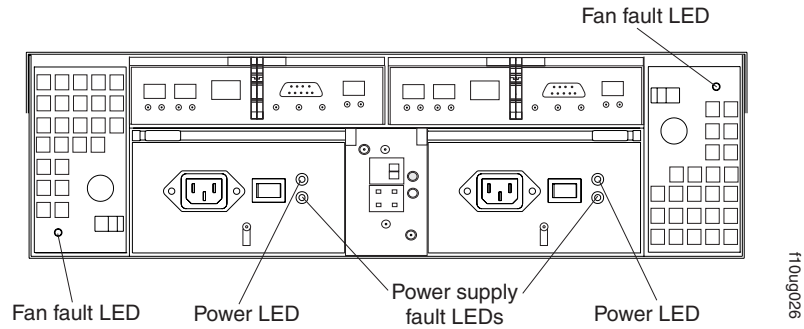


Figure 58. Fan and power supply LEDs

Table 10. Fan LED

LED	Color	Operating states ¹
Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - The fan CRU has failed.

¹ Always use the DS4000 Storage Manager client to identify the failure.

Table 11. Power supply LEDs

LED	Color	Operating states ¹
Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation. • On - One of the following situations has occurred: <ul style="list-style-type: none"> – The power supply has failed. – An over-temperature condition has occurred.
Power	Green	<ul style="list-style-type: none"> • On - Normal operation. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The power supply is disconnected. – The power supply is seated incorrectly. – The storage subsystem has no power. – The power supply is turned off.

¹ Always use the DS4000 Storage Manager client to identify the failure.

Cache memory and RAID controller battery

Each RAID controller in the DS4100 contains 128 MB of cache data. Each controller also contains a rechargeable battery that maintains data in the cache in the event of a power failure. The following sections describe these features and their associated LEDs.

Cache memory

Cache memory is memory on the RAID controller that is used for intermediate storage of read and write data on the DS4100 base storage subsystem 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.

Note: In the DS4100 single-controller storage subsystem, the RAID controller cache memory is used for storing read data only. The controller firmware ignores a write-cache enabled setting. This protects data in the event of a controller failure, which would cause the cache to be inaccessible.

See the DS4000 Storage Manager client documentation for information on setting cache memory options.

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 that the cache memory has failed or the battery has failed (the green Battery LED will be off).

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

Figure 59 shows the location of the Cache active LED on the front of the RAID controller.

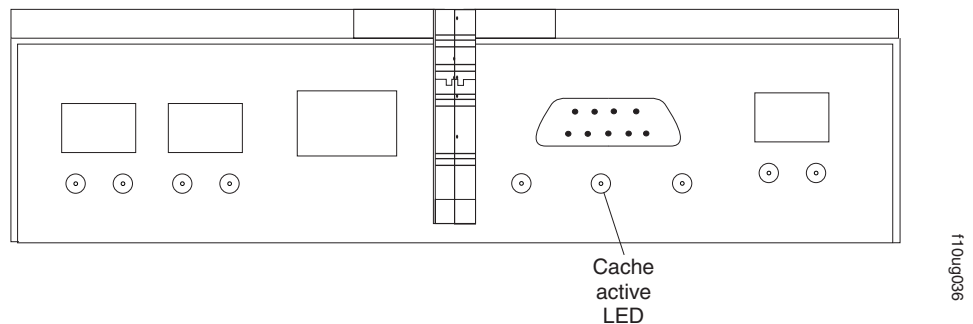


Figure 59. Cache active LED

RAID controller cache battery

Each RAID controller contains a sealed, rechargeable 4-volt lead-acid battery. This battery provides cache backup for up to three days in the event of a power loss.

The service life of the battery is three years, after which time the battery must be replaced. See the DS4000 Storage Manager client for information on how to view and set the battery expiration date.

Each RAID controller has a green Battery LED on the back that indicates the battery status, 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 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.

Figure 60 shows the location of the Battery LED on the front of the RAID controller.

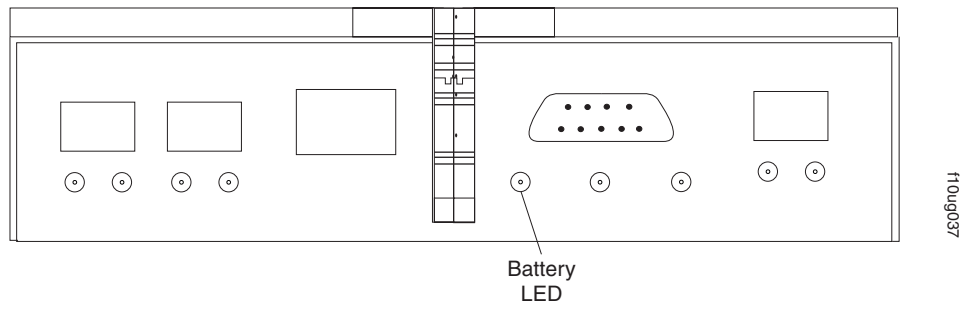


Figure 60. Battery LED

Chapter 5. Installing and replacing components

This chapter provides instructions to help you install or remove customer replaceable units (CRUs), such as hot-swap drives, fans, RAID controllers, and power supplies. This chapter also provides instructions to help you add new DS4000 EXP100 storage expansion enclosures to an existing DS4100 configuration.

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.

Working with hot-swap hard disk drives

Drives are devices that the system uses to store and retrieve data. This section explains how you can increase the storage-server capacity by adding more drives or replacing existing drives with ones containing a larger capacity.

Before you begin, complete the following tasks:

- Read the safety and handling guidelines in “Safety” on page iii and in “Handling static-sensitive devices” on page 20.
- Ensure that your current system configuration is working properly.
- Back up all important data before you make changes to data storage devices.

Attention

1. Check the disk drive options and CRUs for any instructions for controller firmware and ESM firmware requirements. For example, the following firmware levels are required if you are installing the 400 GB option or the new 250 GB drive CRU:

- DS4000 controller firmware 06.12.15.xx or later
- EXP100 ESM firmware 956x or later

Important: If you are installing the new 250 GB SATA drive CRU/FRU (P/N 40K6837) or the 400 GB SATA drive CRU, read the information in “Notes for installing the 400 SATA drive option or the new 250 GB SATA drive CRU/FRU (P/N 40K6837)” on page 85 before you perform this procedure.

2. Never hot-swap a drive CRU when its green Activity LED is flashing. Hot-swap a drive CRU only when its amber Fault LED is completely on and not flashing or when the drive is inactive with the green Activity LED on and not flashing.
3. After you remove a drive CRU, wait at least 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.
4. For protection against drive failure, IBM recommends that you assign at least one drive in each enclosure as a global hot-spare drive.

Before you install or remove drive CRUs, review the following information:

- **Blank trays:** A storage subsystem without a full set of drives (14) contains blank trays in the unused drive bays. Before installing new drives, you must remove these empty trays. Save the empty trays for future use. Each of the 14 bays must always contain either a blank tray or a hot-swap hard disk drive.

Note: For proper cooling and EMC protection, do not leave a drive slot open without either a blank tray or a hard disk drive CRU inserted.

- **Drive CRUs:** The DS4100 supports up to fourteen IBM 1.5 Gbps SATA hard disk drives.

Note: Do not use fibre-channel hard disk drive CRUs in the DS4100.

These drives come preinstalled in drive trays. This drive-and-tray assembly is called a *drive CRU*. You can install the drive CRUs in the 14 drive bays on the front of the storage subsystem.

- **Drive CRU labels:** A label is provided on the front of each hard disk drive. Use this label to record the location information for each drive before you remove it. Ensure that you keep track of the drives and their corresponding bays. Also, record the location information in Table 15 on page 127. If you install a drive in the wrong bay, you might lose data.
- **Drive LEDs:** Each drive tray has two associated LEDs, a green Activity LED and an amber Fault LED, on the chassis of the DS4100. These LEDs indicate the status for that drive. See Table 12 on page 85 for the drive LED states and descriptions.

Table 12. Drive LED activity

LED	LED state	Descriptions
Activity LED	Flashing green	The green LED flashes to indicate fibre-channel activity to the drive.
Activity LED	Steady green	The green LED lights to indicate that the drive is properly installed and is spun up by the DS4000 controller.
Fault LED	Flashing amber	The amber LED flashes to indicate that a drive has been identified by the software.
Fault LED	Steady amber	The amber LED lights to indicate a drive failure.
Activity and Fault LEDs	All unlit	The storage subsystem is powered off.

- **Fibre-channel loop IDs:** When you install a drive CRU in the storage subsystem, the drive CRU connects into a printed circuit board called the *midplane*. The midplane automatically sets the fibre-channel loop ID to the default value 00.
- **Hot-swap hardware:** The storage subsystem contains hardware that you can use to replace a failed hard disk drive without turning off the storage subsystem. Therefore, you can continue operating the system while a hard disk drive is removed or installed. These drives are known as *hot-swap* drives.

Notes for installing the 400 SATA drive option or the new 250 GB SATA drive CRU/FRU (P/N 40K6837)

The 250 GB SATA CRU P/N 90P1349 is being replaced by CRU P/N 40K6837, which requires a certain minimum level of the DS4100 storage subsystem controller firmware and the EXP100 drive expansion enclosure ESM firmware. The 400 GB SATA drive requires the same firmware levels as the new 250 GB SATA drive CRU/FRU.

Prior to installing the hard drive in your DS4100 configuration, your DS4100 storage subsystem firmware must be at the required versions. If a firmware upgrade is required to install the new drive CRU/FRU, complete one of the following actions according to the state of your DS4000 storage subsystem:

1. **DS4000 storage subsystem in Optimal state:** Upgrade to the latest firmware version that is required to maintain this minimum level for your DS4000 storage subsystem. To download the latest firmware, go to the IBM DS4000 TotalStorage Support Web site, and then click on the appropriate link for each of your DS4000 storage subsystems:

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

2. **DS4000 storage subsystem in Needs Attention state:** Contact your IBM support representative for additional instructions.

Important: If you are installing P/N 90P1349, IBM recommends that you update immediately to the latest levels of firmware that support the new 250GB SATA CRU (P/N 40K6837). If upgrading firmware after installing the 250 GB CRU P/N 90P1349, upgrade to the latest firmware version required to maintain this minimum level for your DS4000 storage subsystem. To download the latest firmware, go to the IBM DS4000 TotalStorage support Web site.

Installing hot-swap hard disk drives

You can install hard disk drives while the storage subsystem is turned on and running.

Important: If you are installing the new 250 GB SATA drive CRU/FRU (P/N 40K6837) or the 400 GB SATA drive CRU, read the information in “Notes for installing the 400 SATA drive option or the new 250 GB SATA drive CRU/FRU (P/N 40K6837)” on page 85 before you perform this procedure.

Complete the following steps to install hot-swap hard disk drives in the storage subsystem:

1. Read the documentation that comes with the hard disk drive.
2. Check for Fault LEDs shown in Figure 61. If any amber LEDs are lit, see Chapter 6, “Hardware maintenance,” on page 119.

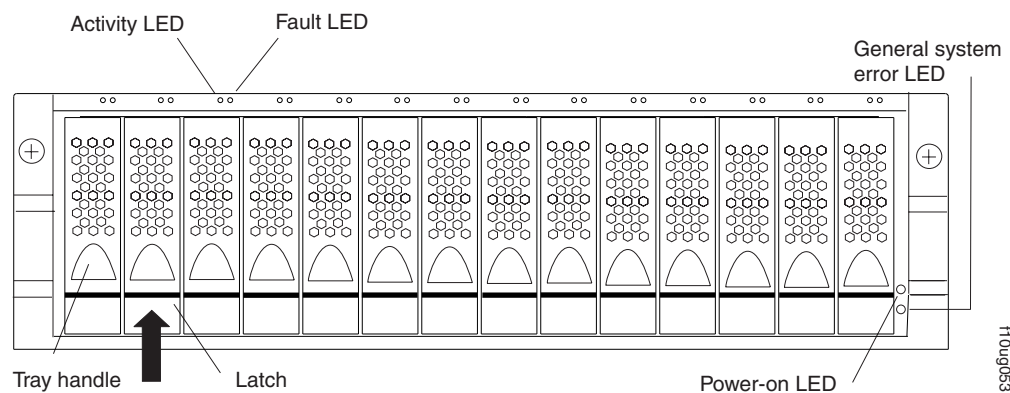


Figure 61. Hot-swap hard disk drive LEDs

3. Determine the bay into which you want to install the drive.
4. Remove the blank tray:

Note: To locate blank drives, look at the Activity LEDs on the front of the storage system. An active drive will have a green light on or flashing. A blank drive will not have any active lights.

- a. Release the latch on the drive CRU by pinching together the blue line on the tray latch and the finger hole on the tray handle, as shown by the arrow in Figure 61.
 - b. Pull the handle on the tray out so that it is in the open position to release the drive CRU, and then pull the blank tray out of the bay.
 - c. Save the blank tray for later use.
5. Install the hard disk drive:

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

- a. Release the latch on the drive CRU by pinching together the blue line on the tray latch and the finger hole on the tray handle.
- b. Pull the handle on the tray out so that it is in the open position, as shown in Figure 62 on page 87.

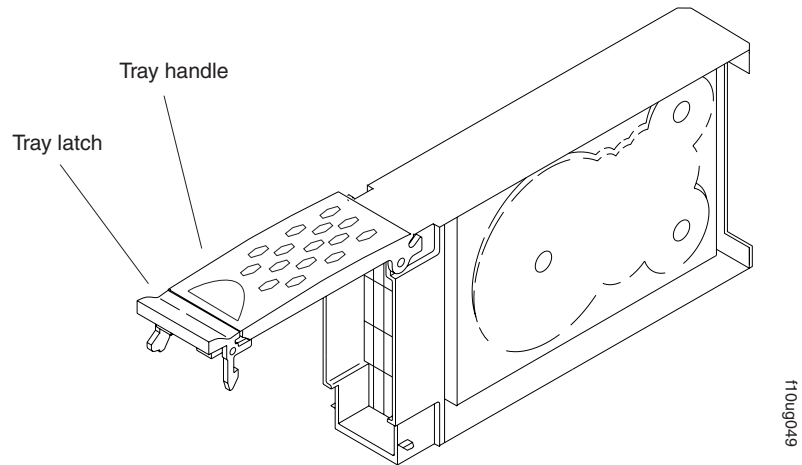


Figure 62. Drive CRU handle

- c. Slide the drive CRU into the empty bay until the hinge of the tray handle latches beneath the storage subsystem bezel.
- d. Push the tray handle down until it latches into place.

Recommendation: If you are installing more than two drives, IBM recommends that you install the drives two at a time, as follows: Insert two drives, wait five to eight minutes until the drives are recognized and displayed in the Storage Manager Subsystem Management window, and then insert the next two drives.

Replacing hot-swap hard disk drives

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

Note: If you want to remove a hard disk drive that is not in a failed or bypass state, always use the DS4000 Storage Manager client program either to place the drive in a failed state or to place the array that is associated with the drive (or drives) in an offline state before you remove the drive from the enclosure.

Attention

1. Before you insert the new SATA drive option or drive CRU/FRU into the DS4100 configuration, you must ensure that the installed DS4100 controller and EXP100 ESM have the minimum controller and ESM firmware versions that are required for the new SATA drive. Always check the documentation that is included with the new drive to find out the minimum controller and ESM firmware versions, or any prerequisite tasks, for the DS4000 controller and EXP100 ESM.
2. Failure to replace the hard disk drives in their correct bays might result in loss of data. If you are replacing a hard disk drive that is part of a configured array and logical drive, ensure that you install the replacement hard disk drive in the correct bay. Check the hardware and software documentation that is provided with your DS4000 storage subsystem to see if there are restrictions regarding hard disk drive configurations.

If you are replacing a drive with the new 250 GB SATA drive CRU/FRU (P/N 40K6837), read the information in “Notes for installing the 400 SATA drive option or the new 250 GB SATA drive CRU/FRU (P/N 40K6837)” on page 85 before you perform this procedure.

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

1. Determine the location of the drive that you want to remove.

Attention: Never hot-swap a drive CRU when its green Activity LED is flashing. Hot-swap a drive CRU only when its amber Fault LED is on and not flashing or when the drive is inactive with the green Activity LED on and not flashing.

If the drive is not in a failed state (as indicated by its lit amber LED), manually fail the drive using the Storage Management client before attempting to remove it from the drive slot.

2. Remove the drive CRU:
 - a. Release the latch on the drive CRU by pinching together the blue line on the tray latch and the finger hole on the tray handle, as shown by the arrow in Figure 62 on page 87.
 - b. Pull the tray handle out into the open position.
 - c. Lift the drive CRU partially out of the bay.
 - d. To avoid possible damage to the drive, wait at least 70 seconds before fully removing the drive CRU from the storage subsystem to allow the drive to stop (spin down).
 - e. Verify that there is proper identification (such as a label) on the drive CRU, and then slide it completely out of the storage subsystem.
3. Install the new drive CRU:
 - a. Gently push the drive CRU into the empty bay until the hinge of the tray handle latches beneath the storage subsystem bezel.
 - b. Push the tray handle down into the closed (latched) position.
4. Check the drive LEDs:
 - When a drive is ready for use, the green Activity LED is either on continuously or rapidly flashing, and the amber Fault LED is off.

- If the amber Fault LED lights and is not flashing, remove the drive from the unit and wait 10 seconds; then, install the drive again.
5. If the drive is part of a defined RAID array, the array reconstruction (without hot-spare) or copy-back (with hot-spare) operation automatically starts.
 6. Use the DS4000 Storage Manager software GUI to verify that the drive is shown in the Subsystem Management window.

Upgrading drives

You can upgrade drives in the following two ways:

- By adding drives to empty slots in the storage subsystem (see “Installing hot-swap hard disk drives” on page 86)
- By replacing existing drives with larger capacity drives

Adding larger-capacity drives

This section provides guidelines for upgrading the drives in the storage subsystem. Read the software documentation and this entire section to determine if you should use this procedure, use a modified version of this procedure, or use a different procedure that is provided by your operating system. *Instructions that are provided with your software should supersede anything stated in this document.*

Attention

1. Before you insert the new SATA drive option or drive CRU/FRU into the DS4100 configuration, you must ensure that the installed DS4100 controller and EXP100 ESM have the minimum controller and ESM firmware versions that are required for the new SATA drive. Always check the documentation that is included with the new drive to find out the minimum controller and ESM firmware versions, or any prerequisite tasks, for the DS4000 controller and EXP100 ESM.
2. Failure to replace the hard disk drives in their correct bays might result in loss of data. If you are replacing a hard disk drive that is part of a configured array and logical drive, ensure that you install the replacement hard disk drive in the correct bay. Check the hardware and software documentation that is provided with your DS4000 storage subsystem to see if there are restrictions regarding hard disk drive configurations.

There are two methods for upgrading drives:

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

This method requires that you back up the data on the affected drives and then turn off the storage subsystem. After replacing all the drives, you must reconfigure the new drives and restore data from backup. See the procedure in “Replacing all drives at the same time” on page 90.

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

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

In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before installing the next drive. After you install the

new drives, you can configure them to make the additional drive space available. See the procedure in “Replacing the drives one at a time” on page 92.

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

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

The method you use depends on the following considerations:

- Which method most closely matches the recommended drive upgrade procedure that is provided in the operating system or the DS4000 Storage Manager client documentation
- Which RAID level is used on the affected drives (RAID 0 requires you to replace all the drives at the same time)
- How much downtime is acceptable as you swap the drives
- How acceptable is the risk of the entire array failing because another drive that is part of the array has failed during the reconstruction process
- The number of drives in an array. Replacing drives one at a time is better suited for arrays consisting of 3 to 5 drives. If you have more than 10 drives, consider replacing all drives at the same time.

Replacing all drives at the same time

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

Attention

1. Before you insert the new SATA drive option or drive CRU/FRU into the DS4100 configuration, you must ensure that the installed DS4100 controller and EXP100 ESM have the minimum controller and ESM firmware versions that are required for the new SATA drive. Always check the documentation that is included with the new drive to find out the minimum controller and ESM firmware versions, or any prerequisite tasks, for the DS4000 controller and EXP100 ESM.
2. Failure to replace the hard disk drives in their correct bays might result in loss of data. If you are replacing a hard disk drive that is part of a configured array and logical drive, ensure that you install the replacement hard disk drive in the correct bay. Check the hardware and software documentation that is provided with your DS4000 storage subsystem to see if there are restrictions regarding hard disk drive configurations.

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

1. Read the following information:

- The information in “Adding larger-capacity drives” on page 89, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
- The information in your software documentation regarding drive upgrades and installation
- The documentation that comes with the new drives

Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.

2. Use the DS4000 Storage Manager client to check the status of the storage subsystem. Correct any problems that are reported.
3. Use the DS4000 Storage Manager software to ensure that the installed DS4100 controller and EXP100 ESM(s) have the minimum controller and ESM firmware versions that are required for the new SATA drive. Always check the documentation that is included with the new drive to find out the minimum controller and ESM firmware versions, or any prerequisite tasks, for DS4000 controller and EXP100 ESM.
4. Perform a complete backup of the drives that you are replacing.

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

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 83.

5. Put on the antistatic strap and unpack the new drives.

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

6. Perform the following steps:

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

- 1) All of the green Drive activity LEDs on the front of the storage subsystem (and on all attached storage expansion enclosures) are not flashing.
- 2) The green Cache active LEDs are off on the front of the RAID controllers.

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

Attention: To turn off all power to the storage subsystem, you must turn off both power-supply switches and disconnect both power cords. Use the procedure in step 7 for the proper shutdown sequence.

7. Turn off the power to each device based on the following shutdown sequence:
 - a. Turn off power to the host before you turn off power to the storage subsystem. If the host must stay powered on to support an existing network, see the operating system documentation for information about disconnecting the storage subsystem logical drives from the host before the storage subsystem is powered off.
 - b. Turn off power to the storage subsystem before you turn off power to the storage expansion enclosures. Turn off both power supply switches on the back of the storage subsystem.

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

Notes:

- 1) You do not need to perform this step if you are servicing only the storage subsystem.
 - 2) 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.
8. Use the procedures in 5 on page 26 to remove the drives that you want to replace. Use the procedures in “Installing hot-swap hard disk drives” on page 86 to install the new drives into the storage subsystem.
 9. After you install all the new drives, check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:
 - a. Turn on the power to the supporting devices (for example, Ethernet switches and management stations) before you turn off power to the storage subsystem.
 - b. You must turn on the storage expansion enclosures before the storage subsystem. The controllers might not recognize the correct configuration if the drives are powered up after the storage subsystem. For instructions on powering up the storage expansion enclosures, see the storage expansion enclosure documentation.
 - c. Turn on the power to the storage subsystem; then restart or turn on the power to the host.
 10. Turn on the power to each device, based on the power-on sequence in step 9. To turn on power to the storage subsystem, turn on the power-supply switches on the back of the storage subsystem. You must turn on both power-supply switches to take advantage of the redundant power supplies.
 11. Check the green Drive activity LED and the amber Drive fault LED below the new drive CRUs.

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

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

- If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait at least 70 seconds, and then reinstall it.
 - If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the DS4000 Storage Manager client online Help for problem determination.
12. Use the DS4000 Storage Manager client to configure the new drives. See the DS4000 Storage Manager client online Help for detailed instructions.
 13. Restore the data from backup to all the drives.

Replacing the drives one at a time

Use this procedure to replace all the drives one at a time. You cannot use this procedure on RAID 0 logical drives (use the procedure in “Replacing all drives at the same time” on page 90).

Note: If your storage subsystem has hot spares assigned, you might want to unassign the hot spares while you perform this procedure. If you do not, reconstruction might start on the hot spare before you insert the new drive.

The data on the new drive is still rebuilt, but the process takes longer for each drive. Remember to reassign the hot spares when you are finished with this procedure.

Attention

1. Before you insert the new SATA drive option or drive CRU/FRU into the DS4100 configuration, you must ensure that the installed DS4100 controller and EXP100 ESM have the minimum controller and ESM firmware versions that are required for the new SATA drive. Always check the documentation that is included with the new drive to find out the minimum controller and ESM firmware versions, or any prerequisite tasks, for the DS4000 controller and EXP100 ESM.
2. Failure to replace the hard disk drives in their correct bays might result in loss of data. If you are replacing a hard disk drive that is part of a configured array and logical drive, ensure that you install the replacement hard disk drive in the correct bay. Check the hardware and software documentation that is provided with your DS4000 storage subsystem to see if there are restrictions regarding hard disk drive configurations.

To replace the drives one at a time, perform the following steps:

1. Read the following information:
 - “Adding larger-capacity drives” on page 89, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
 - Your software documentation regarding drive upgrades and installation
 - The documentation that comes with the new drivesRead all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.
2. Use the DS4000 Storage Manager client to check the status of the unit. Correct any problems that are reported.
3. Use the DS4000 Storage Manager software to ensure that the installed DS4100 controller and EXP100 ESM(s) have the minimum controller and ESM firmware versions that are required for the new SATA drive. Always check the documentation that is included with the new drive to find out the minimum controller and ESM firmware versions, or any prerequisite tasks, for DS4100 controller and EXP100 ESM.
4. Back up the data on the drives that you are replacing.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 83.
5. Put on the antistatic strap and unpack the new drives.

Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the drives.
6. Use the storage management software to ensure that the array that was defined using these drives is in optimal (not degraded) state before manually failing the first drive you want to replace. If the array is in degraded state, use the recovery procedures to bring the array into the optimal state.

Make sure that:

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

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

If you remove an active drive accidentally, wait at least 70 seconds for the drive to properly spin down and then reinstall it.

Because you failed two drives in a RAID array, the array might be marked failed by the controller. This array will not be available to the host for I/O. See the DS4000 Storage Manager client for further recovery instructions. Do not attempt to replace any drives until the array is brought back to optimal state. Call IBM support for help if you are unable to get the array back online.

7. Use the procedures in 5 on page 26 to remove the failed drive. Use the procedures in “Installing hot-swap hard disk drives” on page 86 to install the new drives into the storage subsystem.

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

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

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

8. Check the green Drive activity LED and the amber Drive fault LED below the new drive CRUs.

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

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

- If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait at least 70 seconds for the drive to properly spin down, and then reinstall it.
- If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the DS4000 Storage Manager client for problem determination.

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

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

10. When reconstruction is finished on the new drive, repeat step 6 on page 93 through step 9 for each additional drive that you want to install.
11. Use the DS4000 Storage Manager client to configure the additional space on the new drives.

Working with hot-swap cooling fans

The storage subsystem cooling system consists of two fan CRUs, each containing two fans. The fan CRUs circulate air inside the unit by pulling in air through the vents on the front of the drive CRUs and pushing out air through the vents in the back of each fan CRU. See Figure 63.

If two fans fail, or the fans cannot maintain an internal temperature below 70° C (158° F), the power supplies 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 over-temperature shutdown” on page 74.

Attention: The fans in the storage subsystem draw in fresh air and force out hot air. These fans are hot-swappable and redundant; however, when one fan fails, you must replace the fan CRU within 48 hours to maintain redundancy and optimum cooling. When you replace the failed fan CRU, be sure to install the second fan CRU within 10 minutes to prevent any overheating due to the lack of the additional fan CRU.

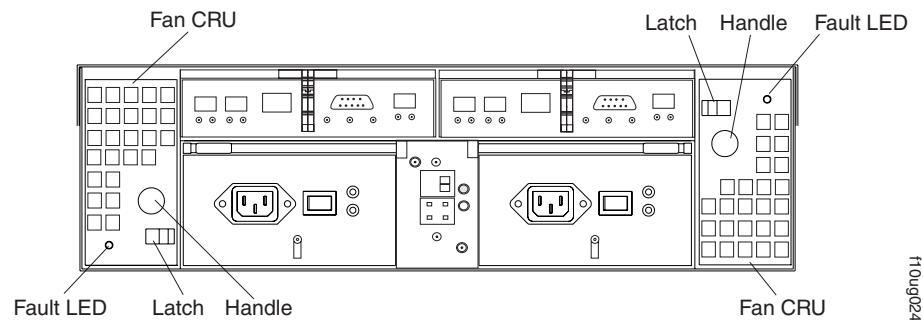


Figure 63. Fan locations

Fan CRUs

The two fan CRUs are hot-swappable and redundant.

Fault LEDs

These amber LEDs light when a fan failure occurs.

Latches and handles

Use the latches and handles to remove or install the fan CRUs.

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

Both fan units must always be in place, even if one is not functioning properly, to maintain proper cooling.

Use the following procedure to replace a hot-swap fan:

1. Check the LEDs on the back of the storage subsystem.
2. If the amber Fault LED is on, remove the fan CRU that has failed.
 - a. Slide the latch to unlock the fan CRU.
 - b. Use the handle (black knob) to pull the fan from the storage subsystem. See Figure 64 on page 96.

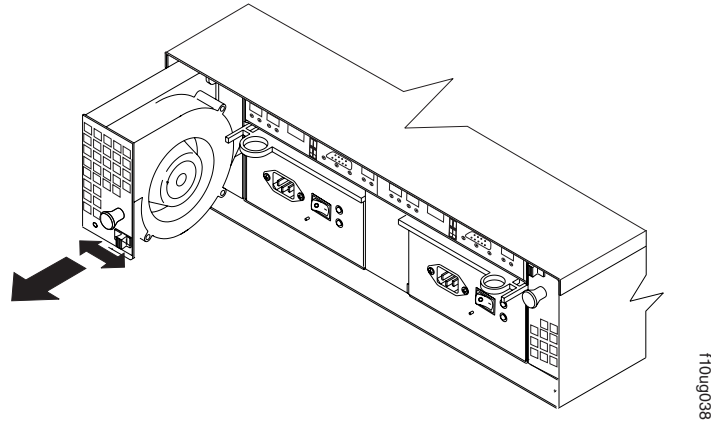


Figure 64. Removing a fan

3. Install the new fan unit.
 - a. Place the fan CRU in front of the fan slot.
 - b. Hold the latch open, and slide the fan all the way into the slot. If the fan does not go into the bay, rotate it 180°. Ensure that the latch is on the side closest to the center of the storage subsystem.
 - c. Release the latch. If the lever remains open, pull back on the fan slightly, and then push it in again until the latch snaps into place.
4. Check the LEDs.

The Fault LEDs turn off after a few seconds. If they remain on, see Chapter 6, “Hardware maintenance,” on page 119.

Working with power supplies

The power supply CRUs provide power to the internal components by converting incoming ac voltage to dc voltage. The DS4100 base storage subsystem power system operates with two power supply CRUs that can be hot-swapped. In the DS4100 base storage subsystem, one power supply CRU can maintain electrical power to the unit if the other power supply is turned off or malfunctions. The power supply CRUs are interchangeable (by reversing the locking levers).

The DS4100 single-controller storage subsystem has only one power supply CRU. You cannot remove or replace a working (non-failed) power supply in the DS4100 single-controller storage subsystem without first powering down the storage subsystem. Before you replace the power supply in the DS4100 single-controller storage subsystem, all I/O activity must be stopped and the storage subsystem must be powered down. Go to “Turning off the storage subsystem” on page 71 and follow the procedure described there before replacing the power supply on a DS4100 single-controller storage subsystem.

Each power supply CRU 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. All power remains off until you cycle the power switches (turn the power switches off, wait at least 30 seconds, then turn the power switches on). For more information,

see “Restoring power after an unexpected shutdown” on page 73 and “Restoring power after an over-temperature shutdown” on page 74.

The power supplies are customer replaceable units (CRUs) and do not require preventive maintenance.

- Always keep the power supplies in their proper places to maintain proper controller-unit cooling.
- Use only the supported power supplies for your specific storage subsystem.

The power-supply controls on the rear of the storage subsystem are shown in Figure 65.

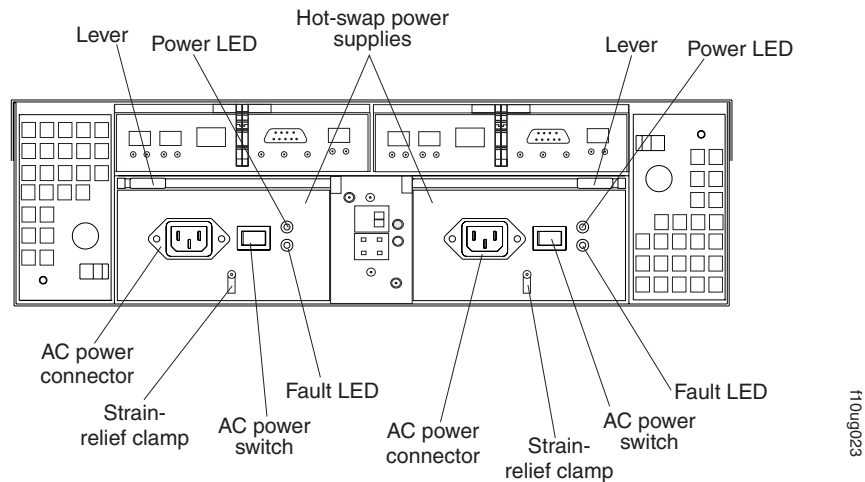


Figure 65. Power supply controls

Levers

Use these locking handles to remove or install a power supply.

Power LED

These green LEDs light when the storage subsystem is turned on and receiving ac power.

Fault LEDs

These amber LEDs light if a power supply failure occurs or if the power supply is turned off.

AC power switches

Use these switches to turn the power supplies on and off. You must turn on both switches to take advantage of the redundant power supplies.

AC power connectors

This connection is for the ac power cord.

Strain-relief clamp

Use this clamp to provide strain relief on the power cord. Secure the clamp tightly with the power-supply clamp-nut.

Removing a power supply

Statement 8:



CAUTION:

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



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

To remove a hot-swap power supply, perform the following steps:

1. DS4100 single-controller storage subsystem only:

If you are replacing a working (non-failed) power supply on a DS4100 single-controller storage subsystem, you must stop all I/O activity and turn off power to the storage subsystem before replacing the power supply. Go to “Turning off the storage subsystem” on page 71 and follow the procedure described there before proceeding with the following steps.

If you are replacing a failed power supply on a DS4100 single-controller storage subsystem, you do not need to power down the storage subsystem before replacing the failed power supply.

2. Turn off the ac power switch. See Figure 66.

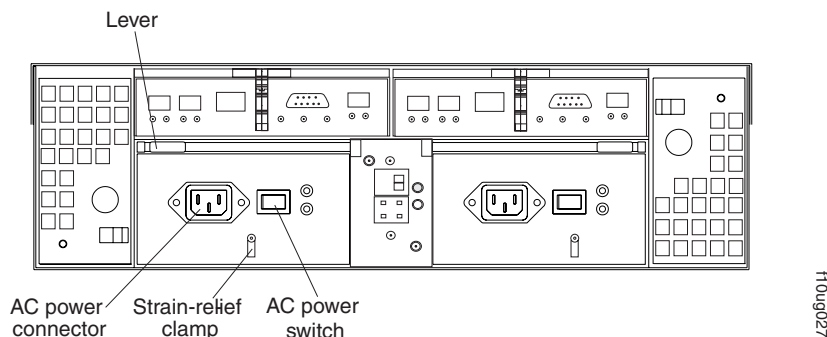


Figure 66. Lever for power supply removal

3. Unplug the power cord from the electrical outlet.
4. Disconnect the power cord from the ac power connector on the power supply.
5. Remove the power-supply nut and power-supply cable strain-relief clamp from the rear of the power supply.
6. Remove the power supply from the storage subsystem, as follows:
 - a. Grasp the pull-ring on the power-supply lever and squeeze the latch to release it.
 - b. Pull the lever open and remove the power supply.

Installing a power supply

Note: When you replace a power supply that has failed, ensure that the power supply latch is mounted on the side of the power supply that faces the middle of the storage subsystem. If it is not, remove the lever screw, flip the lever over, and tighten the screw on the opposite side.

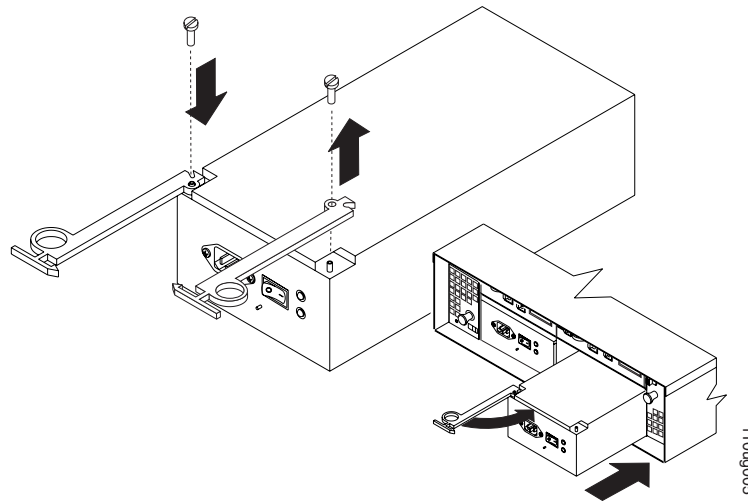


Figure 67. Installing a hot-swap power supply

To install a hot-swap power supply, perform the following steps:

Statement 8:



CAUTION:

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



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

1. Ensure that the ac power switch is off on the power supply that you are installing.
2. Install the power supply in the storage subsystem, as follows:
 - a. Slide the power supply into the storage subsystem. Make sure that the lever is pulled straight out as you slide the power supply into the storage subsystem.

- b. Close the lever until the pull-ring latch locks in place. Make sure that the lever locks into place in the storage-server chassis.
3. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power-supply connection end. Leave some slack between the clamp and the power-supply end of the power cord.
4. Replace the power-supply nut and tighten it securely to secure the clamp to the power supply unit.
5. Connect the power cord to the AC power connector. See Figure 68.

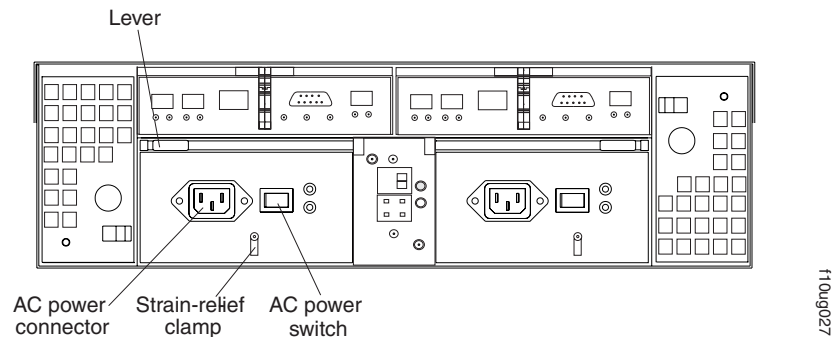


Figure 68. Connecting the power cord to the AC power connector

6. Plug the power cord into a properly grounded electrical outlet.
7. Turn on the power-supply switch.
8. **DS4100 single-controller storage subsystem only:** If you have replaced a working (non-failed) power supply on a DS4100 single-controller storage subsystem, turn on power to the storage subsystem. Go to “Turning on the storage subsystem” on page 70 and follow the procedure described there before proceeding with the following step.
9. Make sure that the green Power LED on the new power-supply CRU is on and the amber Fault LED is off.
 - If the Power LED is off, the power-supply CRU might not be installed correctly. Remove it and then reinstall it.
 - If the Fault LED is on or the Power LED stays off, test the power source to verify that the outlet is working properly.

For more information about the LEDs, see “Checking the LEDs” on page 77.

Working with RAID controllers

The DS4100 base storage subsystem operates with two RAID controllers that can be hot-swapped.

The DS4100 single-controller storage subsystem has only one RAID controller. If you are replacing a failed RAID controller in the DS4100 single-controller storage subsystem, you do not need to power down the DS4100 before replacing the RAID controller.

If you are replacing a functioning (non-failed) RAID controller in the DS4100 single-controller storage subsystem, do not remove or replace the RAID controller in the DS4100 single-controller storage subsystem without first stopping the host applications, unmounting the logical drives from the host server, and powering down the storage subsystem.

Attention

1. Do not use this procedure to upgrade a DS4100 single-controller storage subsystem to a DS4100 dual-controller storage subsystem. Instead, use the instructions that are provided in the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. To purchase the upgrade kit, contact your IBM service representative.
2. Before you replace a RAID controller, verify that the replacement RAID controller part number match the part number of the RAID controller be replaced.

Each RAID controller fits into the back of the storage subsystem and has the following components:

- Battery
- Cache memory
- Two host ports and one expansion port

Note: The expansion port is inactive in the DS4100 single-controller storage subsystem.

- One Ethernet port
- One serial port

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing and installation dates on the top of the controller unit. Figure 69 on page 102 shows the location of these items.

Important: Please read the following information before replacing a RAID controller.

- *The cache battery is not included with the controller CRU.*
- To provide full functionality in a DS4100 base storage subsystem, the two controllers must have the same memory capacity. To ensure that you replace the failed controller with an appropriate replacement controller, verify that the FRU number of the replacement controller matches the FRU number of the failed controller. There are no protection mechanisms to block out an incorrect CRU from being inserted into DS4100 controller slots. Unpredictable results can occur when nonmatching controller CRUs are present in the same DS4100 chassis.
- After the new controller in a DS4100 single-controller storage subsystem completes the boot process, its WWNN will change. If you have any applications that rely on the previous WWNNs, such as fibre channel switch zoning definitions, you must update the applications with the new WWNNs.
- All factory-delivered DS4100 RAID controllers are shipped with a recent version of controller firmware loaded on the RAID controller, but that firmware version might not match precisely the firmware version of the failed RAID controller you have replaced. When you replace one of the RAID controllers in the DS4100 base storage subsystem, the newly replaced controller will automatically be updated with the controller firmware version of the existing controller in the DS4100 chassis.

However, when you replace the RAID controller in the DS4100 single-controller storage subsystem, if the firmware version of the replacement RAID controller is determined to be incompatible with the configuration database during the boot process, the DS4100 single-controller storage subsystem will enter a Stop State

and will not allow any DS4000 Storage Manager operations to be performed. In this case, you must manually upgrade or downgrade the replacement RAID controller firmware to match the version required by the configuration database. See “Manually upgrading the firmware for the DS4100 single-controller storage subsystem” on page 110.

- **DS4100 single-controller storage subsystem only:** Do not use the RAID controller replacement procedure in this section to upgrade a DS4100 single-controller storage subsystem to a DS4100 base (dual-controller) storage subsystem. Instead, use the instructions that are provided in the IBM TotalStorage DS4100 Storage Subsystem Single Controller-to-Dual Controller Upgrade Kit. To purchase the upgrade kit, contact your IBM service representative.

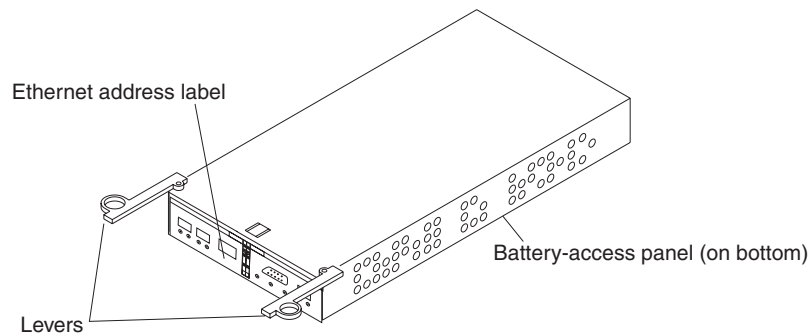


Figure 69. RAID controller levers and labels

In a DS4100 base storage subsystem, you can hot swap one controller while the other is still active. The figures in this procedure show the base storage subsystem. If your storage subsystem is the single-controller storage subsystem, controller slot B will have a blank controller rather than the second controller as shown in these figures.

For information about the RAID controller cache memory and rechargeable battery, see “Cache memory and RAID controller battery” on page 80.

Replacing a RAID controller

When instructed to do so by the DS4000 Storage Manager client, replace a RAID controller that has failed.

The procedure for replacing a failed controller is different for DS4100 single-controller and base (dual-controller) storage subsystems. If a controller in a DS4100 base storage subsystem fails, you can replace the failed controller without interrupting data processing. The system will automatically update the firmware for the new controller to match the configuration database.

If the controller in a DS4100 single-controller storage subsystem fails, you may need to manually update the firmware level to match the configuration database. If the firmware level of the new controller matches the configuration database, the storage subsystem will boot normally after you install the new controller. If the firmware level does not match the database, the storage subsystem will reach a stop state in the boot process, and you will need to manually update the firmware level to match the configuration database.

Attention: Because the replacement RAID controller has a different WWNN that the original RAID controller, you must perform the following tasks in order to bring the DS4100 single-controller storage subsystem to running (optimal) state after you replace the RAID controller.

- Reboot the host server that has mapped logical drives from the DS4100 single-controller storage subsystem.

Rebooting the host server enables the multipath failover to recognize the logical drives under the new WWNN. In addition, if your multipath driver uses the WWNN of the controller as part of the LUN identification, you may have to reconfigure the LUN failover/failback path information.

- Use DS4000 Storage Manager to rediscover the new RAID controller.

To rediscover the new RAID controller, remove the existing DS4100 single-controller storage subsystem entry in the management domain of the DS4000 Storage Manager client Enterprise Management Window (EMW), and then add the DS4100 single-controller storage subsystem back into the management domain using the in-band or out-of-band management method. See step 6 on page 111.

- Re-enable the premium feature keys.

After you replace the RAID controller in a DS4100 single-controller storage subsystem, all of the enabled premium feature keys are displayed as being out-of-compliance. Use the existing key files to re-enable the premium feature keys.

- If you create zones using the RAID controller WWNN, update your zoning definitions with the new WWNN for the replacement RAID controller.

Important

The replacement RAID controller CRU does not come with a RAID controller cache battery installed, nor does it come with the mounting hardware that holds the battery in place inside the RAID controller. You must remove the cache battery that is inside the existing RAID controller that you are replacing, and install that battery inside the replacement RAID controller CRU, using the battery unit mounting hardware taken from the existing controller. The steps to remove and replace the battery are included in the following procedure.

Note: Avoid operating the DS4100 with controllers of different cache sizes. Operating the storage subsystem with controllers of different cache size will disable caching and might adversely affect performance. Always verify that you replace a failed controller with a controller that has the same FRU part number.

To replace a RAID controller, perform the following steps:

1. DS4100 single-controller storage subsystem only:

The DS4100 single-controller storage subsystem has only one RAID controller. If you are replacing a failed RAID controller in the DS4100 single-controller storage subsystem, you do not need to power down the DS4100 before replacing the RAID controller.

If you are replacing a functioning (non-failed) RAID controller in the DS4100 single-controller storage subsystem, do not remove or replace the RAID controller in the DS4100 single-controller storage subsystem without first stopping the host applications, unmounting the logical drives from the host server, and powering down the storage subsystem.

2. Check the DS4000 Storage Manager client for instructions on RAID controller failure-recovery procedures. Follow the steps provided in the software documentation before continuing with the following step.
3. Label each cable that connects to the RAID controller that has failed. This ensures that all cables will be properly reconnected to the new RAID controller.

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.).
4. From the RAID controller that has failed, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 70.

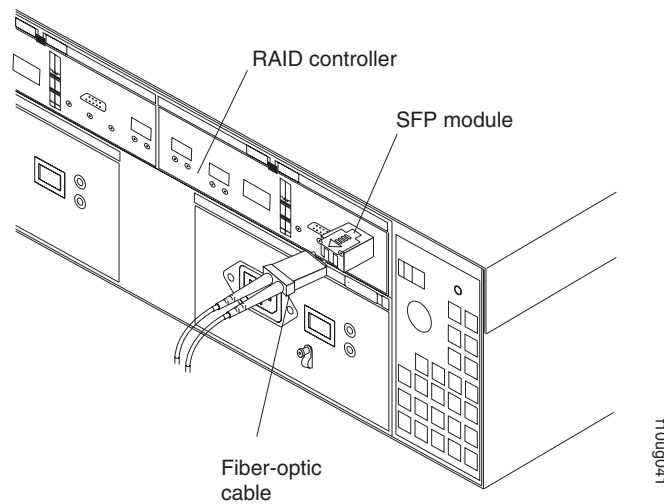


Figure 70. Location of SFPs and fiber-optic cables

After removing the fibre-channel cables, insert the protective caps.

5. 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 47.
 - 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 71 on page 105.

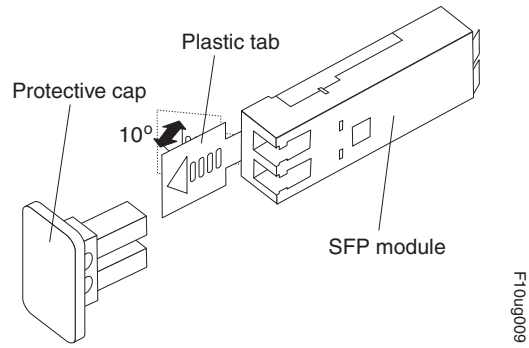


Figure 71. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 72.

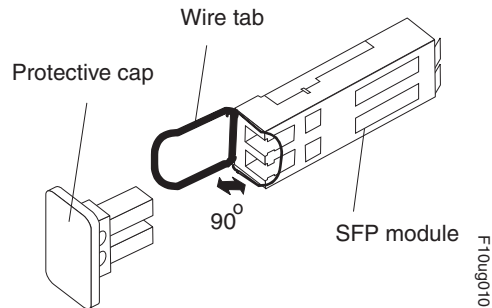
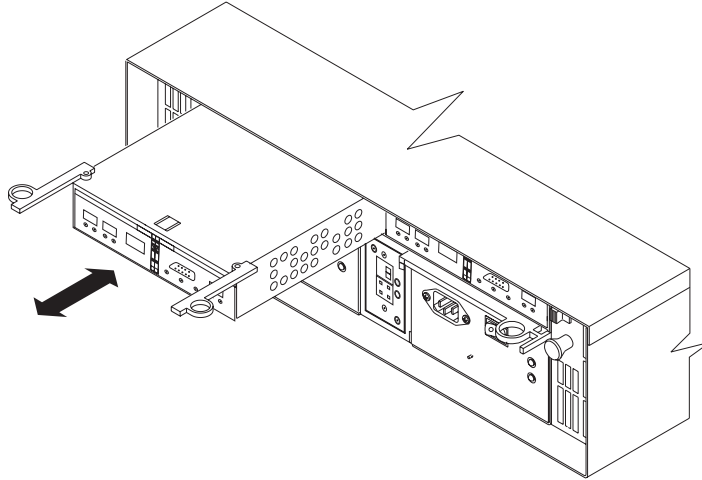


Figure 72. Unlocking the SFP module latch - wire variety

- 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.
6. Remove the failed RAID controller (the Fault LED is on), as follows:
 - a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.

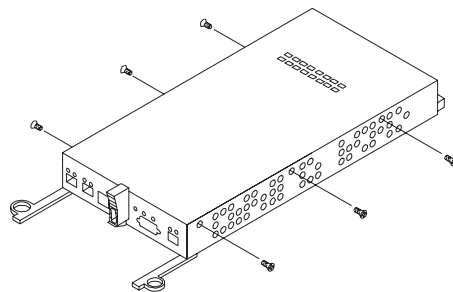


110ug033

Figure 73. Pull-rings for removing a controller

- b. Grasp the pull-rings; then pull on the levers and remove the RAID controller.
7. To access the cache battery, place the RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 74.

Attention: Before you move the cache battery from your old controller to your replacement controller, read the detailed instructions in this procedure.



110ug035

Figure 74. Controller battery-access panel screws

8. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.
9. Carefully flip over the RAID controller bottom panel. Disconnect the battery harness on the battery from the two-pin connector on the controller board, as shown in Figure 75 on page 107.

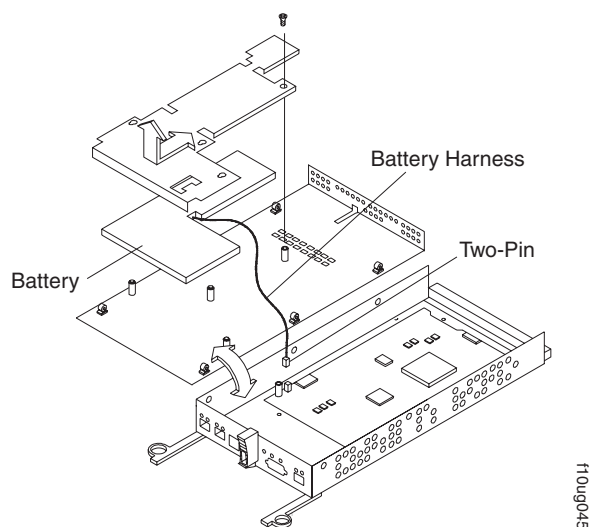


Figure 75. Removing the controller battery

10. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.
11. Remove the battery unit and place it on a dry, level surface. If this is a battery replacement, then replace the old battery with the new one and go to step 19 on page 108.
12. Put on the antistatic strap and unpack the new RAID controller.
Set the RAID controller on a dry, level surface away from magnetic fields.
Save the packing material and documentation in case you need to return the RAID controller.
13. Place the replacement RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 74 on page 106.
14. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.
15. Carefully flip over the RAID controller bottom panel.
16. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.
17. If DHCP/BOOTP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BOOTP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BOOTP record will result in problems trying to manage the storage subsystem using the existing IP address. This step must be performed before you insert the upgrade controller into the DS4000 storage subsystem.
18. Write the battery replacement information on the label on the battery pack.
 - Installed date – Write today's date

- Replacement Date – Copy the expiration date from the battery label on the old controller.

Note: The preferred method of checking for the battery operating age is through the storage subsystem management software.

19. Position the battery inside the replacement RAID controller.
20. Reassemble the battery access panel to the RAID controller bottom panel by aligning it with the three pins on the RAID controller bottom panel. Slide the battery access panel toward the back until you can reinsert the screw that holds the battery access panel to the RAID controller bottom panel. Do not overtighten.
21. You must reconnect the battery harness to the two-pin connector on the controller board.

Note: The connector is keyed so that there is only one way to attach the harness to the connector. Do not force fit.
22. Flip the RAID controller bottom panel over and carefully place it on the controller sides. Push the RAID controller bottom panel toward the front to latch it to the side panels. If the controller bottom panel is placed correctly, you should be able to access the mounting holes for the six screws that you removed from step 7 on page 106. Reinsert the six screws. Do not overtighten.
23. Install the new RAID controller, as follows:
 - a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place. Power on the storage subsystem, if the storage subsystem is not powered on already.
24. Insert the SFPs according to the instructions in “Installing SFP modules” on page 48.
25. Connect the fibre-channel cables to their original locations, according to the instructions in “Installing fiber-optic cables” on page 51. Connect any secondary cables (such as Ethernet cables) in their original locations.
26. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controller.
 - If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the CRU and reinsert it.
 - If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the DS4000 Storage Manager client for problem determination.
27. Follow the appropriate procedure for the your DS4100 storage subsystem model:
 - **For the DS4100 base storage subsystem:** When you replace the failed RAID controller, the DS4000 Storage Manager client automatically updates the firmware for the new controller to match the configuration database. After you replace a controller, always use the DS4000 Storage Manager client to verify the firmware levels and NVSRAM files.

Continue with step 28 on page 110.
 - **For the DS4100 single-controller storage subsystem:**
 - **If the firmware version of the replacement DS4100 RAID controller matches the firmware version of the replaced DS4100 RAID controller:**

The startup process should complete within five minutes. After the startup process completes, the new RAID controller can accept I/Os from the host server and is ready to be managed by the DS4000 Storage Manager client.

Note: If the new RAID controller is not recognized by the DS4000 Storage Manager client, use the Enterprise Management Window to rediscover the DS4100, as described in the following steps.

- a. Remove the entry for the DS4100 from the management domain of the DS4000 Storage Manager client.
- b. Wait at least five minutes.
- c. Add the entry for the DS4100 back to the management domain of the DS4000 Storage Manager client.

Before you continue with the next step, use DS4000 Storage Manager to verify the firmware levels. If your firmware levels need to be updated, reload the DS4100 storage subsystem with the latest version of the controller firmware and the single-controller option NVSRAM files.

Note: Reloading the NVSRAM files will clear any modifications you made to the NVSRAM default settings. If required, modify your NVSRAM settings as needed after reloading the NVSRAM.

Continue with step 29 on page 110.

– **If the firmware version of the replacement DS4100 RAID controller does not appear to match the firmware version of the replaced DS4100 RAID controller:**

The startup process will not complete and the RAID controller enters a Suspend State. If you cannot make management connections to the DS4100 controller and you cannot send I/Os to the RAID controller within ten minutes after powering on the DS4100, then you must determine whether the problem is a result of a mismatch between the new RAID controller firmware and the firmware used by the configuration database in the hard drives.

To verify that the DS4100 controller firmware is mismatched, restart the storage subsystem and monitor the drive LEDs. (Always wait at least 30 seconds between the time you turn off a power switch and the time you turn on the power again.) Wait three minutes after powering on the unit and then monitor the drive LEDs in the front of the unit for at least four minutes.

- If the drive LEDs flash one or more times, then the new DS4100 controller does not have the same firmware as the replaced DS4100 controller, but another problem exists. Verify your fibre channel and Ethernet connections, and then perform the actions recommended in step 29 on page 110. If the problem persists, call IBM support.
- If the drive LEDs stay solidly lit, the new DS4100 controller has different firmware than the replaced DS4100 controller. You must correct the controller firmware version mismatch.

Retrieve the replaced DS4100 controller firmware version from your storage subsystem profile and download the appropriate controller firmware files.

Note: If you cannot determine the controller firmware version of the replaced DS4100 RAID controller, call your IBM support representative.

Go to “Manually upgrading the firmware for the DS4100 single-controller storage subsystem.”

28. **For the DS4100 base storage subsystem:** See the DS4000 Storage Manager client online help for instructions on bringing the controller online. The RAID controller replacement procedure for the DS4100 base storage subsystem is completed.

29. **For the DS4100 single-controller storage subsystem:**

Because the replacement RAID controller has a different WWNN than the original RAID controller, you must perform the following tasks in order to bring the DS4100 single-controller storage subsystem to running (optimal) state after you replace the RAID controller.

- Reboot the host server that has mapped logical drives from the DS4100 single-controller storage subsystem.

Rebooting the host server enables the multipath fail-over to recognize the logical drives under the new WWNN. In addition, if your multipath driver uses the WWNN of the controller as part of the LUN identification, you may have to reconfigure the LUN fail-over/failback path information.

- Use DS4000 Storage Manager to rediscover the new RAID controller.

To rediscover the new RAID controller, remove the existing DS4100 single-controller storage subsystem entry in the management domain of the DS4000 Storage Manager client Enterprise Management Window (EMW), and then add the DS4100 single-controller storage subsystem back into the management domain using the in-band or out-of-band management method. See step 6 on page 111.

- Re-enable the premium feature keys.

After you replace the RAID controller in a DS4100 single-controller storage subsystem, all of the enabled premium feature keys are displayed as being out-of-compliance. Use the existing key files to re-enable the premium feature keys.

- If you create zones using the WWNN, update your zoning definitions with the new WWNN for the replacement RAID controller.

If you are able to make a management connection with DS4000 Storage Manager to the replacement RAID controller, then the RAID controller replacement procedure for the DS4100 single-controller storage subsystem is complete.

If none of these actions enables you to make a management connection with DS4000 Storage Manager to the replacement RAID controller, then call IBM support for help.

Manually upgrading the firmware for the DS4100 single-controller storage subsystem

You will need the most recent printout of your storage subsystem profile to perform this procedure. If you do not have a printout available, contact IBM technical support to determine the controller firmware and NVSRAM version numbers recorded in your storage subsystem profile.

Attention: This procedure is not self-contained. Perform this procedure only if directed to do so in step 27 on page 108. At the end of this procedure, continue with step 29 in the RAID controller replacement procedure.

Be sure that the BOOTP server configuration includes the MAC address you recorded for the new controller. Refer to step 17 on page 107.

All factory-delivered DS4100 RAID controllers are shipped with a recent version of controller firmware loaded on the RAID controller, but that firmware version might not match precisely the firmware version of the failed RAID controller you have replaced. When you replace the RAID controller in the DS4100 single-controller storage subsystem, if the firmware version of the replacement RAID controller is determined to be incompatible with the configuration database during the boot process, the DS4100 single-controller storage subsystem will enter a Stop State and will not allow any DS4000 Storage Manager operations to be performed. In this case, you must manually upgrade or downgrade the replacement RAID controller firmware to match the version required by the configuration database. Refer to the storage subsystem profile that you created before replacing the RAID controller, which identifies the appropriate firmware revision.

1. Use the procedure described in “Turning off the storage subsystem” on page 71 to power off the storage subsystem.
2. Label each of the drives in the storage subsystem according to its location in the storage subsystem (1 - 14) so that you can reinstall them correctly.
3. Remove each drive from the storage subsystem.
4. Use the procedure described in “Turning on the storage subsystem” on page 70 to power on the storage subsystem.
5. In the DS4000 Storage Manager Enterprise Management Window (EMW), remove the old RAID controller from the management domain.
6. If the configuration is to be performed by DS4000 Storage Manager via an Ethernet connection, the replacement controller needs to be assigned an accessible IP address. Factory-delivered replacement controllers will have a factory default IP address that might not be accessible in customer Ethernet environments.
 - If your IP addresses are set by DHCP, then modify the DHCP record for the replacement RAID controller with the new MAC address.
 - If you do not specify the IP address of the new controller using DHCP, and you did not manually set the old controller static IP address using Storage Manager, then you can use the default IP address 192.168.128.101.
 - If you did set the static IP address of the old controller, first try to make management contact using the existing static IP address. If the existing static IP address does not work, try the default IP address 192.168.128.101.

For details on how to obtain the IP address for the replacement RAID controller, refer to the *IBM TotalStorage DS4000 Storage Manager 9.10 Installation and Support Guide* for the appropriate operating system. Do *not* utilize the serial port for this purpose unless directed by your IBM support representative.

7. In the EMW, add the new RAID controller to the management domain using the IP address assigned to the new controller. The RAID controller will appear in the EMW as *Storage Array Unnamed*.
8. Open the Subsystem Management Window (SMW) to download the controller firmware for the new RAID controller. Download the controller firmware version that matches the version number stored in your storage subsystem profile. (Refer to your printout.) After 15-20 minutes, the SMW reports a download failure. Click **OK** to ignore the error warning and instructions. Close the SMW and proceed with the following step.
9. In the EMW, remove the RAID controller from the management domain and again add the new controller using the IP address assigned to it by the IP server.

10. Open the Subsystem Management Window (SMW) to download NVSRAM for the new RAID controller. Download NVSRAM that matches the version number stored in your storage subsystem profile. (Refer to your printout.) After 15-20 minutes, the SMW reports a download failure. Click **OK** to ignore the error warning and instructions. Close the SMW and proceed with the following step.
11. In the EMW, remove the RAID controller from the management domain and again add the new controller using the IP address assigned to the new controller by the IP server.
12. View the storage subsystem profile and confirm that the NVSRAM and controller firmware versions match the versions shown in your storage subsystem profile printout.
13. In the EMW, remove the RAID controller from the management domain.
14. Use the procedure described in “Turning off the storage subsystem” on page 71 to power off the storage subsystem.
15. Reinstall each drive in the slot from which it was removed.
16. Power on the storage subsystem, using the procedure described in “Turning on the storage subsystem” on page 70.
17. In the EMW, add the RAID controller back into the management domain using the original IP address (refer to your printout).
18. Verify that the RAID controller is accessible.
19. Continue with 24 on page 108 in the RAID controller replacement procedure.

Replacing the battery in the RAID controller

Each RAID controller contains a rechargeable battery that maintains the data in the cache memory for three days without power to the unit.

Important: If you are replacing the battery in a DS4100 single-controller storage subsystem, complete the following steps before beginning the replacement procedure:

1. Schedule down time for the battery replacement, because the disk will not be available during the procedure.
2. Complete any necessary server preparation tasks.
3. Save the configuration storage subsystem profile.

Note: Before any planned system shutdown or after any system additions, removals, or modifications (including 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 DS4100 storage subsystem.

4. Stop I/O to the storage subsystem.
5. Unmount any mapped LUNs from the storage subsystem.
6. Power down the DS4100 single-controller storage subsystem, as described in “Turning off the storage subsystem” on page 71.

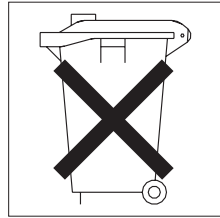
Use the following procedure if the DS4000 Storage Manager client instructs you to replace the battery because the current battery has failed or is nearing its expiration date. You can also use the DS4000 Storage Manager client to check the status of the battery.

1. Check the DS4000 Storage Manager client online help for instructions on battery replacement procedures. If you are using write-cache mirroring, this might involve clearing cache memory on the RAID controller that contains the battery that needs to be replaced. This is done by either placing the controller offline before removing it from the DS4100 server or turning off caching in the DS4100 server, using the DS4000 Storage Manager client. Follow the steps given in the software procedure before you continue with this procedure.
Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 83.
2. Put on the antistatic strap and unpack the new battery.
Set the new battery on a dry, level surface. Save all packing materials in case you need to return the battery.

Note: The battery comes with a new battery label. You will need this label later in the procedure.
3. Review all documentation that comes with the new battery for updated replacement procedures and other information.
4. Use the DS4000 Storage Manager client to locate the RAID controller that contains the failed battery (the RAID controller Fault LED might be on).
Attention: On the DS4100 single-controller storage subsystem, you cannot place the controller offline. Instead, you must power down the DS4100 storage subsystem. For more information on preparation tasks, see the Important note in the beginning of this section.
5. Label each cable that connects to the RAID controller that contains the battery that has failed. This ensures that all cables will be properly reconnected to the RAID controller after you replace the battery.
6. Use the storage management software to take offline the RAID controller that contains the battery that has failed.
Attention: To prevent data loss, you must shutdown the system before you can replace the RAID controller battery. For the proper shutdown sequence, see “Turning off the storage subsystem” on page 71.
7. Remove the fibre-channel cables and the SFPs from the RAID controller that contains the battery that has failed or is nearing its expiration date. For more information, see “Working with SFPs and fiber-optic cables” on page 47.
8. Remove the RAID controller as described in “Replacing a RAID controller” on page 102.
9. To remove the cache battery, place the RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 74 on page 106.
10. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.
11. Carefully flip over the RAID controller bottom panel. Disconnect the battery harness on the battery from the two-pin connector on the controller board as shown in Figure 75 on page 107.
12. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.
13. Remove the battery unit and place it on a dry, level surface. If this battery is a replacement battery, then replace the old battery with the new one.

14. Write the battery replacement information on the label on the battery pack.
 - Installed date – Write today's date
 - Replacement Date – Write the date three years from today's date

Note: The preferred method of checking for the battery operating age is through the storage subsystem management software.



CONTAINS
SEALED LEAD
BATTERY.
BATTERY
MUST BE
RECYCLED.

Pb

CAUTION:

This product contains a sealed lead acid battery. The battery must be recycled or disposed of properly. In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM sealed lead acid batteries. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333 or contact your IBM representative. For information on disposal of sealed lead acid batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility. If the battery CRU is physically damaged or leaking electrolyte gel, *do not* ship it to a recycling center. The battery contains sealed lead-acid batteries that might be considered hazardous material. You must handle this unit in accordance with all applicable local and federal regulations.

15. Position the replacement battery inside the RAID controller.
16. Reassemble the battery access panel to the RAID controller bottom panel by aligning it with the three pins on the RAID controller bottom panel. Slide the battery access panel toward the back until you can reinsert the screw that holds the battery access panel to the RAID controller bottom panel. Do not overtighten
17. You must reconnect the battery harness to the two-pin connector on the controller board.

Note: The connector is keyed so that there is only one way to attach the harness to the connector. Do not force fit.

18. Flip the RAID controller bottom panel over and carefully place it on the controller sides. Push the RAID controller bottom panel toward the front to latch it to the side panels. If the controller bottom panel is placed correctly, you should be able to access the mounting holes for the six screws that you removed in step 7 on page 106. Reinsert the six screws. Do not overtighten.
19. Dispose of the used battery CRU according to local and federal regulations, which might include hazardous material handling procedures.

This product contains a sealed lead acid battery. The battery must be recycled or disposed of properly. In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM sealed lead acid batteries. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333 your IBM representative. For information on disposal of

sealed lead acid batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

20. Install the RAID controller, as shown in Figure 76.

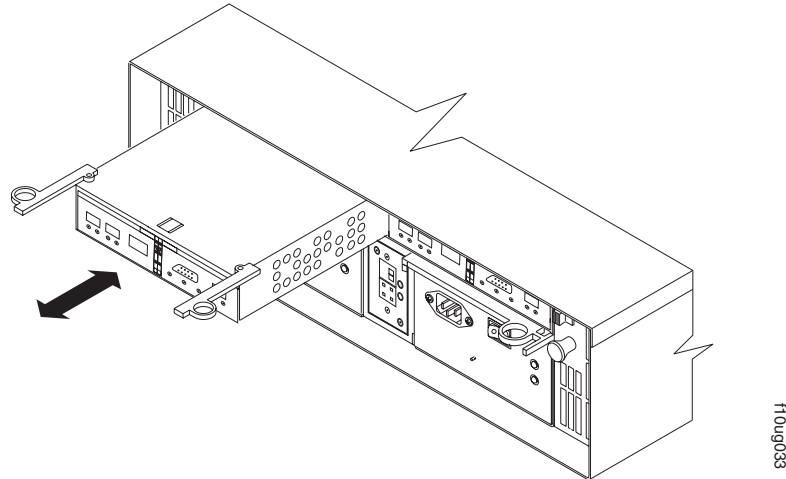


Figure 76. Installing a new RAID controller

- a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.
21. Install the SFPs and then connect the fibre-channel cables to their original locations.
 22. On the DS4100 single-controller storage subsystem, turn on power to the storage subsystem and attached devices. For the proper power-on sequence, see “Turning on the storage subsystem” on page 70.
 23. On the DS4100 base storage subsystem, wait approximately one minute and then use the DS4000 Storage Manager client to place the controller in online state (it was placed offline in step 6 on page 113).
 24. If the operation fails, repeat the command. If the operation fails again, reseal the controller and repeat this step.

Note: Note that on all DS4100 models, it might take 15 minutes to a few hours for a new battery to become fully charged. The DS4000 Storage Manager client will show the battery as failed until it is fully charged. Controller caching is automatically disabled until the new battery becomes fully charged.

25. Use the DS4000 Storage Manager client to monitor the status of the storage subsystem and to reset the battery age.

Note: On the DS4100 base storage subsystem, there are two cache batteries in the unit (one for each controller). Make sure that you reset the age for the correct battery.

Installing SFPs and fiber-optic cables

Each RAID controller unit has two host ports and one storage expansion enclosure port. 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.

Adding a DS4000 storage expansion enclosure to an existing DS4100 configuration (base storage subsystem only)

You can add up to seven DS4000 storage expansion enclosures to a DS4100 storage subsystem. However, you do not need to configure the DS4100 with the maximum number of DS4000 storage expansion enclosures at the time of initial installation. You can add additional DS4000 storage expansion enclosures to an existing DS4100 configuration (up to the maximum number of DS4000 storage expansion enclosures supported in a drive loop) as you need more capacity.

Important

There might be a requirement for new firmware to support the maximum number of DS4000 storage expansion enclosures in a drive loop. Always add new DS4000 storage expansion enclosures when the DS4100 is powered on and in optimal state. Do not add new DS4000 storage expansion enclosures when the DS4100 is powered down.

Before you cable DS4000 storage expansion enclosures to a loop, refer to the *DS4100 Storage Subsystem Fibre Channel Cabling Instructions* that come with your storage subsystem for specific instructions.

Figure 77 on page 117 shows the process of adding an additional storage expansion enclosure (in this case, a DS4000 EXP100) to an existing DS4100 storage subsystem configuration. Drive loops A and B form one redundant fibre-channel loop.

Note: Always add a new DS4000 storage expansion enclosure to the *end* of a drive loop.

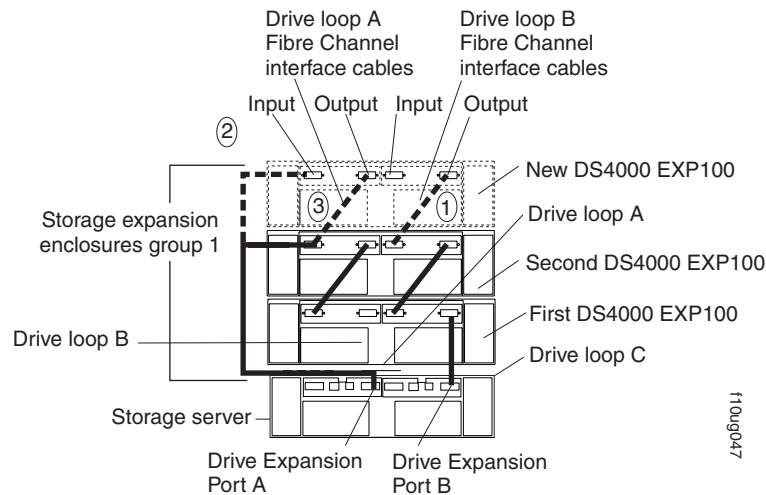


Figure 77. Add a new storage expansion enclosure to a redundant loop

In Figure 77, the existing DS4100 configuration already includes two DS4000 storage expansion enclosures. The dashed lines show you how to add a third DS4000 storage expansion enclosure to the configuration. To add the new DS4000 storage expansion enclosure shown in Figure 77, you would perform the following steps:

1. Verify that the existing configuration is powered on and is in optimal state. Use the DS4000 Storage Manager client to correct any problems before proceeding.
2. Put on the antistatic strap and unpack the new DS4000 storage expansion enclosure and mount it in the proper position on the rack cabinet.
3. Make the fibre-channel connection marked 1 in Figure 77 (drive loop B). Then power on the new DS4000 storage expansion enclosure and verify that it is recognized in the DS4000 Storage Manager Subsystem Management window.
4. Make the fibre-channel connection marked 2 in Figure 77.
5. Make the fibre-channel connection marked 3 in Figure 77 (drive loop A).
6. If the new DS4000 storage expansion enclosure is a DS4000 EXP100 model, use the DS4000 Storage Manager client to verify the ESM firmware version of the new EXP100.
 - If the ESM firmware version of the new DS4000 EXP100 is version 953x or lower, disconnect the new DS4000 EXP100 and contact IBM support, your IBM reseller, or your IBM representative for assistance.
 - If the ESM firmware version of the new EXP100 is version 9554, 956x, or higher, but does not match exactly the ESM firmware version of the DS4000 EXP100s that were already installed in the DS4100 configuration, then refer to the procedures for resolving ESM firmware mismatches in Chapter 3 of the *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation, User's, and Maintenance Guide*.

Important: There are several EXP100 drive CRU types and firmware versions. Do not install or replace any EXP100 drive CRU or storage expansion enclosure until you read the information in Chapter 3 of the *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation, User's, and Maintenance Guide*.

Chapter 6. Hardware maintenance

This chapter contains information to help you solve some of the simpler problems that you might have with your storage subsystem. It contains the problem indicators and error messages along with suggested actions to take to resolve the problem.

For instructions on how to obtain service and technical assistance for your storage subsystem and other IBM products, see “Getting information, help, and service” on page xxii.

Note: See the *IBM TotalStorage DS4000 Problem Determination Guide* for additional troubleshooting and debugging procedures.

General checkout

Use the status LEDs, Symptom-to-FRU index, and the storage management software to diagnose problems. See “Checking the LEDs” on page 77.

To diagnose a cluster system, use the cluster problem determination procedure in the *IBM TotalStorage DS4000 Problem Determination Guide*.

Note: If power was just applied to the controller unit, the green and amber LEDs might turn on and off intermittently. Wait until the controller unit finishes powering up before you begin to check for faults.

Using the diagnostic hardware

The DS4100 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 TotalStorage DS4000 Problem Determination Guide* for more information.

The loopback test and the sendEcho test are described in the *IBM TotalStorage DS4000 Problem Determination Guide*. In the IBM TotalStorage 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 use the symptom-to-FRU index (Table 13 on page 120) to find solutions to problems that have definite symptoms.

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

Table 13. Symptom-to-FRU index

Problem indicator	Component	Possible cause	Possible solutions
Amber LED on	Drive CRU	Drive failure	Replace the drive that has failed.
	Fan CRU	Fan failure	Replace the fan that has failed.
	RAID controller Fault LED	RAID controller failure	<p>If the RAID controller Fault LED is on, replace the RAID controller.</p> <p>If the RAID controller has been placed offline by the user, use storage management software to place it online. If the controller failed, replace the RAID controller.</p> <p>Attention: In the DS4100 single-controller storage subsystem, the RAID controller Fault LED will <i>not</i> light in the event of a RAID controller failure or removal.</p>
	Expansion or host port bypass LED	SFP port empty	No corrective action is needed if this is a stand-alone storage subsystem with no storage expansion enclosures attached, and if the system is properly configured.
		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	Reattach the SFPs and fibre-channel cables. Replace input and output SFPs or cables as necessary.
Front panel	General system error	Indicates that a Fault LED somewhere on the storage subsystem has turned on. (Check for amber LEDs on CRUs.) Use DS4000 Storage Manager software to diagnose server problems.	
Amber LED is off and green LED off	Power-supply CRU	Power switch is turned off or ac power failure	Turn on all power-supply power switches.
Amber and green LEDs on	Power-supply CRU	Power supply failure	Replace the failed power-supply CRU.

Table 13. 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 storage-server power cords are plugged in and the 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.
		Power supply failure	Replace the power supply.
		Midplane failure	Have the midplane replaced (service technician only).
Amber LED flashing	Drive CRUs	Drive identify is in process	No corrective action is needed.
One or more green LEDs off	Power supply CRUs	Power cord unplugged or switches turned off	Make sure that the power cord is plugged in and the power-supply switches are turned on.
	All drive CRUs	Midplane failure	Have the midplane replaced (service technician only).
	Front panel	Power supply problem	Make sure that the cords are plugged in and power supplies are turned on.
		Hardware failure	If any other LEDs are on, replace the midplane (service technician only).
	Battery	Battery failure	Replace the battery.
	Cache active	The cache is disabled	Use the DS4000 Storage Manager client to enable the logical drive read and write cache settings.
		The cache memory has failed	Replace the RAID controller.
		The cache battery has failed	Use the DS4000 Storage Manager client to check and replace the battery.
	Host loop	Host or switch is off or has failed	Check if host or switch is on. Replace attached devices that have failed.
		Fibre-channel cable has failed	Ensure that the fibre-channel cables are undamaged and properly connected.
SFP has failed		Ensure SFP is seated properly; replace SFP.	
RAID controller has no power or has failed		Ensure that the unit is powered on. Replace RAID controller.	

Table 13. Symptom-to-FRU index (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more green LEDs off (continued)	Expansion loop	Drives are improperly installed or not installed	Ensure that the drives are properly installed.
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace the RAID controller.
		Impending drive failure	A bad drive or drives can issue LIPs that cause the drive expansion loop to go down momentarily. Use the RLS function in the DS4000 Storage Manager client to determine which drives are bad. Replace the bad drives.
		Externally attached expansion port device has failed	Replace the storage expansion enclosure SFP or fibre-channel cable.
Intermittent or sporadic power loss to the storage subsystem	Some or all CRUs	Defective ac power source or partially plugged-in power cord	Check the ac power source; verify that the ac circuit that the storage subsystem connects to is not being overloaded. Reseat all installed power cables and power supplies. If applicable, check the power components. Replace defective power cords.
		Power supply has failed	Check for a Fault LED on the power supply, and replace the failed CRU.
		Midplane has failed	Have the midplane replaced (service technician only).
Unable to access drives	Drives and expansion loop	Fibre-channel cabling has failed.	Ensure that the fibre-channel cables are undamaged and properly connected.
		RAID controller has failed	Replace the RAID controller.
		SFP has failed	Ensure SFP is seated properly; replace SFP.
Random errors	Subsystem	Midplane has failed	Have the midplane replaced (service technician only).

Table 13. 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	No drives are present in the storage subsystem.	Ensure that at least one drive is present in the storage subsystem so that it can be configured properly.
		One controller was replaced incorrectly. The controller firmware versions probably failed to synchronize correctly.	<p>To recover, perform the following steps:</p> <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, repeat this procedure. If the problem still persists, contact IBM support.

Note: If you cannot find the problem in the Symptom-to-FRU index, test the entire system.

Parts listing

Figure 78 on page 124 and the following table provide a parts listing for the DS4100.

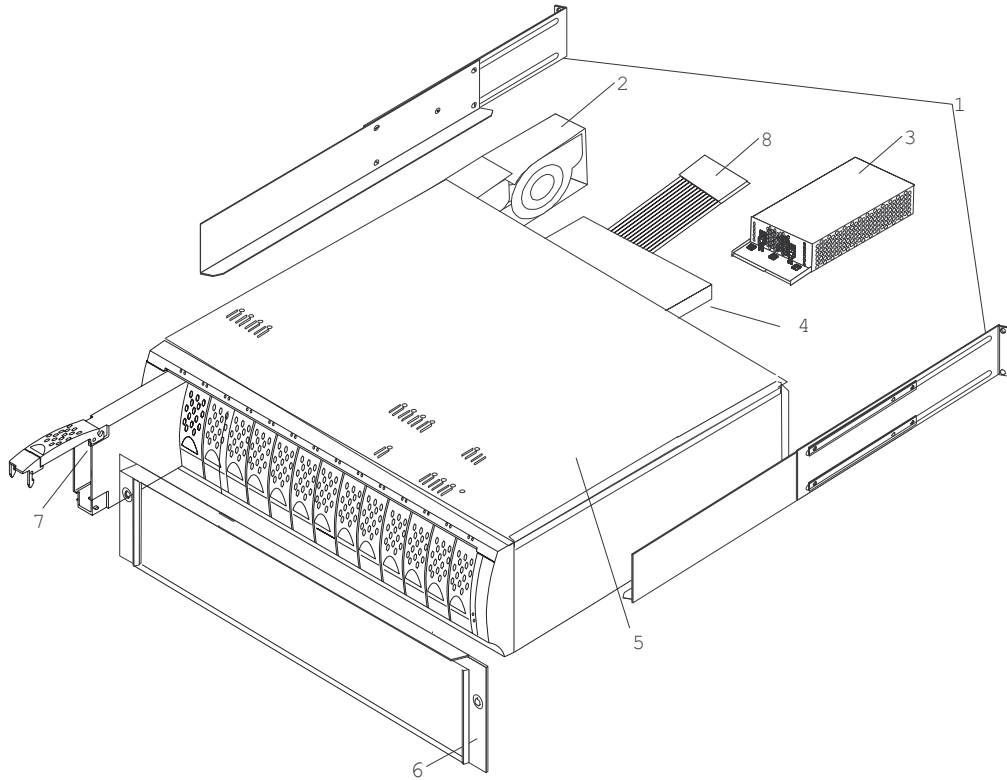


Figure 78. DS4100 parts list

Table 14. Parts listing (TotalStorage DS4100 storage subsystem)

Index	DS4100 storage subsystem	FRU P/N
1	Rail kit	01K6670
2	Fan ASM CRU	19K1293
3	Power supply CRU, 400W	19K1289
4	DS4100 SATA RAID controller	25R0099
5	SATA frame, midplane (base storage subsystem)	25R0211
5	SATA frame, midplane (single-controller storage subsystem)	25R0321
6	DS4100 bezel ASM	25R0217
	SATA tray, blank	90P1348
7	SATA 250 GB drive CRU	90P1349 or 40K6837 (see note at end of table)
7	SATA 400 GB drive CRU	39M4575
8	Switch, harness	19K1297
	Miscellaneous hardware kit	24P8813

Table 14. Parts listing (TotalStorage DS4100 storage subsystem) (continued)

Index	DS4100 storage subsystem	FRU P/N
	Power supply blank tray (single-controller storage subsystem only)	25R0323
	Controller blank tray (single-controller storage subsystem only)	25R0324
	Cable, FRU-1M	19K1265
	Cable, FRU-5M	19K1266
	Cable, FRU-25M	19K1267
	Short wave SFP	19K1280
	Long wave SFP	19K1281
	Power cord, 2.8M	6952300
	Power cord, jumper	36L8886
	Battery	24P8062
	Wrap plug (loopback adapter)	17P6918
	LC-SC fibre channel cable adapter	19K1268

Note: The drive CRU with P/N 40K6837 is a replacement of the drive CRU P/N 90P1349. These two CRUs are functionally equivalent. However, the 40K6837 requires DS4000 controller firmware version 06.12.15.xx or later and EXP100 ESM firmware version 956x or later.

Appendix A. Records

Whenever you add options to your DS4100, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other options and provide needed data whenever you contact your IBM technical support representative.

Identification numbers

Record and retain the following information.

Product name:	IBM TotalStorage DS4100 storage subsystem
Machine type:	1724
Model number:	100, 1Sx
Serial number:	
Controller firmware version:	

The serial number is located on a label at the rear of the DS4100. The machine and model number are found on the product information label above the serial number.

Installed device records

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

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

Table 15. Hard disk drive record

Bay Number	Hard disk drive serial number	Replaced hard disk drive serial number

Appendix B. Rack mounting template

This appendix provides duplicate copies of the rack mounting templates. If you want to tear out the templates from this document for easier use, use these copies rather than those provided in “Rack mounting template” on page 22.

Use the following templates (Figure 79 on page 130 and Figure 80 on page 131) to identify the proper locations for inserting M6 screws when mounting the support rails and DS4100 in a rack cabinet. The locations for the M6 screws are highlighted in the templates.

The DS4100 is 3 U high. Align the template with the rack at a U boundary. U boundaries are shown as horizontal dashed lines in the rack mounting templates.

Note: The mounting holes that are shown in the following templates are square. The holes in your rack cabinet might be round or square.

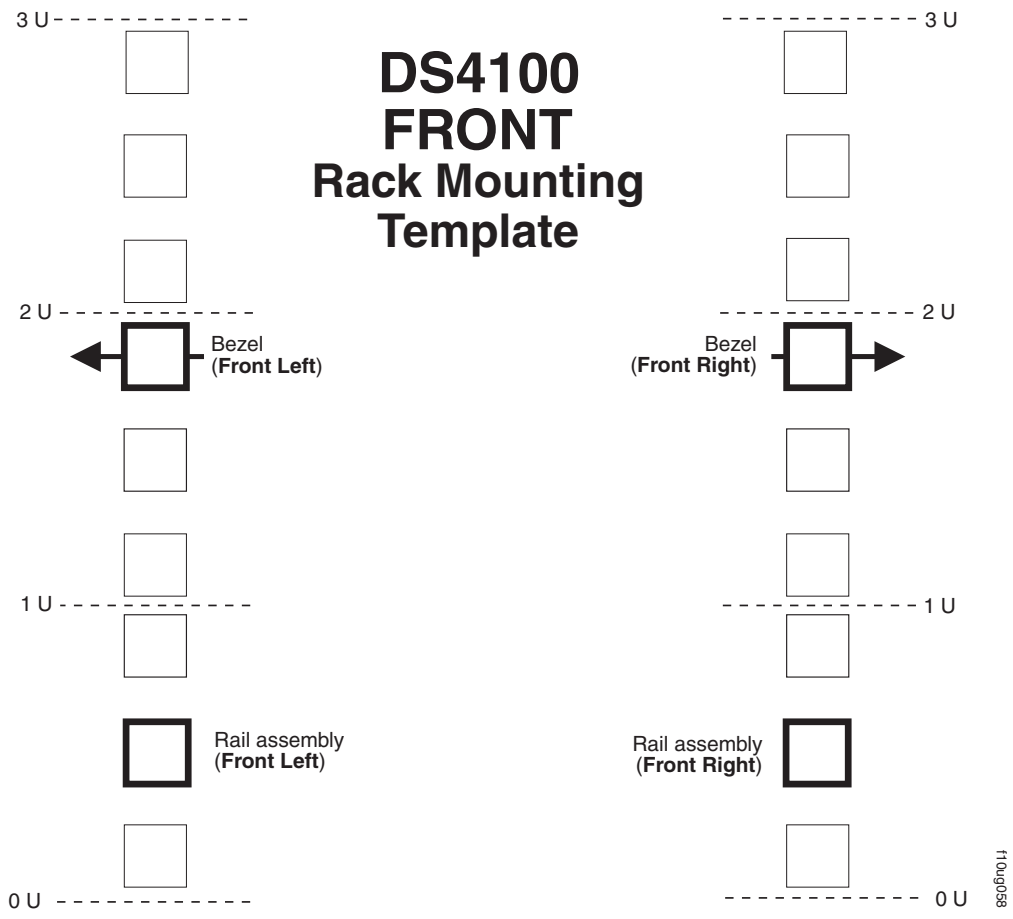
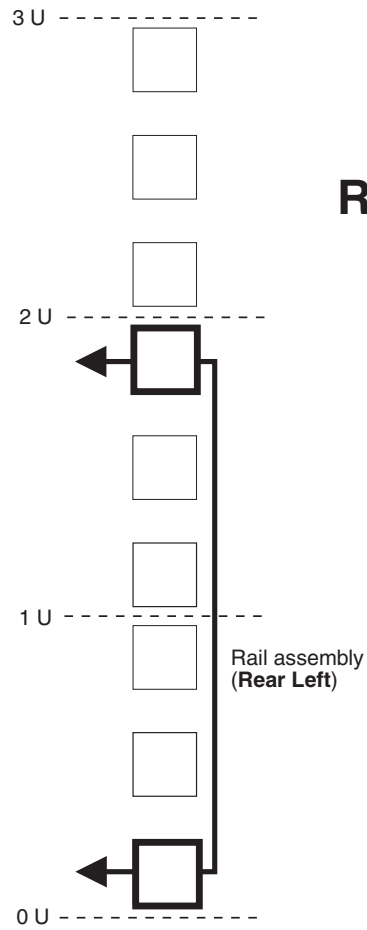


Figure 79. Front rack mounting template



DS4100 REAR Rack Mounting Template

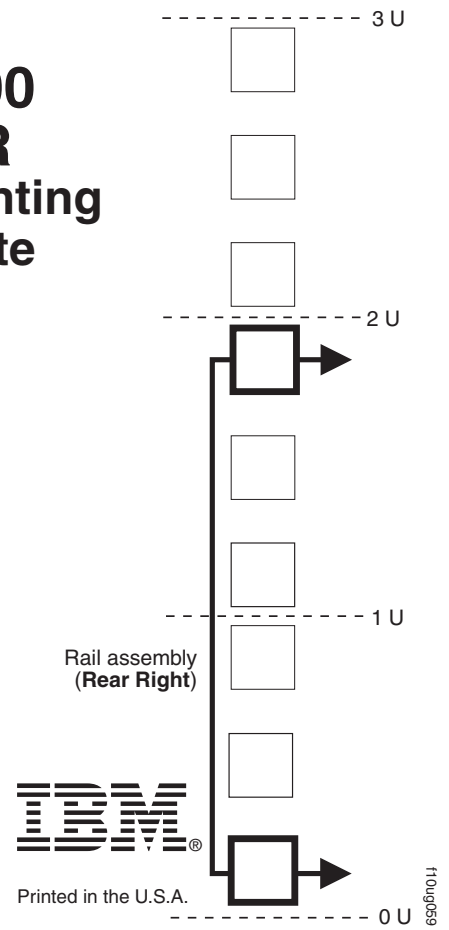


Figure 80. Rear rack mounting template

Appendix C. 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
13F9979	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
13F9997	250V/10A 2.8M	Denmark

IBM power cord part number	Cord specifics	Used in these countries or regions
14F0015	250V/10A 2.8M	Bangladesh, Lesotho, Maceo, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda
14F0033	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
14F0051	250V/10A 2.8M	Liechtenstein, Switzerland
14F0069	250V/10A 2.8M	Chile, Italy, Libyan Arab Jamahiriya
14F0087	250V/10A 2.8M	Israel
1838574	250V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Caicos Islands, Canada, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Taiwan, United States, Venezuela
36L8880	250V/10A 2.8M	Argentina, Paraguay, Uruguay
02K0546	250V/6A 2.8M	PRC (China)
6952300	125V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Taiwan, Thailand, Turks and Caicos Islands, United States, Venezuela
6952301	125V/10A 1.8M	

Appendix D. Additional DS4000 documentation

The following tables present an overview of the IBM TotalStorage DS4000 Storage Manager and DS4000 Storage Subsystem product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address.

You can access the documents listed in these tables at one of the following Web sites:

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

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

DS4000 Storage Manager Version 9 library

Table 16 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

Table 16. TotalStorage DS4000 Storage Manager Version 9.1 titles by user tasks

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

DS4500 Fibre Channel Storage Server library

Table 17 associates each document in the DS4500 (previously FAStT900) Fibre Channel Storage Server library with its related common user tasks.

Table 17. TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks

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

DS4400 Fibre Channel Storage Server library

Table 18 associates each document in the DS4400 (previously FAStT700) Fibre Channel Storage Server library with its related common user tasks.

Table 18. TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM DS4400 Fibre Channel Storage Server User's Guide, GC26-7730</i>	✓	✓		✓	✓	✓
<i>IBM DS4400 Fibre Channel Storage Server Installation and Support Guide, GC26-7731</i>	✓	✓		✓	✓	
<i>IBM DS4400 Fibre Channel Cabling Instructions, GC26-7732</i>	✓	✓				

DS4300 Fibre Channel Storage Server library

Table 19 associates each document in the DS4300 (previously FAStT600) Fibre Channel Storage Server library with its related common user tasks.

Table 19. TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks

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

DS4100 SATA Storage Server library

Table 20 associates each document in the DS4100 (previously FAStT100) SATA Storage Server library with its related common user tasks.

Table 20. TotalStorage DS4100 SATA Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4100 Installation, User's and Maintenance Guide, GC26-7733</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4100 Cabling Guide, 24P8973</i>		✓				

DS4800 Storage Subsystem library

Table 21 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 21. TotalStorage 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 TotalStorage DS4800 Installation, User's and Maintenance Guide, GC26-7748</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4800 Installation and Cabling Overview, 22R4738</i>		✓				

Other DS4000 and DS4000-related documents

Table 22 associates each of the following documents with its related common user tasks.

Table 22. TotalStorage DS4000 and DS4000–related document titles by user tasks

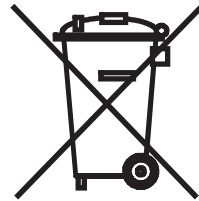
Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM Safety Information, 33P2406</i>					✓	
<i>IBM TotalStorage DS4000 Quick Start Guide, GC26-7738</i>	✓	✓				
<i>IBM TotalStorage DS4000 Hardware Maintenance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

Table 22. TotalStorage DS4000 and DS4000–related document titles by user tasks (continued)

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

Appendix E. European Directive About Product Recycling and Disposal

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



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

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

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

注意: このマークは EU 諸国およびノルウェーにおいてのみ適用されます。

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

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

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

Appendix F. Battery Return Program

This product may contain sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to <http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml> or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

In Taiwan, the following applies:



Please recycle batteries.

廢電池請回收

svc00066

Appendix G. Cable Warning

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

Appendix H. 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 23 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 23. 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 23. 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.

Notices

This publication was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

*IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.*

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this publication to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product, and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Trademarks

The following terms are trademarks of International Business Machines Corporation in the United States, other countries, or both:

IBM	ServerProven
eServer logo	TotalStorage
IntelliStation	xSeries
Netfinity	

Intel is a trademark of Intel Corporation in the United States, other countries, or both.

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

Important notes

Processor speeds indicate the internal clock speed of the microprocessor; other factors also affect application performance.

CD-ROM drive speeds list the variable read rate. Actual speeds vary and are often less than the maximum possible.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for approximately 1000 bytes, MB stands for approximately 1 000 000 bytes, and GB stands for approximately 1 000 000 000 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity may vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives available from IBM.

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

IBM makes no representation or warranties regarding non-IBM products and services that are ServerProven, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. These products are offered and warranted solely by third parties.

IBM makes no representations or warranties with respect to non-IBM products. Support (if any) for the non-IBM products is provided by the third party, not IBM.

Some software may differ from its retail version (if available), and may not include user manuals or all program functionality.

Electronic emission notices

This section gives the electronic emission notices or statements for the United States and other countries or regions.

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio

communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Chinese class A compliance statement

Attention: This is a class A statement. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

中华人民共和国“A类”警告声明

声明

此为A级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，可能需要用户对其干扰采取切实可行的措施。

Industry Canada Class A emission compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

United Kingdom telecommunications safety requirement

Notice to Customers

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

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to CISPR 22/European Standard EN 55022. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Taiwan Class A warning statement

警告使用者：
這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

Japanese Voluntary Control Council for Interference (VCCI) statement

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM TotalStorage DS4000 publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following Web site:

www.ibm.com/ibm/terminology

This glossary also includes terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- *IBM Glossary of Computing Terms*. New York: McGraw-Hill, 1994.

The following cross-reference conventions are used in this glossary:

See Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also

Refers you to a related term.

Abstract Windowing Toolkit (AWT). A Java graphical user interface (GUI).

accelerated graphics port (AGP). A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access volume. A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter. A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the

host system and the external fibre-channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture. A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent. A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP. See *accelerated graphics port*.

AL_PA. See *arbitrated loop physical address*.

arbitrated loop. One of three existing fibre-channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA). An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array. A collection of fibre-channel or SATA hard drives that are logically grouped together. All the drives in the array are assigned the same RAID level. An array is sometimes referred to as a "RAID set." See also *redundant array of independent disks (RAID)*, *RAID level*.

asynchronous write mode. In remote mirroring, an option that allows the primary controller to return a write I/O request completion to the host server before data has been successfully written by the secondary controller. See also *synchronous write mode*, *remote mirroring*, *Global Copy*, *Global Mirroring*.

AT. See *advanced technology (AT) bus architecture*.

ATA. See *AT-attached*.

AT-attached. Peripheral devices that are compatible with the original IBM AT computer standard in which signals on a 40-pin AT-attached (ATA) ribbon cable followed the timings and constraints of the Industry Standard Architecture (ISA) system bus on the IBM PC AT computer. Equivalent to integrated drive electronics (IDE).

auto-volume transfer/auto-disk transfer (AVT/ADT).

A function that provides automatic failover in case of controller failure on a storage subsystem.

AVT/ADT. See *auto-volume transfer/auto-disk transfer*.

AWT. See *Abstract Windowing Toolkit*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

bootstrap protocol (BOOTP). In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge. A storage area network (SAN) device that provides physical and transport conversion, such as fibre channel to small computer system interface (SCSI) bridge.

bridge group. A bridge and the collection of devices connected to it.

broadcast. The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT). A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client. A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command. A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string. The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download. A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

customer replaceable unit (CRU). An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC). (1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type. Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the fibre channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister. A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

error correction coding (ECC). A method for encoding data so that transmission errors can be detected and corrected by examining the data on the receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the

frame header. A fabric can be as simple as a point-to-point channel between two N_ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FAST MSJ. See *FAST Management Suite Java*.

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

FC. See *fibre channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

fibre channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel (FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and

electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as "Asynchronous Mirroring without Consistency Group." Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode, Global Mirroring, remote mirroring, Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as "Asynchronous Mirroring with Consistency Group." Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode, Global Copy, remote mirroring, Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface*.

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC). In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring. This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB. See *management information base*.

micro channel architecture (MCA). Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS). MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or

application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub. An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant fibre channel connections from the host computers, either directly or through a fibre channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port*, *gigabit interface converter (GBIC)*, *small form-factor pluggable (SFP)*.

mirroring. A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

parity check. (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the

premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks (RAID)*.

RAID level. An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array, redundant array of independent disks (RAID)*.

RAID set. See *array*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array, parity check, mirroring, RAID level, striping*.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring, Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, HP-UX, and Solaris host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage 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 packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

WORM. See *write-once read-many*.

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

Index

A

about this document xvii
AC power requirements 16
acoustical noise emission values 16
Activity LED 11
address label, hardware Ethernet 101
address, IBM xxiv
airflow 17

B

battery
 LED 81
 life of 81
 recycling properly 114
 replacing 81, 112
 voltage of 81
bays, hot-swap drive 9
best practices 8
blank tray 11

C

cabling
 an IBM DS4000 EXP100 52
 an IBM DS4100 52
 drive loop 116
cabling the storage subsystem
 connecting host to RAID controller 58
 connecting power cables 63
 connecting secondary interface cables 59
 connecting storage expansion enclosures 60
 maintaining redundancy 63
cache battery
 See battery 81
cache memory
 cache active LED 81
 size of 80
Class A electronic emission notice 152
cluster server support 6
components, storage subsystem
 back view 11
 hard disk drives 83
 hot-swap fans 95
 power supply 96
 RAID controller 100
Concepts Guide 135
configuration, installing the storage subsystem 45
controller firmware
 manually upgrading for the DS4100 single-controller
 storage subsystem 110
 requirements for DS4100 66
controls, front 10
cooling 17
copper cables 119
Copy Services Guide 135

customer replaceable units (CRUs)
 removing a fan unit 27, 29
 removing a hard disk drive 30
 removing a power supply 27, 28
 removing a RAID controller 27
 removing hard disk drives 27

D

diagnostic hardware
 wrap-plug 119
diagnostic interface port 14, 59
direct management method 37
documentation
 DS4000 135
 DS4000 Storage Manager 135
 DS4000-related documents 141
 DS4100 SATA Storage Server 139
 DS4300 Fibre Channel Storage Server 138
 DS4400 Fibre Channel Storage Server 137
 DS4500 Fibre Channel Storage Server 136
 DS4800 Storage Subsystem 140
documentation checklist 7
drive
 amber Fault LED 10
 blank tray 11
 DS4000 1.5 Gbps SATA 10
 green Activity LED 10
 trays 10
drive CRU
 250 GB 124
 400 GB 124
drive, hard disk
 adding larger-capacity 89
 LEDs 77
 overview 83
 replacing all at same time 89, 90
 replacing one at a time 89, 92
DS4000 documentation 135
DS4000 Hardware Maintenance Manual 141
DS4000 Problem Determination Guide 141
DS4000 Quick Start Guide 141
DS4000 Storage Manager
 documentation 135
 related documents 141
DS4000 Storage Manager client
 installing 65
 using to monitor storage subsystem status 76
DS4000/FAST product renaming xvii
DS4100 SATA Storage Server library 139
DS4100 single controller - to - dual controller
 upgrade 3
DS4100 single-controller storage subsystem
 restrictions 3, 12, 13
DS4300 Fibre Channel Storage Server library 138
DS4400 Storage Server library 137
DS4500 Fibre Channel Storage Server library 136
DS4800 Storage Subsystem library 140

E

- EIA 310-D Type A 19-inch rack cabinet 24
- electrical input 16
- electronic emission Class A notice 152
- Electronic emission notices
 - Australia and New Zealand Class A statement 153
 - European Union EMC Directive conformance statement 153
 - Federal Communications Commission (FCC) statement 152
 - Industry Canada Class A emission compliance statement 153
 - Japanese Voluntary Control Council for Interference (VCCI) statement 154
 - Taiwanese Class A warning statement 154
 - United Kingdom telecommunications safety requirement 153
- emergency shutdown
 - performing 73
 - restoring power 74
- enclosure ID settings 35
- enclosure ID switch 14
- environment 16
- ESM firmware for storage expansion enclosures 3
- Ethernet
 - address label on RAID controller 101
 - connecting to RAID controller 59
 - ports 14

F

- fan
 - LEDs 80
 - overview 95
 - replacing 95
- FAST/DS4000 product renaming xvii
- Fault LED, hard disk drive 11
- FCC Class A notice 152
- features of the storage subsystem 5
- fiber-optic cable
 - handling 47
 - installing 51
 - removing 52
 - working with 47
- fibre channel
 - connections 38
 - loop configurations 39
- fibre channel defined 4
- fibre channel loop ID
 - midplane 35
 - setting 35
- fibre-channel cable adapter
 - LC-SC using the 55
- fibre-channel loop
 - adding a storage expansion enclosure 116
- fibre-channel loop IDs 85
- fire suppression xxiv
- firmware
 - manually upgrading for the DS4100 single-controller storage subsystem 110

- firmware (*continued*)
 - requirements for DS4100 66
- front indicators
 - Activity LED 11
 - Fault LED 11
 - general system error LED 11
 - power on LED 11

G

- GBIC
 - removing 52
- glossary 155

H

- handling static-sensitive devices 20
- hard disk drive
 - adding larger-capacity 89
 - LEDs 77
 - overview 83
 - replacing all at same time 89, 90
 - replacing one at a time 89, 92
- hardware Ethernet address label 101
- hardware service and support xxiii
- Health Check process 68
- heat dissipation 16
- heat output 17
- host adapter, connecting to RAID controller 58, 59
- host-agent management method 36
- hot swap
 - drive Activity LED 10
 - drive bays 9
 - drive CRU 11
 - drive LED activity described 85
 - hardware 85
- hub
 - See managed hub 58, 59

I

- IBM address xxiv
- IBM Safety Information 141
- IBM TotalStorage DS4100
 - Activity LED 11
 - drive latches 11
 - Fault LED 11
 - front controls 10
 - general system error LED 11
 - hot-swap drive CRU 11
 - installing into a rack cabinet 19
 - introduction 1
 - inventory checklist 6
 - mounting in a rack cabinet 22
 - operating specifications 15
 - power on LED 11
 - preparing for installation 20, 27
 - removing CRUs 27
 - site preparation 21
 - size of 16
 - speed settings, setting the 36

IBM TotalStorage DS4100 (continued)

- tray handle 11
- unpacking the 20
- weight 16
- in-band management method 36
- indicators 10
- installation
 - into a rack cabinet 19
- installing and replacing devices
 - blank trays 84
- installing components
 - fan 95
 - fiber-optic cable 51
 - hot-swap hard disk drives 86
 - power supply 99
 - RAID controller 102
- interface ports and switches 13
- inventory checklist 6

L

- latch, hard disk drive 11
- LC-LC fibre-channel cable 52
 - latches and lever 57
 - removing 54
 - using the 52
- LC-SC fibre-channel cable adapter
 - connecting to a device 55
 - connecting to an LC-LC fibre-channel cable 56
 - described 55
 - protective caps 56
 - removing an LC-LC fibre-channel cable 57
 - using the 55
- LEDs
 - amber drive fault 11
 - cache battery 81
 - fan 80
 - general system error 11
 - green drive activity 11
 - green power-on 11
 - hard disk drive 77
 - power supply 80
 - RAID controller 78
 - storage subsystem 77
- lever on power supply, changing location 99
- loop configurations
 - overview 39
 - redundant 39
- loop redundancy, described 62

M

- managed hub
 - in fibre channel loop configurations 39, 42
 - using to connect host to RAID controller 58, 59
- memory, cache
 - cache active LED 81
 - size of 80
- Migration Guide 135

N

- notes, important 152
- notices
 - electronic emission 152
 - FCC, Class A 152
 - static-sensitive precautions 83
 - trademarks 151
 - used in this book iii
 - used in this document xxi

O

- out-of-band management method 37
- over-temperature condition, shutdown 74

P

- parts list 123
- power cords 133
 - connecting 63
- power on sequence, storage subsystem 70
- power supply
 - changing lever location 99
 - installing 99
 - LEDs 80
 - overview 96
 - removing 98
 - strain-relief clamp 97

R

- rack cabinet
 - EIA 310-D Type A 19 inch 24
 - preparatory procedures 22
 - rail installation 24
 - site preparation 20
- rack mounting template for DS4100 22, 129
- RAID controller
 - cache battery 81
 - connecting Ethernet cable to 59
 - connecting host to 58
 - connecting RS-232 (serial) cable 59
 - LEDs 78
 - overview 100
 - replacing 102
- Reader Comment Form xxiv
- recycling the cache battery 114
- redundant host and drive loops 39
- removing components
 - fiber-optic cable 52
 - GBIC 52
 - power supply 98
- renaming xvii
- replacing
 - a hot-swap hard disk drive 87
- replacing components
 - cache battery 112
 - fan 95
 - RAID controller 102

- replacing CRUs
 - fan unit 33
 - hat-swap hard disk drives 34
 - power supply 32
 - RAID controller 32
- restoring power
 - after emergency shutdown 74
 - after unexpected shutdown 73
- RS-232 (serial) port 14, 59

S

- safety information iii
- SATA defined 4
- serial number 127
- serial port 14
- server ID settings 35
- server ID switch 14
- setting interface options 34
- SFP modules
 - important information about 48
 - installing 48
 - removing 50
 - working with 47
- shutdown sequence, storage subsystem 71
- single controller - to - dual controller upgrade 3
- single-controller storage subsystem
 - restrictions 3, 12, 13
- small form-factor pluggable module (SFP)
 - connecting to an LC-LC fibre-channel cable 53
 - removing an LC-LC cable 54
- software checklist 7
- software service and support xxiii
- specifications 16
- speed settings 15
- static-sensitive devices, handling 83
- static-sensitive precautions 83
- storage expansion enclosure
 - connecting to storage subsystem 60
 - turning on before storage subsystem 71, 92
- storage subsystem
 - components
 - back view 11
 - hard disk drives 83
 - installing power supply 99
 - power supply 96
 - replacing RAID controller 102
 - configuring 36
 - emergency shutdown 73
 - enclosure ID settings 35
 - features 5
 - fibre channel connections 38
 - identification numbers 127
 - installing SFP modules 48
 - interface ports and switches 13
 - LEDs 77, 78, 80
 - over-temperature shutdown 74
 - records 127
 - restoring power after emergency shutdown 74
 - restoring power after over-temperature shutdown 74
 - restoring power after unexpected shutdown 73

- storage subsystem (*continued*)
 - server ID settings 35
 - turning off 71
 - turning on 70
- storage subsystem configuration, installing 45
- strain-relief clamp on power supply 97
- symptom-to-FRU index 119

T

- tasks by document title 135
- tasks by documentation title 135
- trademarks 151
- tray handle, hard disk drive 11
- turning off the storage subsystem 71
- turning on the storage subsystem 70

U

- United States electronic emission Class A notice 152
- United States FCC Class A notice 152

W

- web sites, related xxiii
- wrap-plug 119

Readers' Comments — We'd Like to Hear from You

IBM TotalStorage DS4100 Storage Subsystem
Installation, User's, and Maintenance Guide

Publication No. GC26-7733-01

Overall, how satisfied are you with the information in this book?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Overall satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How satisfied are you that the information in this book is:

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Accurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy to find	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Well organized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applicable to your tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please tell us how we can improve this book:

Thank you for your responses. May we contact you? Yes No

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you.

Name

Address

Company or Organization

Phone No.



Fold and Tape

Please do not staple

Fold and Tape



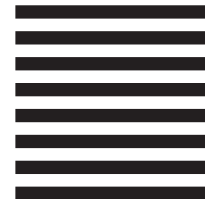
NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 40 ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

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



Fold and Tape

Please do not staple

Fold and Tape



Part Number: 39M5966

Printed in USA

GC26-7733-01



(1P) P/N: 39M5966

